A COMPARATIVE RELIABILITY ANALYSIS OF COMPUTER-GENERATED BITEMARK OVERLAYS

by

Anne H. McNamee, DDS

A thesis submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE

in

THE FACULTY OF GRADUATE STUDIES

Department of Oral Biological and Medical Sciences
Faculty of Dentistry

Approved by ______________________________
Chairperson of Supervisory Committee

The University of British Columbia
April 2003

ABSTRACT

Bitemark evidence is routinely accepted in the judicial system, but with recent United States court rulings such as *Daubert* and *Kuhmo* an emphasis has been placed on establishing the validity and reliability of current scientific techniques.

The current study compares the reliability of two popular methods used to produce computer-generated bitemark overlays. Images of twelve dental casts were sent to thirty examiners. Examiners were instructed to produce an overlay for each cast image based on the instructions provided for the two techniques. After the overlays were submitted, measurements of the area of the biting edge and the x-y coordinate of each tooth's position were obtained. The reliability assessment of the measurements was performed using an analysis of variance and calculation of reliability coefficients.

The analysis of variance results showed that the forensic experience level of the examiner and the cast variations all contribute to a significant effect in the variances seen for the area for both techniques. The inter- and intra-examiner reliability coefficients are low.

The results for the positional measurements showed the forensic experience level of the examiner contributes no significant differences to the variances. The differences are seen within the cast variations. The inter- and intra-examiner

reliability coefficients are exceptionally high. It was concluded that both techniques were reliable methods to produce bitemark overlays to assess tooth position.

TABLE OF CONTENTS

CHAPTER ONE – INTRODUCTION

Section One – Forensic Odontology and Bitemarks

Section Two – Bitemark Analysis Techniques and Methods

Section Three – Computers and Digital Imaging in Bitemark Analysis

CHAPER TWO – STATEMENT OF THE PROBLEM

CHAPTER THREE – MATERIALS AND METHODS

CHAPTER FOUR – RESULTS

CHAPTER FIVE – DISCUSSION

CHAPTER SIX – CONCLUSIONS

REFERENCES

APPENDICES

LIST OF TABLES

LIST OF FIGURES

Figure ***Page***

LIST OF ABBREVIATIONS

AAFS	American Academy of Forensic Science
ABFO	American Board of Forensic Odontology
ASFO	American Society of Forensic Odontology
UV	Ultraviolet Light
IR	Infrared Light
ANOVA	Analysis of Variance
DABFO	Diplomate of the American Board of Forensic Odontology
SAS	Statistical Analysis Software
MS	Mean Squares
DF	Degrees of Freedom
R	Reliability Coefficient

ACKNOWLEDGEMENTS

I wish to thank the many individuals who continue to support and encourage my unending quest for knowledge. I am grateful for the special relationships I have developed over the years, and for all who have contributed their own unique impression upon my life. With sincere gratitude I would like to acknowledge:

My parents, Paul and Wendy McNamee, whose support has transcended emotional and financial boundaries and who have taught me the true power of my potential;

My family, who consistently offered encouragement and would always lend assistance and direction in times of need;

My friends, namely Melanie White and Diane Fairley, who were always able to help maintain my balance between work and play;

My boyfriend, Joseph Stuccio, whose pride in me and endless support always gave me the strength needed to continue the task at hand;

My colleague, Dr. Iain Pretty, who helped forge a collaborative research effort and would offer professional advice;

My committee members, Drs. Doug Waterfield, Don Brunette, David Lowe, and Pierre Dow who have always challenged me to excel beyond my expectations;

Finally, my research supervisor and friend, Dr. David Sweet, whose selfless and giving nature has allowed me the opportunity to explore and learn forensic dentistry from the best and who always made me feel like Vancouver, BC wasn't that far from home after all.

FUNDING

This research has been generously funded by grants and support from the following organizations:

American Board of Forensic Odontology

American Society of Forensic Odontology

University of British Columbia Faculty of Dentistry
Research Grant

Bureau of Legal Dentistry Laboratory

"You can lead a jury to the truth but you can't make them believe it. Physical evidence cannot be intimidated. It does not forget. It doesn't get excited at the moment something is happening - like people do. It sits there and waits to be detected, preserved, evaluated, and explained. This is what physical evidence is all about. In the course of the trial, defense and prosecuting attorneys may lie, witnesses may lie, the defendant certainly will lie. Even the judge may lie. Only the evidence never lies."

H.L. MacDonell, 1984

Chapter One

Introduction

Section One

Forensic Odontology and Bitemarks

1.1 FORENSIC ODONTOLOGY

From infancy to old age, the teeth serve a multitude of functions. Each tooth provides a unique contribution from the mechanical digestion of food to the proper phonetic enunciations. In addition to the functionality of daily routines, teeth play a significant role in the identification of individuals. Most often utilized in a medico-legal context, identifying individuals based upon their dental uniqueness is the foundation upon which the discipline of forensic odontology is established.

Forensic odontology can be thought of as the interdisciplinary approach between dentistry and the criminal and civil justice system. The terms "forensic odontology" and "forensic dentistry" are interchangeable. Forensic dentistry encompasses a diverse range of subjects, which include comparative dental identification, mass disaster management, human abuse and neglect, dental jurisprudence issues, and bitemark analysis (1). The beginnings of forensic dentistry date back nine hundred years to England where King William secured the authenticity of royal documents by affixing to them a piece of wax that bore his bite impression (2). The acceptance of an individual's dental uniqueness continued to prove advantageous throughout the years. In 1775, Paul Revere as a silversmith and dentist, constructed a silver and ivory bridge to replace missing teeth for Dr. Joseph Warren. It was the distinctive nature and manufacturing of this bridge that ultimately led to the identification of Warren's body following the Battle of Bunker Hill (3). Additionally, the unique teeth impressions that are left behind after an individual bites an object or person are noted in several historical cases. One case involving bitemark testimony was discovered to have taken place as far back as 1870. The case of *Ohio* v. *Robinson* involved a murder in which a bitemark was found on the victim's arm (4). Although compelling bitemark evidence was presented and accepted by the judge, the accused was acquitted of the charges due to reasonable doubt brought forth by the defense of a possible alternative perpetrator. However, this case helped forge an introduction to forensic dental evidence and the eventual acceptance within the legal system.

Today, a variety of organizations exist that are dedicated to the development and advancement of forensic odontology. In North America, these include the American Academy of Forensic Sciences (AAFS), which has a prominent odontology section, the American Board of Forensic Odontology (ABFO), which aids in the development of guidelines and standards as well as oversees voluntary certification examinations of specialty status, and the American Society of Forensic Odontology (ASFO), whose members include a variety of professionals that engage in and expand the causes of forensic dentistry (5). It is through these organizations that forensic dentistry continues to thrive and progress as a science.

As with any discipline, a continued commitment to improving and advancing the domain is critical. This is accomplished through research, evaluation, and critical review of current and emerging techniques. With technologies advancing and evidentiary laws continually challenged, forensic dentistry is not without controversy. The most contentious issue involves human bitemarks. Whether the focus is on bitemark detection or dynamics, the methodologies used in analysis, or the evidentiary value of an injury, the topic of bitemarks continues to fuel heated debates.

1.2 BITEMARKS

The term bitemark refers to "a physical alteration in a medium caused by the contact of teeth" (6). These marks can be left on objects, food, or skin and produced by humans or animals. Within the context of this Introduction, the term bitemark will refer to a human bitemark left on human skin, as is most often the circumstance in actual forensic casework.

1.2.1 Recognition

The first step in forensic casework is the recognition of a patterned injury found on the skin as a human bitemark. Often the first individual to recognize a patterned injury on a deceased victim is an individual other than a forensic odontologist, such as a police officer or medical examiner. In the case of a living victim, a sexual assault examiner or emergency room personnel may initially recognize the patterned injury. Although skilled in their own respective disciplines, unfortunately without proper training in bitemark recognition many bitemarks go undetected each year due to the inability of the first responders to recognize the injury as a bitemark. Proper instruction of auxiliary personnel and greater availability of forensic dental consultations are, thus, essential in facilitating more accurate and complete recognition of bite injuries.

1.2.1.1 Physical Characteristics

When a hard object contacts a softer object and leaves an impression, this is a toolmark. Forensic toolmark analysis includes a vast array of different investigations of such impressions, such as ballistic matching, tire track identification, and the identification of specific knives to particular crimes. The science of bitemark analysis may be thought of as another form of a toolmark investigation. In this case, the tooth or teeth act as the harder object and leave their corresponding impression on the skin. When an analysis follows this approach, levels of distinguishing characteristics can begin to be documented. These characteristics are divided into gross, class, and individual characteristics.

Figure 1. A human bitemark

Figure 1 illustrates a typical human bitemark. According to the ABFO Guidelines and Standards (6), the description of the prototypical human bitemark is as follows:

> *"...a circular or oval patterned injury consisting of two opposing (facing) symmetrical, U-shaped arches separated at their bases by open spaces. Following the periphery of the arches, are a series of individual abrasions, contusions and/or lacerations reflecting the size, shape, arrangement and distribution of the class characteristics of the contacting surfaces of the human dentition."*

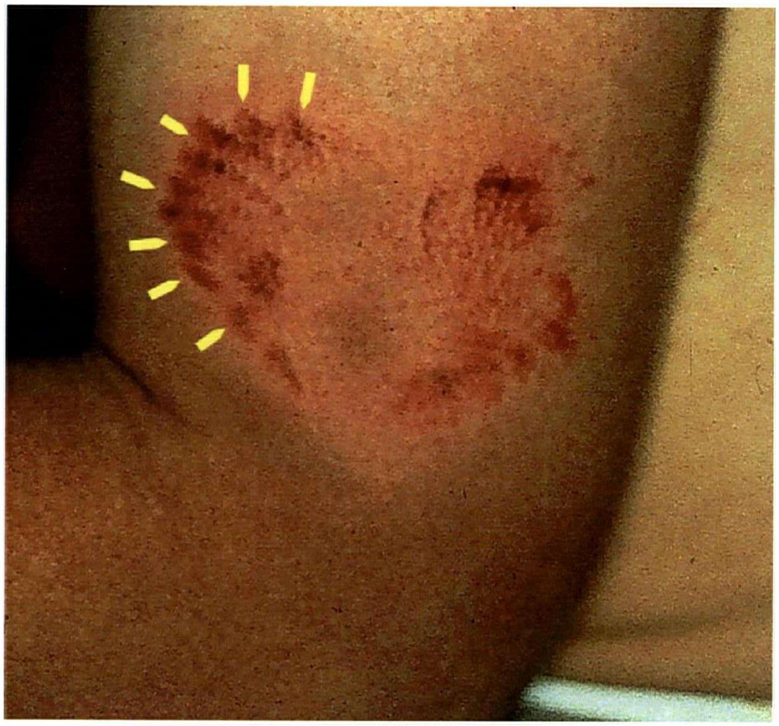
Using this definition as a reference, an explanation of the appearance of bitemarks will be described with respect to the different levels of toolmark characteristics.

1.2.1.1.1 Gross Characteristics

Gross characteristics are used to identify the general source of the tool (7). A common example is a footwear impression found in the sand. An initial assessment of the gross characteristics could reveal that the impression came from a shoe. For example, it is determined to be from a running shoe rather than a woman's heel. The scope of the search to find the shoe that made the imprint may now be narrowed to all running shoes. All other shoes can be excluded as the cause.

This same concept may be applied in bitemark recognition. When first assessing a patterned injury the question "Is this a bitemark?" must be answered. In Figure 2, a typical bitemark will have a circular or elliptical pattern with a diameter of 2.5 - 4.0 cm, exhibiting several small lacerations (shown by the yellow arrows), and often show a central area of bruising (6,7). These are the gross characteristics that will support the conclusion that the injury is a bitemark and not from some other source.

Figure 2. Human bitemark illustrating gross characteristics

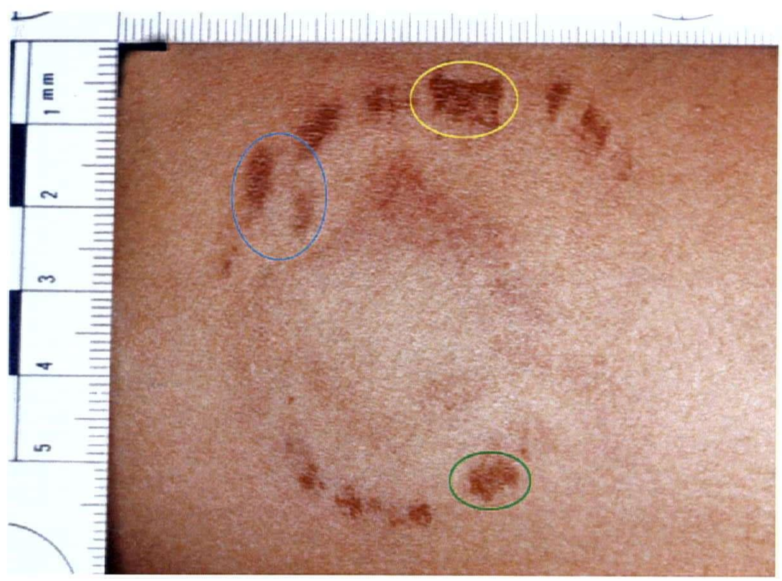


1.2.1.1.2 Class Characteristics

Class characteristics are measurable features of a toolmark that indicate a restricted origin (7). Continuing with the shoe print example, if it can be determined that the mark came from a size ten men's Reebok® running shoe, then the population of running shoes that could have caused this impression has been immediately reduced. This may now redirect the investigation to consider the dimensions, specific tread markings, and distinct features that Reebok® places within the sole of its size ten men's running shoes.

In bitemark analysis typical class characteristics are the shape, location, number, and dimensions of the teeth (6,7). For instance, a human bitemark can be distinguished from an animal bitemark based on the placement of the teeth in each arch and whether the teeth involved follow the normal biological formula for the human dentition. The biological formula is defined as teeth per quadrant. This translates to two incisors, one canine, two premolars, and three molars in humans. In human bitemarks, the biting edges of the anterior teeth are the portion of the dentition most often seen in the bite injury. Therefore, the focus is predominantly on the incisors and canines with the occasional marking of the premolars. Figure 3 depicts a bitemark showing some typical class characteristics. The blue circle highlights two cusp marks typically seen in a maxillary premolar, the yellow circle highlights the rectangular tooth mark seen in maxillary incisors, and the green circle highlights the rectangular tooth mark seen in mandibular incisors.

Figure 3. Human bitemark illustrating class characteristics



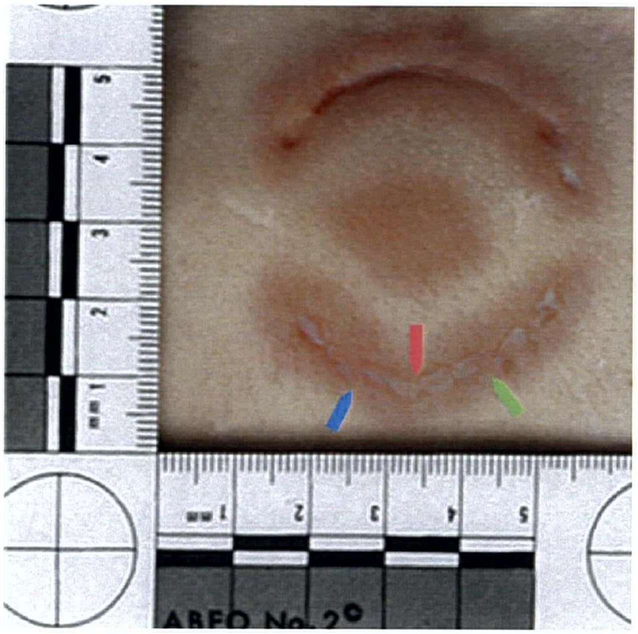
Furthermore, an adult human bitemark would have a measurable difference in width when compared to a child's bitemark. The typical intercanine distances for adults and children have been published and may be used as references (8).

1.2.1.1.3 Individual Characteristics

Individual or accidental characteristics are imperfections or irregularities present in the toolmark that are caused by use, misuse, or damage to the tool (7). The worn edge of the sole and a cut or nick in a specific portion of the sole would demonstrate individual characteristics that could differentiate John Smith's size ten Reebok® running shoe from all other running shoes of the same make and size.

In bitemark analysis, it is these individual characteristics that make it possible to distinguish one biter from another. Examples of individual characteristics include the specific dimensions, rotations, fractures, attritional wear patterns, and spacing of the teeth (6,7). These features form the foundation upon which each person's dental uniqueness is based. The more prominent the individual characteristics are recorded in a bite injury, the greater the chance of identifying the biter. Figure 4 illustrates a bitemark with individual characteristics (9). Each coloured arrow indicates an area where the teeth are crowded or overlapped resulting in a distinct pattern of tooth marks.

Figure 4. Simulated bitemark illustrating individual characteristics



1.2.1.2 Variable Features

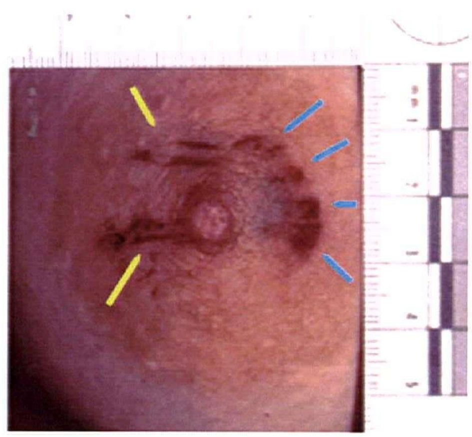
Advocates and opponents of bitemark evidence begin to disagree on the limits of the possible evidentiary value of the evidence. Biting is a dynamic process. The results of an inflicted bite will depend upon a variety of factors. Three critical factors include: a) the biting forces involved, b) location of the bitemark injury, and c) the response of human skin to biting injuries.

1.2.1.2.1 Biting Forces

A bitemark results when teeth come together with force upon the skin. The degree of force can influence the resulting patterned injury. Research into the mechanical forces in biting began in 1974 by Barbenel and Evans, and questions on the dynamics of biting remain unanswered. This early study showed that in addition to a biting force produced by the teeth, a combined sucking and tongue thrusting force also exists which produces a central ecchymosis (10). The outcome is also affected by the manner and extent to which the sucking force is applied. If the skin is held in place by the contact of the teeth and a sucking action is applied afterwards, the injury would appear differently than if the suction had been applied before the bite was made. In either case, a distinctly different injury occurs (10).

In addition to the amount of force and suction applied, the bitemark can give clues as to how it was inflicted. A static mark occurs when individual teeth marks leave a distinct impression in the skin. In this case, little movement is involved at the time of the bite. Conversely, if the teeth appear to have been dragged across the skin resulting in scratches or abrasions, this can be classified as a striated mark. A striated mark indicates the victim or suspect was moving during the biting. Figure 5 illustrates the difference in appearance between striated and static marks.

Figure 5. Difference between striated (yellow arrows) and static (blue arrows) bite injuries.



Jakobsen and Keiser-Nielson described in depth the implications of how the evidence left behind when a bite injury occurs could reveal how the bite was originally inflicted. For example, factors such as skin thickness when gripped within the teeth, the stretching of the skin's surface, and the position of the body may uniquely define a bitemark injury (11).

Finally, forces from the injury cause changes to occur within the skin as healing begins. Leakage of blood cells and serum into the dermal regions can cause either bruising or blistering subsequently to occur and this may change the colour or distention of the tissue (12). Not only will this affect the appearance of the injury, but also the dimensional changes that may occur as the injury changes with time. Soon after a bite is inflicted on the skin, the area will become edematous and stiffer than the surrounding tissues (10). This change can lead to a distorted appearance and only after the tissues are resorbed over a period of days will this effect be reduced. Therefore, proper evidence collection should include immediate photographic documentation and additional documentation of changes that occur over consecutive days.

1.2.1.2.2 Location

Bitemarks often occur in the most heinous crimes and in almost all anatomical locations. Notable trends exist in the location where bitemarks are found. Table 1 shows the anatomical locations of bitemarks and their frequency of occurrence in a representative sample of 101 United States cases (13).

Table 1. Anatomical distribution of bitemark locations found in 101 U.S. cases

Anatomical Location	Percentage of bites	
	Females	Males
Abdomen	2.8	0.0
Arms	13.0	63.6
Back	7.5	9.1
Breast	40.0	0.0
Face or Head	6.6	0.0
Foot	0.0	0.0
Genitals	6.6	0.0
Hands or Fingers	3.8	18.2
Legs	7.5	0.0
Neck	6.6	0.0
Shoulder	0.0	9.1
Thigh	5.6	0.0

Two studies note that when a victim is found with a bitemark, a high probability exists that additional bitemarks will also be found (13,14). Pretty and Sweet (13) citied over 70% of bitemark cases that involved injury to the breast also had additional bitemarks to the genitalia, neck, face, and head. This evidence supports the need for a thorough examination of the victim for multiple injuries. Interestingly, proper investigation also searches for injuries on the perpetrator's body. Table 1 shows that males are most likely to be bitten on their arms, hands, and shoulders. These wounds usually result from the victim's attempt to fend off the attack. It is believed that a greater number of defensive bites are actually inflicted on aggressors than attack bites on victims, and a call for all suspects to be examined immediately upon apprehension for tooth marks is recommended (11).

1.2.1.2.3 Human Skin as a Substrate

Paramount to the quality of the bite evidence is the ability of the underlying skin to record the bite injury. Skin is a poor substrate to register an impressed mark (15). The highly visco-elastic nature of skin allows stretching to occur during the biting process or when the evidence is collected (16). Furthermore, each anatomical location exhibits varying underlying musculature curvature, and adherence of the skin to the underlying tissue, which can alter the skin's response (16,17).

Research into this challenging issue has been limited because of the ethical concerns with the generation of bitemarks on living victims. DeVore attempted to analyze differences by utilizing a printing mould of concentric circles and inked simulated bitemarks on varying locations of a volunteer's body while photographically documenting the evidence. When the participant changed positions and the injuries were re-photographed, the sites showed significant differences (18). This same type of experiment was undertaken within the analysis of an actual case. In this instance, the victim's own skin was used as a template as well as an anatomically similar volunteer. It was concluded that using a substrate similar in consistency and elasticity to the substrate the bitemark was found on is crucial to the successful duplication of the wound pattern for comparison (19).

1.2.1.3 Forensic Significance of Bitemarks

Taking into consideration all of the variables involved in bitemark analysis, it is the individual odontologist and the legal system that determine the forensic significance of the evidence based upon the quality of the bitemark, the collection of the evidence, and current evidentiary admissibility standards.

1.2.1.3.1 Value of Evidence

Each case presents its own unique set of elements. Indication of a bitemark injury may provide a lead towards other potential evidence. For example, it may establish a timeline of repeated abuse (20), link a suspect to a victim or crime scene (21,22,23), or even exemplify the violent nature of an act (24,25). The odontologist determines evidential value and then chooses the appropriate analysis method. Bitemark evidence may be analyzed with physical, biological, and psychological components.

1.2.1.3.1.1 Physical Evidence

The recognition of a patterned injury on the skin is considered physical evidence of a crime. Within a legal context, physical evidence is an example of circumstantial evidence. Physical evidence and its presence not only provides useful information to the investigators, but directs the focus of the investigation as well. As each bitemark is unique in appearance, a classification system was developed by the Northwestern University Dental School in Chicago, IL to help distinguish the degrees of injury. This classification is shown in Table 2. If more than one class of injury is present in the same bitemark, the overall classification is based upon the most severe damage recorded.

Table 2. Northwestern University Dental School's bitemark classification system

Bitemark Classification	Physical Description
Class I	Erythema
Class II	Contusion
Class III	Abrasion
Class IV	Laceration
Class V	Avulsion

Advancing this classification, Sheasby and MacDonald have attempted to establish a classification based upon the probable distortion found in bite injuries (26). Primary distortion includes any distortion that may occur at the time of biting. This takes into account the dynamics involved at the time of biting and also the underlying tissue effects that have been previously discussed. Secondary distortion involves the distortion that occurs from the time the bite was inflicted to the time it had been examined. Here, variables such as time-related effects, postural differences, and photographic distortion may be important considerations (26).

Physical evidence provides the means to complete comparisons between a suspect and the bite injury. Two specific comparisons, "metric" and "pattern association" will be discussed further in a subsequent section.

1.2.1.3.1.2 Biological Evidence

The admissibility of DNA evidence has underscored the importance of also collecting saliva that is deposited during the bite. With sophisticated techniques such as the polymerase chain reaction a small amount of saliva is all that is necessary to yield a DNA profile of a saliva contributor. Salivary evidence can be collected from skin, foodstuff, or other objects that may have been bitten at the crime scene to identify the biter. Retrieval of DNA evidence from bitemarks has also successfully linked suspects to their crime scenes (27,28). The double swab technique, developed by Sweet, is the preferred technique for the collection of salivary DNA evidence (29).

1.2.1.3.1.3 Psychological Evidence

The use of criminal profiling to attempt to identify violent offenders is widely used. The desire to understand motivations behind deviant behaviours is applicable to bite attacks. Few researchers have explored the notion that there are characteristics that are common to all biters, and a review of the literature drew attention to the need to investigate this area further (30). Limited studies were conducted by Walter, a psychologist, who categorizes biters into three distinct groups: 1) anger-impulsive biters, 2) sadistic biters, and 3) ego-cannibalistic biters (31,32).

Case reports of convicted offenders who bite include results of psychological testing that show greater tendencies toward oral sadistic behaviours (33). Injury assessment has shown that different types of bites exhibit variations, which may provide insight into the biter's state of mind. Variations may exist as quick or haphazard bites as though made in self-defense. In contrast, a sadist bites his victims slowly and intentionally, and renders well-defined tooth marks (34). It should be cautioned that an odontologist who begins to testify in court about the psychological nature of the suspect is opening up the door for criticism by commenting upon subject matters beyond their training and expertise.

1.2.1.3.2 Collection of Evidence

An evidence collection protocol is essential to any crime scene investigation. Without a specific protocol, the chance of introducing error and affecting the analysis is high. For bitemark casework, the collection of the physical evidence is the primary focus. Two studies determined that a significant number of victim photographs and suspect exemplars were collected by individuals other than the investigating odontologist (35,36). This deviates from the suggested guidelines for bitemark evidence collection.

1.2.1.3.2.1 American Board of Forensic Odontology Guidelines

Listed in Table 3 is a compilation of the ABFO guidelines for victim and suspect evidence collection (6). The ABFO recommends these guidelines be used in conjunction with additional methods of documentation as required. Deviation from these generally accepted guidelines requires justification and accountability.

Table 3. ABFO guidelines for victim and suspect evidence collection

VICTIM EVIDENCE GUIDELINES	SUSPECT EVIDENCE GUIDELINES
• **Photography** Orientation and close-up photographs should be obtained with and without the presence of a scale placed adjacent to the bitemark. The scale must be positioned within the same plane as the bitemark and should include a linear and circular reference to aid in eliminating possible distortion. The film resolution should be high quality with proper color balance. Serial photographs are recommended in living victims.	• **Clinical Examination** Extraoral examination should include recording hard tissue factors that may influence biting dynamics such as TMJ and muscle tone. Measurements of maximum mouth opening should be obtained. Intraoral examination should include documentation of tongue size and function, the periodontal condition and mobility of the teeth and a full dental history.
• **Salivary Swabbing** Saliva swabs should be collected in circumstances in which the bite site area has not been altered from the time when the bite was inflicted.	• **Photography** Extraoral and intraoral photographs should be taken including frontal views, lateral views and occlusal views.
• **Impressions** Impressions of the bite site area should be taken when there is sufficient surface detail which may yield beneficial information. The material used must meet the American Dental Association specifications and suitable support should be included for proper support and reproducibility of the body site contour.	• **Impressions** At least two dental impressions should be taken of each arch using recommended American Dental Association specifications and properly prepared. The interocclusal record should be recorded.
• **Tissue Samples** Tissue samples should be retained if it appears they may yield useful information.	• **Study Cast and Bites** Master casts should be prepared with American Dental Associations approved Type II dental stone. Additional casts should be fabricated for special studies. Sample bites should be made in an appropriate material simulating the bite.

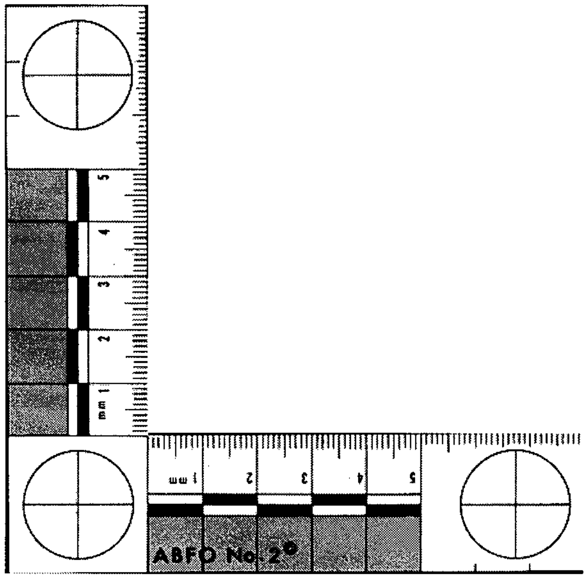
1.2.1.3.2.2 Victim Evidence Collection

A critical investigation of bite injuries begins with proper photographic documentation. A review of forensic photography protocols urges examiners to maintain records of the why, where, how, when, and under what circumstances the photograph was taken as well as an awareness of the rules, procedures, and laws regarding photographic evidence according to the jurisdiction of the local court (37).

The ABFO recommends that the photographs should be taken by conventional film photography, utilizing off-angle lighting and containing a rigid reference scale (6). Given that a part of the analysis is based upon a metric comparison, the importance of a proper reference scale cannot be overstated. The possibility of introducing perspective distortion in bitemark photographs is extremely high if a proper scale is not used and the angle of the camera to the substrate is not controlled (38). The presence of a scale is also very important to produce enlargements of the bitemark at known sizes. For example, life-size (100%), 200% or 300%.

The ABFO developed an L-shaped reference scale that has widespread use in the documentation of forensic evidence. Figure 6 illustrates the various features that make up the ABFO No. 2 reference scale. These features include the rigid design for horizontal and vertical measurements, three circles located in the corners to aid in rectification of angular distortion, and the 18% gray areas for proper colour matching of exposure.

Figure 6. ABFO No. 2 reference scale



A study analyzing the ABFO No. 2 ruler showed an overall accuracy to +/- 0.01 mm or 1% for the major centimeter graduations (39).

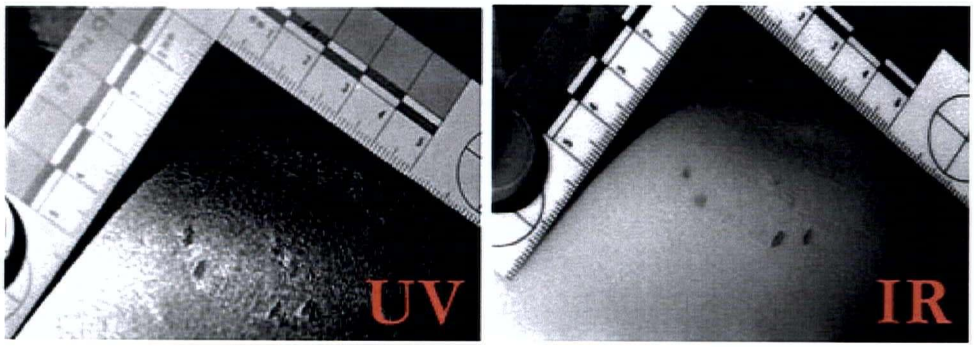
Additionally, three considerations are necessary when the scale is placed adjacent to the bitemark and then photographed (39):

> *"...(1) the required portion of the bitemark and the entire widths of the legs of the scale should be well within the camera's fields of view, (2) the film plane should be closely parallel to the plane of the scale and (3) the camera should be firmly mounted, not only to facilitate meeting the above conditions, but also to avoid any camera movement during exposure and between successive exposures."*

Additional photographic studies (40,41) supported these recommendations.

In addition to conventional film techniques, odontologists have explored the possibilities of using alternative lighting sources. The use of ultraviolet (UV) and infrared (IR) light are well accepted in forensic science, and show the most promise in the capture of a bitemark image. Wright, in 1998, proposed the use of colour, black and white, UV, and IR photography to obtain the most evidentiary value from a bite injury (42,43). He concluded that by using these four photographic techniques, the injury can be captured in three distinct planes of reference: highlighted surface detail (UV), detail below the surface of the skin (IR), and detail readily seen with the eye captured in both black and white and colour (43). Figure 7 demonstrates the differences obtained using UV and IR photographic techniques on the same bitemark injury (43).

Figure 7. Examples of bitemark photographs using alternative lighting sources



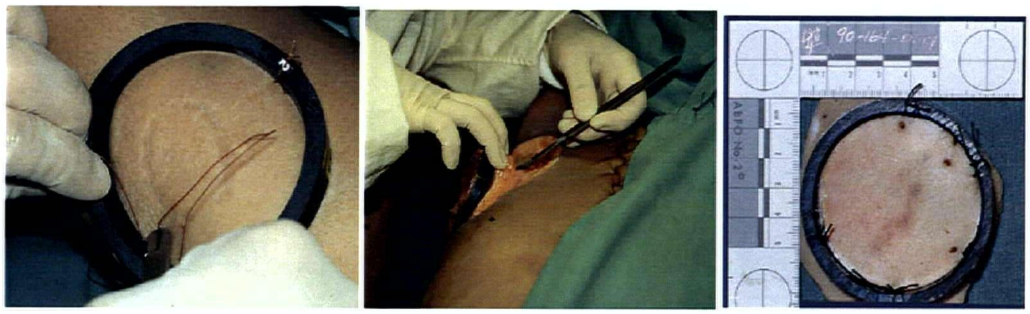
An impression of the bite site proves useful when there are distinct indentations left within the injury or there has been disruption of the skin's surface integrity.

The most common method to obtain a bite site impression includes a highly accurate dental impression material such as vinyl polysiloxane supplemented with a rigid backing (35). The backing is molded to the surface curvature of the skin and the orientation with respect to the position on the body is noted. This impression is used to produce a stone cast of the bite site for three-dimensional analysis.

At this time, an impression of the victim's teeth may also be obtained if the bite occurred in a location that is accessible to the victim's mouth. This will be helpful in determining if the bite was self-inflicted.

The last item of victim evidence is exclusive to the deceased individual. This is the excision of the bite site. Several authors have developed techniques that are advocated for the excision and preservation of excised tissue (44,45). Figure 8 shows the steps involved in the collection of the tissue from one such technique.

Figure 8. Excision of a bitemark site



A study by Rothwell examined the distortion of the preserved skin and concluded there is significant contraction and expansion in various bitemark specimens (15). Although controversial, some odontologists routinely excise the bite injury for use in transillumination analysis, histological studies, and tissue preservation.

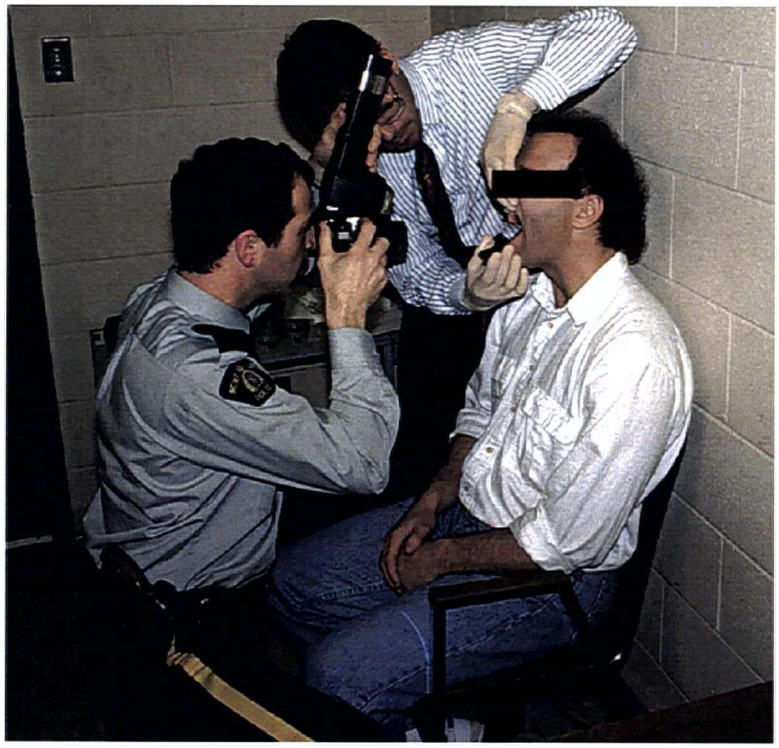
1.2.1.3.2.3 Suspect Evidence Collection

Collection of evidence from a suspect needs to follow established legal guidelines. It is usually necessary to acquire a warrant for all procedures, and the procedures must be accomplished within a specified timeframe. At issue may be the cooperation of the suspect. If so, specific protocols will help expedite the process.

A thorough dental examination of the suspect is the first step in the collection of the evidence (6). In addition, information about any dental treatments that were received by the suspect after the alleged bite attack are noted. Photographic records are collected and should include: extraoral photographs of the full frontal view of the face and intraoral photographs to document the front, left, and right views of the teeth, the teeth in centric occlusion, and the maxillary and mandibular occlusal views.

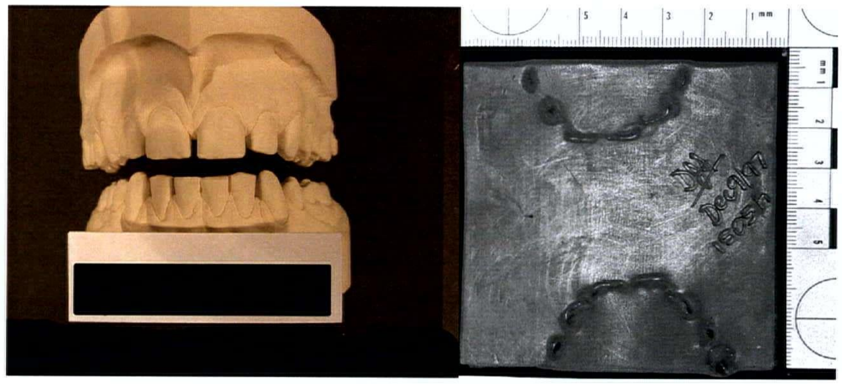
The clinical examination collects data that is utilized in the odontologist's assessment of a suspect's ability to bite. For example, data on the maximum vertical opening, Temporomandibular joint function, tongue size, and periodontal status is helpful and will tell a great deal about an individual's biting behaviour (6). Figure 9 shows the documentation of a clinical examination of a suspect.

Figure 9. Clinical examination of a bitemark suspect



Collection of the dental impressions from each suspect are critical to the analysis and requires highly accurate methods. The ABFO recommends that two impressions be taken of each dental arch using impression materials approved by the American Dental Association (6). The impressions are used to produce stone dental casts, which facilitate comparisons to the injury. Additionally, the suspect is asked to bite into dental wax to provide a record of the interocclusal relationship (6). Figure 10 illustrates acceptable master dental casts and sample wax bite.

Figure 10. Suspect's dental cast and sample wax bite



1.2.1.3.3 Bitemark Evidence in Court

The goal of evidence collection is the generation of data, which becomes the basis for conclusions. An early case involving the use of bitemark evidence to convict a suspect occurred in 1906 in England where two men were arrested for burglary. One of the suspects had bitten a piece of cheese at the crime scene and this pattern in the cheese matched the tooth marks of one of the suspects (46). Although the suspect ultimately confessed, this case was the first to admit bitemark evidence into the courtroom.

1.2.1.3.4 Bitemark Evidence Admissibility Standards

Acceptance of evidence by the courts requires that standards of admissibility be followed. Throughout the years, the court's use of scientific evidence has fallen under scrutiny and specific doctrines against which the evidence is evaluated for acceptance have changed.

Evidentiary challenges have been fought based on the Federal Rules of Evidence and the *Frye*[i], *Daubert*[ii], and *Kuhmo*[iii] standards, (47) which are summarized in Table 4.

Table 4. United States Scientific Evidence Admissibility Standards

Frye Standard (1923)	Expert testimony be supported by scientific principles or evidence generally accepted by the relevant scientific or professional community.
Federal Rules of Evidence 702 (1991 Amendment)	"If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise".
Daubert Standard (1993)	Defines a four-prong test for determining the "evidentiary reliability" of a scientific theory or technique: 1) Whether it "can be (and has been) tested"? 2) Whether it has been "subjected to peer review and publication"? 3) What is its "known or potential rate of error"? 4) Its "widespread acceptance" which "can be an important factor in ruling particular evidence admissibility".
Kuhmo Standard (1999)	A trial judge must determine whether proposed expert testimony that "reflects scientific, technical or other specialized knowledge" has a "reliable basis in the knowledge and experience of [the relevant] discipline".

[i] From *Frye* v. *United States*, 293 F. 1013, 1014, D.C. Cir. (1923)

[ii] From *Daubert* v. *Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993)

[iii] From *Kuhmo Tire Co.* v. *Carmichael*, 526 U.S. 137 (1999)

Most cases involving bitemark evidence have met these standards. An extensive listing of bitemark evidentiary issues may be found in a collection of comprehensive review articles (48-53). Although most challenges by the accused to bitemark admissibility have been denied, the forensic dental community cannot assume that this will always be so. An adversarial legal system will continue to encourage the discrediting or disapproval of scientific testimony. A primary objective of any discipline subjected to judicial scrutiny should be the active research and support of the foundations and theories that uphold it. Bitemark analysis and forensic odontologists continue to try and meet this challenge.

Section Two

Bitemark Analysis Techniques

1.3 THEORY OF BITEMARK COMPARISONS

After evidence has been collected and a probative value established, bitemark analysis may begin. To understand the different approaches used in analysis the theory behind bitemark comparisons will be detailed. This theory is based upon the notion of each individual's dental uniqueness. The foundation of bitemark analysis lies in the following two premises: 1) each individual's dentition is presumed to be unique, and 2) this presumed uniqueness is accurately recorded in the characteristics of the injury on the skin (54).

1.3.1 Uniqueness of the Human Dentition

Dental uniqueness, especially the morphological and restorative traits and characteristics of the teeth, has been acknowledged by the legal community as an acceptable means in the positive identification of human remains. The ability to compare antemortem and postmortem radiographs of deceased individuals is widely accepted. This uniqueness is based upon differences in dental anatomy, restorative work, pathological conditions, and other distinguishing features that are distinctive to each dentition.

Though rarely contested for comparative identification, this uniqueness is not transferable to bitemark comparisons. The qualities that are represented in a bitemark show the three-dimensional characteristics of the teeth. These characteristics may be able to include or exclude an individual as having been the cause of a bite but authors caution odontologists in making a positive identification of an individual with the same degree of certainty as a comparative identification of found remains until further study of the uniqueness of the arrangement of the anterior teeth is completed (55).

Several researchers have attempted to establish statistical evidence of the uniqueness of the dentition. These studies have included examining the frequency of dental characteristics in a population of dental casts (56), the dental uniqueness of bitemarks found in monozygotic twins (57), and an analysis of sample test bites collected across the United States (58). But the studies provided limited preliminary results based upon the population samples. Further research is needed to extrapolate the generalization of anterior dental uniqueness among all individuals.

Despite the lack of solid statistical support, dental uniqueness is still generally accepted in bitemark analysis. Most dentists anecdotally report never seeing two patients that exhibit the same anterior dental pattern during long clinical careers.

However, there are case reports that caution against the reliance upon single unique features to establish a bitemark identification. One case involved two suspects whose dental characteristics appeared dissimilar in the beginning, but only after the comparisons were applied to the bitemark did the similarities become apparent (59). Other authors contend that in an attack involving a limited number of people whose names are known, identification may be based on a single unique feature. However, in an open population of suspects, a single feature may not be extraordinary enough to establish an identification of the biter (60,61).

Opinion on the uniqueness of the human dentition will continue to fuel debate. Odontologists should be familiar with its shortcomings. Bowers echoed this sentiment in a web-based essay describing arguments behind the individuality of human teeth (55):

> *"Individual dental characteristics are reported to be features that are unique to an individual variation within a defined group. The presence of worn, fractured or restored teeth is valued as unique features. If a bitemark possesses the reflection of such a feature(s), the degree of confidence in a match increases. The odontological literature is silent regarding the frequency of these traits. It is actually counter-intuitive to assume enamel chips, fractures, and dental restorations are ALWAYS inherently unique. The shape of the human teeth is quite constant in nature and their changes over time are based on common events. The chance of more than one person having a crooked front tooth is quite large. That is why orthodontists have such large practices."*

1.3.2 Comparison Methods

Bitemark analysis is a complex process that can take on several forms. The ABFO surveyed the most popular analytical methods and presented these in the ABFO Bitemark Guidelines and Standards (6). These procedures are listed in Table 5.

Table 5. ABFO guidelines for bitemark analysis

Methods of Comparing Bitemark Evidence
Generation of Overlays
1. Acetate tracing directly from models of suspect
2. Acetate tracing indirect from photocopy of model with scale
3. X-ray film overlay created from Radiopaque material applied to the wax bite
4. Life-sized or greater photos of model printed on acetate film
Test Bite Media
1. Wax exemplars (aluwax, baseplate wax, etc.)
2. Styrofoam
3. Volunteer's skin
4. Alternative methods (fruit, clay, etc.)
Comparison Techniques
1. Acetate tracings to life-size photos of wound
2. Working study model of teeth to life-size photo of wound
3. Working study model of impression of wound or to actual victim
4. Acetate overlays of teeth compared to greater than life-size photo of wound
Technical Aids Employed for Analysis
Transillumination of tissue, Computer enhancement and/or digitization of mark or teeth, Stereomicroscopy, Scanning Electron Microscopy, Videotape, Caliper utilization for measurement

In a critical review of the scientific basis for bitemark analysis, attention was directed to the variety of techniques found in the literature (16). Occasions in which competing expert witnesses utilize identical techniques are rare and, therefore, the weight of the evidence may shift to the techniques rather than the experts' conclusions. Most methods that are used incorporate both metric and non-metric components. Metric analysis is a comparison using the physical measurements of class and individual characteristics located within the bitemark and the suspect's teeth. Non-metric analysis, or pattern association, is the associative comparison of the class and individual characteristics located within the bitemark and suspect's teeth especially tooth position, diastemata between teeth, dental rotation, etc. (7). An overview of these two types of comparison methods is described below.

1.3.2.1 Metric Comparisons

The specific dimensions of a dental arch can be an important factor to immediately include or exclude a suspect. The basic arrangement of human teeth follows general developmental lines but variations between individuals exist. The measurements of significance are the mesial-distal width, buccal-lingual width, and rotational angle of each tooth.

Numerous studies have examined the differences in human teeth measurements (62-66) based upon different population groups and noticeable differences have been seen. Most measurements are manually obtained by using an instrument such as a caliper. The possibility of introducing human and instrumental error is relatively high. A study on the reliability of human odontometric data showed a high inter-observer error component and a greater discrepancy in the mesial-distal dimension than in the buccal-lingual dimension (67). New metric comparison methods are emerging that may reduce this error and enable the use of computer software programs. These techniques will be discussed in a subsequent section.

It is important to note the limitations of the evidence under examination. Often, an investigator is faced with the task of comparing absolute measurements obtained from a suspect's cast to vague or diffuse injuries depicted in a day-old bite or photograph. A positive identification should not be based exclusively on a metric analysis without a supplemental physical comparison.

1.3.2.2 Physical Comparisons

The most common method of bitemark analysis is the physical comparison or association of the suspect's teeth to the bite injury. This involves matching the pattern of an outline of the suspect's anterior teeth to an identically-sized photographic image of the bitemark. The examination includes the documentation of any consistencies and inconsistencies demonstrated between the two patterns.

A minimum number of concordant points needed for a positive identification of bitemarks has not been established. The debate focuses around the idea that some experts consider a formal identification is established only if a minimum number of corresponding characteristics with no unexplained non-conformity is put into evidence (68). Other experts contend the identification is a matter of judgment based upon the evaluation of the contributions to individuality on a quantitative and a qualitative level (68). Differences in subjective interpretations of patterns exist amongst odontologists.

The ABFO has developed a list of acceptable terms used to describe the link between a bitemark and a suspect. These recommendations are listed in Table 6. The opinion rendered by the odontologist is based upon a personal threshold that is arrived at after comprehensive examination, consideration of all variables, and determination of the degree of concordance.

Table 6. Degrees of certainty describing the link between bitemark and suspect

Potential Conclusions	
Term	**Connotation**
Positive Identification	virtual certainty; no reasonable or practical possibility that someone else did it
Probable Identification	more likely than not
Possible Identification	could be; can't be ruled out
Negative Identification	not the biter
Insufficient Evidence	insufficient quality of evidence to make any statement of relationship to the biter

The reliability of using these categorical conclusions was assessed during the 1999 ABFO Bitemark Workshop (69). Examiners were asked to draw conclusions based upon how certain they were that different suspects had made specific bitemarks. Receiver operating characteristics analysis revealed an accuracy score of 0.86, which the authors concluded was less than optimal accuracy due to the legal context in which bitemarks are found. With a need to be able to defend procedures and techniques in a court of law, a conservative approach was recommended when examining bitemark evidence.

1.4 BITEMARK OVERLAYS

The physical comparison of the suspect to the bite is achieved by producing a transparent bitemark overlay. This aids in visualizing the biting edges of the teeth while they are compared to the bitemark photograph. An overlay contains outlines of the perimeters of the suspect's anterior teeth that would most likely be seen in a resulting bitemark. This outline produces what is referred to as a hollow-volume overlay. That is, an outline that is transparent outside and inside the contours of the teeth of interest. (See Figure 10.) Numerous techniques have been developed to produce bitemark overlays. The most common methods are described below.

1.4.1 Hand-Traced from Stone Casts

The most simplistic overlay technique involves a hand-traced representation of the suspect's teeth. This method, originally described by Luntz and Luntz (70), produces a life-size representation of the suspect's teeth by securing a sheet of clear film over a cast of the suspect's teeth and tracing the perimeter of the anterior teeth with a fine-tipped marker. These representations of the teeth were subsequently directly compared to a life-size photograph of the bite injury. This method is quick and economical, but highly subjective in the depiction of the biting edges, accuracy of the actual biting edges recorded on the film, and the stability of the transparency sheet.

1.4.2 Hand-Traced from Wax Impressions

Luntz and Luntz also described another hand tracing method by integrating a step in which the stone casts are indented into a wax wafer (70). By creating an impression of the biting edges into softened wax, the configuration of a likely bite pattern is recorded. A sheet of clear film is positioned on top of the wax impression, and the perimeter of the indented tooth markings is traced with a fine-tipped marker. This may be directly compared to a life-size photograph. The main critique of this method is the subjectivity in the creation of the wax impression through the amount of pressure applied to the dental casts. Different forces significantly alter the depth that the teeth impress into the wax. These differences in depth penetration produce impressions in the wax whose dimensions may be significantly different than the dimensions of the teeth at the biting edges. The previously described subjectivity of the depiction of the biting edges and the stability of the transparent sheet are also a problem with this technique.

1.4.3 Hand-Traced from Xerographic Methods

In 1991, Dailey published a technique for the production of overlays using a photocopier (71). Initially, the photocopier is calibrated to ensure 100% image output. Upper and lower dental casts are placed on the glass of the copier and weighted to ensure maximal incisal contact with the glass. An ABFO No. 2 scale is positioned next to the casts and photocopied at 100% magnification. The photocopied image is then placed face down on a light box. The illumination allows the examiner to visualize and trace the outlines of the incisal edges on the back of the photocopy. This eliminates unwanted background images and focuses the attention on the teeth of interest. This tracing is then inserted into the photocopy machine and printed out on a transparency film to produce an overlay. A margin of error exists that is inherent in the continued reproduction of the images. Using photocopies of photocopies to produce an image is questionable. Additionally, examiner subjectivity is still present in the tracing of the incisal edges.

1.4.4 The Radiopaque Impression Method

Published in 1996, Naru and Dykes presented a new spin on the previous wax impression method (72). Dental casts are impressed into a softened piece of wax to record the biting surfaces. Radiopaque powder, such as amalgam or $BaSO_4$, is mixed with alcohol to produce a solution. This mixture is carefully placed in the hollow indentations of the tooth marks and left for five minutes to facilitate alcohol evaporation. Occlusal radiographic film is placed under the wax wafer and a radiographic image is exposed and developed. The film will show radiopacities where the tooth marks are positioned. A computer or photocopier is programmed to reverse the image and produce an inverted representation of the pattern.

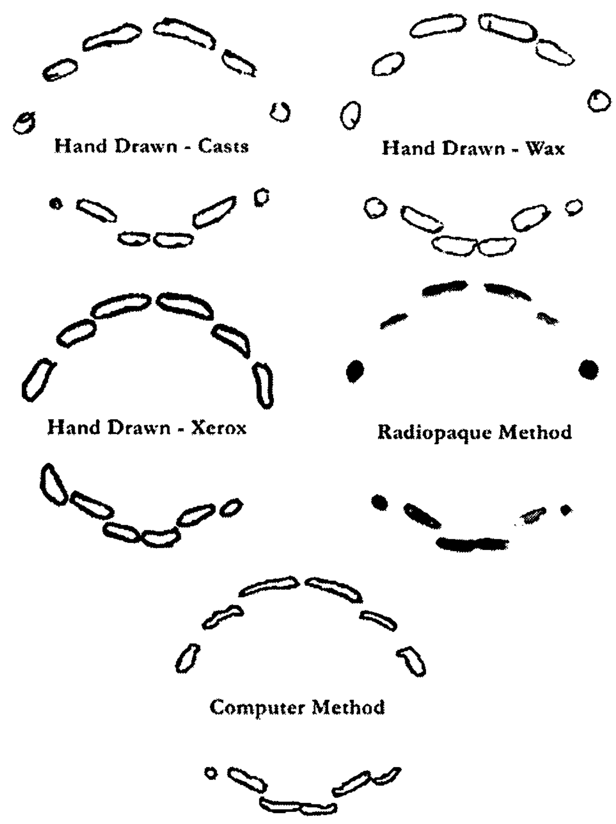
1.4.5 Computer-Generated Overlays

In 1998, Sweet endeavoured to reduce examiner subjectivity in the production of overlays by developing a technique using a computer, scanner, and imaging software program (54). Dental casts are placed on the glass platen of a flatbed scanner along with an ABFO No. 2 scale. The image is scanned into Adobe Photoshop®. Using the Magic Wand Tool, the biting edges of the teeth are objectively selected and pasted into a new layer. The Magic Wand Tool selects portions of an image based on the similarities of adjacent pixel values. By removing the background layer containing dental structures not related to the biting edges, the images of the teeth recorded in the new layer can be printed on a clear sheet and used for an overlay.

1.4.6 Comparison of Overlay Techniques

Several studies have evaluated the accuracy of various overlay production methods. In 1998 Sweet and Bowers compared the five most common overlay methods described above (73). Examples of the overlays produced by each method are shown in Figure 10.

Figure 10. Examples of five common overlay techniques



Data was collected for the area and relative rotation from each tooth present on the 150 sets of overlays studied. Results of a multivariate analysis of variance showed significant differences between the techniques for both area and rotation. The computer-based production method was the most accurate and most objective, and was used as a gold standard to compare the accuracy of the other methods. Hand-traced methods were determined to be inaccurate and subjective.

Another study examined differences in examiner expertise with the reproducibility in the production of overlays using manual and digital methods (72). Four examiners were selected; an odontologist, a dental nurse, a dental surgeon, and a layman. Results demonstrated how subjectivity, perception, and manual ability can influence variations among the examiners for the hand drawings. The digital method was less sensitive to these factors.

Although not completely objective, the use of computers is forging the way toward less subjectivity in the comparisons of bitemarks. With advancements in computer technology and imaging, a movement is underway to integrate the numerous digital applications that are beneficial in a forensic investigation to bitemark comparisons.

Section Three

Computers and Digital Imaging in Bitemark Analysis

1.5 COMPUTERS AND DIGITAL IMAGING

Computers are rapidly becoming an essential element of everyday life. Their low cost, availability, and ease-of-use make the digital manipulation of information easier than it has been before. Forensic odontology investigations have followed similar trends and have begun to take advantage of computers and other digital resources.

1.5.1 Computer Applications in Forensic Odontology

In 1996, Rawson reviewed the most likely uses for computers in forensic dentistry and are listed in Table 7 (74).

Table 7. 1996 listing of computer uses in forensic dentistry

Uses for Computers in Forensic Dentistry
1) Writing and processing documents
2) Searching for missing people and handling antemortem and postmortem records relating to mass disasters
3) Reviewing charts and managing records
4) Researching and handling data such as literature reviews
5) Radiographic images
6) Taking digital photographs and enhancing and comparing images

Although this list provides a general overview, the uses for computers have continued to expand. The applications related to the identification of human remains, analysis of evidence, and web use in research and casework has seen vast improvements. A few significant areas of focus relating to the identification of human remains and bitemark analysis are discussed below.

1.5.1.1 Techniques in Digital Identification of Remains

Two computer programs are used in mass disaster identifications. CAPMI (Computer-Assisted Post-Mortem Identification), was developed by the United States Army Institute of Dental Research and is DOS-based (75). WinID was developed by Dr. James McGivney and is made available free of charge to all interested parties, including the largest response team in North America, the United States Public Health Services Disaster Mortuary Operational Response Team (75). Several other computer applications for disaster response teams have been developed in Europe, Canada, and Australia. The use of these programs significantly reduces the time involved by narrowing the list of potential individuals that most likely match the remains.

Additionally, computers have proven to be useful in identifying specific sets of remains. Computer imaging programs have been used to compare dental restorations and structures in antemortem and postmortem radiographs (76,77), distinguish different types of restorative materials (78), and to estimate the age of adult teeth (79).

1.5.1.2 Techniques in Digital Bitemark Analysis

In 1995, Nambiar et al developed SCIP, an interactive shape analysis computer program (80). This program is useful in measuring the locations and positional relationships between two shapes. It is based on a "least squares" method, which finds the common location and orientation of two shapes to compare their similarities and differences. This information is used to calculate a similarity index. Nambiar tested this program by experimenting with bitemarks from known suspects on flat wax surfaces, foodstuff, and human skin (80,81). The authors concluded that a similarity index of 2.0 or less could identify a biter.

Some studies have focused on the differences in accuracy between manual measurements versus computer measurements (82,83). In both instances, it was shown that scanning three-dimensional models into two-dimensional images produces measurements that are at least as accurate as those produced by other techniques.

McGivney and Barsley developed a method for the mathematical documentation of bitemarks (84). In this method the centroid of each mark is determined and used as a point of reference for defining the mark. Lines are then used to connect each point around the arch. The lengths of these lines and the angles formed between adjacent lines are recorded and used to describe the bitemark. The authors suggest that these lengths and angles may yield information to distinguish identifiable physical characteristics in the biter. For example, large lengths may indicate large teeth or interdental spacings, whereas shorter lengths may signify small or overlapping teeth. The authors warn that applying this method to poorly-defined bitemarks may prove inconclusive. Further research is necessary.

The most critical factor in bitemark analysis is the quality of the injury photograph as it is this evidence that is used in the direct comparison to a suspect's teeth. Therefore, photographic elements such as lighting exposure, focus, resolution, and angle are crucial in obtaining a high-quality end product. Sadly, many bitemark photographs fall short of expectations. Odontologists have developed specialized techniques to attempt to address this shortfall.

1.5.1.2.1 Correction of Photographic Distortion

Distortion associated with bitemark photographs is a direct result of improperly aligning the camera to the injury when the image is captured. Bowers (85) classified four types of distortion found in bitemark photographs, which are summarized in Table 8.

Table 8. Categories of off-angle distortion found in bitemark photographs

Distortion Type	Definition
I	Entire scale and evidence on the same plane, the camera is not properly aligned
II	Entire scale and evidence are not parallel
III	Portion of scale is off plane
IV	Scale is bent, curved or skewed

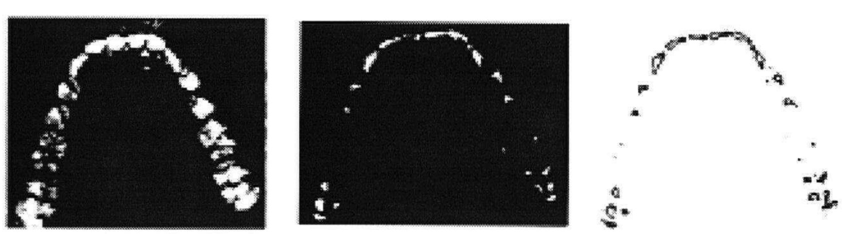
A study examining the use of Adobe Photoshop® to correct these distortions was completed by Johansen and Bowers (85). The results showed that Type I distortion can be reliably corrected using Adobe Photoshop®. The authors further concluded that Type III and IV distortion, which are subsets of the category of distortion found in Type I, are amenable to digital rectification methods. But in Type II distortions, the distortion is caused by the misalignment of the original evidence and scale. This situation would require the bitemark to be re-photographed.

In addition to problems with distortion, bitemark images may exhibit a poor visual quality. Digital enhancement techniques have been developed to improve the features captured in the photograph. In 2001, Karazalus and Palmback described the application of a computer program called Lucis®, a Differential Hysterisis Processing technique, to use in forensic cases (86). The principle behind Lucis® is the ability to work with hundreds of levels of contrast rather that the limited levels seen by the human eye. Lucis® selects a contrast range that can suppress distracting fine background details and visually enhance the critical portions of the image. The authors report that Lucis® is an image enhancement program and not an image restoration method. This software has opened the door to future applications to improve the quality of photographic evidence.

Adobe Photoshop® is a popular method used to select the biting surfaces of anterior teeth and produce an overlay (9,54). In 2001, Pretty and Sweet examined the effectiveness of the use of bitemark overlays produced using Photoshop® (87). A series of simulated bitemarks were created on pig-skin, overlays were produced representing possible suspects and distributed to examiners for case analysis. The examiners were selected to represent three different groups based upon previous bitemark experience. The effectiveness of overlays for physical comparison was measured by examining the sensitivity and specificity of the examiners' conclusions with a forced decision model. These results were then analyzed as a single variable of accuracy using receiver operator characteristics analysis. The mean area under the curve for the groups was 80.7%, which means the examiners were able to correctly identify the biter eight out of ten times. Interestingly, the study also showed that experience had little impact on the effectiveness of the use of overlays. This study established error rates for the use of overlays and laid a foundation for further investigation.

Overlays are also produced using software programs that analyze the tone contrast found in scanned cast images. Using tone-line imaging, it has been suggested that artistic ability, knowledge of dental anatomy, and personal bias do not influence the result producing a more objective analysis (88). Naru and Dykes developed a technique that enables an overlay to be created by inverting the tonal elements within the cast image to produce an outline of the original biting edges (72, 89). Figure 12 illustrates a few steps involved in the production of an overlay using this technique.

Figure 12. Overlay production using computer imaging contrast conversion methods



These two methods are the most popular for the production of computer-generated overlays. They are used widely in North America and Europe, respectively. In the current study, we will compare the results of each technique to evaluate their comparative reliability.

Chapter Two

Statement of the Problem

2.1 Statement of the Problem

Courts have recently taken an aggressive approach toward the scientific foundation of expert testimony. The validity and reliability of scientific techniques used in the courtroom have brought many previously accepted methods of forensic investigation under closer inspection. Significant cases such as *Daubert* and *Kuhmo* have demonstrated that scientific evidence must meet a minimum level of judicial scrutiny before testimony is accepted.

The current study aims to compare the reliability of two different methods to produce computer-generated bitemark overlays. Questions must be answered on how often one examiner would produce an overlay identical to another examiner and on how examiners would produce consistent overlays using the two different techniques.

While researchers have examined different computer methods individually, there has never been a direct comparison of one leading technique to the other. This study will focus on the production of overlays by using a) Adobe Photoshop® Magic Wand Tool, and b) Adobe Photoshop® Inversion Tool, the techniques popular in North America (Sweet and Bowers) and Europe (Naru and Dykes). By evaluating the inter- and intra-examiner reliability of the two techniques, the scientific foundation of bitemark analysis will be furthered.

Chapter Three

Materials and Methods

3.1 EXPERIMENTAL DESIGN AND PROTOCOLS

Participants were asked to produce hollow-volume overlays using two different computer techniques. The overlays were collected and measurements of the area and x- and y- positions were obtained for each of the six upper and six lower anterior teeth. These measurements were evaluated using analysis of variance and calculations of reliability coefficients.

3.1.1 Examiner Groups

The following groups were selected to address this issue:

- Diplomates of the American Board of Forensic Odontology with extensive bitemark experience
- Forensic Dentists with limited bitemark experience
- 2nd Year Dental Students

Ten examiners were recruited in each group based upon their ability to meet the established criteria: access to a computer with version Adobe Photoshop® v5.0 or higher, capability to save digital images to either a Zip disk or CD-ROM, and willingness to volunteer their time to the study. A total of thirty examiners received the study materials.

3.1.2 Cast Selection

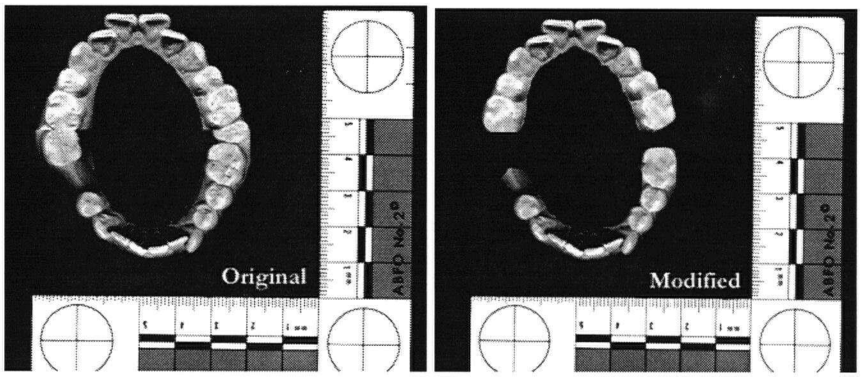
The dental casts were selected to be representative of a typical range of the variations found in the human dentition. Six casts were chosen that exhibited assorted levels of difficulty based upon tooth placement and rotation. The casts were stratified as follows: two casts had perfect alignments, two casts showed moderate levels of crowding, and two casts had buccal-lingual inversions.

3.1.3 Cast Preparation

Digital images of the casts were obtained by scanning to high-quality JPEG format using the method described by Johansen (9). An ABFO No. 2 scale was included in each image. The final images were confirmed to be life-size and were saved in a Photoshop Document (PSD) file format at a resolution of 150 pixels/inch. The casts were labeled A through F and can be found in Appendix A.

In order to evaluate intra-examiner reliability, it was necessary that some of the casts would need to be examined more than once. To accomplish this, all cast images were duplicated and altered at the occlusal surfaces of the posterior teeth to mislead the examiners into thinking the casts were different. Figure 13 illustrates an example of an original and modified cast.

Figure 13. Example of an original and modified cast image used to assess intra-examiner reliability



To control for the potential for the examiners to improve their skills with each successive overlay, the order the casts were to be completed was randomized. Each examiner was placed into one of ten participant groups and the cast order was randomized within these groups.

Each of the six original casts were duplicated and modified resulting in twelve casts images that were distributed to the examiners. The casts were labeled Cases 1 through 12 dependent upon which randomization group the examiner was placed in. Each examiner would create an overlay for each case twice allowing for calculations of intra-examiner reliability without the need for a washout period to elapse between examinations.

3.1.4 Study Package

Each examiner received a package including the following:

- Instructions
- Questionnaire
- CD-ROM labeled "Study CD" containing the twelve cast images labeled Cases 1-12
- CD-ROM or Zip Disk labeled "Blank CD or "Blank Disk" to submit their overlays
- Pre-addressed envelope for the return of the materials

A pilot study was completed to assess the comprehensibility of the instructional booklets. Three independent examiners were given a cast image and asked to follow the instructions to create an overlay using each technique. The resulting overlays and examiners' comments were evaluated to determine if the instructions were adequate. The study booklets were modified accordingly.

3.1.4.1 Study Questionnaire

A questionnaire was developed to gauge experience levels for each examiner. A copy of the questionnaire can be found in Appendix B. The questionnaire focused on two areas: computer and bitemark experience.

3.1.4.2 Technique A

Technique A is the well-known, peer-reviewed method routinely used in North America. Appendix C contains the complete instructions provided to the participants and an example showing the main steps involved to produce an overlay using Technique A for the maxillary anterior teeth. The main feature in Technique A is the use of the Magic Wand Tool. The Magic Wand cursor is placed over the biting edge of each tooth and the area is selected. The area selected will include all adjacent pixel tones of similar values based upon the tolerance setting of the Magic Wand Tool. This will create an outline of the perimeters of the biting surface of each tooth. The perimeter is then defined by stroking a solid black line around the selected area to produce the overlay. Figure 14 summarizes the process involved.

Figure 14. Technique A overlay production steps

Open image in Photoshop®

⇓

Zoom-in to magnify the incisal edges of the anterior teeth

⇓

Select the incisal edges using the Magic Wand Tool

⇓

Copy the selected areas into a new layer called 'Overlay'

⇓

Clear the center noise and stroke the perimeter of the teeth on the inside with 2 pixel black line

⇓

Deselect the background image of the cast and save the overlay

3.1.4.3 Technique B

Technique B is used predominately in Europe and is based on previously published methods (72, 89) that focus on different contrast levels found in the cast image. Appendix D contains the complete instructions provided to the participants and an example showing the main steps involved to produce an overlay using Technique B for the maxillary anterior teeth. The main feature in Technique B is the use of the Glowing Edges filter. This filter objectively selects and highlights the edges of the cast and teeth. The contrast of the image is then inverted and the unwanted areas are erased until only an outline of the incisal edges of the anterior teeth remain. Figure 15 summarizes the process involved.

Figure 15. Technique B overlay production steps

Open the image in Photoshop®

⇓

Zoom-in to magnify the incisal edges of the anterior teeth

⇓

Select Filter > Stylize > Glowing Edges

⇓

Select Image > Adjust > Invert

⇓

Erase unwanted areas until you are left with an outline of the incisal edges of the anterior teeth

⇓

Continue to erase separating the individual anterior teeth and save the overlay

3.1.4.4 Follow-up Questionnaire

After the overlays were returned by the examiners, a follow-up questionnaire was used to collect additional data. Appendix E contains the questionnaire. Three questions were asked:

> 1) Which technique did you prefer for the production of a bitemark overlay? Why?
>
> 2) What was the average time it took you to produce an overlay using Technique A? Technique B?
>
> 3) For both techniques, when you focused on the anterior teeth was the entire arch/cast visible or did you zoom-in on the teeth to get a closer look at the incisal edges?

3.2 MEASUREMENT OF AREA AND POSITION

The renderings of the biting edges of the teeth recorded on the overlays by the examiners were converted to black using Adobe Photoshop®. The area (square mm) and position (x-coordinate, y-coordinate) of the black regions were calculated using Scion Image®. A description of these stages is explained below.

The overlay was opened in Adobe Photoshop®. The tolerance setting of the Magic Wand Tool was adjusted to 18. The entire overlay was selected and then inverted so that only the biting edges remain selected. A new file was created with a standard width and height of 14 centimeters each with a resolution of 150 pixels/inch in a grayscale mode on a white background. The selected images of the teeth were pasted into this new file. The selection was Filled using 100% opacity black and normal blending. The image was Deselected and the layers were merged and flattened. The final product was saved as an uncompressed TIFF image. Figures 16 and 17 illustrate one of the examiner's original hollow-volume overlays and the converted solid-volume overlays for each technique.

Figure 16. Original and converted overlay example for Technique A

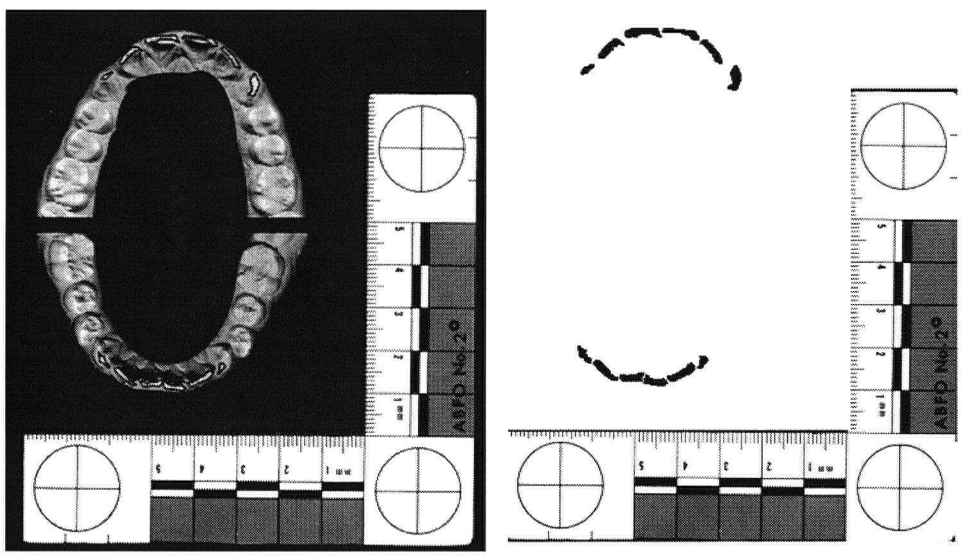
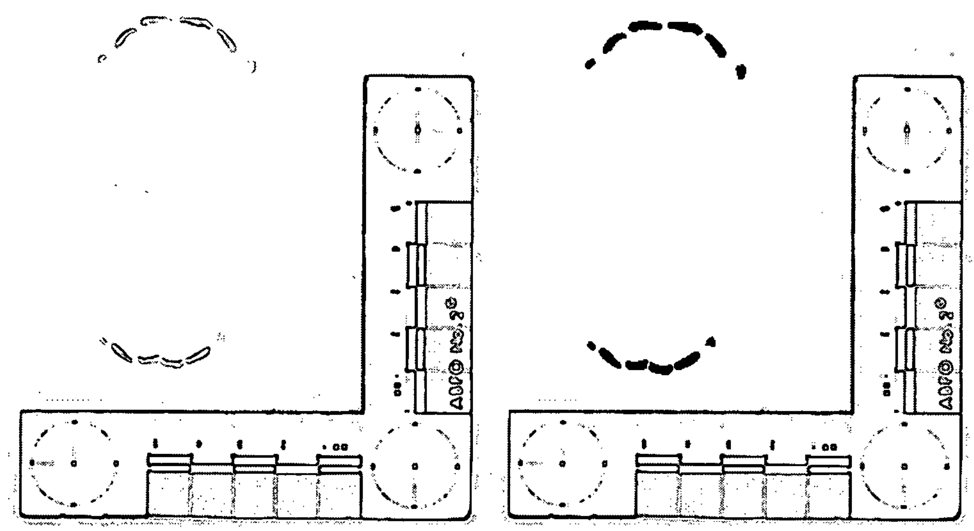


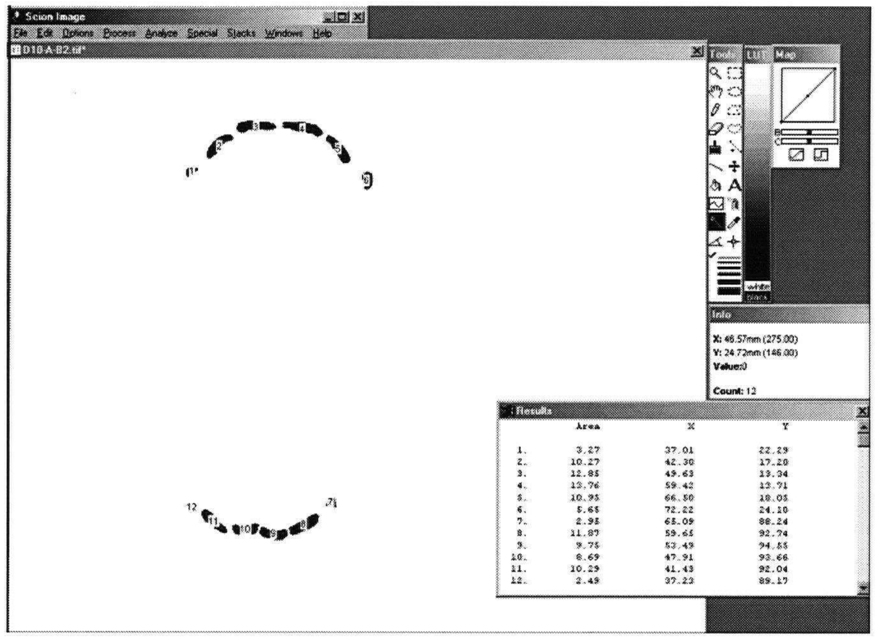
Figure 17. Original and converted overlay example for Technique B



If two teeth were found adjoined, a one-pixel wide break was created using the eraser tool at the normal anatomical separation between the teeth. This was necessary to differentiate each tooth.

Each converted overlay was opened in Scion Image® and the following preferences were set: a) area measurements in millimeters, b) x-y centroid position, and c) activation of the wand auto-measure tool. Each measurement was recorded in a spreadsheet. Figure 18 shows a sample image of an overlay analysis. Appendix F contains the complete data set for each examiner with the follow examiner group codes: D = Diplomates, F = Forensic Dentists and S = Dental Students. The Universal Tooth Numbering System (#1-32) was used to identify the specific teeth.

Figure 18. Data acquisition using Scion Image®



Measurements of area, x-coordinate, and y-coordinate were collected for each tooth on each converted overlay. This resulted in 36 data points for each case. A total of 432 data points were collected for each examiner for each technique.

3.3 ASSESSMENT METHODS

3.3.1 Reliability

Reliability is defined as the extent to which a method of measurement performs consistently (90). Often, reliability assessments focus on the premise of reproducibility. The principle aim of a reliability analysis is to determine the degree of agreement between examiners when using a particular rating scheme or technique. Ratings can be qualitative or quantitative measurements. The type of rating measured will determine the most appropriate reliability test for the final analysis.

Reliability assessments may follow two different approaches commonly seen in clinical and laboratory settings. In a clinical setting, it is common to examine observer agreement regarding the presence or absence of a particular sign or symptom (91). The outcome of this type of assessment is highly dependent upon the detail of the rating scale. For example, ten examiners may be asked to evaluate an individual's dental anxiety. One scale may have the examiner rate anxiety levels as simply the presence or absence of anxiety. A different scale may have the examiner rate the individual's anxiety on a scale of 1-10 with 1 as low anxiety and 10 as high anxiety. It is evident that when there are more categories included, there is a lower chance of perfect agreement between the examiners.

Therefore, a more appropriate term for this type of assessment is the degree of association between the examiners (91). An analysis based upon this approach will allow trends to show significance without demanding perfect agreement as a means of reproducibility.

In the laboratory setting, cases are assessed where there is an inestimable number of possible rating responses. This assessment typically involves an estimation of the precision of a technique by measuring samples and determining the variability of individual measurements (91). Precision is defined as how close repeated measurements of the same quantity are to each other (90). In this case, the reproducibility of the scores is determined by the amount of error in an individual assessment. Variability is measured by evaluating the standard deviation of the individual values around the calculated mean (91). Although this type of assessment is expressed as distinct numerical values, it is not sufficient to conclude a technique is reliable based solely upon insignificant differences in the means. Consequently, reliability assessments should focus both upon the observers' error rates and the association between the ratings designated to the individuals by different observers (91).

3.3.2 Reliability Tests

To determine the variance due to different factors, a technique called analysis of variance (ANOVA) is used. This approach involves dividing the various factors into categories to determine the individual effects.

The variability due to the samples is calculated by the difference between the score obtained and the mean sample score. This difference is squared and added together to produce the sum of squares (91). The variability due to observers is calculated the same way using the observer scores. The calculation of the random error involves determining how much each individual score deviates from its expected value (91). Once these values have been established, the total variance of the scores can be broken down into the three components. The mean square is obtained by dividing the sum of squares by the degree of freedom (DF) (90). The degree of freedom is determined by subtracting one from the number of samples or observers involved for that component.

The components of variance (σ^2) can then be estimated by relating the mean squares using the equations below (90).

$$\sigma^2_{sample} = \frac{\text{mean square samples} - \text{mean square error}}{\text{number of observers}}$$

$$\sigma^2_{observer} = \frac{\text{mean square observers} - \text{mean square error}}{\text{number of samples}}$$

$$\sigma^2_{error} = \text{mean square error}$$

Finally, this information may be used to estimate the reliability of the measurements. The reliability coefficient (R) is used to quantify the magnitude of effect. The intraclass correlation coefficient equation is shown below (90).

$$R = \frac{\sigma^2_{sample}}{\sigma^2_{sample} + \sigma^2_{observer} + \sigma^2_{error}}$$

R values will range between zero and one. A coefficient close to one indicates excellent reliability whereas a value close to zero indicates poor reliability (90).

An analysis of variance is commonly employed when comparing the effects of different factors between different groups of examiners. To understand the results, an overview of a typical SAS printout for an analysis of variance design is displayed in Table 9.

Table 9. A typical SAS printout for an analysis of variance

SOURCE	DF	Sum of Squares	Mean Square	F Value	Pr >F
Model/Treatment	3	712.586	237.529	3.77	0.028
Error	19	1196.631	62.981		
Corrected Total	22	1909.217			

From Mendenhall, 1979

The objective of an analysis of variance is to locate important independent variables in a study and determine how they interact and affect the response (92). Of particular interest to the impact of different variables is the calculation of the F value. This value is calculated by dividing the mean square error into the mean square for the treatment (92). This F value can then be compared to a table of critical F Values to test the null hypothesis that there is no difference between the treatment means. For the purposes of this study, the computer automatically compares this value and determines a probability of observing a value of F as large or larger than the calculated F value, given the null hypothesis is true. In the example shown in Table 9, the probability of 0.028 translates to a 2.8% chance of having no significant difference between the treatment means. Therefore, the smaller the p value the more significant effect will be seen and the null hypothesis is rejected. A limitation of using p values is that if an investigator calculates a small p value and rejects the null hypothesis, they have little idea of how big or small the effect could be in the population. Supplemental analyses, which focus on the effect size are recommended.

Up until this point the focus has been on examining the differences between unique observers, which is an evaluation of the inter-examiner reliability. Technique assessments often also include an examination of the intra-examiner reliability. This is accomplished through repeated measurements of the same sample at different times by the same observer. The data can be collected and analyzed using the same methods as the inter-examiner assessment.

3.3.3 Reliability Model

Assessing the reliability of the production of computer-generated bitemark overlays is multi-faceted. The influences of several independent variables involved have the potential to affect the final results significantly. A statistical model was needed that could incorporate these various factors and measure the size of their effects. Alan Donald, Ph.D., a statistical consultant, was employed to develop and apply a suitable model to assess the reliability for the parameters of the study. An analysis of variance was required to assess the effect of the following factors: forensic experience, examiners, casts, teeth, and random error.

3.3.3.1 Calculation of Expected Mean Squares and Variances

One of the values obtained in an analysis of variance is the mean squares of different factors. The mean squares provide an estimate of the effect sizes and variance of the factors involved in the ANOVA. The mean square is not a direct estimate of the variance for that factor. Rather, the composition of the mean square depends upon the relationship between the factors and whether they are fixed or random.

For this study, Technique A and Technique B are considered fixed factors. If the experiment were replicated, the identical techniques would be employed. Therefore, technique was not a factor in the analysis. Additionally, the experience level of the examiner groups is considered a fixed factor. The remaining factors; examiners, casts, teeth, and error are considered random factors. The selection of these factors are based on a representative sample taken from a larger population. A repeat of the experiment with different participants or dental casts may yield different results. An analysis was performed on each examiner group independently and as a cumulative assessment.

The three outcome measures that have been obtained for each tooth are: 1) area in square millimeters, 2) x-coordinate of the centroid position, and 3) y-coordinate of the centroid position. All of the outcome measures were analyzed independently. The statistical model for the collected data is as follows:

$$y = \mu + A_i + B_j + C_k + D_{l(k)} + \varepsilon_{m(ijkl)}$$

y - any of the three outcome measures
A - experience; fixed; levels; a = 3; index i; effect is ϕ_A
B - examiners, nested in experience; random; levels; b = 8; index j; variance is σ^2_B
C - casts; random; levels; c = 6; index k; variance is σ^2_C
D - teeth, nested in casts; random; levels; d = 12; index l; variance is σ^2_D
ε - error; random; levels, n = 2; index m; variance is σ^2_ε

A table was created to illustrate the calculations involved in determining the expected mean squares based upon the data collected. See Table 10.

Table 10. Calculations for the expected mean squares

Factor	Experience	Observer	Cast	Teeth	Error	Expected Mean Square
Levels	3	8	6	12	2	
Fixed or Random	Fixed	Random	Random	Random	Random	
Index	i	j	k	l	m	
A_i	0	8	6	12	2	$1152\phi_A + 144\sigma^2_B + \sigma^2_\varepsilon$
B_j	2	1	6	12	2	$144\sigma^2_B + \sigma^2_\varepsilon$
C_k	2	8	1	12	2	$576\sigma^2_C + 48\sigma^2_D + \sigma^2_\varepsilon$
$D_{l(k)}$	2	8	1	1	2	$48\sigma^2_D + \sigma^2_\varepsilon$
$\varepsilon_{m(ijkl)}$	1	1	1	1	1	σ^2_ε

The variances are calculated by using the expected mean square calculations and the observed mean square (MS) values obtained in the ANOVA analysis. The estimates of the variances are as follows:

$$\sigma^2_B = \frac{MSB - MSE}{144}$$

$$\sigma^2_C = \frac{MSC - MSD}{576}$$

$$\sigma^2_D = \frac{MSD - MSE}{48}$$

$$\sigma^2_\varepsilon = MSE$$

With the estimates of variance determined, the next thing to consider is how to apply these results into an assessment of reliability. A measurement of reliability was calculated using the following equation:

$$R = \frac{\sigma^2_C + \sigma^2_D}{\sigma^2_B + \sigma^2_C + \sigma^2_D + \sigma^2_\varepsilon}$$

A reliability coefficient was determined for each outcome measure, for each group of observers, and for each technique under investigation. The results were then compared.

Chapter Four

Results

4.1 INTER-EXAMINER AND INTRA-EXAMINER RELIABILITY

A SAS PROC GLM program was used to perform the ANOVAs. The observed mean squares from the ANOVAs were put into a Quattro-Pro spreadsheet to calculate the reliability coefficients. The results for reliability are displayed in Tables 11 through 18 for each examiner group and a cumulative total. The ANOVA analysis for the area, x-position, and y-position are displayed in Tables 19 through 24.

4.1.1 Diplomates

Table 11. Diplomate reliability analysis for Technique A

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Rater	1028.966	7.116	**Inter-examiner = 0.421** **Intra-examiner = 0.651**
	Cast	167.478	0.200	
	Tooth	128.985	7.793	
	Error	4.294	4.294	
X-position	Rater	37.934	0.205	**Inter-examiner = 0.952** **Intra-examiner = 0.953**
	Cast	886.306	0.000	
	Tooth	2754.057	171.605	
	Error	8.337	8.337	
Y-position	Rater	6.348	0.012	**Inter-examiner = 0.997** **Intra-examiner = 0.997**
	Cast	101.728	0.000	
	Tooth	23474.970	1466.892	
	Error	4.691	4.691	

Table 12. Diplomate reliability analysis for Technique B

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Rater	779.796	5.346	**Inter-examiner = 0.510** **Intra-examiner = 0.615**
	Cast	263.466	0.000	
	Tooth	265.461	15.967	
	Error	9.986	9.986	
X-position	Rater	35.801	0.222	**Inter-examiner = 0.973** **Intra-examiner = 0.974**
	Cast	246.633	0.000	
	Tooth	2353.284	146.837	
	Error	3.899	3.899	
Y-position	Rater	61.223	0.411	**Inter-examiner = 0.998** **Intra-examiner = 0.999**
	Cast	17079.060	0.000	
	Tooth	22933.370	1433.211	
	Error	1.991	1.991	

4.1.2 Forensic Dentists

Table 13. Dentist reliability analysis for Technique A

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Rater	1785.346	12.344	**Inter-examiner = 0.260**
	Cast	176.781	0.319	
	Tooth	115.601	6.743	**Intra-examiner = 0.478**
	Error	7.713	7.713	
X-position	Rater	40.118	0.211	**Inter-examiner = 0.942**
	Cast	767.004	0.000	
	Tooth	2583.731	160.878	**Intra-examiner = 0.943**
	Error	9.681	9.681	
Y-position	Rater	8.660	0.023	**Inter-examiner = 0.996**
	Cast	80.800	0.000	
	Tooth	23379.780	1460.906	**Intra-examiner = 0.996**
	Error	5.283	5.283	

Table 14. Dentist reliability analysis for Technique B

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Rater	1823.307	12.550	**Inter-examiner = 0.349**
	Cast	239.393	0.000	
	Tooth	262.178	15.381	**Intra-examiner = 0.489**
	Error	16.081	16.081	
X-position	Rater	18.093	0.071	**Inter-examiner = 0.949**
	Cast	181.305	0.000	
	Tooth	2367.079	147.447	**Intra-examiner = 0.949**
	Error	7.931	7.931	
Y-position	Rater	52.998	0.266	**Inter-examiner = 0.990**
	Cast	17435.390	0.000	
	Tooth	22745.370	1420.664	**Intra-examiner = 0.990**
	Error	14.754	14.754	

4.1.3 Dental Students

Table 15. Student reliability analysis for Technique A

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Rater	316.858	2.161	**Inter-examiner = 0.423** **Intra-examiner = 0.503**
	Cast	308.816	1.198	
	Tooth	78.709	4.563	
	Error	5.699	5.699	
X-position	Rater	44.032	0.238	**Inter-examiner = 0.940** **Intra-examiner = 0.941**
	Cast	679.397	0.000	
	Tooth	2537.232	157.963	
	Error	9.831	9.831	
Y-position	Rater	11.464	0.042	**Inter-examiner = 0.996** **Intra-examiner = 0.996**
	Cast	58.522	0.000	
	Tooth	23270.850	1454.088	
	Error	5.438	5.438	

Table 16. Student reliability analysis for Technique B

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Rater	407.564	2.764	**Inter-examiner = 0.522** **Intra-examiner = 0.584**
	Cast	304.400	0.456	
	Tooth	216.815	12.955	
	Error	9.536	9.536	
X-position	Rater	2.038	0.000	**Inter-examiner = 0.968** **Intra-examiner = 0.968**
	Cast	209.753	0.000	
	Tooth	2354.097	146.831	
	Error	4.808	4.808	
Y-position	Rater	14.802	0.022	**Inter-examiner = 0.992** **Intra-examiner = 0.992**
	Cast	17141.110	0.000	
	Tooth	22802.640	1424.436	
	Error	11.671	11.671	

4.1.4 Cumulative Reliability Analysis

Table 17. Cumulative reliability analysis for Technique A

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Status	580.283		**Inter-examiner = 0.327** **Intra-examiner = 0.527**
	Rater	1043.724	7.206	
	Cast	614.899	0.539	
	Tooth	304.685	6.221	
	Error	6.075	6.075	
X-position	Status	14.018		**Inter-examiner = 0.946** **Intra-examiner = 0.947**
	Rater	40.661	0.219	
	Cast	2317.895	0.000	
	Tooth	7864.347	163.650	
	Error	9.135	9.135	
Y-position	Status	8.538		**Inter-examiner = 0.997** **Intra-examiner = 0.997**
	Rater	8.824	0.026	
	Cast	236.620	0.000	
	Tooth	70119.320	1460.714	
	Error	5.050	5.050	

Table 18. Cumulative reliability analysis for Technique B

Outcome Measured	Variable Factor	Mean Square	Variance Estimate	Reliability Coefficient
Area	Status	2794.373		**Inter-examiner = 0.437** **Intra-examiner = 0.550**
	Rater	1003.556	6.886	
	Cast	747.478	0.057	
	Tooth	714.652	14.638	
	Error	12.041	12.041	
X-position	Status	7.642		**Inter-examiner = 0.964** **Intra-examiner = 0.964**
	Rater	18.643	0.092	
	Cast	621.701	0.000	
	Tooth	7069.326	147.164	
	Error	5.436	5.436	
Y-position	Status	16.989		**Inter-examiner = 0.993** **Intra-examiner = 0.993**
	Rater	43.008	0.233	
	Cast	51609.060	0.000	
	Tooth	68465.860	1426.175	
	Error	9.446	9.446	

4.1.5 Area

Table 19. Area ANOVA results for Technique A

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Status	2	1160.566	580.283	95.52	<0.0001
Observer (Status)	21	21918.196	1043.724	171.81	<0.0001
Cast	5	3074.495	614.899	101.22	<0.0001
Tooth (Cast)	66	20109.208	304.685	50.16	<0.0001

Table 20. Area ANOVA results for Technique B

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Status	2	5588.747	2794.373	232.08	<0.0001
Observer (Status)	21	21074.677	1003.556	83.35	<0.0001
Cast	5	3737.388	747.478	62.08	<0.0001
Tooth (Cast)	66	47167.056	714.652	59.35	<0.0001

4.1.6 Position

Table 21. X-Position ANOVA results for Technique A

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Status	2	28.0367	14.018	1.53	0.2157
Observer (Status)	21	853.883	40.661	4.45	<0.0001
Cast	5	11589.475	2317.895	253.74	<0.0001
Tooth (Cast)	66	519046.890	7864.347	860.91	<0.0001

Table 22. X-Position ANOVA results for Technique B

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Status	2	15.284	7.642	1.41	0.2453
Observer (Status)	21	391.523	18.6439	3.43	<0.0001
Cast	5	3108.507	621.7014	114.36	<0.0001
Tooth (Cast)	66	466575.485	7069.3255	1300.41	<0.0001

Table 23. Y-Position ANOVA results for Technique A

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Status	2	17.077	8.538	1.69	0.1845
Observer (Status)	21	185.302	8.824	1.75	0.0187
Cast	5	1183.102	236.620	46.85	<0.0001
Tooth (Cast)	66	4627875.096	70119.320	13884.8	<0.0001

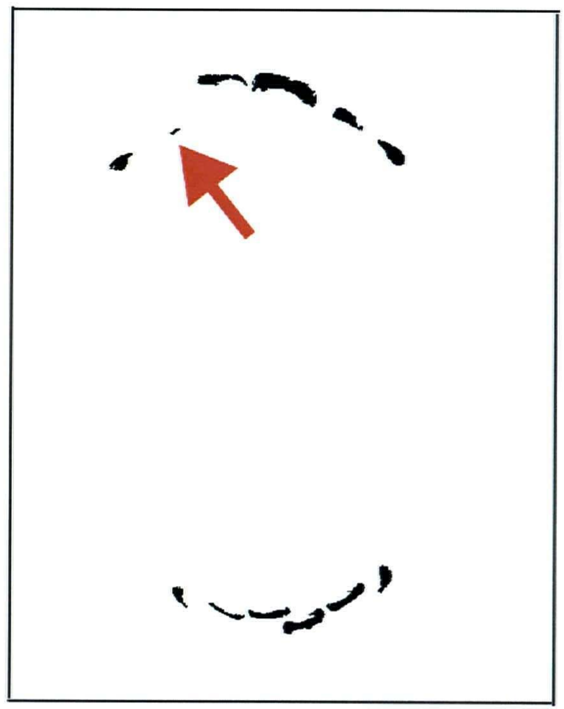
Table 24. Y-Position ANOVA results for Technique B

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Status	2	33.978	16.989	1.80	0.1657
Observer (Status)	21	903.165	43.008	4.55	<0.0001
Cast	5	258045.290	51609.058	5463.87	<0.0001
Tooth (Cast)	66	4518747.050	68465.864	7248.51	<0.0001

4.2 EXAMINER OVERLAY EXAMPLES

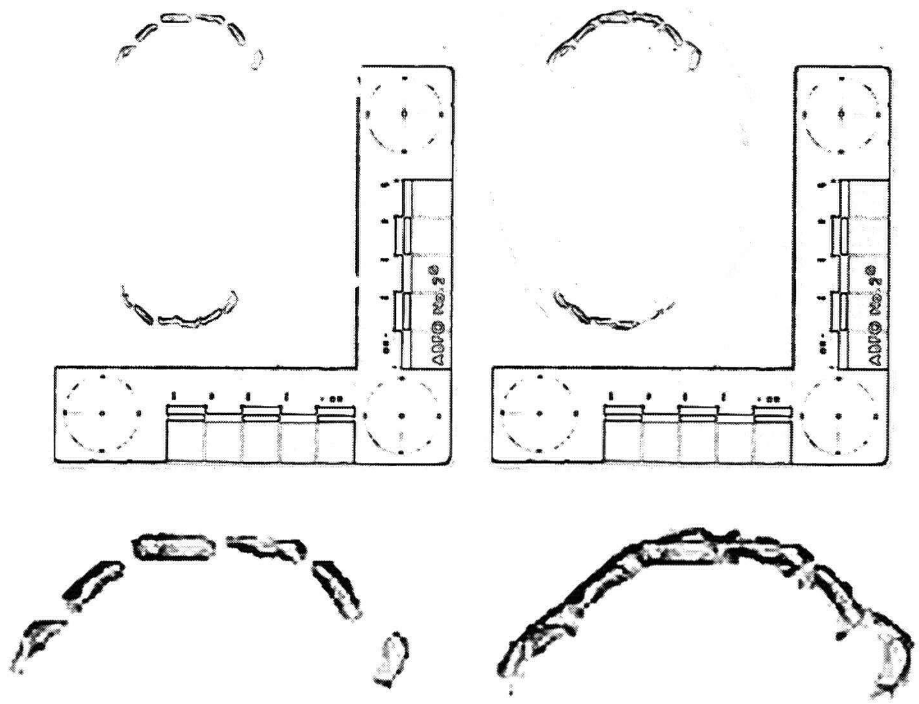
Figures 19 and 20 are examples of the different types of overlays produced by the examiners.

Figure 19. Converted solid-volume overlay produced by a single click on a tooth (arrow) and the original overlay



Close-up of original overlay

Figure 20. Comparison of two hollow-volume overlays produced using Technique B



Close-up view of maxillary arch

Chapter Five

Discussion

5.1 EXPERIMENTAL DESIGN

A.R. Feinstein once stated, "To advance the art and science of forensic odontology, the equipment an odontologist needs most to improve is himself/herself" (6). Although poignant about the biased nature of man, the techniques used to study and advance forensic dentistry requires proper investigation. All experimental designs should follow a sound, scientific methodology. These requirements usually include defining a problem, developing a hypothesis and prediction, and collecting and evaluating data (6). Therefore, a discussion on the experimental design used for this study is appropriate for a complete analysis of the findings.

5.1.1 Examiner Selection

Forensic dentistry encompasses a diverse range of topics. Without a mandatory licensing board, a forensic dentist can purport to be an expert based on accumulated experience and not necessarily training. It is not uncommon, therefore, to have an experienced forensic dentist who is skilled in one area of interest but lacking practice in another. The overwhelming majority of a forensic dentist's time is spent on comparative identifications of found remains and not bitemark analyses. Nonetheless, forensic dentists are being called upon to analyze bite injuries despite a lack of bitemark experience. Differences in the levels of experience amongst examiners who are analyzing bitemark overlays is a key issue for investigation.

In a previous study (100), three examiner groups were also chosen to represent differing levels of bitemark experience. These groups consisted of 1) Diplomates of the American Board of Forensic Odontology (DABFO), 2) forensic dentists from the ASFO, and 3) general dental practitioners. The study's conclusions showed no significant differences between the three groups suggesting that experience and training in bitemark analysis have no affect on the success of using overlays to identify biters correctly.

The current study focuses on having the examiners produce the overlays, rather than the use of an overlay to analyze a bitemark.

Diplomates of the ABFO are certified specialists who have successfully passed the certification examination. They represent the group with the highest level of training and experience in bitemark injuries. The second group of forensic dentists in the current study were selected from members of the ASFO. These examiners have experience in comparative identifications and minor to moderate experience in bitemark analysis. The final group represented examiners with limited dental knowledge and no forensic experience. They were 2^{nd} year dental students recruited from the University of British Columbia, Faculty of Dentistry.

Recruitment of examiners to participate in this study was a challenge due to the time commitment. Most of those in the first two groups maintain full-time clinical practices and also have additional forensic casework. It was anticipated that the time commitment for each participant would be approximately two to four hours, and this was determined to be the maximum, reasonable time requested of the participants. After having committed to the project, a few examiners decided they no longer had the available time and withdrew from the study. Furthermore, some examiners revealed, after the fact, that they lacked the version of Adobe Photoshop® necessary to complete the project and were forced to withdraw. The deadline allocated for each participant to complete the study was six weeks. Most of the data was not received until more than twelve weeks had passed. The overall response was an 80% return rate. The end result was eight Diplomates, eight forensic dentists, and eight students. In future studies, it would be beneficial to collect data and information like this in a workshop or symposium. A controlled environment, standardization of computer software and hardware, and immediate acquisition of the results would eliminate some of the obstacles that were encountered in the collection of this data.

5.1.2 Cast Selection

Every individual has a presumed dental uniqueness that is exhibited in the shape, size, position, and anatomical variations found within the teeth and corresponding alveolar structures. Therefore, the selection of the casts used for this study had to reflect a degree of dental uniqueness found in the population.

Cast selection was taken from an actual bitemark case in which the odontologist was given six different dental casts to compare to one bitemark. There were different degrees of difficulty randomly shown in each cast. Six casts were selected so as to allow examiners time to perform their analyses within the allotted timeframe. To increase compliance, both inter- and intra-examiner studies were completed simultaneously in one session. Some examiners commented that they noticed a few cast images were duplicates but appreciated being able to complete the study in one setting. The analysis of variance showed that all casts and individual teeth contribute to significant variations of the means. Therefore, the specific degree of difficulty associated with each cast had no significant effect on the results.

5.1.3 Materials and Instructions

When using examiners in a research study, a clear explanation of methods must be defined. A step-wise instruction manual was provided in the study package containing the protocol to be followed. This enabled examiners to read and visualize exactly what should be appearing on their computer screen. Examiners commented on how helpful this aspect of the study was. The step-by-step instructions and the supplemental figures assisted examiner adherence to the protocols.

Lastly, after the initial assessment of the first submitted overlays, a concern surfaced about the magnification used to visualize the biting surfaces of the teeth. The instructions stated and also showed that the entire arch was visible for demonstrative purposes. In actuality, an analysis would include zooming-in to a level of magnification that would allow better visualization of each tooth. To assess if each examiner had magnified the cast image, a follow-up response was sent out. The overwhelming response was that the examiners zoomed-in for further clarification. This confirmed consistency in examiner techniques.

5.1.4 Imaging Programs

The use of Adobe Photoshop® and Scion Image® provided a reliable method for the collection and measurement of the data. Of greatest concern was the potential for introducing measurement error during the conversion of the hollow-volume overlays to solid-volume overlays. To address this, two independent examinations were completed. The first test was performed to assess the potential for instrument error by looking at the reproducibility of the measurements obtained from Scion Image®. In this case, a random sample of 10% of the solid-volume overlays was measured twice. The two sets of measurements were compared and no differences were noted. (Data not shown) The second test was performed to assess the potential for observer error in the production of the solid-volume overlays. The author was responsible for creating the solid-volume overlays. To test consistency in the author's protocol used, a random sample of 10% of the original hollow-volume overlays were converted to solid-volume overlays twice. Measurements were obtained and compared to the first set of data. There were no differences noted in the x- and y-coordinates and only a negligible difference was seen in the area measurements. (Data not shown) Thus, the use of the computer programs was acceptable.

5.2 EXPERIMENTAL DATA

Each examiner group was analyzed separately followed by a cumulative assessment for each technique.

5.2.1 Reliability

The reliability of the production of computer-generated overlays using Technique A and Technique B was assessed by ANOVA and the calculation of a reliability coefficient.

5.2.1.1 Area

The area selected for the biting surfaces of the teeth was measured. This characteristic is an important consideration in bitemark analysis because the specific dimensions of a suspect's teeth confines the dimensions that a resulting bite injury would display. There is an inherent variability found within the area produced by teeth in a bitemark. The marks left by a set of teeth may vary in dimension due to the depth of penetration into the skin and the length of the teeth involved, and the response of the skin to the force of the injury as depicted through abrasion or bruising, etc.

5.2.1.1.1 Technique A

The reliability coefficients obtained for the area measurements in Technique A were considerably lower than expected. The inter-examiner values were as follows: Diplomates = 0.412, forensic dentists = 0.260, and dental students = 0.423. These values fell well below an acceptable range of reliability. The intra-examiner values were only slightly better with Diplomates = 0.651, forensic dentists = 0.480, and dental students = 0.503.

The unfavourable results can be explained with a closer examination of some of the overlays submitted. It was apparent that for some novice examiners, and some experienced examiners with limited computer practice, there was a tendency to produce and overlay by simply single clicking the Magic Wand Tool on the biting surface of each tooth. If the selection was in an area of different contrast levels of pixels than the majority of the remaining biting surface, such as a chip or worn edge of a tooth, the Magic Wand tool would limit the highlighted area to that specific region. An example of a resulting solid-volume overlay produced using this single click method is shown in Figure 18 of the results section.

Instances of single clicking were found in all levels of examiners suggesting that this was not a result of lack of knowledge regarding bitemarks, but rather lack of experience with the use of Adobe Photoshop®. In addition, the instructions for Technique A should be more clear as to the likelihood of having to select multiple clicks for each individual tooth. Having the examiners print out the overlays to use in an actual bitemark comparison could eliminate the occurrence of this type of mishap. The absence of the image of the teeth would clearly demonstrate to the examiner if the overlay captured the elements intended. An overlay printed on a transparency film could be directly compared to a bite injury and the examiner could evaluate the applicability of the overlay they produced.

5.2.1.1.2 Technique B

The reliability coefficients calculated for Technique B were slightly greater for all three examiner groups. The inter-examiner values were as follows: Diplomates = 0.510, forensic dentists = 0.394, and dental students = 0.522. The intra-examiner values were as follows: Diplomates = 0.615, forensic dentists = 0.489, and dental students = 0.584. Again, these values fall beneath an acceptable reliability level.

While Technique A involved selecting areas to include in an overlay, Technique B focused on removing unwanted areas to result in an overlay. An overwhelming majority of participants commented on the tedious task of erasing the unnecessary portions. The lack of control of the mouse, inability to differentiate the tooth surface from the cast surface in a contrast-inverted image, and the fickle nature of the Eraser tool were criticism of this technique.

An interesting factor noticed with the overlays received from Technique B was the attention to detail, or lack there of, to define the individual perimeters of the teeth. While some examiners clearly defined each individual tooth, others simply followed the curvature of the teeth to produce a general outline of the arch. Figure 19 in the results section illustrates some differences in the overlays received.

This factor may have contributed to the extreme variability found within the area of each tooth. By not erasing the excess "noise" around the perimeters of each tooth, a substantial amount of additional area becomes included in the overlay.

5.2.1.1.3 Cumulative Reliability Analysis

The overall inter-examiner reliability coefficient found for Technique A was 0.337 and for Technique B was 0.437. The intra-examiner reliability coefficients were calculated to be 0.527 for Technique A and 0.550 for Technique B. These values indicate a less than adequate measure of reliability.

The analysis of variance calculations indicate that all four variables analyzed for their contribution to the effect size, (experience, examiner, cast, and tooth) resulted in a p value of <0.0001 for both techniques. This suggests that each variable had a significant effect on the differences in the means, thus eliminating the chance the differences were caused by random error alone.

5.2.1.2 Position

The position of the tooth in each overlay was measured. This measurement is a valuable factor in bitemark analysis as an unexplainable inconsistency in tooth position can immediately exclude a suspect from having caused a bite injury.

5.2.1.2.1 Technique A

The reliability coefficients calculated for all examiner groups were exceptionally high with near perfect agreement in some cases. The inter-examiner reliability coefficients for x-position and y-position, respectively, were: Diplomates = 0.952 and 0.997, forensic dentists = 0.942 and 0.996, and dental students = 0.940 and 0.996. The intra-examiner reliability coefficients were equally impressive: Diplomates = 0.953 and 0.997, forensic dentists = 0.943 and 0.996, and dental students = 0.941 and 0.996.

These results indicate a high degree of inter- and intra-examiner reliability and demonstrate the objective advantage of using computers to determine positional data. Of additional interest is the fact that there were no significant differences in the values obtained for each examiner group seen in the ANOVA results. This suggests that previous bitemark experience is not a significant factor in the production of an overlay.

5.2.1.2.2 Technique B

The reliability coefficients for Technique B were equally remarkable. The inter-examiner reliability coefficients for x-position and y-position, respectively, were: Diplomates = 0.973 and 0.998, forensic dentists = 0.949 and 0.990, and dental students = 0.968 and 0.992. The intra-examiner reliability coefficients were: Diplomates = 0.974 and 0.999, forensic dentists = 0.949 and 0.990, and dental students = 0.968 and 0.992.

The positional reproducibility by all examiner groups strengthens the notion that computer-generated bitemark overlays can be consistently and objectively produced.

5.2.1.2.3 Cumulative Reliability Analysis

The overall inter-examiner reliability coefficients calculated for Technique A for the x- and y- position was 0.946 and 0.997 and for Technique B was 0.964 and 0.993. The intra-examiner reliability coefficients were calculated to be 0.947 and 0.997 for Technique A and 0.964 and 0.993 for Technique B. These results confirmed a high degree of reliability for both techniques in the assessment of the positional data.

The analysis of variance results for Technique A indicated that for the x-position, the examiner, cast, and tooth all had a p value <0.0001, translating to a significant effect on the differences in the means. However, the experience factor had a larger p value of 0.2157. This value implies that experience level was responsible for less of a significant effect in the means than the other factors. This same trend was noted for Technique B with the experience factor having a p value of 0.2453.

The analysis of variance results for Technique A for the y-position showed that the cast and tooth had significant effects on the differences in the means with both factors having a p value of <0.0001. The effects of the experience level and observer had a lesser effect with p values of 0.1845 and 0.0187, respectively. These results support the notion that the forensic experience level of the examiners has less of an effect on the differences than the cast and the teeth. Similarly, Technique B showed the experience level to have less of an effect than the other factors with a p value of 0.1657.

5.3 INDIVIDUAL EXAMINER PREFERENCES

The examiners were asked their opinions of the two techniques under investigation. The opinions of each technique will be discussed separately.

The overwhelming majority of participants preferred Technique A. Comments in support highlighted many of the practical advantages of this technique. The most often cited comment was the ability to accurately and clearly interpret the cast image. With a true representation of the cast visible, examiners said they had more control in selecting the biting surfaces based on their interpretation of the anatomy of the teeth. The average time required to complete an overlay using Technique A was faster than using Technique B.

Criticisms of Technique A centered on the fastidious nature of the Magic Wand Tool. Novices in the production of computer-generated overlays remarked on the difficulties experienced in selecting the biting edges. One participant commented, "I would try to highlight small areas, but the Magic Wand would not allow the area I wanted to be highlighted, instead highlighting large areas around the teeth as well." This problem can be resolved by adjusting the Tolerance setting of the Magic Wand Tool. The initial tolerance setting was 18. Further in the instructions was the following disclaimer:

> Please note: the "Tolerance" setting may need to be reduced if unwanted areas are being selected. This can be done at your discretion at any time until you have achieved the outline of all maxillary and mandibular anterior teeth <u>that you believe are most likely to leave an imprint while biting</u>.

Examiners unfamiliar with Adobe Photoshop® may not be aware of the significance of adjusting the tolerance level of the Magic Wand Tool or even have the knowledge to be able to modify the settings. Clarification of this step should be included in any further studies.

One examiner commented that the ability to adjust the tolerance settings introduces examiner subjectivity into the experimental design. This step was intentionally included for that fact. Critics of the use of overlays remark that examiners introduce a personal bias in their selection of the biting edges. One of the aims of this study was to show that even with a subjective preference setting, computer-generated overlays are a reliable and reproducible method. The results showed this for tooth position.

Most participants found Technique B to be more subjective than Technique A. The greatest complaint was the loss of the true image of the cast after the contrast inversions. One comment said:

> *"Technique B is very two-dimensional and nearly impossible to develop any appreciation of the depth in the teeth. It seems quite subjective as the operator subtracts what he or she doesn't "like". The subtraction itself is a problem in two major ways. 1) the operator may not notice an inadvertent slip of the mouse since the evidence of the slip by definition is erased, and 2) the cumulative erasures reduces the number of available landmarks upon one might (should) base the decision on what to further keep and what to erase."*

This sentiment was mentioned by most of the participants. The few examiners who preferred Technique B to Technique A felt that the Eraser Tool was easier for them to control than the Magic Wand Tool.

Technique A is more commonly used in North America and because all the examiners reside in North America, this may be a contributing factor. However, the partiality towards Technique A was seen in the group of dental students as well, who would have no previous familiarity with any established techniques.

5.4 COMPARISON OF TECHNIQUE A AND B

The reliability assessment of Technique A and Technique B produced similar results. Both techniques scored low for the area measurements and extremely high for the positional measurements. Both techniques are reliable methods to produce bitemark overlays to assess tooth position.

Chapter Six

Conclusions

6.1 CONCLUSIONS

- Recruitment of experienced forensic dentists to participate in research using specific software programs is difficult.
- The number of cases included is dependant upon the maximum time available to examiners.
- The inter- and intra-examiner reliability coefficients are low for the comparison of area measurements for both Technique A and Technique B in all examiner groups.
- Analysis of variance shows that experience level, examiner, cast, and tooth differences all contribute to a significant effect in the differences of the means for tooth area measurements.
- The inter- and intra-examiner reliability coefficients are exceptionally high for the comparison of positional measurements for both Technique A and Technique B in all examiner groups.
- Analysis of variance shows that experience level does not have a significant effect in the differences of the means for tooth position measurements, whereas the examiner, cast, and tooth differences do contribute to a significant effect.
- Most examiners preferred Technique A to Technique B
- Technique A and Technique B are reliable methods to produce bitemark overlays to assess tooth position.

6.2 FUTURE DIRECTIONS

Future research in the area of computer-generated bitemark overlays could take several directions. While investigators have studied the reliability of the use and production of bitemark overlays, the next step is to test the external validity of bitemark overlays. This would include having examiners both produce and utilize their original overlays in a simulated bitemark comparison. By applying these techniques in a mock forensic investigation, the applicability of the overall reliability of computer-generated bitemark overlays could be established.

Additional studies comparing overlays should assess the differences in tooth rotation. In bitemark comparisons, the positional measurements and degree of rotation of each tooth play a critical role in the inclusion or exclusion of a suspect. Further to this, the depth to which a tooth impresses the skin seen in a bitemark is variable. Therefore, studies evaluating the differences seen in the area and positional measurements produced by the same cast with different degrees of penetration is encouraged. As with any study that involves outside examiners to follow a specified technique, the importance of the training tools, such as directions and instructions, cannot be over-emphasized. Future overlay studies should include a quantitative test of the instructions prior to assessing the technique.

Further, studies regarding the effects of different scanning procedures could provide insight as to the best way to obtain cast images. Examining different variables such as scanning resolutions, placement of the casts, and different dental stone materials may aid in standardizing optimal procedures.

Finally, as computer software programs continue to be modified and upgraded from previous versions, the changes in the features should continue to be examined for potential benefits. Whether the software may enhance the bitemark photograph or assist in the examination of the suspect's cast, the use of computers will continue to advance bitemark analysis.

References

1. Stimson PG, Mertz CA. Forensic Dentistry. Boca Raton, FL: CRC Press, 1997.

2. Gladfelter YA. Dental Evidence: a Handbook for Police. Springfield, IL: CCThomas, 1975.

3. Harvey W. Dental Identification and Forensic Odontology. London: Kimpton, 1976.

4. Pierce LJ, Strickland DJ, Smith ES. The case of Ohio v. Robinson; an 1870 bite mark case. *Am J Forensic Med Pathol* 1990;11(2):171-177.

5. Fixott RH. How to become involved in forensic odontology. *Dent Clin North Amer* 2001;45(2):417-425.

6. American Board of Forensic Odontology, Inc. "ABFO Guidelines and Standards." Manual of Forensic Odontology. 3rd Ed. Bowers and Bell. Grimsby,ON: Manticore Publishers, 1997:299-357.

7. Sweet DJ. "Human bitemarks: examination, recovery, and analysis." Manual of Forensic Odontology. 3rd Ed. Bowers and Bell. Grimsby,ON: Manticore Publishers, 1997: 148-169.

8. Spencer D. "Bitemarks in child abuse." Manual of Forensic Odontology. 3rd Ed. Bowers and Bell. Grimsby,ON: Manticore Publishers, 1997: 177-178

9. Johansen RJ, Bowers CM. Digital Analysis of Bitemark Evidence. Santa Barbara, CA: Forensic Imaging Services, 2000.

10. Barbenel JC, Evans JH. Bite marks in skin - mechanical factors. *J Forensic Sci* 1974;14:235-238.

11. Jakobsen JR, Keiser-Nielson S. Bite mark lesions in human skin. *Forensic Sci Int* 1981;18:41-55.

12. Millington PF. Histological studies of skin carrying bite marks. *J Forensic Sci* 1974;14:239-240.

13. Pretty IA, Sweet D. Anatomical locations of bitemarks and associated findings in 101 cases from the United States. *J Forensic Sci* 2000;45(4):812-814.

14. Vale GL, Noguchi TT. Anatomical distribution of human bite marks in a series of 67 cases. *J Forensic Sci* 1983;28(1):61-69.

15. Rothwell BR, Thein AV. Analysis of distortion in preserved bite mark skin. *J Forensic Sci* 2001;46:573-576.

16. Pretty IA, Sweet D. The scientific basis for human bitemark analyses - a critical review. *Sci Justice* 2001;41(2):85-92.

17. Sakoda S, Fujita MW, Zhu B-L, Oritani S, Ishida K. Wounding dynamics in distorted bitemarks: two case reports. *J Forensic Odontostomotol* 2000;18(2):46-51.

18. DeVore DT. Bite marks for identification? - a preliminary report. *Med Sci Law* 1971;11(3):144-145.

19. Thompson IOC, Phillips VM. A bitemark case with a twist. *J Forensic Odontostomotol* 1994;12(2):37-40.

20. Hein PM, Pannenbecker J, Schulz E. *Bite injuries upon a newborn. Int J Legal Med* 1992;105(1):53-55.

21. Bernitz H, Piper SE, Solheim T, Van Niekerk PJ, Swart TJP. Comparison of bitemarks left in foodstuff with models of the suspects' dentitions as a means of identifying a perpetrator. *J Forensic Odontostomotol* 2000;18(2):27-31.

22. McKenna CJ, Haron MI, Brown KA, Jones AJ. Bitemarks in chocolate: a case report. *J Forensic Odontostomotol* 2000;18(1):10-14.

23. Kerr NW. Apple bite mark identification of a suspect. *Int J Forensic Dent* 1969;13:20-23.

24. Deming JE, Mittleman RE, Wetli CV. Forensic science aspects of fatal sexual assaults on women. *J Forensic Sci* 1983;28(3):572-576.

25. Rawson RD, Koot A, Martin C, Jackson J, Novosel S, Richardson A, Bender T. Incidence of bite marks in a selected juvenile population: a preliminary report. *J Forensic Sci* 1984;29(1):254-259.

26. Sheasby DR, MacDonald DG. A forensic classification of distortion in human bite marks. *Forensic Sci Int* 2001;122:75-78.

27. Sweet D, Hildebrand DP. Saliva from cheese bite yields DNA profile of burglar: *a case report. Int J Legal Med* 1999;112(3):201-3.

28. Sweet D, Shutler GC. Analysis of salivary DNA evidence from a bitemark on a body submerged in water. *J Forensic Sci* 2000;44(5):1069-72.

29. Sweet D, Lorente M, Lorente JA, Valenzuela A, Villanueva E. An improved method to recover saliva from human skin: the double swab technique. *J Forensic Sci* 1997;42(2):320-2.

30. Webb DA, Sweet D, Hinman DL, Pretty IA. Forensic implications of biting behavior: a conceptually underdeveloped area of investigation. *J Forensic Sci* 2002;47(1):103-106.

31. Walter RD. Anger biting: the hidden impulse. *Am J Forensic Med Pathol* 1985;6(3):219-221.

32. Walter RA. An examination of the psychological aspects of bite marks. *Am J Forensic Med Pathol* 1984;5(1):25-29.

33. Morrison HL. Psychiatric observations and interpretations of bite mark evidence in multiple murders. *J Forensic Sci* 1979;24(2):492-502.

34. Furness J. Teeth marks and their significance in cases of homicide. Forensic Science Case Book. Seventeenth Symposium; London, 1968.

35. McNamee AH, Sweet D. Adherence of forensic odontologists to the ABFO guidelines for victim evidence collection. *J Forensic Sci* 2003;48(2):382-385.

36. Pretty IA, Sweet D. Adherence of forensic odontologists to the ABFO bite mark guidelines for suspect evidence collection. *J Forensic Sci* 2001;46(5):1152-1158.

37. Spring GE. Evidence Photography: an overview. *J Biol Photogr* 1987;55(4):129-132.

38. Rawson RD, Vale GL, Herschaft EE, Sperber ND, Dowell S. Analysis of photographic distortion in bite marks: a report of the bite mark guidelines committee. *J Forensic Sci* 1986;31(4):1261-1268.

39. Hyzer WG, Krauss TC. The bite mark standard reference scale - ABFO No. 2. *J Forensic Sci* 1988;33(2):498-506.

40. Krauss TC. Photographic techniques of concern in metric bite mark analysis. *J Forensic Sci* 1984;29(2):633-638.

41. Havel DA. The role of photography in the presentation of bitemark evidence. *J Biol Photogr* 1985;53(2):59-62.

42. Wright FD. Photography in bite mark and patterned injury documentation - part 1. *J Forensic Sci* 1998;43(4):877-880.

43. Wright FD. Photography in bite mark and patterned injury documentation - part 2: a case study. *J Forensic Sci* 1998;43(4):881-887.

44. Dorion R. "Excision of bitemarks." Manual of Forensic Odontology. 3rd Ed. Bowers and Bell. Grimsby,ON: Manticore Publishers, 1997: 171-172.

45. Sweet DJ, Bastien RB. Use of acrylonitrile-butadiene-styrene (ABS) plastic ring as a matrix in the recovery of bitemark evidence. *J Forensic Sci* 1991;36(5):1565-71.

46. Layton JJ. Identification from a bitemark in cheese. *J Forensic Sci* 1966;6:76-80.

47. Standards of evidentiary reliability. http://www.ipce.info/library 3/files/camp/standards.htm

48. Cottone JA, Standish MS. Outline of Forensic Dentistry. Chicago, IL: Year Book Medical Publishers, 1982.

49. Bowers CM. Jurisprudence issues in forensic odontology. *Dent Clin North Amer* 2001;45(2):399-415.

50. Zarkowski P. Bite mark evidence: its worth in the eyes of the expert. *J Law Ethics Dent* 1988;1(1):47-57.

51. Aksu MN, Gobetti JP. The past and present legal weight of bite marks as evidence. *Am J Forensic Med Pathol* 1996;17(2):136-140.

52. Gundelach A. Lawyers' reasoning and scientific proof: a cautionary tale in forensic odontology. *J Forensic Odontostomotol* 1989;7(2):11-16.

53. Whatmough LN, Nuckles DB. Bite mark evidence: increasing acceptance with a qualified expert witness. *Leg Med* 1992:49-78.

54. Sweet D, Parhar M, Wood RE. Computer-based production of bite mark comparison overlays. *J Forensic Sci* 1998;43(5):1050-1055.

55. Bowers CM. Arguments on the individuality of human teeth. www.forensic.to/webhome/bitemarks/arguments_on_the_individuality_o1.htm

56. MacFarlane TW, MacDonald DG, Sutherland DA. Statistical problems in dental identification. *J Forensic Sci* 1974;14:247-252.

57. Sognnaes RF, Rawson RD, Gratt NM, Nguyen NBT. Computer comparison of bitemark patterns in identical twins. *J Am Dent Assoc* 1982;105:449-451.

58. Rawson RD, Ommen RK, Kinard G, Johnson J, Yfantis A. Statistical evidence for the individuality of the human dentition. *J Forensic Sci* 1984;29(1):245-253.

59. Pretty IA, Turnbull MD. Lack of dental uniqueness between two bite mark suspects. *J Forensic Sci* 2001;46(6):1487-1491.

60. de Villiers CJ, Phillips VM. Personal identification by means of a single unique dental feature. *J Forensic Odontostomotol* 1998;16(1):17-19.

61. Kieser J, Firth N, Buckley H. Dental misidentification on the basis of presumed unique features. *J Forensic Odontostomotol* 2001;19(2):36-9.

62. Smith SS, Buschang PH, Watanabe E. Interarch tooth size relationships of 3 populations: does Bolton's analysis apply? *Am J Orthod Dentofacial Orthop* 2000;117:169-174.

63. Gillen RJ, Schwartz RS, Hilton TJ, Evans DB. An analysis of selected normative tooth proportions. *Int J Prosthodont* 1994;7(5):410-417.

64. Kieser JA, Groeneveld HT. High-dimensional plots in the evaluation of interpopulation differences in human tooth size. *J Dent Assoc S Afr* 1992;47:361-364.

65. Kieser JA, Groeneveld HT, Preston CB. A metric analysis of the South African caucasiod dentition. *J Dent Assoc S Afr* 1985;40:121-125.

66. Santoro M, Ayoub ME, Pardi VA, Cangialosi TJ. Mesiodistal crown dimensions and tooth size discrepancy of the permanent dentition of Dominican Americans. *Angle Orthod* 2000;70(4):303-307.

67. Kieser JA. Groeneveld HT, McKee J, Cameron N. Measurement error in human mensuration. *Ann Hum Biol* 1990;17(6):523-528.

68. Taroni F, Mangin P, Perrior M. Identification concept and the use of probabilities in forensic odontology - an approach by philosophical discussion. *J Forensic Odontostomatol* 2000;18(1):15-18.

69. Arheart KL, Pretty IA. Results of the 4th ABFO bitemark workshop - 1999. *Forensic Sci Int* 2001;124:104-111.

70. Luntz L, Luntz P. Handbook for dental identification. Philadelphia, PA; Lippincott, 1973.

71. Dailey JC. A practical technique for the fabrication of transparent bite mark overlays. *J Forensic Sci* 1991;36(2):565-570.

72. Naru AS, Dykes E. The use of a digital imaging technique to aid bite mark analysis. *Sci Justice* 1996;36(1):47-50.

73. Sweet DJ, Bowers CM. Accuracy of bite mark overlays: a comparison of five common methods to produce exemplars from a suspect's dentition. *J Forensic Sci* 1998;43(2):362-367.

74. Rawson RD. Computers in forensic dentistry. *J Calif Dent Assoc* 1996;24(5):58-61.

75. Lewis C. WinID2 verses CPMI4: two computer-assisted dental identification systems. *J Forensic Sci* 2002;47(3):536-538.

76. Bowers CM, Johansen RJ. Digital imaging methods as an aid in dental identification of human remains. *J Forensic Sci* 2002;47(2):354-359.

77. Wood RE, Kirk NJ, Sweet DJ. Digital dental radiographic identifications in the pediatric, mixed and permanent dentitions. *J Forensic Sci* 1999;44(5):901-916.

78. Wenzel A, Hintze H, Horsted-Bindslev P. Discrimination between restorative dental materials by their radiopacity measured in film radiographs and digital images. *J Forensic Odontolostomotol* 1998;16(1):8-13.

79. Kolltveit KM, Solheim T, Kvaal SI. Methods of measuring morphological parameters in dental radiographs: Comparison between image analysis and manual measurements. *Forensic Sci Int* 1998;94:87-95.

80. Nambiar P, Bridges TE, Brown KA. Quantitative forensic evaluation of bite marks with the aid of a shape analysis computer program: part 1; the development of "SCIP" and the similarity index. *J Forensic Odontostomotol* 1995;13(2):18-25.

81. Nambiar P, Bridges TE, Brown KA. Quantitative forensic evaluation of bite marks with the aid of a shape analysis computer program: part 2; "SCIP" and bite marks in skin and foodstuff. *J Forensic Odontostomotol* 1995;13(2):26-32.

82. Brook AH, Pitts NB, Renson CE. Determination of tooth dimensions from study casts using an image analysis system. *J Int Assoc Dent Child* 1983;14:55-60.

83. Atsu SS, Gokdemir K, Kedici PS, Ikyaz YY. Bitemarks in forensic odontology. *J Forensic Odontostomotol* 1998;16(2):30-34.

84. McGivney J, Barsley R. A method for mathematically documenting bitemarks. *J Forensic Sci* 1999;44(1):185-186.

85. Bowers CM, Johansen RJ. Photographic evidence protocol: the use of digital imaging methods to rectify angular distortion and create life size reproductions of bite mark evidence. *J Forensic Sci* 2002;47(1):178-185.

86. Karazalus CP, Palmbach TT, Lee HC. Digital enhancement of sub-quality bitemark photographs. *J Forensic Sci* 2001;46(4):954-958.

87. Pretty IA, Sweet D. Digital bite mark overlays-an analysis of effectiveness. *J Forensic Sci* 2001;46(6):1385-1391.

88. Robinson E, Wentzel J. Toneline bite mark photography. *J Forensic Sci* 1992;37(1):195-207.

89. Naru AS, Dykes E. Digital image cross-correlation technique for bite mark investigations. *Sci Justice* 1997;37(4):251-258.

90. Brunette D. Critical Thinking. London; Quintessence Books, 1996.

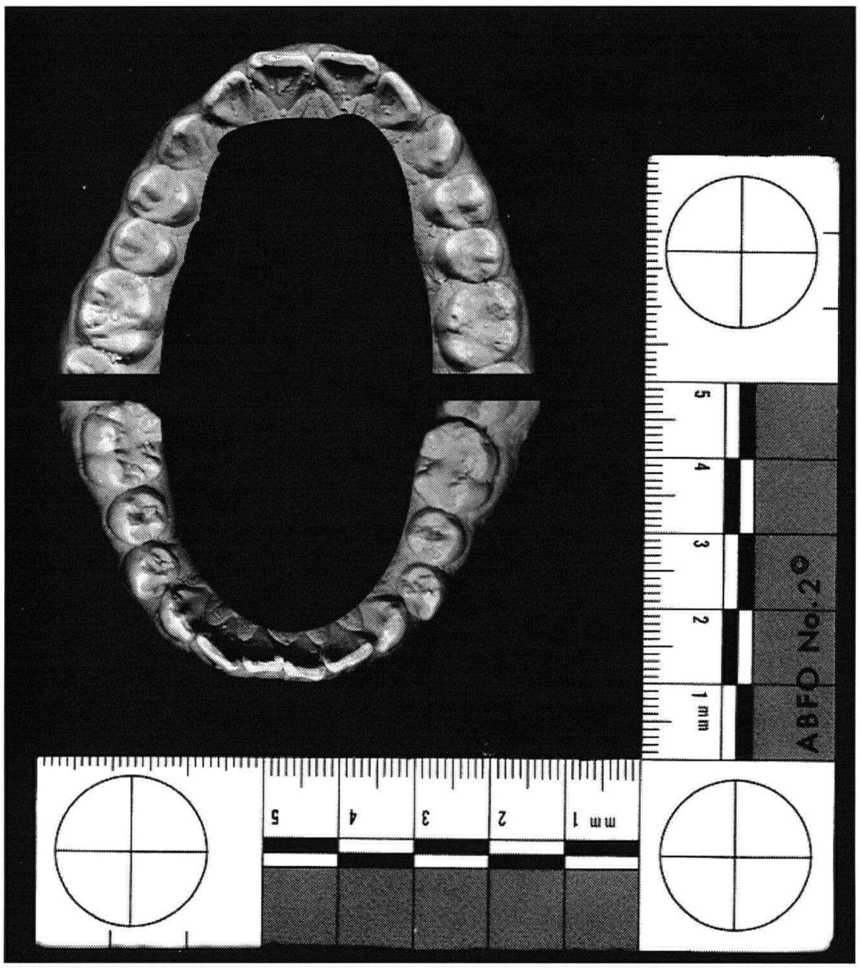
91. Streiner DL, Norman GR. Health Measurement Scales. A practical guide to their development and use. Oxford; Oxford University Press, 1989.

92. Mendenhall W. Introduction to Probability and Statistics. 5th Edition, North Scituate, MA; Duxbury Press, 1979.

Appendix A

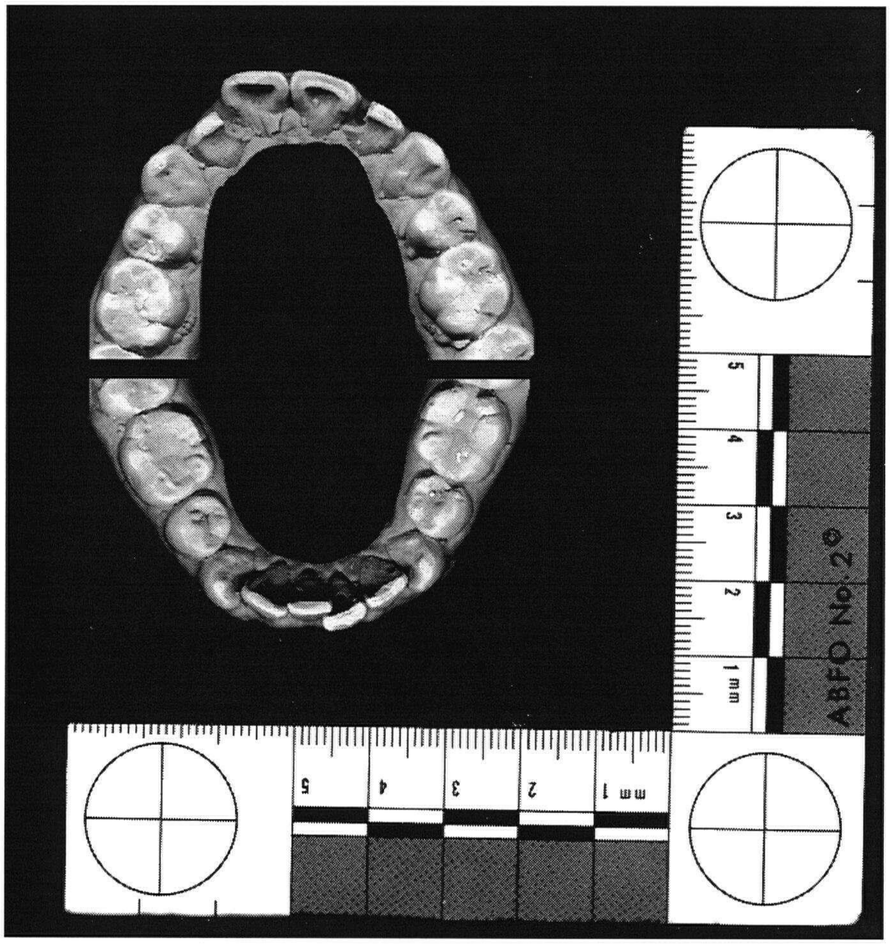
Study Cast Images

CAST A

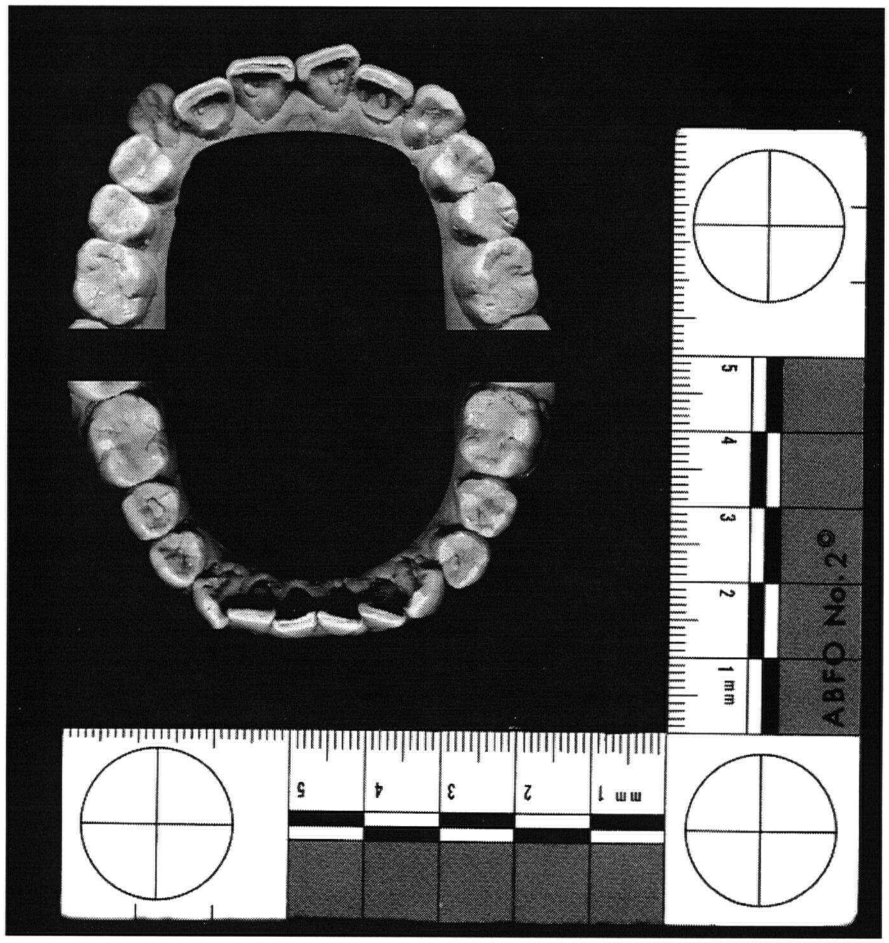


CAST B

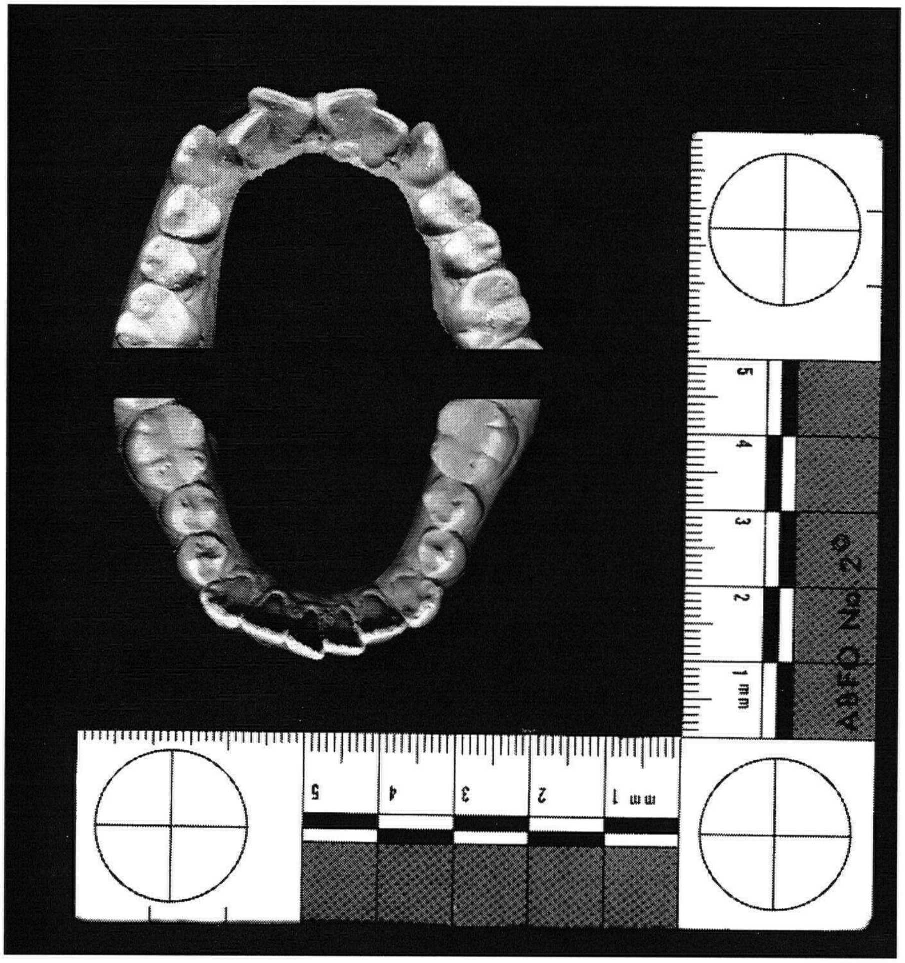
CAST C



CAST D



CAST E



CAST F

Appendix B

Study Questionnaire

<u>Bitemark Study Questionnaire</u> **Participant Code ________**

Please circle the appropriate responses:

1. Research study group DABFO Forensic Dentist Dental Student

<u>Basic Computer Assessment</u>

2. I use computers: everyday weekly monthly seldom never

3. I routinely use computers for: (circle all the apply)

internet/email word processing/spreadsheet use photo imaging programs

4. I am familiar with and have used Adobe Photoshop®. yes no

5. If you answered yes to #4, I use Adobe Photoshop® for: (circle all that apply)

Personal photographs Graphic design elements/Web site design Bitemark case analysis

<u>Bitemark Assessment</u>

6. The number of bitemark cases I have been involved in is: 0 1-3 4-7 7-10 more than 10

7. I am familiar with the use of computer generated overlays for bitemark analysis: yes no

8. I have experience with the production of computer generated overlays for bite mark analysis: yes no

9. If you answered yes to #8, how many overlays have you produced in your career:

1-3 4-7 7-10 more than 10

10. I have received specialized training in the production of computer generated overlays: (through CE courses, symposiums, workshops, etc.) yes no

11. I use the following software in the production of computer generated overlays:

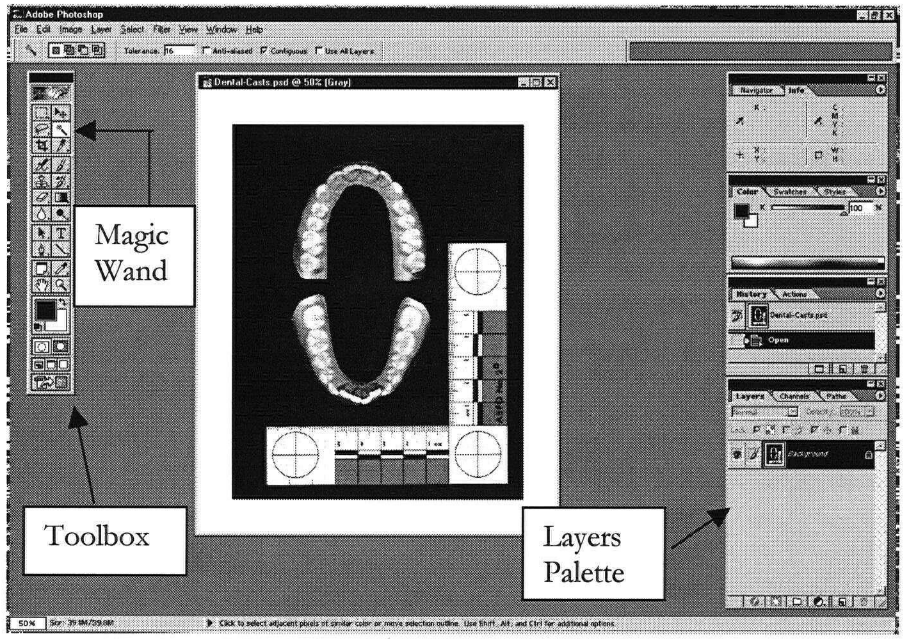
Adobe Photoshop® 5.0 Adobe Photoshop® 6.0 Adobe Photoshop® 7.0 Other____________

Appendix C

Technique A Instructions and Example

Technique A Instructions

1. Open up the image in Adobe Photoshop®. (The following are for illustrative purposes only and are not life size.)



2. From the Menu Bar, select View > Zoom In, until you are at a magnification in which you can comfortably see the incisal edges of the anterior teeth.

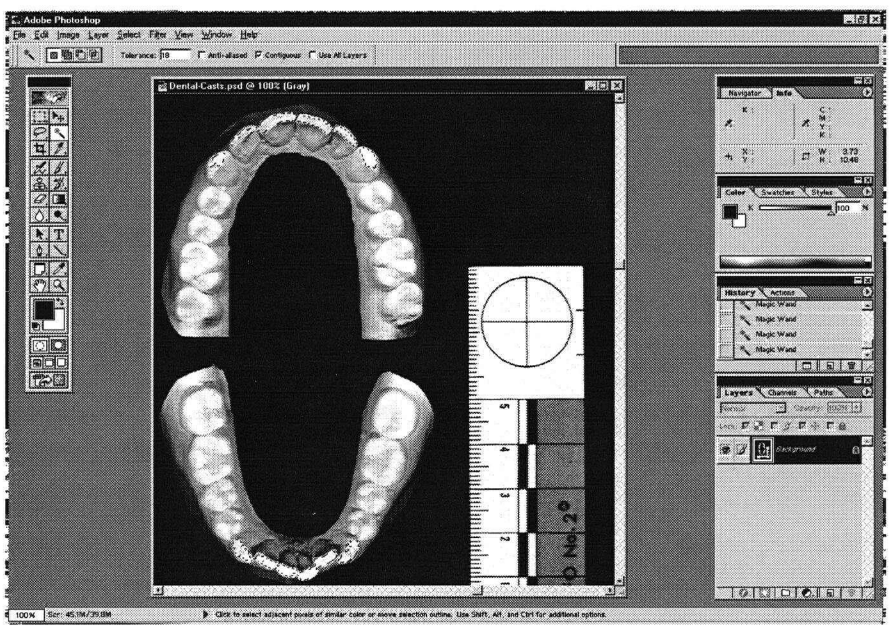
3. From the Toolbox, select the Magic Wand tool. If you have trouble locating the Magic Wand icon, simply hold your cursor over each icon and the title of the icon will be displayed.

4. Before we begin, make sure that in the menu on the top, Anti-Aliased is unchecked and Contiguous is checked and our initial Tolerance setting is 18. To create an overlay, you will be selecting the biting edges of the twelve anterior teeth. The biting edges of the teeth are selected using the Magic Wand Tool.

5. Position the Magic Wand tool over each tooth's biting edge to select it. An outline of "marching ants" should appear.

6. To add to the selected area of the tooth or to continue to outline the remaining biting edges, the Shift key must be held down while clicking on additional areas. Select all biting edges for the twelve anterior teeth.

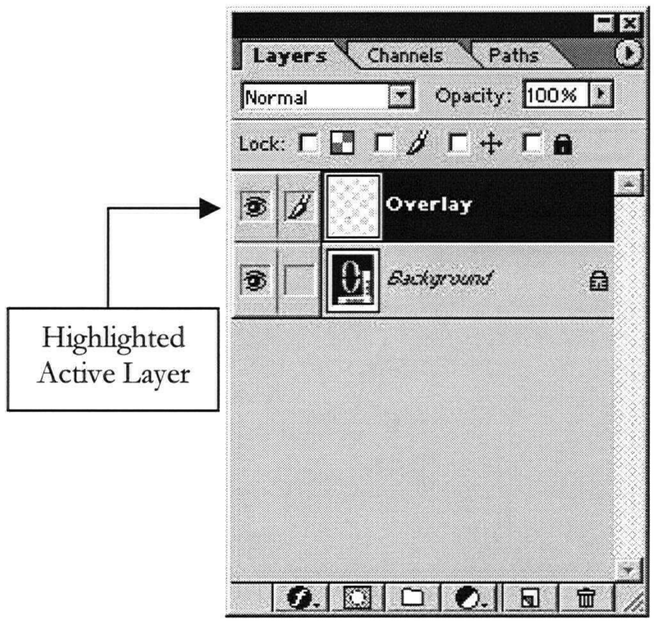
7. If you make a selection that you do not want to include in your final outline, simply click Ctrl +Z or (Command +Z for the Mac) and Photoshop will step back one step to the previous selection. Please note: the "Tolerance" setting may need to be reduced if unwanted areas are being selected. This can be done at your discretion at any time until you have achieved the outline of all maxillary and mandibular anterior teeth <u>that you believe are most likely to leave an imprint while biting</u>. Your figure should look similar to the one below.



<u>Creating a New Layer in Photoshop</u>

8. From the Menu Bar, select Layer > New > Layer. This will open a pop-up window. The default title of the new layer is 'Layer 1'. Rename this layer 'Overlay'. Click OK.

In the Layers Palette, the new layer called Overlay is now positioned above the 'Background' layer. This layer is highlighted and shows a paint brush in the second column, which indicates that it is the active layer you are working in. See Figure below.



9. Click on the 'Background' layer so that it becomes the active layer you are working in.

10. From the Menu Bar, select Edit > Copy.

11. Click on the 'Overlay' layer to now activate that layer.

12. From the Menu Bar, select Edit > Paste. The biting edges of the casts that you selected are now pasted into the 'Overlay' layer.

13. From the Menu Bar, select Select > Reselect. An outline of "marching ants" should reappear.

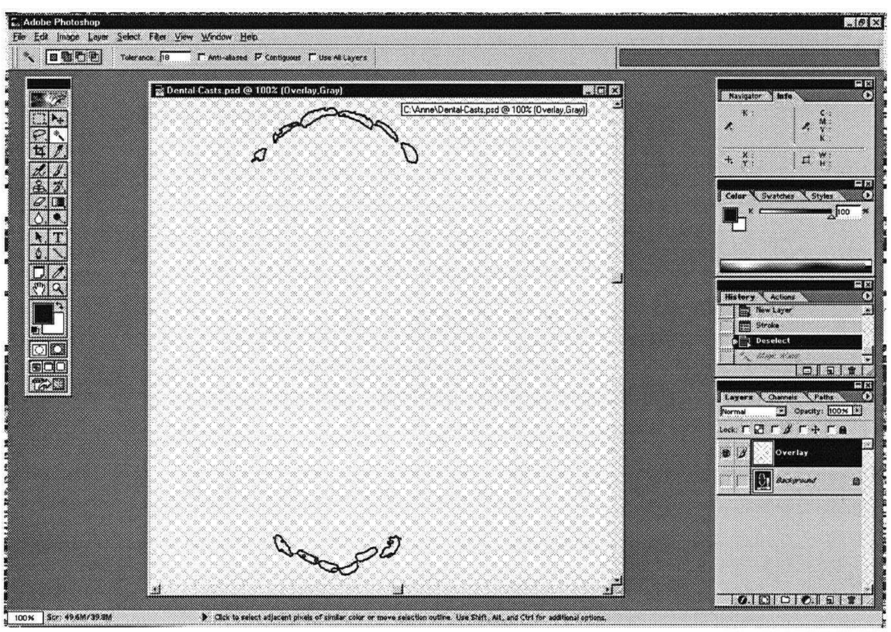
14. From the Menu Bar, select Edit > Clear to remove the noise from inside the marching ants.

Creating a Hollow Volume Overlay

15. We want to outline the biting edges at the position of the "marching ants" to create a hollow volume of the teeth. From the Menu Bar, select Edit > Stroke. A pop-up window will appear. Choose a stroke with the following values: Width = 2, Color = Black, Location = Inside, Blending = Normal and 100%. Click OK.

These two last steps have a) cleared the center area resulting in a hollow volume of the teeth and b) outlined the biting edges with a solid line 2 pixels wide.

16. From the Menu Bar, select Select > Deselect to remove the marching ants. See Figure below.



Saving the Overlay

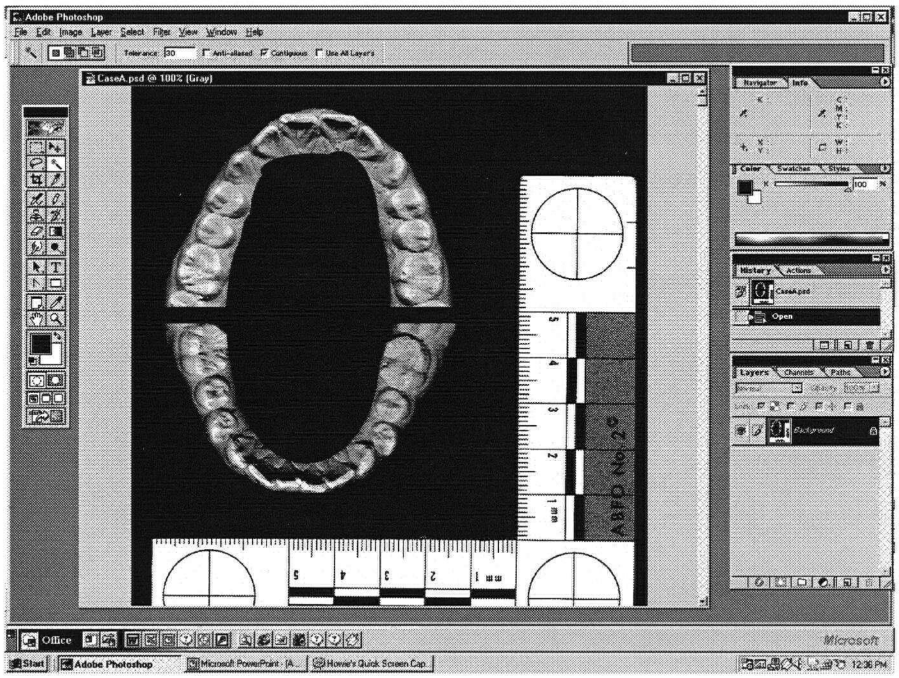
17. Create a new folder on your desktop labeled "Technique A". Do this by minimizing all your active windows, Right-Click in a blank area on your desktop and selecting New > Folder.

18. Bring Photoshop® back into view. Go to the Menu Bar, select File > Save As and save the current file in the new folder Technique A.

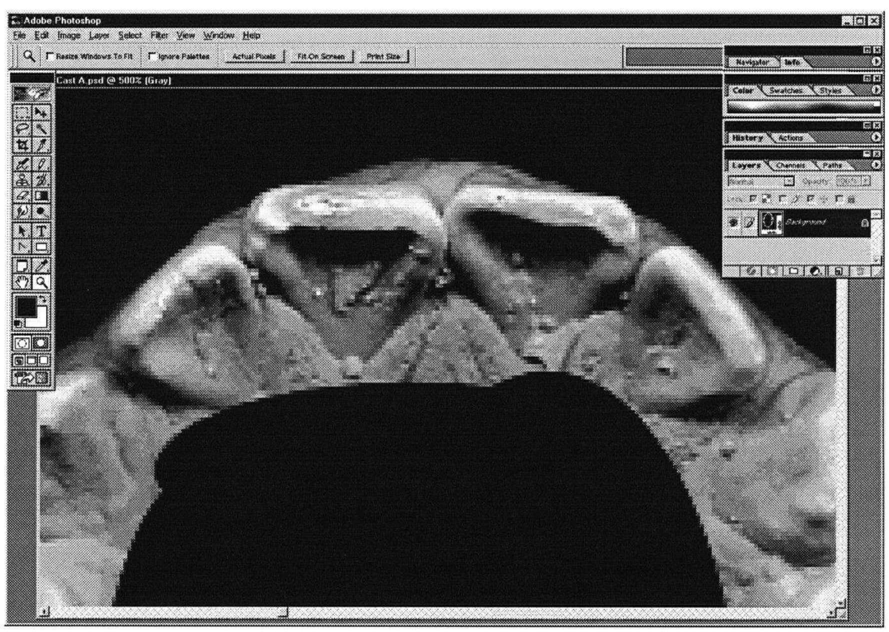
19. Once you have completed all the overlays for both techniques, save them to the CD-ROM. See the instructions for this following the instructions for Technique B.

Technique A Example

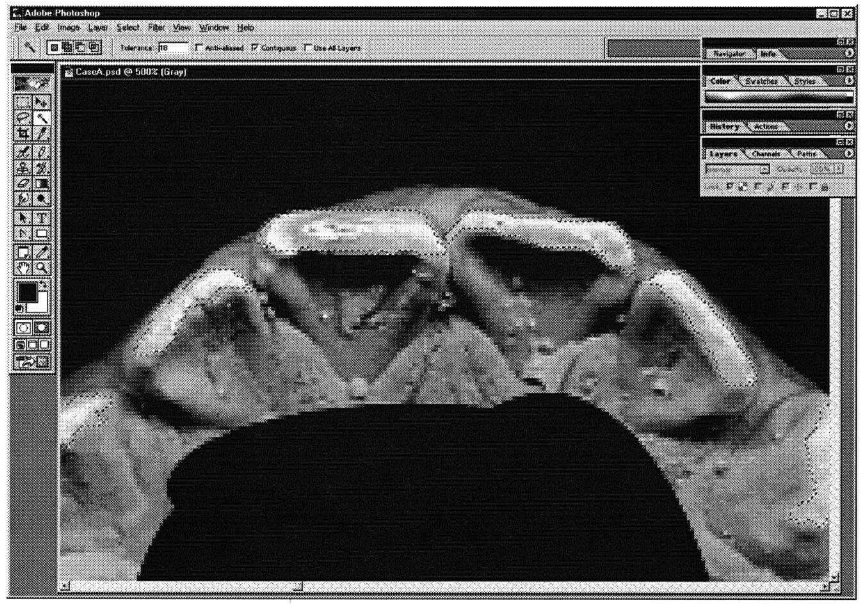
1) Open image in Photoshop®



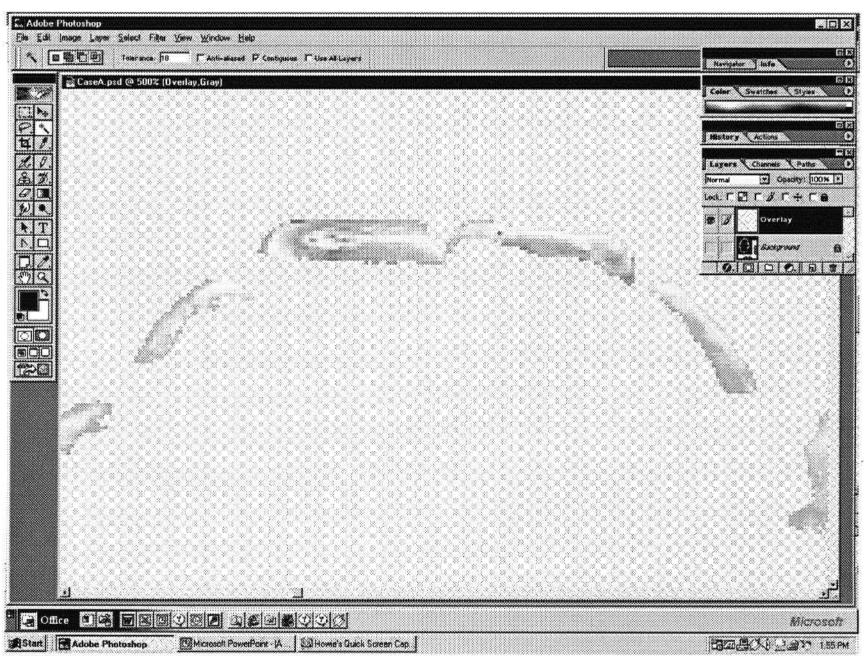
2) Zoom-in to magnify the incisal edges of the anterior teeth



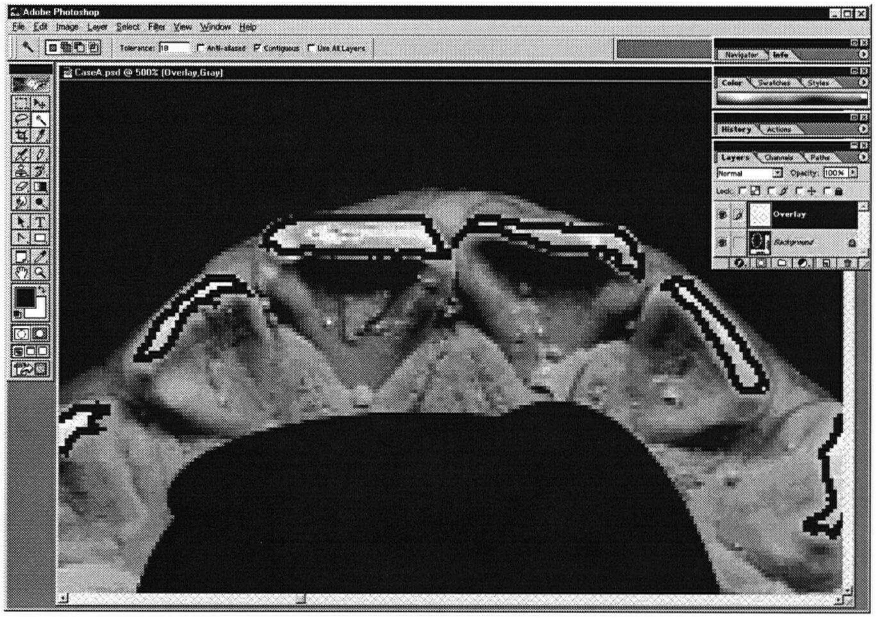
3) Select the incisal edges using the Magic Wand Tool



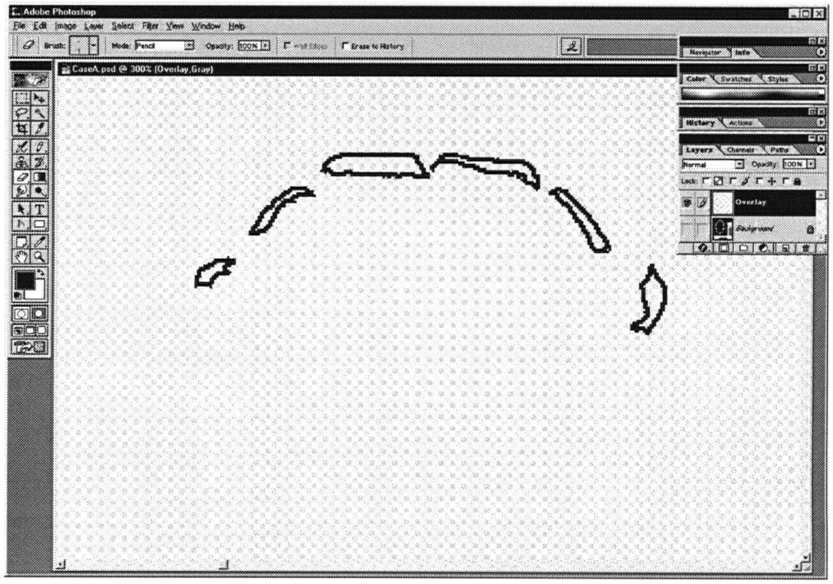
4) Copy the selected areas into a new layer called 'Overlay'



5) Clear the center noise and stroke the perimeter of the teeth on the inside with a 2 pixel black line



6) Deselect background image of casts and save the overlay



Appendix D

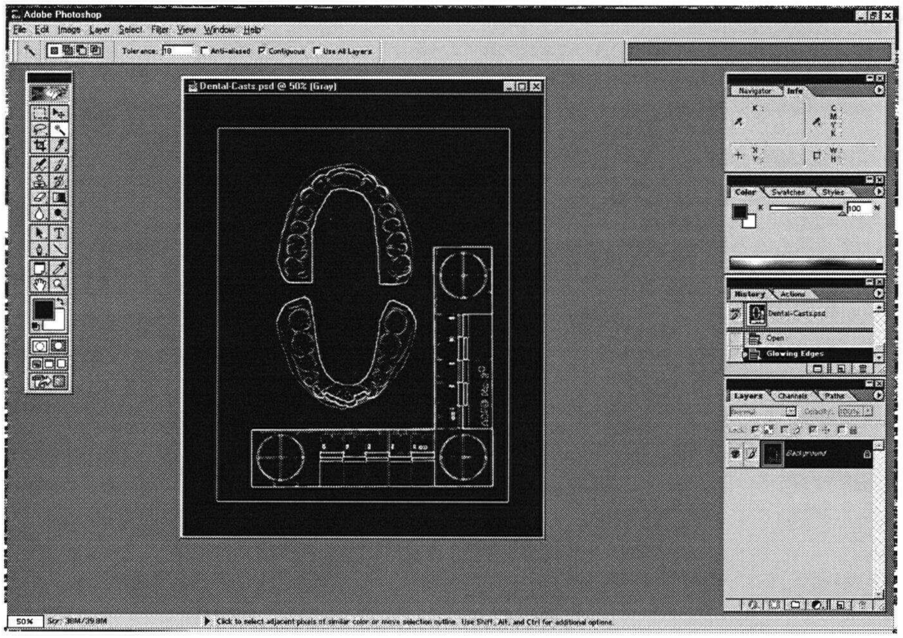
Technique B Instructions and Example

Technique B Instructions

1. Open up the image in Adobe Photoshop®.

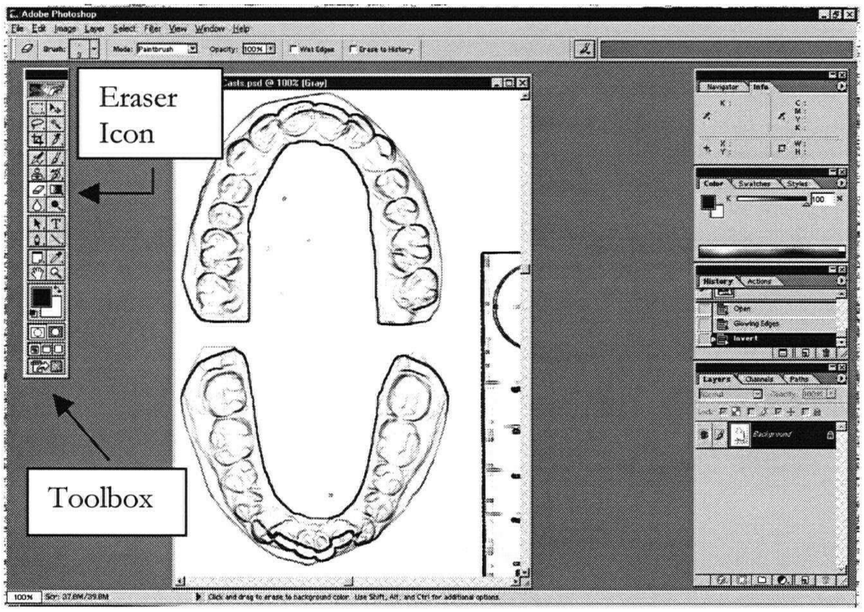
Selecting the Edges

2. From the Menu Bar, select Filter > Stylize > Glowing Edges. Accept the default settings of Edge width =2, Edge Brightness = 6, Edge Smoothness = 5. Your image should now look similar to the figure below.



3. From the Menu Bar, select Image > Adjust > Invert.

4. Now define the perimeters of the biting edges of the teeth. From the Menu Bar, select View > Zoom In. Repeat the Zoom In step until you are at a magnification in which you can see the incisal edges of the upper and lower anterior teeth. Your image should appear similar to the one shown below.



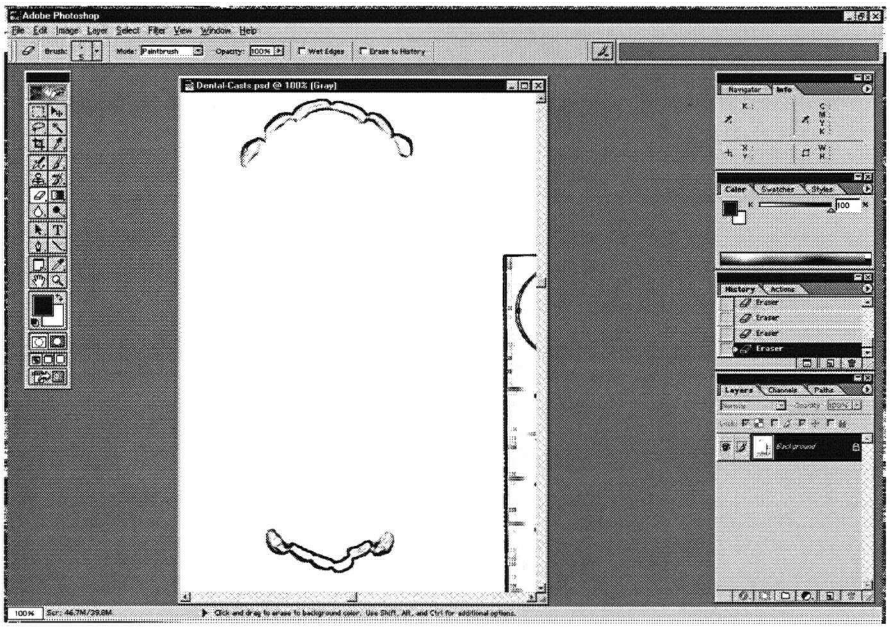
Removing Unwanted Areas

5. From the Toolbox, select the Eraser Tool.

6. To remove large, unwanted areas, use an Eraser size such as 19. To select an Eraser size, simply look under the main Menu Bar, at the Eraser Options Bar. Enter the new size in the box. Choose a large size to remove the posterior regions of the casts, and then select a smaller number (like 3 or 5) to remove around the perimeter of the anterior biting edge surfaces.

7. To erase an area, hold the Eraser tool over an area and depress the mouse button. Continue holding the button as you sweep over the areas to erase. Continue erasing the unwanted areas until you are left with an

outline of the biting edges of all six upper and lower anterior teeth. See Figure below.



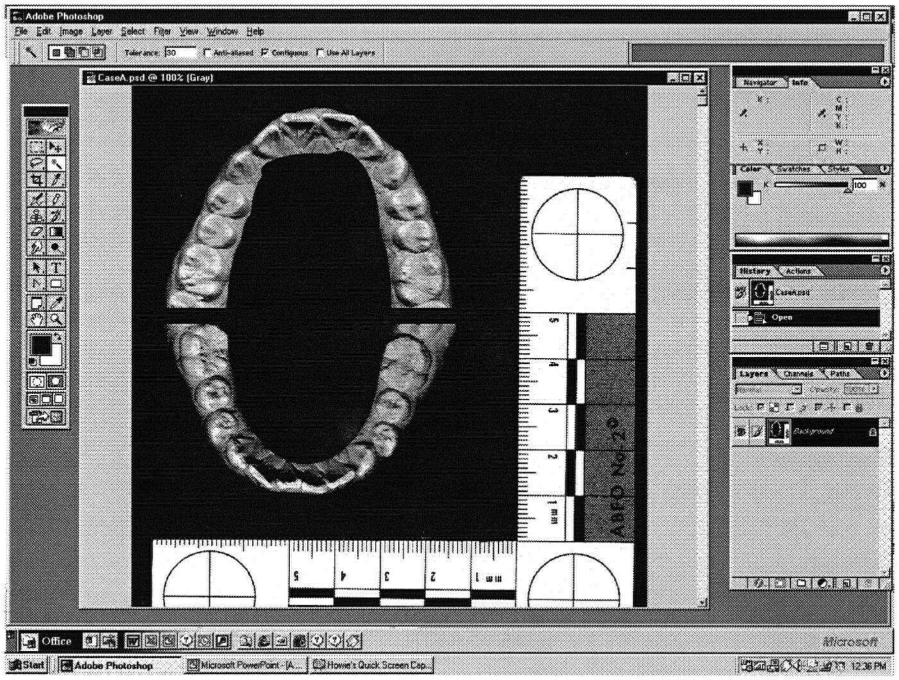
Saving the Overlay

8. Create a new folder on your desktop labeled "Technique B". Save the overlay you just produced in this new folder.

9. You have now completed the first image. Once you have completed all the overlays for <u>both techniques</u>, save them to the CD-ROM.

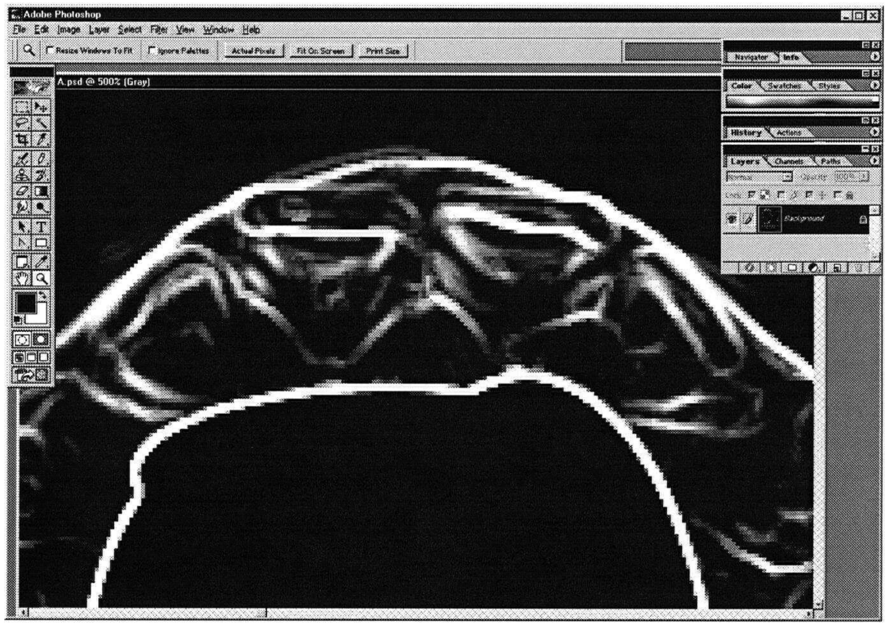
Technique B Example

1) Open image in Photoshop®

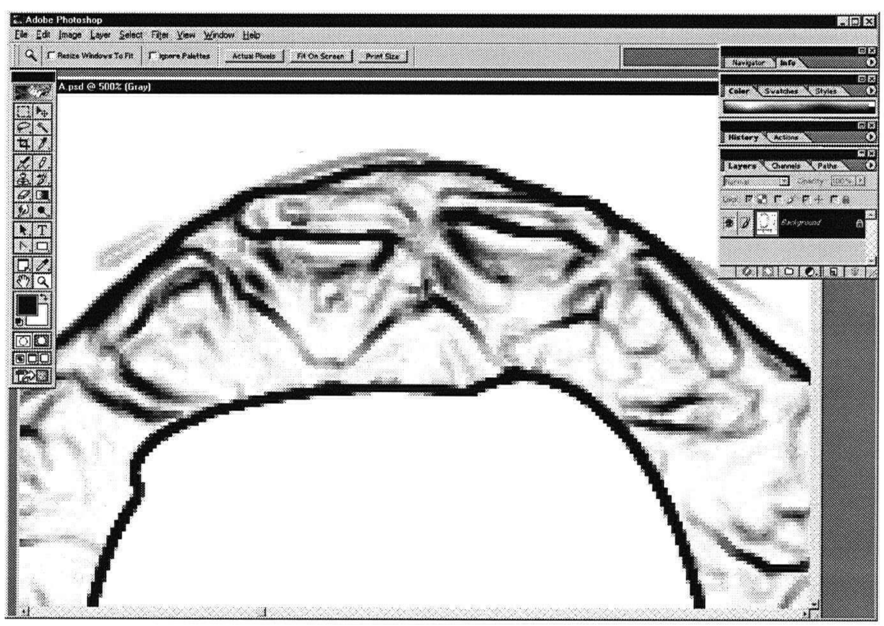


2) Zoom-in to magnify the incisal edges of the anterior teeth

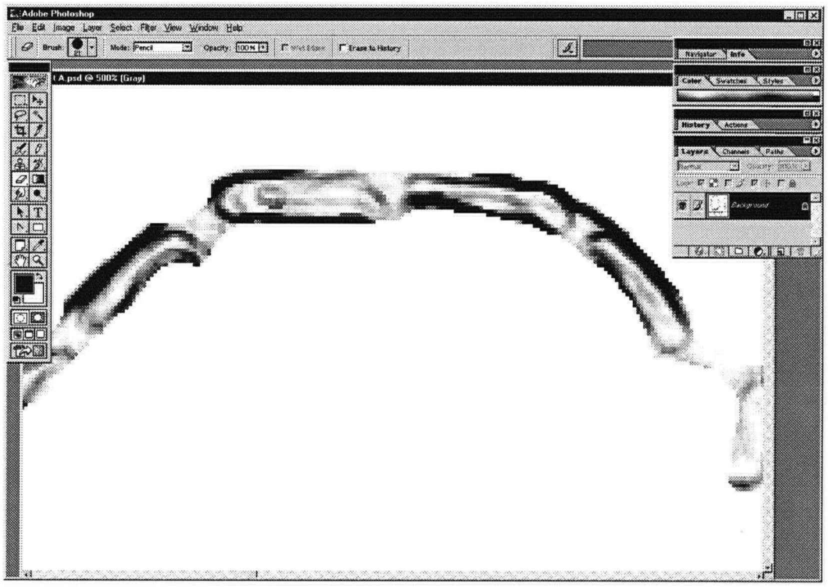
3) Select Filter > Stylize > Glowing Edges



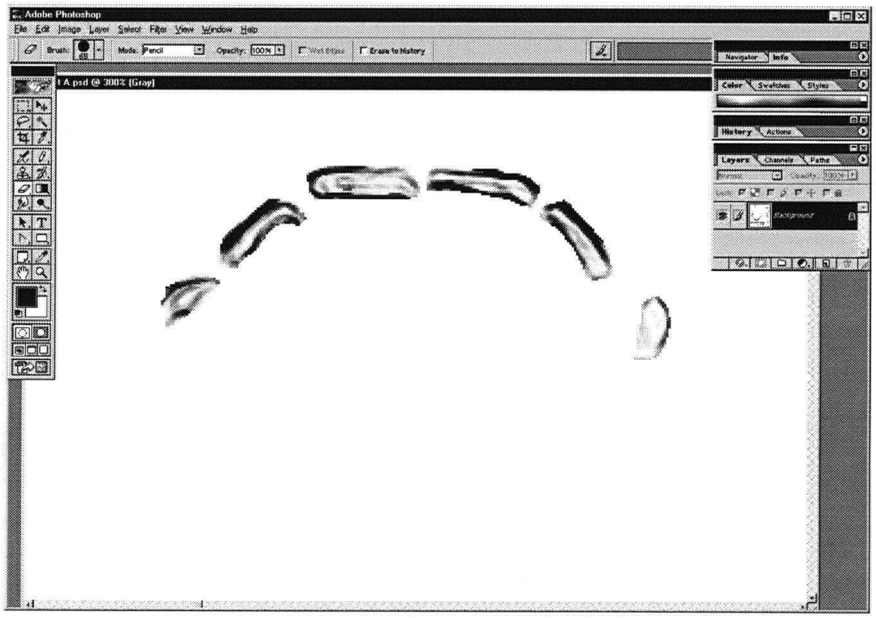
4) Select Image > Adjust > Invert



5) Erase unwanted areas until you are left with an outline of the incisal edges of the anterior teeth



6) Continue to erase separating the individual anterior teeth and save the overlay



Appendix E

Follow-up Questionnaire

Appendix F

Examiner
Data Reports

Area Data Report - D1												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	7.89	3.21	4.99	5.08	6.14	7.14	3.07	3.35	9.98	7.17	6.88	7.14
7	6.65	8.26	11.35	11.35	9.29	9.43	15.05	15.28	7.28	6.37	10.58	8.37
8	14.14	14.39	14.77	13.96	12.87	13.10	17.75	17.55	10.55	11.38	18.35	17.12
9	10.75	10.55	15.54	12.62	18.01	18.18	15.37	15.77	11.78	9.52	17.26	15.86
10	8.17	8.92	8.32	8.95	7.48	8.63	15.83	16.17	4.04	4.01	10.95	11.15
11	8.72	8.34	7.94	8.72	5.48	6.34	10.35	11.24	5.28	8.32	11.56	7.77
22	9.29	8.20	2.92	5.33	9.81	9.84	14.51	7.00	6.45	4.39	8.00	15.00
23	8.49	7.89	7.57	4.42	7.83	8.89	8.26	7.63	6.85	6.14	8.95	9.49
24	7.94	7.20	9.03	9.15	9.29	9.29	7.63	7.37	5.28	5.65	7.40	7.63
25	6.77	6.39	8.29	7.48	8.14	8.29	8.06	7.63	5.22	5.42	7.46	8.46
26	6.74	6.51	6.54	5.94	9.63	7.97	9.06	8.52	6.42	8.49	8.14	9.18
27	14.31	10.98	7.43	4.33	3.04	8.09	7.94	4.22	9.95	9.18	8.29	6.19
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	16.17	16.40	15.00	17.66	19.27	19.18	7.80	5.33	19.81	18.18	17.89	19.61
7	16.29	15.51	19.24	19.87	14.94	15.77	24.54	23.17	13.28	13.65	15.17	15.31
8	21.53	22.05	22.51	22.11	19.56	20.90	26.38	21.16	17.41	19.56	16.34	18.15
9	15.86	17.41	21.53	22.42	27.96	27.70	23.25	20.42	17.95	18.72	17.55	17.55
10	17.29	18.44	18.12	18.61	13.42	13.39	24.34	23.97	8.37	9.52	18.47	15.71
11	13.42	15.68	14.31	19.84	17.09	17.63	19.33	18.04	22.14	23.86	19.84	23.74
22	15.68	16.97	22.48	19.73	14.16	19.21	14.16	17.38	15.14	20.59	22.42	24.49
23	27.93	15.25	11.58	11.90	16.29	15.25	14.54	14.45	13.16	14.80	13.65	12.67
24	12.39	12.33	13.36	14.68	17.06	18.06	11.7	11.76	12.22	11.76	11.01	11.61
25	11.64	11.27	13.42	14.68	13.85	13.13	13.28	13.91	13.48	13.08	13.13	12.87
26	15.91	16.60	12.67	13.22	14.91	14.11	13.91	13.22	15.60	15.23	14.22	16.54
27	12.13	18.29	15.83	19.15	16.46	18.47	18.49	18.21	16.75	16.43	19.13	18.52

Position Data Report - D1

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.64	38.45	52.93	38.26	52.69	46.69	52.70	46.18	51.72	44.91	51.86	45.05	50.73	37.38	50.79	36.98	54.58	39.37	53.84	39.69	50.24	28.10	50.43	26.10
7	58.40	32.96	58.47	32.90	60.13	42.18	60.13	41.67	57.67	40.60	57.91	40.51	55.87	37.75	56.33	37.76	61.13	37.19	61.24	37.27	56.56	22.71	56.84	20.53
8	66.37	29.36	66.27	29.40	65.54	37.56	65.79	37.09	64.93	34.09	64.93	34.10	64.11	34.15	64.50	34.17	66.07	33.60	66.43	33.71	64.93	18.27	64.78	16.13
9	75.27	29.44	75.17	29.45	74.23	37.57	73.71	36.99	73.54	34.71	73.70	34.73	72.07	33.03	72.38	33.02	74.29	33.26	74.02	33.14	74.55	18.08	74.69	15.94
10	82.59	33.83	82.37	33.74	79.33	42.29	79.39	41.75	81.60	38.93	81.80	38.90	80.32	35.83	80.68	35.84	80.70	36.18	80.80	36.26	82.40	21.84	82.54	19.81
11	87.91	40.18	87.79	40.04	86.88	47.25	86.59	46.38	87.80	43.36	87.89	43.30	87.53	38.17	87.73	38.19	86.16	39.81	86.26	40.33	88.14	26.95	89.00	25.20
22	80.73	104.82	80.59	104.83	85.34	100.38	85.02	99.87	87.05	98.94	87.22	98.96	85.78	103.78	85.63	104.19	85.71	100.47	85.05	101.45	81.96	116.28	82.68	113.18
23	75.56	108.55	75.48	108.49	81.22	99.72	80.96	98.94	81.98	101.71	82.35	101.54	79.92	106.52	80.33	106.48	80.01	103.84	79.77	103.97	76.13	118.50	76.09	116.44
24	69.55	110.27	69.09	110.32	75.62	101.90	75.48	101.34	76.45	104.97	76.64	104.97	74.29	107.36	74.75	107.43	74.51	106.13	74.34	106.08	70.26	120.51	70.41	118.46
25	64.09	109.51	64.03	109.51	69.85	101.54	69.80	101.08	71.73	103.71	71.88	103.69	68.51	107.61	69.03	107.61	69.30	106.19	69.31	106.24	64.16	120.06	64.24	118.08
26	57.58	107.82	57.33	107.74	64.97	98.35	65.13	98.18	65.58	103.33	65.92	103.27	62.93	106.51	63.34	106.59	63.90	104.20	64.12	104.10	58.09	117.74	58.34	115.69
27	52.29	103.34	52.26	103.62	59.59	95.99	59.81	95.26	59.93	101.58	60.24	101.73	57.11	105.48	58.16	106.04	58.13	101.43	58.10	101.47	51.99	115.42	51.95	113.22

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.47	20.17	36.11	22.99	34.75	32.50	34.75	32.84	31.57	29.41	30.65	29.47	32.11	17.58	31.33	16.85	35.07	48.10	35.36	47.64	34.24	14.60	34.07	15.05
7	42.19	14.58	42.21	17.25	42.63	27.62	42.49	27.75	37.92	24.25	36.67	24.70	37.33	18.05	37.12	17.63	42.95	44.61	43.11	44.69	41.12	8.78	41.03	8.83
8	50.05	10.86	50.00	13.69	47.84	23.16	47.59	23.13	44.60	17.95	43.47	18.24	45.62	14.30	45.20	13.72	47.69	41.01	47.89	41.06	49.02	3.92	49.24	3.98
9	59.38	10.97	59.26	13.70	56.64	23.15	56.71	23.18	54.28	18.85	52.96	18.83	53.63	13.22	53.73	12.54	55.88	40.61	55.96	40.68	58.89	3.71	58.91	3.68
10	66.37	15.07	66.39	17.81	62.14	27.81	62.03	27.78	61.53	22.68	60.70	22.93	61.71	15.98	61.56	15.65	62.52	43.80	62.49	43.75	67.40	8.15	67.45	7.98
11	71.70	21.99	71.65	24.28	69.55	32.96	69.89	33.12	68.17	27.47	67.07	27.66	69.41	18.78	69.71	18.73	67.80	47.57	68.05	47.42	73.73	13.35	73.81	13.74
22	64.80	86.29	64.64	89.12	68.10	84.91	68.03	85.69	67.36	82.87	65.78	82.10	66.70	83.86	66.76	83.54	66.96	108.19	67.41	107.80	67.94	100.32	67.90	100.09
23	56.71	90.77	59.55	92.71	63.25	84.85	63.40	85.06	62.33	85.46	61.29	85.62	61.30	86.58	61.21	86.28	61.23	111.57	61.51	111.34	60.97	103.96	60.75	104.07
24	53.41	91.69	53.21	94.20	57.82	87.39	57.93	87.43	56.60	89.00	55.67	89.13	55.79	87.44	55.44	87.07	55.98	113.47	56.14	113.50	54.87	106.28	54.96	106.33
25	47.84	90.89	47.67	93.57	52.18	87.05	52.15	87.09	51.95	87.60	50.83	87.79	50.15	87.75	49.80	87.46	50.47	113.46	50.77	113.38	48.86	105.67	48.87	105.69
26	41.66	89.44	41.63	92.36	47.28	83.90	47.38	84.07	45.63	86.95	44.51	87.08	44.33	86.69	44.19	86.35	45.01	111.53	45.09	111.18	42.75	103.25	42.43	103.12
27	36.66	84.80	36.42	87.00	41.57	82.15	42.22	82.29	39.93	85.18	38.83	84.79	38.66	85.44	38.42	85.23	39.41	108.73	39.49	108.73	35.89	99.59	35.40	98.69

Area Data Report - D2

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	1.98	2.06	4.96	5.42	4.22	4.22	0.00	0.00	2.90	3.41	6.11	5.82
7	1.46	1.66	7.63	7.63	4.73	4.42	4.36	5.36	5.62	5.39	3.81	3.35
8	3.41	3.50	6.19	5.22	5.79	9.86	3.13	4.07	5.02	6.08	2.98	4.62
9	3.56	3.33	6.34	6.54	3.33	3.53	4.87	3.38	8.17	7.80	5.22	6.31
10	3.44	3.35	8.00	8.09	2.55	1.72	3.07	3.10	2.52	3.15	2.87	4.65
11	2.06	4.39	7.34	7.46	5.48	5.53	5.02	6.05	3.44	4.30	4.73	5.08
22	10.47	2.75	0.95	2.18	4.42	4.22	4.56	4.59	1.41	1.38	1.66	1.66
23	4.01	3.50	2.75	2.92	6.31	4.96	2.70	3.64	1.75	1.55	4.50	6.51
24	6.16	3.35	5.13	6.16	7.68	8.97	5.02	3.99	3.38	3.33	6.57	6.59
25	5.94	5.45	6.59	6.59	4.24	4.24	7.28	6.39	4.24	4.24	7.00	7.05
26	3.38	3.53	0.23	2.52	4.01	1.38	5.28	5.28	3.78	4.24	1.92	5.65
27	0.77	0.77	2.09	1.84	2.61	2.61	3.99	3.90	4.76	3.81	3.58	3.56

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	6.59	6.02	7.51	8.46	5.96	4.24	0.00	0.00	6.82	7.63	6.68	5.91
7	10.52	11.56	18.92	15.60	10.15	7.57	12.33	19.41	9.09	11.10	4.99	3.38
8	21.19	18.24	18.29	13.10	17.55	11.96	23.25	21.42	12.87	15.66	7.28	6.42
9	17.41	11.3	13.59	14.45	25.95	11.61	16.89	18.70	11.56	12.76	7.80	7.51
10	16.69	10.27	13.71	13.39	14.31	11.10	20.07	19.50	6.14	6.28	7.37	5.85
11	8.49	8.66	12.44	11.01	14.05	8.11	12.04	11.07	4.27	4.01	12.24	10.55
22	6.80	5.99	6.08	4.44	8.06	6.14	6.14	5.99	7.03	5.71	3.56	4.82
23	13.19	11.84	9.09	5.82	15.48	9.52	11.93	11.96	9.78	7.20	9.89	7.11
24	13.22	11.44	13.79	12.24	17.26	13.85	10.21	10.29	8.46	6.82	9.66	7.14
25	11.18	9.89	12.59	9.06	13.28	11.53	10.87	11.07	9.09	8.52	9.78	8.49
26	12.73	8.69	4.87	4.96	12.70	10.29	10.21	11.67	8.34	7.57	9.63	5.82
27	3.15	6.68	8.29	9.98	4.82	4.44	5.45	4.99	9.12	12.30	7.17	4.65

Position Data Report - D2

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.53	37.75	52.55	37.73	52.86	46.70	52.91	46.64	51.84	44.73	51.84	44.73	0.00	0.00	0.00	0.00	53.68	40.15	53.67	40.20	50.29	28.79	50.28	28.85
7	59.27	31.45	59.32	31.48	60.36	42.09	60.36	42.09	58.11	40.07	58.11	40.07	54.10	37.20	54.02	37.22	61.20	37.47	61.18	37.50	57.06	22.91	57.14	22.92
8	67.54	29.11	67.24	29.13	65.13	37.30	64.90	37.26	64.69	33.74	64.59	34.09	62.44	33.54	62.55	33.56	66.95	33.60	66.85	33.63	62.62	18.36	64.64	18.35
9	74.33	28.87	74.38	28.86	73.59	37.41	73.57	37.41	73.68	35.07	73.69	35.08	71.93	32.17	71.78	32.12	73.62	33.35	73.65	33.34	74.83	18.18	74.80	18.27
10	81.21	32.63	81.18	32.61	79.50	42.27	79.50	42.27	81.34	38.35	81.49	38.13	78.37	35.08	78.32	35.08	80.76	36.14	80.92	36.22	82.79	22.12	82.33	22.19
11	87.54	38.85	87.40	39.36	86.89	46.97	86.86	46.95	87.80	43.36	87.80	43.35	86.54	38.00	86.39	38.00	86.26	39.26	86.25	39.65	89.46	27.96	89.41	28.06
22	79.88	104.63	79.50	105.69	85.52	99.99	85.41	100.33	87.01	99.12	87.00	99.09	83.37	104.65	83.36	104.66	84.92	101.97	84.91	101.97	82.89	116.85	82.89	116.85
23	73.46	109.12	73.39	109.17	80.85	99.57	80.86	99.58	82.05	101.84	82.14	101.77	78.88	106.78	78.95	106.78	80.22	104.11	80.31	104.10	76.11	119.32	76.20	119.24
24	68.29	110.17	67.67	110.17	76.21	101.96	76.14	101.94	76.47	105.02	76.45	104.97	72.78	107.27	72.92	107.33	74.62	106.11	74.63	106.12	70.39	121.13	70.37	121.14
25	63.35	109.38	63.25	109.36	70.02	101.61	70.02	101.61	71.89	104.00	71.89	104.00	67.22	107.46	67.48	107.47	69.59	106.22	69.61	106.22	64.31	120.68	64.35	120.68
26	56.77	107.89	56.70	107.83	66.72	99.82	65.70	99.29	65.88	103.54	66.84	104.15	61.35	106.65	61.36	106.65	64.41	104.16	64.50	104.19	59.97	119.08	58.50	118.53
27	51.87	103.67	51.87	103.67	59.96	97.32	59.92	97.28	59.87	101.52	59.87	101.52	56.29	105.90	56.28	105.89	58.96	102.03	59.08	102.15	51.88	115.99	51.87	115.99

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.28	22.10	37.13	22.21	35.22	32.35	28.35	31.06	31.76	28.94	31.93	28.70	0.00	0.00	0.00	0.00	35.05	47.77	34.46	47.71	33.30	14.21	33.64	13.49
7	42.37	17.11	42.22	17.30	42.76	27.7	35.92	26.55	38.43	23.92	38.22	24.34	37.34	17.60	34.78	17.44	42.63	44.84	42.01	44.80	40.14	8.11	40.49	7.42
8	50.09	13.59	50.26	13.65	47.97	23.09	40.63	21.62	44.92	17.85	44.53	17.87	45.49	14.27	42.79	13.80	47.55	41.03	47.19	41.09	47.75	3.59	48.12	2.91
9	59.68	13.72	59.64	13.52	56.33	22.92	49.34	21.72	53.96	18.61	53.26	18.26	53.99	13.09	50.90	12.71	55.17	40.76	54.91	40.68	57.76	3.49	58.01	2.82
10	66.43	17.95	66.52	17.81	61.86	27.81	55.07	26.64	61.76	22.83	61.81	22.95	61.76	16.00	59.08	15.46	62.39	43.81	61.76	43.72	65.75	7.53	65.99	6.86
11	72.00	23.96	72.01	23.91	69.49	32.68	62.49	31.55	67.83	26.97	67.99	27.27	68.76	18.21	66.10	17.68	67.48	46.29	66.82	46.26	71.28	12.99	71.77	12.35
22	64.24	90.19	64.13	90.21	67.72	86.46	60.82	85.07	67.12	83.00	67.19	82.93	66.21	85.08	63.52	84.51	66.77	108.73	66.00	108.77	65.17	102.62	65.74	101.49
23	59.41	92.86	59.43	92.70	63.58	84.74	56.57	83.81	62.35	85.41	62.30	85.78	61.35	86.68	58.61	86.13	61.17	111.43	60.98	111.45	59.29	104.43	59.59	103.80
24	53.30	94.47	53.27	94.52	58.00	87.43	50.91	86.28	56.74	88.92	56.61	89.05	55.77	87.61	52.98	87.03	55.97	113.69	55.16	113.65	53.40	106.44	53.73	105.74
25	47.80	93.68	47.95	93.76	52.21	87.31	45.31	85.88	51.99	87.65	51.98	87.76	50.11	87.86	47.42	87.28	50.55	113.42	49.70	113.33	47.25	105.96	47.77	105.29
26	41.54	92.08	41.51	91.98	47.89	84.76	41.09	83.74	45.60	86.91	45.77	87.21	43.95	86.92	41.58	86.20	44.85	111.30	43.97	111.15	41.49	103.64	41.51	103.06
27	37.38	86.25	36.56	88.78	42.03	81.34	35.01	80.6	40.03	85.12	40.01	85.37	39.01	85.81	36.46	85.45	39.57	108.83	38.70	108.68	35.17	101.19	35.81	100.97

Area Data Report - D3

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	3.64	3.99	7.71	7.68	6.22	7.51	6.51	4.47	8.95	7.11	8.11	7.31
7	9.69	8.60	13.53	12.65	11.33	10.15	9.12	17.23	8.92	10.47	12.07	10.04
8	12.47	10.70	15.68	15.74	14.14	14.45	20.19	20.10	15.37	12.01	13.36	14.77
9	10.04	12.10	14.97	14.42	21.30	20.07	18.95	15.68	13.19	12.24	13.13	13.08
10	9.03	10.44	11.21	10.92	8.23	9.58	17.95	17.92	5.48	6.22	10.49	6.97
11	10.84	6.71	9.86	8.14	7.80	8.11	10.84	8.32	10.06	7.23	12.56	8.52
22	4.16	4.24	8.52	10.29	10.75	5.85	4.47	5.91	6.57	5.08	7.05	5.30
23	10.58	10.24	6.19	7.28	10.38	10.18	11.44	11.93	8.77	4.99	7.43	7.25
24	8.06	7.77	11.15	9.43	12.50	11.70	9.38	9.41	7.46	5.30	7.31	7.89
25	7.86	8.00	9.86	9.41	9.38	9.52	9.89	10.09	7.11	5.62	7.80	8.03
26	9.12	8.89	9.00	8.97	12.19	9.66	10.81	10.52	10.81	6.71	6.74	9.72
27	5.71	5.19	10.12	8.54	16.72	4.87	6.19	6.11	11.33	10.35	7.74	6.62

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.55	3.27	6.54	4.73	7.11	4.65	4.47	9.29	4.07	1.75	6.39	4.93
7	10.78	10.27	16.37	10.87	14.91	10.52	21.51	12.96	10.27	5.99	13.99	10.67
8	16.89	12.85	20.19	14.16	19.67	17.35	24.03	16.66	16.72	11.01	19.78	14.25
9	11.99	13.76	14.91	12.76	24.40	13.16	21.94	11.56	14.65	7.46	17.98	11.50
10	12.70	10.95	12.85	10.29	12.99	5.02	22.57	15.37	7.89	5.28	15.37	10.29
11	6.22	5.65	7.48	6.59	12.67	4.42	9.29	9.23	4.47	3.30	12.39	8.66
22	4.39	2.95	4.22	3.15	6.25	3.15	7.57	3.67	6.68	8.66	2.70	2.06
23	12.73	11.87	11.58	4.16	13.85	7.20	13.36	7.86	9.12	5.19	9.46	7.46
24	10.75	9.75	11.84	7.40	13.79	7.57	10.49	6.11	8.66	6.22	9.35	7.94
25	8.95	8.69	10.67	6.34	12.22	5.16	11.01	5.76	8.40	4.90	10.04	7.31
26	10.72	10.29	5.36	2.29	12.07	7.28	12.82	7.11	10.47	5.10	9.32	3.78
27	3.70	2.49	2.84	2.87	3.93	2.87	4.62	2.87	11.96	3.53	4.44	2.35

Position Data Report - D3

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.09	37.88	52.95	37.88	52.99	46.72	52.98	46.71	51.90	44.84	52.15	44.65	51.09	37.87	51.18	37.71	54.27	39.99	53.94	40.04	50.43	29.10	50.48	28.80
7	58.29	32.91	58.50	32.71	60.47	42.26	60.44	42.27	57.69	40.83	57.87	40.62	55.68	37.47	55.86	37.73	61.50	37.50	61.36	37.36	56.96	23.50	56.85	23.33
8	65.78	29.18	65.84	29.22	65.89	37.79	65.94	37.79	64.53	34.24	64.96	34.08	64.18	34.17	64.33	34.01	66.83	34.04	66.53	33.86	64.62	18.68	64.59	18.72
9	75.25	29.37	74.94	29.42	73.96	37.70	73.87	37.68	73.56	34.99	73.71	34.85	72.11	33.12	72.34	32.84	74.22	33.54	73.91	33.55	74.82	18.47	74.63	18.47
10	82.16	33.59	82.01	33.75	79.52	42.38	79.54	42.43	81.53	38.91	81.76	38.91	80.48	35.86	80.48	35.69	80.98	36.38	80.70	36.39	82.89	22.49	82.88	22.36
11	87.54	40.03	87.63	39.58	86.85	47.10	86.81	46.92	87.71	43.48	87.87	43.31	88.07	38.45	87.86	37.97	86.12	39.23	86.29	40.01	88.55	27.61	89.18	27.86
22	79.96	105.87	79.79	105.87	85.20	100.42	85.18	100.43	87.05	99.18	87.16	99.21	84.86	104.68	84.89	104.67	85.54	101.30	85.31	101.60	82.62	116.75	82.48	116.81
23	75.30	108.46	75.13	108.48	81.13	99.77	81.12	99.82	82.01	101.87	82.15	101.76	80.03	106.66	79.99	106.44	80.36	104.03	79.80	104.32	76.48	119.31	76.31	119.21
24	68.90	110.38	68.54	110.35	75.60	102.10	75.92	102.16	76.46	105.24	76.67	104.99	74.27	107.44	74.37	107.25	74.66	106.25	74.60	106.28	70.65	121.22	70.49	121.19
25	63.71	109.54	63.45	109.53	69.89	101.78	69.87	101.76	71.78	103.90	71.94	103.74	68.67	107.61	68.78	107.51	69.51	106.31	69.50	106.35	64.55	120.72	64.47	120.66
26	57.23	107.83	57.07	107.87	65.14	98.85	65.17	98.84	65.78	103.58	65.61	103.24	62.93	106.60	63.03	106.46	64.32	104.20	64.11	104.20	58.75	118.55	58.45	118.28
27	52.38	104.17	52.26	104.24	59.88	96.65	59.55	96.33	60.02	101.21	60.14	101.66	57.8	106.11	57.84	105.97	58.45	101.64	58.25	101.49	52.39	115.98	52.07	115.83

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.20	22.30	37.01	22.29	35.38	32.28	35.40	32.59	31.54	29.40	31.77	29.26	30.18	20.90	29.85	22.01	35.72	46.96	35.76	47.06	33.78	13.47	34.01	15.42
7	42.44	17.23	42.30	17.20	42.93	27.66	43.07	27.80	37.96	24.55	38.05	24.44	37.40	20.08	36.97	20.06	42.63	45.18	42.59	45.26	39.86	8.44	40.18	10.15
8	50.23	13.74	49.63	13.34	48.02	23.18	48.30	23.24	44.54	18.14	44.41	18.30	45.61	16.51	45.67	16.32	48.07	41.24	48.14	41.39	48.11	3.58	48.17	5.53
9	60.11	13.73	59.42	13.71	56.44	23.01	56.51	23.04	53.87	18.74	53.97	19.00	53.76	15.38	53.58	15.35	55.59	40.91	55.49	41.04	57.97	3.27	58.05	5.05
10	66.42	17.91	66.50	18.05	62.04	27.85	62.22	27.90	61.68	22.92	62.00	23.09	62.00	18.25	61.88	18.10	62.68	43.98	62.69	44.06	66.67	7.58	66.93	9.54
11	72.29	23.94	72.22	24.10	69.72	33.00	69.73	32.74	67.87	27.11	68.13	27.69	69.61	20.75	68.77	20.26	67.66	46.45	67.80	46.39	71.75	12.28	72.08	14.40
22	65.10	88.03	65.09	88.24	68.12	86.45	68.10	86.50	67.29	83.20	67.36	83.24	66.10	87.25	66.18	86.97	67.33	108.68	67.12	109.11	66.48	101.34	66.66	103.27
23	59.71	92.71	59.65	92.74	63.95	85.44	63.69	85.16	62.24	85.74	62.34	86.07	61.36	88.82	61.15	88.68	61.92	111.67	61.47	111.83	59.77	103.77	59.93	105.88
24	53.50	94.54	53.49	94.55	58.10	87.46	58.44	87.52	56.74	89.03	56.91	89.06	55.87	89.72	55.51	89.83	56.20	113.73	56.23	113.91	53.98	105.73	54.01	107.74
25	47.99	93.67	47.91	93.66	52.48	87.31	52.48	87.48	51.96	87.89	52.25	88.09	50.13	90.07	50.40	89.91	51.13	113.90	51.12	114.03	47.81	105.30	48.06	107.35
26	41.49	92.10	41.43	92.04	48.29	84.72	48.43	85.17	45.72	87.14	46.15	87.56	44.49	88.87	43.80	89.08	45.46	111.71	45.63	112.12	42.04	103.04	41.97	105.38
27	36.53	88.24	37.23	89.17	41.79	80.47	42.52	82.95	39.95	85.41	39.99	85.45	39.17	88.22	38.85	87.99	39.83	109.16	40.68	109.99	35.07	99.96	35.52	102.73

Area Data Report - D4												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	1.75	1.55	4.27	4.96	4.04	3.24	0.00	0.00	3.30	2.04	5.82	3.99
7	4.42	3.96	9.98	11.93	4.42	3.30	12.56	12.53	5.19	4.85	8.86	6.31
8	13.16	11.30	6.68	12.59	9.26	10.41	15.40	11.93	9.26	6.88	14.65	12.59
9	8.60	7.11	10.98	11.56	18.12	15.20	13.53	10.21	7.28	7.83	14.82	12.62
10	7.14	6.31	7.46	7.89	5.45	5.13	9.12	10.27	2.70	2.38	12.04	3.93
11	5.53	4.96	7.08	8.20	5.48	4.01	6.11	4.90	3.33	2.06	10.49	7.11
22	1.92	6.77	4.04	1.12	3.93	3.35	4.42	3.70	2.47	1.26	4.44	3.53
23	7.31	6.48	1.78	2.52	6.45	4.90	9.23	6.85	3.10	3.07	6.19	5.68
24	5.16	4.39	7.05	6.37	7.57	7.71	6.62	4.96	2.38	2.21	6.94	6.16
25	5.19	4.73	6.91	4.42	4.33	3.73	6.59	6.57	4.24	3.81	7.34	6.65
26	5.33	2.84	4.62	5.13	6.59	4.19	5.96	4.42	3.21	2.52	5.85	4.44
27	1.18	1.81	2.98	1.63	2.49	1.49	3.90	2.32	1.66	1.29	4.22	3.10
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	5.02	6.28	8.54	8.66	8.06	9.23	0.00	0.00	7.05	8.95	7.97	7.28
7	9.15	10.78	19.13	11.87	14.16	12.16	19.64	16.89	9.92	11.30	17.46	13.48
8	19.3	17.92	21.56	21.28	17.69	17.12	24.80	24.37	16.69	19.24	28.82	33.32
9	14.82	13.48	21.79	16.00	20.85	19.67	20.04	20.50	13.99	14.16	27.96	33.15
10	15.31	15.60	17.75	16.26	13.59	11.76	18.72	18.35	8.49	10.52	25.29	19.30
11	11.90	8.83	11.27	11.35	11.70	8.86	10.18	6.54	4.99	4.13	18.21	14.82
22	7.60	6.14	3.44	6.19	9.23	6.16	7.43	7.97	8.97	9.61	6.31	9.23
23	11.38	14.51	6.11	4.62	13.36	9.95	14.45	17.06	9.15	11.7	6.57	8.60
24	11.67	10.78	13.56	9.49	16.72	13.59	10.67	13.51	10.09	11.61	10.58	7.91
25	10.64	10.92	10.58	14.97	13.28	10.44	11.15	12.33	11.96	10.35	12.67	11.24
26	14.16	10.92	11.30	11.58	13.19	13.71	13.05	15.23	14.34	15.40	14.19	12.87
27	3.84	5.65	8.32	8.83	4.90	4.99	8.69	7.57	12.59	15.63	10.35	6.71

Position Data Report - D4

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.75	37.90	52.87	38.15	52.79	46.94	52.86	47.04	51.84	44.89	51.87	44.80	0.00	0.00	0.00	0.00	53.81	40.10	53.98	39.46	50.28	28.85	49.90	28.82
7	57.96	32.92	58.26	33.00	60.50	42.29	60.57	42.39	58.11	40.24	58.07	40.30	54.42	37.75	54.52	37.75	61.17	37.67	61.01	37.70	56.80	23.35	56.55	23.32
8	65.72	29.39	65.65	29.67	65.45	37.52	66.10	37.95	64.14	34.07	64.78	34.17	63.15	34.18	63.63	34.07	66.47	33.81	66.67	33.87	64.64	18.84	64.88	18.82
9	75.06	29.47	75.20	29.61	73.98	37.64	74.06	37.77	73.53	34.91	73.47	34.82	71.07	33.09	70.52	33.15	73.5	33.53	73.50	33.47	74.75	18.72	74.48	18.60
10	81.96	33.87	82.03	33.89	79.31	42.38	79.46	42.61	81.67	39.07	81.76	39.01	78.72	35.61	79.38	35.85	81.01	36.49	80.99	36.57	82.41	22.69	82.22	22.05
11	87.48	39.63	87.66	39.77	86.89	47.16	86.84	47.29	87.80	43.53	87.87	43.47	86.55	38.16	86.66	38.02	86.24	39.43	85.98	38.99	88.47	27.73	88.97	27.89
22	79.72	105.96	80.37	104.75	85.13	100.75	85.37	100.61	87.00	99.25	87.04	99.28	83.52	104.83	83.45	104.63	85.51	101.23	85.94	100.99	82.31	116.84	82.51	116.82
23	75.05	108.43	75.15	108.64	80.56	99.77	80.86	99.91	82.11	101.95	82.19	101.85	78.69	106.65	78.69	106.26	79.61	104.38	79.81	104.27	76.16	119.35	76.19	119.16
24	68.47	110.36	68.60	110.47	75.72	102.06	75.7	102.07	76.49	105.20	76.56	105.12	72.98	107.45	72.94	107.14	74.42	106.29	74.18	106.27	70.35	121.22	70.27	121.17
25	63.46	109.54	63.58	109.70	69.99	101.73	69.94	101.81	71.85	104.17	72.01	104.13	67.48	107.62	67.43	107.45	69.41	106.29	69.34	106.38	64.33	120.76	64.37	120.65
26	56.81	107.78	56.73	107.90	65.43	98.96	65.13	98.86	65.28	103.30	65.49	103.37	61.32	106.68	61.46	106.57	64.28	104.22	64.07	104.29	58.42	118.54	58.05	118.38
27	52.08	103.48	51.87	103.84	59.52	96.57	59.64	97.06	59.86	101.69	59.71	101.58	56.45	106.06	56.13	105.29	57.84	101.62	57.71	101.52	51.71	115.88	51.80	116.01

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.73	22.52	37.08	22.27	35.36	32.20	35.32	32.19	31.40	29.17	31.66	29.41	0.00	0.00	0.00	0.00	34.78	48.02	35.36	47.99	33.65	13.11	33.84	13.46
7	42.40	17.12	42.25	17.22	42.87	27.71	42.99	27.93	37.72	24.72	37.76	24.87	37.30	19.96	37.52	20.14	42.44	45.45	43.09	44.99	39.96	8.23	39.70	9.00
8	49.85	13.75	50.18	13.60	48.43	23.27	47.91	23.17	44.60	18.06	44.89	18.17	45.43	16.43	45.43	16.42	48.03	41.37	48.21	41.16	47.98	4.47	48.19	4.28
9	59.54	13.88	58.88	13.79	56.78	23.15	56.10	23.07	53.84	18.53	53.79	19.02	53.59	15.20	53.17	15.38	55.34	40.91	55.53	40.86	57.72	4.09	57.92	4.02
10	66.37	17.99	66.27	18.01	62.22	27.90	62.24	27.80	61.58	22.88	61.75	22.84	62.05	18.29	61.59	18.16	62.53	43.96	62.58	43.96	66.12	7.63	65.96	7.58
11	72.01	24.21	71.91	24.02	69.72	32.95	69.50	32.71	67.84	27.52	68.18	27.80	69.30	20.61	69.02	20.70	67.70	46.51	67.66	46.28	72.10	11.98	71.91	12.32
22	64.11	90.45	63.79	90.52	69.61	84.35	67.88	86.42	67.01	83.49	67.03	83.57	66.12	87.32	65.89	87.19	66.79	108.81	66.73	109.25	66.22	100.66	65.83	100.93
23	59.38	93.02	59.48	92.79	63.89	84.99	62.68	85.59	62.15	85.77	62.15	85.96	61.32	88.90	61.19	88.68	61.15	111.52	61.60	111.59	60.09	103.77	59.80	104.11
24	53.15	94.65	52.96	94.57	58.25	87.48	58.65	87.56	56.59	89.20	56.65	89.15	55.76	89.68	55.71	89.60	55.53	113.47	56.09	113.70	53.63	105.29	53.60	106.03
25	47.59	93.92	47.74	93.67	52.27	87.22	52.54	87.49	51.87	87.86	51.85	87.95	50.23	89.98	50.11	89.62	50.44	113.63	50.99	113.64	47.72	104.72	47.81	105.29
26	41.45	91.92	41.32	91.94	46.96	84.51	47.62	84.43	45.48	87.11	45.47	87.21	44.36	89.06	44.13	88.62	45.21	111.43	45.25	111.15	41.62	102.42	41.68	102.98
27	36.63	86.58	36.44	87.72	42.64	82.37	41.91	81.60	39.97	85.67	40.10	85.42	39.10	88.38	38.84	87.86	39.87	109.13	39.42	108.63	35.50	100.07	34.86	100.23

Area Data Report - D5

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	5.68	9.49	9.43	7.46	9.09	9.03	0.00	18.12	9.20	9.20	6.85	9.55
7	10.58	6.88	13.53	13.10	11.35	10.58	17.26	16.92	8.92	9.43	13.39	10.55
8	15.89	16.17	16.75	15.94	14.54	15.71	20.39	19.53	13.13	15.46	15.66	17.75
9	12.39	12.13	17.43	13.76	20.16	20.16	18.27	17.58	12.56	12.62	16.09	16.83
10	10.75	10.64	10.75	10.98	8.69	8.23	17.03	18.15	5.42	5.25	9.86	11.78
11	7.11	10.95	10.44	10.81	8.43	9.03	13.59	13.51	6.14	7.31	11.56	12.33
22	11.30	12.24	4.76	8.32	12.42	6.51	12.47	15.66	5.42	6.16	13.02	19.07
23	10.32	10.52	6.28	7.77	11.56	10.01	7.37	6.42	6.48	7.05	7.83	7.46
24	8.95	9.06	9.69	11.33	11.53	11.58	8.43	7.66	6.48	5.56	7.25	7.77
25	7.91	8.11	9.98	9.35	5.56	9.58	9.46	4.70	6.02	5.94	8.00	8.46
26	7.05	8.26	6.28	5.45	8.92	8.11	10.78	7.28	6.22	5.48	9.72	10.01
27	2.98	13.65	7.63	3.61	6.57	5.02	6.37	6.85	9.78	10.01	13.82	6.82

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	5.33	6.11	9.84	6.11	10.87	9.86	17.32	23.46	10.38	7.83	8.06	13.99
7	13.73	11.73	13.99	15.05	17.03	13.65	19.04	25.32	13.45	14.60	16.00	18.81
8	19.10	20.47	19.13	20.16	26.49	23.17	25.52	23.46	15.20	16.54	18.81	32.95
9	16.11	12.16	21.85	21.42	24.97	22.60	23.25	23.28	15.80	17.95	14.97	34.01
10	15.66	12.53	17.38	14.19	14.65	11.93	19.64	24.40	7.00	7.14	16.03	17.63
11	11.04	9.06	11.81	6.31	16.40	12.87	14.11	14.62	3.13	4.44	15.46	13.51
22	6.97	10.06	11.10	12.39	8.00	5.53	7.40	7.83	7.66	7.00	5.10	6.74
23	15.54	17.00	12.33	9.84	11.13	12.96	13.76	11.15	9.41	7.14	10.72	13.10
24	11.38	10.84	11.15	13.30	12.47	16.03	11.41	12.47	8.52	10.44	10.72	10.24
25	8.63	10.90	10.55	11.10	12.85	12.39	11.56	11.9	8.95	10.70	10.04	11.93
26	11.96	10.35	7.20	7.60	12.16	10.21	11.41	11.93	10.55	10.38	11.84	12.39
27	4.79	7.25	8.32	8.97	5.13	4.82	11.96	9.66	10.49	13.91	7.14	7.23

Position Data Report - D5

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.85	37.84	53.84	38.01	52.88	47.00	52.93	46.76	51.73	45.39	51.76	45.35	0.00	0.00	50.94	39.12	54.41	39.75	54.27	39.93	50.43	28.88	50.65	28.95
7	58.30	32.81	58.64	32.94	60.64	42.09	60.40	42.26	57.86	40.83	57.81	40.83	56.90	37.91	57.38	38.21	61.50	37.50	61.54	37.42	56.64	23.74	57.06	23.34
8	65.95	29.39	66.64	29.39	66.19	37.67	66.01	37.81	64.96	34.26	64.96	34.32	65.33	34.19	65.94	34.38	66.67	33.88	66.80	34.05	64.65	18.92	65.40	18.95
9	74.56	29.46	75.72	29.50	74.55	37.61	73.87	37.65	73.56	34.91	73.57	34.91	73.19	33.08	73.71	33.25	74.03	33.58	74.01	33.63	74.81	18.79	74.72	18.66
10	81.83	33.77	82.58	33.90	79.64	42.22	79.55	42.43	81.73	38.98	81.81	39.09	81.48	35.85	82.01	36.03	81.06	36.46	80.99	36.37	82.75	22.53	82.84	22.57
11	87.46	39.60	87.95	39.99	86.92	46.87	87.00	47.51	87.82	43.44	88.08	43.75	88.69	38.38	89.06	38.47	86.40	39.31	86.45	40.05	88.41	27.72	88.58	27.63
22	80.06	104.75	80.73	104.75	85.42	100.52	85.18	100.42	87.19	99.12	87.18	99.35	86.70	103.86	87.40	103.86	85.64	101.40	85.38	101.42	82.99	115.73	82.95	115.81
23	75.05	108.44	75.67	108.45	81.27	99.61	81.20	99.83	82.34	101.78	82.14	101.93	80.97	106.27	81.71	106.45	80.01	104.24	80.01	104.27	76.27	119.29	76.46	119.31
24	68.80	110.32	69.31	110.30	76.02	102.00	75.56	102.09	76.65	105.15	76.67	105.16	75.50	107.36	75.84	107.60	74.55	106.18	74.59	106.21	70.49	121.22	70.62	121.20
25	63.41	109.53	64.03	109.53	70.04	101.60	69.78	101.74	71.90	104.23	71.92	103.91	69.78	107.64	69.96	107.77	69.64	106.33	69.88	106.47	64.40	120.72	64.53	120.73
26	56.74	107.84	57.61	107.93	65.26	98.66	64.80	98.46	66.13	103.53	65.85	103.41	64.09	106.61	64.39	107.00	64.46	104.29	64.58	104.35	58.51	118.39	58.68	118.36
27	52.48	103.19	52.25	103.53	59.90	96.62	59.90	97.42	60.12	101.98	60.17	101.87	58.85	106.14	59.53	106.41	58.40	101.46	58.62	101.64	51.61	114.63	52.29	115.93

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.02	22.21	37.17	22.18	36.05	31.93	35.46	32.37	31.72	29.04	31.28	29.19	30.29	20.83	29.91	21.18	35.26	48.04	34.87	47.88	33.79	13.53	34.62	12.98
7	42.63	16.85	42.69	17.17	42.69	27.70	42.43	27.87	37.84	24.24	37.99	24.39	37.26	19.96	37.37	20.03	43.01	44.92	43.00	44.75	39.83	8.48	39.74	8.82
8	50.17	13.61	50.26	13.72	48.56	23.14	48.20	23.11	44.60	18.54	44.47	18.37	45.47	16.50	45.14	16.51	47.63	41.20	47.97	41.11	48.09	3.49	48.38	4.24
9	59.42	13.65	59.37	13.44	56.95	23.16	56.96	23.19	53.93	18.99	53.91	19.04	53.82	15.30	53.33	15.28	55.74	40.89	55.54	41.03	57.67	3.64	57.82	4.05
10	66.63	18.08	66.54	18.04	62.45	27.80	62.37	28.00	61.60	23.06	61.94	22.77	62.11	18.16	61.42	17.97	62.94	44.18	62.92	43.98	66.41	7.44	66.47	7.61
11	71.94	24.46	71.83	24.14	69.84	33.51	70.01	32.95	67.85	27.45	67.79	27.11	68.83	20.30	68.31	20.14	67.80	46.52	67.75	46.42	72.08	12.20	71.78	12.27
22	63.90	90.35	64.61	90.44	67.91	86.90	67.43	86.12	67.20	83.13	67.23	83.33	67.65	88.12	65.98	87.26	66.92	108.93	66.72	109.24	66.13	100.89	65.77	101.36
23	59.09	92.64	59.26	92.82	64.23	85.03	63.30	84.78	62.27	85.60	62.34	85.79	61.62	88.90	60.95	88.55	61.40	111.54	61.88	111.47	59.85	103.64	60.13	103.49
24	52.99	94.38	53.38	94.49	58.20	87.59	58.20	87.43	56.30	89.19	56.78	89.08	55.86	89.85	55.42	89.44	56.45	113.98	56.60	113.78	53.89	105.72	53.93	105.70
25	47.50	93.65	47.71	93.59	52.34	86.97	52.35	86.95	52.01	87.81	51.64	87.77	49.87	90.02	50.09	89.68	51.45	113.87	51.11	113.93	47.63	105.24	47.87	105.21
26	41.40	91.78	41.46	91.92	48.17	84.65	48.47	84.64	45.46	87.20	45.73	87.42	44.27	88.87	43.93	88.72	46.00	111.39	45.67	111.67	42.22	102.89	42.17	102.87
27	37.66	88.27	37.47	87.77	42.36	83.10	42.59	83.28	40.02	85.50	39.94	85.61	39.46	88.78	39.24	88.70	40.51	109.32	39.78	109.04	35.53	100.95	35.62	101.03

Area Data Report - D6												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	1.89	2.18	4.13	4.82	3.07	3.81	0.00	0.00	3.73	3.96	4.90	4.90
7	4.24	4.36	9.86	10.04	4.42	4.59	13.79	13.02	5.33	5.53	7.34	7.17
8	13.30	10.70	11.04	10.41	11.67	11.7	12.19	13.42	9.49	9.66	14.51	14.37
9	8.17	8.40	10.98	12.13	15.57	16.03	11.35	12.47	7.63	7.94	12.30	12.30
10	6.97	6.19	7.46	7.43	5.45	5.53	12.16	13.16	2.55	2.78	10.95	10.92
11	8.06	5.33	7.17	7.46	5.85	5.30	9.12	6.71	3.93	3.93	11.04	10.95
22	2.92	7.37	2.35	4.01	3.41	3.38	4.82	3.99	2.78	2.41	3.93	3.84
23	7.17	7.23	3.96	3.90	5.48	5.73	6.25	6.80	3.01	3.33	6.59	6.57
24	5.13	3.56	6.16	7.57	7.43	8.52	5.68	5.79	3.67	3.70	6.91	6.91
25	5.13	5.22	5.51	6.68	3.87	4.33	6.94	6.80	4.27	4.33	7.23	7.23
26	4.27	3.84	6.82	3.58	3.78	3.64	5.62	5.94	3.76	3.38	5.42	5.25
27	2.32	3.01	5.22	6.05	1.89	2.49	3.87	3.38	5.71	3.96	5.56	5.45
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	5.68	6.14	7.46	10.35	10.84	10.67	25.61	0.00	13.02	10.81	8.83	9.32
7	12.47	11.84	16.34	20.10	12.47	14.05	19.24	20.36	14.65	15.68	17.09	14.77
8	18.70	19.76	19.61	23.74	22.82	19.70	25.29	24.72	19.50	18.29	20.04	21.53
9	15.03	17.81	22.97	23.23	22.80	24.49	22.45	20.65	15.20	17.84	20.07	21.59
10	11.76	13.62	17.89	15.08	13.22	11.24	22.25	21.56	8.43	8.34	17.52	17.29
11	13.53	8.69	11.70	10.49	14.28	12.99	21.99	15.83	16.80	7.17	12.73	12.16
22	10.49	8.26	22.16	11.18	6.39	6.22	21.59	6.74	15.71	9.12	6.37	7.68
23	13.02	13.68	12.24	7.66	10.64	13.22	14.80	11.93	13.85	11.50	9.32	9.00
24	12.36	11.58	13.42	12.90	11.81	14.65	12.44	10.32	9.32	10.52	10.12	8.43
25	10.70	12.13	12.62	12.22	11.47	12.04	10.98	11.33	10.87	10.49	10.75	9.72
26	9.32	9.49	15.03	7.17	13.10	12.85	13.79	13.99	14.05	12.30	11.15	8.20
27	4.30	6.91	19.61	15.48	5.30	4.56	18.09	6.11	16.77	14.39	6.19	7.37

Position Data Report - D6

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.84	38.11	52.77	38.09	52.75	46.96	52.84	46.89	51.82	44.83	51.86	44.83	0.00	0.00	0.00	0.00	53.79	40.21	53.76	40.23	50.09	28.98	50.09	28.98
7	58.10	33.07	58.18	32.83	60.54	42.26	60.54	42.27	58.11	40.24	58.17	40.17	54.20	37.86	54.23	37.65	61.18	37.67	61.2	37.65	56.81	23.38	56.89	23.34
8	65.90	29.55	65.76	29.34	65.81	37.79	65.62	37.72	64.67	34.22	64.74	34.25	63.12	34.28	62.49	34.02	66.37	33.79	66.41	33.82	64.38	18.90	64.39	18.89
9	75.30	29.64	75.21	29.47	73.89	37.63	74.13	37.65	73.56	34.84	73.56	34.84	70.43	33.25	70.37	33.01	73.59	33.48	73.68	33.48	74.39	18.59	74.39	18.59
10	82.13	34.04	82.08	33.71	79.30	42.39	79.36	42.42	81.70	38.97	81.63	39.02	79.13	36.10	79.09	35.87	80.78	36.32	80.91	36.40	82.45	22.69	82.46	22.69
11	87.41	40.29	87.64	39.71	86.98	47.33	86.95	47.27	87.77	43.53	87.84	43.56	85.78	38.15	86.43	38.18	86.27	39.82	86.26	39.79	88.27	27.72	88.29	27.72
22	79.82	106.04	80.36	104.64	85.31	100.78	85.12	100.75	87.02	99.26	87.03	99.26	83.26	104.36	83.11	104.66	85.37	101.48	85.23	101.65	82.44	117.02	82.43	117.05
23	75.24	108.59	75.24	108.43	81.09	99.79	81.02	99.78	82.06	102.03	82.10	101.98	78.61	106.54	78.48	106.33	79.59	104.39	79.85	104.32	76.21	119.35	76.19	119.35
24	68.65	110.48	67.93	110.32	75.68	102.29	75.73	102.07	76.48	105.21	76.49	105.15	72.64	107.41	72.64	107.23	74.62	106.26	74.50	106.25	70.34	121.24	70.34	121.24
25	63.61	109.7	63.62	109.55	69.85	101.70	69.99	101.75	71.88	104.19	71.99	104.15	67.11	107.62	67.18	107.45	69.56	106.38	69.52	106.35	64.37	120.75	64.37	120.75
26	56.74	107.82	56.77	107.78	65.11	99.14	65.06	98.61	65.60	103.53	65.60	103.55	61.09	106.73	61.23	106.58	64.00	104.17	64.14	104.18	58.46	118.6	58.49	118.62
27	52.42	104.41	52.33	104.25	60.25	97.76	59.56	96.15	59.74	101.57	59.88	101.70	56.06	106.02	55.99	105.7	58.12	101.47	58.85	102.19	52.04	115.94	52.03	115.96

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.14	22.25	37.13	22.24	35.40	32.26	35.29	32.26	31.52	29.35	31.90	29.05	30.12	21.72	0.00	0.00	35.19	47.83	35.22	47.94	34.18	15.36	34.35	15.26
7	42.23	17.46	42.36	17.33	42.59	27.64	42.00	27.91	37.91	24.68	37.98	24.43	37.02	20.22	37.44	19.86	43.19	44.62	43.15	44.75	40.24	10.38	39.72	10.50
8	50.10	13.53	50.19	13.64	48.35	23.15	47.70	23.07	44.25	18.32	44.56	18.20	45.42	16.48	45.44	16.33	48.02	41.17	47.66	41.20	48.18	5.53	48.08	5.60
9	58.92	13.64	59.25	13.70	56.95	23.18	56.74	23.16	53.47	18.73	53.79	18.76	54.16	15.30	53.62	15.09	56.34	40.76	55.87	40.94	58.34	5.28	58.18	5.33
10	66.47	18.07	66.34	17.84	62.02	27.80	62.17	27.87	61.78	22.87	61.73	23.06	61.69	18.13	61.72	18.07	62.85	44.25	62.93	43.98	66.37	9.71	66.55	9.68
11	71.82	24.56	72.02	23.87	69.69	32.54	69.58	32.56	67.82	27.18	67.99	27.43	69.28	21.08	68.65	20.39	67.81	46.43	67.82	47.08	72.11	14.49	71.92	14.34
22	64.47	89.68	64.09	90.11	68.35	85.77	67.62	86.34	67.12	83.11	67.36	83.06	67.54	86.21	65.94	87.01	67.29	108.85	66.34	109.17	66.01	103.11	66.04	103.10
23	59.49	92.67	59.45	92.72	64.13	85.13	63.26	85.15	62.40	85.85	62.17	85.74	61.44	88.84	61.20	88.70	61.17	111.74	61.39	111.53	60.05	105.66	59.95	105.80
24	53.27	94.37	53.53	94.39	58.16	87.26	58.20	87.53	56.89	88.78	56.54	89.10	55.67	89.68	55.29	89.55	56.45	113.75	56.11	113.7	53.97	107.73	53.83	107.76
25	47.85	93.58	47.90	93.45	52.44	87.04	52.32	87.20	51.87	87.83	51.75	87.77	50.23	89.77	50.01	89.71	51.02	113.70	50.76	113.58	48.18	107.23	48.05	107.30
26	41.42	91.87	41.68	92.11	47.49	84.20	48.11	85.02	45.70	87.09	45.76	87.26	44.34	88.88	44.28	88.63	45.46	111.44	45.35	111.57	41.96	104.94	42.04	104.99
27	37.28	87.52	37.36	87.88	42.21	82.19	42.22	81.75	40.05	85.44	40.11	85.56	38.53	87.92	38.93	88.03	39.66	108.9	39.69	109.21	35.39	102.14	35.69	102.27

Area Data Report - D7

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	3.78	1.78	4.87	4.13	2.9	2.52	0.00	0.00	3.87	2.09	3.93	4.53
7	4.10	5.16	9.61	8.97	6.39	5.94	8.63	11.81	3.81	4.13	7.23	6.11
8	8.69	10.01	9.98	9.46	8.80	8.00	11.13	12.1	8.11	7.40	7.14	10.41
9	7.43	8.14	11.78	9.89	9.63	9.52	13.08	11.27	6.45	7.17	5.13	7.48
10	6.14	5.10	7.74	5.22	4.85	6.74	11.93	9.41	2.58	3.33	4.36	7.60
11	4.96	4.70	7.43	6.51	4.01	4.30	3.35	3.99	2.04	1.95	5.88	6.91
22	4.50	5.22	2.41	4.36	4.76	2.61	1.95	2.47	3.24	2.81	3.18	3.61
23	7.94	6.51	2.75	3.73	7.14	6.25	7.17	5.91	4.65	4.70	6.14	6.34
24	3.99	4.22	5.68	6.19	7.17	7.17	4.42	4.07	3.70	4.19	5.88	6.65
25	3.44	4.5	5.94	5.85	6.82	6.97	4.76	5.53	3.64	3.90	6.39	5.71
26	5.30	5.42	4.07	5.28	6.82	6.59	6.02	5.48	5.42	6.34	7.54	6.59
27	5.48	3.96	5.33	4.67	2.44	2.47	2.52	1.95	3.47	2.52	3.30	4.19

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	7.71	8.66	10.78	11.81	14.19	10.75	18.49	13.30	10.32	12.24	8.97	10.41
7	15.34	13.48	18.67	18.44	14.77	14.82	19.58	25.00	11.76	12.79	15.89	12.65
8	20.33	20.22	22.45	21.25	19.15	19.87	26.58	27.33	17.66	21.28	16.00	18.95
9	16.34	16.14	22.14	22.11	26.09	29.56	25.23	21.76	16.77	15.20	18.90	19.15
10	14.77	16.26	17.61	19.70	15.05	14.02	26.52	24.29	9.72	9.58	15.97	18.06
11	8.57	13.33	13.85	14.68	11.96	14.14	14.68	14.54	9.09	8.54	14.60	13.59
22	4.59	17.78	9.29	5.48	6.59	6.08	7.48	9.72	7.43	13.08	4.76	8.83
23	13.42	14.31	16.43	20.44	13.99	15.63	13.76	16.14	14.97	13.56	10.49	11.33
24	12.82	13.02	12.82	14.37	15.14	17.09	11.73	12.82	12.04	12.50	11.76	12.53
25	10.01	12.47	8.86	13.42	12.87	15.28	10.12	12.13	12.13	12.16	11.76	12.19
26	11.33	14.11	12.42	9.09	13.19	15.05	8.46	13.25	16.14	16.60	13.13	13.68
27	6.74	9.32	5.71	19.30	3.41	5.28	13.42	8.80	14.05	16.52	9.66	11.18

Position Data Report - D7

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.20	38.68	52.54	38.47	50.48	46.88	52.80	46.60	51.85	44.64	51.59	45.01	0.00	0.00	0.00	0.00	53.89	40.02	54.01	39.53	50.07	28.83	50.16	28.84
7	58.45	33.10	58.10	33.07	58.25	42.25	60.65	41.95	57.46	40.58	57.92	40.44	54.17	37.93	54.66	37.75	61.25	37.82	60.98	37.74	56.28	23.80	56.77	23.29
8	66.25	29.57	65.76	29.52	63.30	37.74	65.82	37.36	64.78	33.94	64.90	34.16	63.48	34.48	63.44	34.25	66.82	33.91	66.37	33.79	64.10	18.50	64.18	18.72
9	75.44	29.43	75.08	29.60	71.74	37.67	74.41	37.32	73.75	34.46	73.59	34.58	70.62	33.23	71.22	33.03	74.12	33.42	73.85	33.35	74.95	18.17	75.19	18.38
10	82.01	33.25	81.90	33.71	77.08	42.43	79.52	42.15	81.42	38.75	81.82	39.36	79.24	36.21	79.48	36.10	81.58	36.79	81.16	36.74	83.07	22.47	82.64	22.46
11	88.17	39.65	87.68	39.85	84.66	47.43	87.17	47.58	87.87	43.30	87.86	43.51	87.03	38.41	86.84	38.19	86.28	39.00	85.99	38.97	89.24	27.96	89.13	27.88
22	80.93	104.88	80.42	104.85	83.11	100.60	86.02	99.12	87.19	98.59	87.13	98.89	83.68	104.17	83.77	103.75	85.62	101.25	85.61	100.89	82.91	116.41	82.81	116.40
23	75.56	108.42	75.34	108.56	78.76	99.63	81.10	99.46	81.88	101.75	81.99	101.90	78.75	106.69	78.73	106.47	80.24	104.30	79.98	104.23	76.35	119.32	76.32	119.25
24	69.17	110.38	68.55	110.40	73.19	101.96	75.68	101.79	76.63	104.88	76.48	105.18	73.00	107.58	72.76	107.36	74.89	106.46	74.38	106.26	70.28	121.29	70.21	121.16
25	64.21	109.88	63.58	109.67	67.68	101.77	70.02	101.45	71.85	103.71	71.65	103.86	67.56	107.56	67.67	107.48	69.49	106.31	69.39	106.40	64.44	120.74	64.00	120.53
26	57.32	107.82	57.26	108.02	62.86	98.80	64.99	98.41	65.62	103.15	65.61	103.49	61.54	106.60	61.82	106.72	64.10	104.09	64.12	104.32	58.19	118.37	58.51	118.43
27	52.91	103.28	52.73	103.76	57.29	95.73	59.86	95.94	59.89	101.50	59.99	101.75	56.23	105.72	56.13	105.48	58.94	102.01	58.21	101.52	52.23	115.78	51.78	115.52

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.25	21.88	37.11	21.94	35.22	31.52	35.09	31.59	31.88	28.68	32.19	28.47	30.55	20.45	30.08	20.27	35.03	47.44	34.90	47.72	33.68	13.32	33.88	13.10
7	42.10	17.13	42.19	17.28	42.48	27.16	42.49	27.07	37.88	24.16	37.78	24.22	37.56	19.96	37.30	20.02	43.27	44.43	43.37	44.49	39.54	8.81	39.68	8.34
8	50.18	13.38	50.30	13.68	47.92	22.65	48.16	22.71	44.50	18.08	44.59	18.14	45.41	16.53	45.26	16.38	47.97	41.08	48.19	41.07	47.93	3.35	48.48	3.50
9	59.54	13.60	59.32	13.69	56.90	22.66	57.08	22.65	54.22	18.69	54.08	18.91	53.72	15.44	53.35	15.26	55.80	40.75	55.69	40.73	58.04	3.22	58.11	3.20
10	66.45	17.92	66.46	17.81	62.21	27.25	62.51	27.23	61.79	23.00	62.00	23.05	61.82	18.06	61.44	18.02	62.88	43.81	62.80	44.01	66.52	7.53	66.26	7.56
11	72.02	23.88	72.08	24.49	69.34	31.19	69.59	31.91	68.13	27.29	67.63	26.83	69.31	20.54	68.43	20.13	67.96	47.01	68.00	47.16	72.33	12.35	71.83	11.89
22	64.30	90.15	64.78	89.31	67.97	86.64	67.83	85.57	67.38	83.00	67.12	83.53	65.92	87.39	65.50	86.91	67.83	109.49	66.82	109.06	66.28	100.92	64.97	101.52
23	59.26	92.72	59.24	92.93	63.85	84.83	63.74	85.14	62.33	85.63	62.21	85.70	61.51	88.76	60.91	88.34	61.68	111.53	61.28	111.79	59.80	103.76	59.99	103.72
24	53.11	94.25	53.38	94.48	58.20	86.86	58.18	86.86	56.77	89.11	56.72	89.13	55.78	89.53	55.48	89.48	56.01	113.67	55.99	113.62	53.93	105.79	54.07	105.82
25	47.76	93.44	47.96	93.61	52.66	86.59	52.51	86.68	52.04	87.68	51.84	87.86	50.32	89.50	50.20	89.62	50.91	113.73	50.86	113.70	47.87	105.20	47.72	105.18
26	41.39	91.68	41.51	92.08	47.84	83.70	48.23	84.16	45.76	87.23	45.68	87.05	44.70	88.45	44.17	88.46	45.75	111.45	45.35	111.25	41.64	102.86	41.67	102.91
27	37.39	87.74	37.25	87.99	41.93	82.33	41.98	81.47	39.92	85.49	39.87	85.39	39.18	88.54	38.91	88.19	39.18	108.66	39.46	108.91	35.44	100.57	35.86	100.66

Area Data Report - D8

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	5.99	6.14	9.43	10.49	7.51	9.78	0.00	0.00	13.82	13.68	8.29	9.75
7	10.27	12.73	17.98	16.86	8.95	9.98	13.71	13.73	12.56	12.56	13.22	10.61
8	14.14	15.20	14.02	17.61	16.20	14.65	25.26	25.81	14.88	18.12	19.30	10.98
9	11.50	15.91	17.41	17.55	25.86	28.01	23.17	23.37	17.03	17.15	19.38	10.49
10	12.82	9.98	14.25	14.77	11.21	11.99	22.97	24.06	9.15	8.17	7.57	9.03
11	13.76	10.15	15.77	12.44	10.18	10.38	13.51	16.66	10.01	10.04	14.60	9.98
22	14.85	6.42	8.80	8.80	8.17	8.43	7.89	7.83	9.32	9.29	8.06	4.53
23	14.48	15.23	9.55	9.58	12.07	13.16	9.95	10.01	7.94	8.46	9.61	9.32
24	9.98	11.38	13.39	14.74	14.42	14.34	13.28	11.76	8.97	8.83	9.20	8.97
25	10.84	11.10	12.01	12.16	8.40	9.18	12.99	13.08	9.03	9.46	9.66	9.78
26	10.04	12.30	10.67	9.49	8.54	9.26	11.70	11.47	9.84	10.06	11.99	8.95
27	8.14	9.58	5.71	9.84	5.76	5.94	9.12	8.37	9.23	10.44	8.89	5.91

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	4.22	7.51	8.06	8.86	14.60	7.94	7.11	0.00	8.11	7.05	15.05	7.14
7	12.85	13.73	18.35	15.31	13.91	12.62	23.77	22.34	15.14	13.08	15.17	6.11
8	20.07	20.90	19.64	17.86	19.99	18.84	26.21	24.72	13.79	16.69	20.30	8.17
9	16.37	17.32	19.76	20.93	25.38	25.78	22.34	22.91	15.80	15.66	19.90	7.97
10	13.45	15.25	16.03	14.68	13.82	11.93	24.00	23.11	7.48	7.43	17.63	6.94
11	9.98	9.52	14.31	13.13	14.25	8.46	16.17	15.05	8.34	7.11	17.72	12.07
22	6.59	3.81	3.84	5.85	7.74	7.34	8.00	8.03	6.51	5.85	18.24	1.58
23	14.62	13.56	11.70	8.52	15.00	14.22	15.66	14.62	13.10	10.24	11.99	8.14
24	12.50	13.56	14.14	11.96	17.12	13.28	13.25	13.16	12.39	11.64	12.16	7.86
25	10.47	12.30	13.48	12.56	13.82	13.68	14.34	13.25	10.44	9.69	12.82	8.26
26	12.65	13.22	4.73	4.87	12.90	14.54	15.05	15.08	13.82	15.97	13.42	5.99
27	5.59	16.72	7.00	11.44	4.96	4.99	10.72	12.01	16.32	15.91	18.35	5.10

Position Data Report - D8

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.98	37.87	53.15	37.87	52.96	46.58	53.14	46.47	51.87	44.86	52.15	44.81	0.00	0.00	0.00	0.00	54.42	39.79	54.42	39.77	50.33	28.85	50.46	28.83
7	58.21	32.94	58.58	32.76	60.48	42.06	60.43	42.12	58.15	40.25	58.30	40.24	54.14	37.46	53.99	37.45	61.56	37.37	61.56	37.37	56.71	23.48	56.78	23.34
8	65.65	29.35	65.85	29.32	65.46	37.38	65.65	37.50	65.33	34.24	65.31	34.06	62.63	34.19	62.52	34.20	66.71	33.71	66.69	33.83	64.47	18.86	64.69	18.44
9	74.77	29.18	74.97	29.35	73.87	37.43	73.90	37.43	73.64	34.92	73.73	35.00	70.81	33.03	70.73	33.01	74.25	33.48	74.24	33.47	74.79	18.77	74.84	18.32
10	82.02	33.61	81.84	33.07	79.55	42.31	79.55	42.29	81.68	39.03	81.79	39.02	78.92	35.85	78.70	35.84	81.17	36.45	80.95	36.29	83.22	22.53	82.73	22.41
11	87.45	40.03	87.78	39.63	86.48	46.83	86.81	46.92	87.71	43.47	87.85	43.45	86.19	38.18	85.94	38.24	86.42	40.01	86.42	40.01	88.36	27.69	89.00	27.90
22	80.22	104.74	80.01	105.88	85.20	100.39	85.20	100.39	86.96	99.32	87.16	99.31	83.34	104.80	83.18	104.79	85.25	101.72	85.40	101.61	82.26	116.86	82.43	117.11
23	74.94	108.53	75.10	108.52	81.08	99.61	81.10	99.60	82.08	101.90	82.21	101.93	78.78	106.83	78.61	106.83	79.68	104.42	79.66	104.40	76.26	119.32	76.26	119.22
24	68.88	110.43	68.94	110.37	75.72	101.94	75.59	101.96	76.44	105.15	76.57	105.16	72.98	107.49	72.81	107.44	74.79	106.24	74.83	106.26	70.39	121.23	70.41	121.13
25	63.56	109.49	63.77	109.45	69.98	101.68	69.86	101.70	71.79	104.19	71.99	104.13	67.29	107.63	67.10	107.62	69.81	106.43	69.77	106.43	64.31	120.74	64.31	120.66
26	57.10	107.99	57.29	107.84	65.30	98.93	65.36	99.00	65.85	103.71	65.93	103.62	61.31	106.74	61.13	106.75	64.54	104.27	64.49	104.29	58.38	118.37	58.47	118.49
27	52.23	104.13	52.41	104.12	59.97	97.29	59.70	96.57	59.95	101.80	60.13	101.81	56.38	106.20	56.17	106.13	59.04	102.16	59.00	102.06	52.02	115.93	51.96	116.01

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.03	19.63	37.44	19.34	35.25	32.09	33.23	31.17	31.88	28.71	28.46	25.25	32.39	17.63	0.00	0.00	35.18	47.85	35.31	43.96	33.97	13.28	33.81	13.49
7	42.37	14.45	42.35	14.61	42.77	27.54	41.13	26.62	37.95	24.46	35.12	20.30	37.46	17.97	37.16	18.28	43.18	44.43	42.90	41.19	39.95	8.34	40.07	7.84
8	50.29	10.82	50.40	11.00	48.35	23.04	46.32	22.09	44.79	17.97	42.01	13.87	45.62	14.38	45.63	14.65	48.00	41.26	47.82	37.28	48.12	3.61	48.41	2.98
9	59.50	10.92	59.57	11.06	56.26	23.01	54.82	21.95	53.85	18.68	50.65	14.43	53.69	13.20	53.39	13.60	55.41	40.82	55.29	37.12	58.02	3.26	58.54	2.90
10	66.44	15.22	66.46	15.34	62.18	27.91	59.93	26.62	61.84	22.85	58.66	18.78	61.77	16.03	61.72	16.41	62.55	43.86	62.69	40.09	66.43	7.61	66.40	7.00
11	72.09	21.18	72.09	21.33	69.53	32.46	67.42	31.60	68.09	27.18	65.11	23.38	68.72	18.27	68.35	18.47	67.74	47.10	67.80	43.55	72.16	12.31	71.85	12.23
22	64.07	87.44	64.91	88.12	67.64	86.04	65.63	85.16	67.20	83.08	64.06	78.75	66.06	85.19	65.89	85.38	67.45	109.50	67.46	105.59	66.90	100.35	66.29	101.45
23	59.44	89.92	59.42	90.07	64.09	84.99	61.70	83.93	62.31	85.59	59.33	81.38	61.30	86.59	61.16	87.00	61.89	111.62	61.81	107.76	59.95	103.66	59.72	103.82
24	53.14	91.54	53.23	91.76	58.06	87.37	56.12	86.34	56.71	89.04	53.74	84.73	55.70	87.49	55.60	87.87	56.00	113.45	56.08	109.79	54.02	105.85	53.99	105.72
25	47.78	90.78	47.85	91.01	52.30	87.23	50.24	86.04	51.96	87.65	48.89	83.58	50.17	87.81	50.11	88.06	50.89	113.56	51.12	109.85	47.84	105.18	47.87	105.26
26	41.46	89.16	41.52	89.41	48.29	84.89	46.19	83.73	45.85	87.10	42.68	82.83	44.35	86.78	44.20	87.05	45.09	111.27	45.38	107.39	41.59	102.86	41.69	103.04
27	37.67	84.75	36.89	83.17	43.15	83.14	40.08	81.06	40.00	85.27	36.91	81.18	39.50	86.46	39.19	86.92	39.37	108.83	39.48	104.97	34.94	99.41	35.60	100.70

Area Data Report - F1

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.61	1.98	5.08	4.70	3.33	4.22	0.00	0.00	3.18	2.67	5.33	6.02
7	3.70	4.10	7.63	9.66	4.90	4.73	8.14	3.73	5.62	5.39	0.92	3.58
8	5.59	6.22	9.18	9.18	7.23	6.11	4.47	4.50	4.13	9.98	2.49	5.13
9	3.33	4.76	9.66	5.39	10.24	16.57	2.84	3.58	8.77	9.12	6.45	6.37
10	3.96	4.24	5.94	5.48	4.65	5.05	12.50	1.84	3.15	3.15	2.55	2.84
11	7.17	4.73	7.17	5.71	5.48	5.53	9.09	7.00	4.50	4.50	8.00	6.80
22	1.92	2.44	3.07	4.65	4.39	3.93	4.27	4.24	1.75	0.80	2.32	1.66
23	3.38	3.44	0.03	0.37	5.76	3.33	3.67	2.90	0.63	1.84	6.22	6.42
24	5.19	4.01	7.11	3.04	8.97	7.37	6.74	5.99	3.44	3.78	6.74	6.62
25	5.22	5.10	7.14	7.00	2.72	2.67	6.88	7.25	3.93	4.33	7.08	7.08
26	3.81	4.27	9.58	3.01	3.53	2.24	4.30	5.82	2.55	2.52	5.65	5.71
27	0.80	1.43	11.13	1.69	2.61	2.61	3.73	2.87	4.16	0.69	6.39	3.56

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	9.43	9.38	9.58	10.27	11.50	12.27	15.14	15.66	11.24	20.99	13.05	12.27
7	13.65	16.49	18.81	22.48	13.48	13.96	19.44	19.99	12.13	15.28	13.16	17.55
8	20.90	20.93	20.87	19.84	19.56	20.44	26.15	23.46	15.00	18.01	21.59	17.12
9	16.32	20.01	20.01	19.93	21.42	22.42	22.60	21.02	15.28	15.60	24.29	17.55
10	15.14	18.67	19.81	21.45	15.91	14.45	22.11	24.11	7.11	8.89	16.97	12.27
11	9.78	12.44	14.60	12.79	14.05	12.30	13.71	16.97	12.19	15.28	13.79	10.87
22	9.89	8.43	11.18	11.18	7.31	6.19	9.89	9.75	11.61	12.99	6.34	18.44
23	13.13	12.76	9.29	10.29	11.18	12.50	15.46	15.00	11.38	13.25	12.44	11.10
24	9.55	12.65	14.88	13.62	15.08	13.76	12.73	11.21	10.64	12.70	11.38	12.24
25	11.41	11.07	12.59	13.02	11.38	9.75	12.44	12.65	12.07	12.65	11.78	12.01
26	11.33	12.82	11.99	14.11	14.74	15.03	14.22	12.27	14.57	17.23	13.42	15.71
27	8.97	8.89	9.03	10.21	6.31	7.31	12.82	15.63	16.34	17.98	14.82	14.25

Position Data Report - F1

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.77	37.89	52.70	37.92	52.87	46.69	52.84	46.88	51.83	44.72	51.84	44.90	0.00	0.00	0.00	0.00	53.70	40.30	53.88	39.38	50.34	28.96	50.30	28.87
7	58.04	32.85	57.72	33.13	60.36	42.09	60.52	42.27	58.12	40.06	58.11	40.24	54.70	36.91	54.04	37.25	61.20	37.64	60.84	37.67	56.71	22.82	57.13	22.92
8	65.42	29.27	65.91	29.29	65.39	37.42	65.39	37.59	64.86	33.79	64.69	33.91	61.60	33.60	62.48	33.60	67.00	33.76	66.35	33.97	62.76	18.40	64.55	18.43
9	74.55	29.03	74.49	29.11	73.75	37.41	73.33	37.49	74.56	34.86	73.58	34.80	71.00	32.11	71.83	32.11	73.62	33.51	73.05	33.81	75.00	18.29	74.75	18.27
10	81.47	32.95	81.66	33.24	79.62	42.42	79.72	42.64	81.51	38.59	81.66	38.87	77.95	35.62	78.85	35.17	80.92	36.39	80.58	36.39	82.79	22.17	82.76	22.20
11	87.37	39.90	87.55	39.56	86.90	46.99	86.84	46.96	87.80	43.36	87.80	43.52	85.27	37.95	86.31	37.95	86.27	39.89	85.93	39.89	87.78	27.37	89.16	27.98
22	79.72	105.96	79.69	105.87	85.25	100.52	85.14	100.65	87.01	99.12	87.00	99.25	82.48	104.65	83.33	104.64	84.84	102.17	84.62	102.11	82.70	117.09	82.89	116.85
23	73.60	109.34	73.70	109.21	81.28	98.89	80.12	99.50	82.10	101.81	81.10	102.73	78.48	106.81	78.91	106.78	79.14	104.58	78.47	104.62	76.31	119.34	76.19	119.25
24	68.32	110.34	68.21	110.36	75.92	101.98	76.32	102.11	76.45	104.97	76.45	105.21	71.97	107.28	72.83	107.27	74.64	106.28	74.34	106.28	70.49	121.24	70.35	121.14
25	63.55	109.57	63.55	109.57	69.95	101.62	70.00	101.78	72.00	104.10	71.97	104.27	66.41	107.46	67.25	107.46	69.80	106.51	69.22	106.37	64.48	120.74	64.32	120.66
26	56.78	107.90	56.66	107.75	65.33	98.96	65.43	99.28	65.93	103.61	66.19	103.97	60.62	106.71	61.25	106.61	64.44	104.34	65.11	104.69	58.65	118.61	58.49	118.54
27	52.03	103.84	52.49	103.97	59.94	96.61	59.99	97.51	59.87	101.52	59.87	101.69	55.40	105.87	55.98	105.32	59.17	102.33	57.8	101.92	52.17	115.90	51.87	115.99

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.82	22.37	37.01	22.43	35.14	32.17	35.42	32.07	31.39	29.02	31.60	29.05	29.49	21.33	29.20	21.08	35.56	46.97	35.53	47.48	33.91	13.46	33.95	13.36
7	42.22	17.24	42.33	17.19	43.00	27.65	42.61	27.59	37.85	24.24	37.85	24.42	37.37	20.00	37.14	19.68	42.77	45.00	42.42	44.64	39.58	8.42	39.84	8.60
8	50.25	13.69	49.97	13.56	48.18	23.11	48.20	23.06	44.57	18.14	44.52	18.16	45.48	16.50	44.90	16.11	48.54	41.33	48.10	41.26	48.35	4.09	48.61	3.61
9	59.47	13.64	58.76	13.33	57.02	23.05	56.79	23.05	53.48	18.54	53.92	18.49	53.78	15.33	53.84	15.02	56.27	40.74	56.01	40.68	57.98	4.20	57.72	3.29
10	66.37	18.03	66.23	17.74	62.38	27.93	62.55	27.95	61.80	22.99	61.75	22.99	61.84	18.02	61.66	17.95	62.34	43.58	62.62	43.81	66.35	7.49	66.96	7.57
11	72.30	24.17	71.84	24.08	69.77	32.64	69.50	32.68	68.11	27.47	67.99	27.11	69.18	20.39	68.43	20.33	67.40	46.13	67.81	46.41	72.21	12.16	72.65	12.17
22	64.30	90.24	64.03	90.14	67.63	87.21	67.74	86.38	67.08	83.13	67.33	82.82	65.87	87.25	65.82	86.88	67.29	109.12	66.88	109.13	65.83	101.12	66.34	100.76
23	59.24	92.66	58.92	92.91	63.48	84.76	63.49	84.58	62.20	85.80	62.47	85.82	61.24	88.64	61.27	88.69	60.73	111.84	61.49	111.59	60.15	103.52	59.91	103.70
24	53.91	94.46	53.14	94.40	58.13	87.45	58.22	87.33	56.75	88.89	56.76	88.99	55.74	89.70	55.60	89.39	56.35	113.81	56.27	113.54	53.85	105.76	54.04	105.85
25	47.93	93.57	47.62	93.52	52.42	87.01	52.41	86.92	51.91	87.93	51.83	88.07	50.25	89.76	49.99	89.69	50.82	113.72	50.82	113.68	47.67	105.12	47.74	105.23
26	41.25	91.89	41.51	92.23	47.57	83.58	47.72	84.29	45.60	87.11	45.70	87.23	44.39	88.78	44.22	88.51	45.45	111.58	45.44	111.77	41.73	102.82	41.36	102.67
27	36.84	88.17	37.13	87.77	42.36	82.13	42.09	81.58	39.97	85.20	40.53	86.09	39.14	88.80	38.63	88.57	39.29	108.85	39.53	108.99	34.93	99.52	34.42	99.29

Area Data Report - F2

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	17.35	5.56	18.72	18.95	15.94	7.91	8.40	6.05	11.78	12.56	12.24	16.40
7	11.53	10.98	18.52	20.62	9.26	9.92	23.14	20.44	12.24	11.24	11.27	12.30
8	19.18	15.60	19.33	23.05	14.34	20.39	23.05	24.54	16.77	12.47	18.72	20.39
9	16.26	16.14	16.89	21.42	25.52	25.15	23.46	23.51	19.87	19.64	18.75	20.99
10	13.65	14.65	13.53	14.16	13.19	11.81	23.40	23.43	9.41	10.24	12.59	12.73
11	17.46	8.86	17.46	16.57	9.32	10.18	16.14	17.98	13.28	9.15	13.48	14.08
22	7.17	14.39	5.59	12.59	16.46	12.04	16.23	17.52	19.47	16.66	12.01	12.24
23	12.39	16.32	9.06	9.63	14.48	13.28	11.33	15.31	9.15	7.91	7.31	11.35
24	10.38	10.61	13.36	14.37	14.80	14.68	11.64	12.65	8.80	8.20	10.58	9.15
25	11.10	10.64	11.21	11.27	12.87	13.30	12.42	12.50	8.20	9.12	9.78	9.32
26	12.56	12.79	15.60	14.74	10.78	14.45	13.28	13.91	8.80	9.92	8.46	8.43
27	17.00	15.68	16.06	15.66	16.77	18.29	13.25	24.23	12.90	12.67	7.97	11.21

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	9.98	22.85	17.00	20.99	22.34	21.05	18.18	29.16	22.82	21.76	22.37	20.53
7	16.46	21.19	22.74	23.08	14.45	13.48	27.61	23.11	15.60	15.51	21.51	19.04
8	20.56	27.87	26.81	25.52	21.73	24.92	28.27	26.90	25.18	23.40	22.8	20.85
9	19.13	22.05	25.32	22.14	30.31	29.33	26.61	25.09	16.80	19.58	21.13	19.56
10	18.52	13.85	19.04	20.24	14.60	14.14	26.09	23.51	8.63	9.32	19.24	18.67
11	17.63	17.86	19.27	20.47	17.20	16.75	21.59	17.55	32.14	24.32	15.63	15.43
22	5.73	15.60	11.73	26.61	17.23	8.29	8.69	27.15	12.65	13.05	1.43	14.74
23	15.51	17.06	11.67	12.85	17.72	13.94	14.82	14.80	15.34	18.09	10.35	10.15
24	9.23	12.70	14.82	13.68	18.84	15.68	15.71	14.94	13.28	12.30	10.52	10.49
25	9.52	11.73	15.11	12.90	18.04	12.10	19.5	13.33	13.02	13.51	12.13	12.01
26	13.39	12.04	13.56	19.13	20.99	15.46	15.11	14.71	18.61	17.84	12.70	11.70
27	6.71	0.00	17.23	21.25	30.51	17.66	22.25	22.57	17.29	18.01	7.20	5.99

Position Data Report - F2

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.06	38.58	53.45	37.88	54.08	46.23	54.08	46.39	53.36	44.63	51.95	44.80	51.22	37.51	50.94	37.86	54.83	37.85	54.15	39.62	50.89	28.78	51.28	28.90
7	58.68	32.85	58.83	32.82	59.95	42.22	60.12	42.26	58.44	40.04	58.23	40.10	56.52	37.87	55.74	37.76	61.82	35.76	61.19	37.49	56.91	23.36	57.08	23.42
8	66.31	29.32	66.29	29.33	65.93	37.64	65.57	37.75	64.69	33.98	64.40	34.32	64.80	34.20	64.03	34.18	67.26	32.18	66.58	33.72	64.64	18.83	64.90	18.93
9	75.32	29.45	75.50	29.45	73.93	37.42	74.35	37.69	73.69	34.87	73.59	34.86	72.88	33.04	72.11	33.03	75.17	31.80	74.48	33.49	74.81	18.73	75.13	18.84
10	82.50	33.73	82.49	33.69	79.53	42.33	79.69	42.51	81.70	39.01	81.55	38.92	80.85	35.80	80.26	35.81	80.69	34.42	80.20	36.22	82.72	22.53	82.89	22.54
11	87.69	39.96	88.20	39.58	86.36	46.83	86.46	47.04	87.95	43.51	87.71	43.47	87.72	38.05	87.42	38.30	86.41	37.52	86.09	39.99	88.52	27.74	88.45	27.67
22	80.30	105.98	80.72	104.76	85.34	100.44	85.14	100.46	87.15	98.90	87.12	99.10	86.68	103.47	85.40	103.92	86.14	98.45	85.45	100.10	82.90	115.74	83.07	115.75
23	75.34	108.63	75.06	108.50	81.08	99.58	81.25	99.57	82.41	101.69	82.00	101.81	80.69	106.59	79.78	106.57	80.29	102.61	79.29	104.40	76.57	118.74	76.55	119.06
24	69.28	110.32	69.35	110.39	75.72	101.94	75.51	102.10	76.63	105.16	76.46	105.14	75.20	107.37	74.35	107.38	75.14	104.57	74.20	106.12	70.84	120.98	70.68	121.14
25	64.09	109.43	63.97	109.49	70.12	101.73	69.96	101.81	71.81	103.86	71.92	103.77	69.27	107.61	68.70	107.55	70.03	104.66	69.47	106.41	64.50	120.62	64.59	120.65
26	57.86	107.96	57.77	107.89	65.23	98.87	65.15	98.91	65.88	103.37	65.58	103.28	63.56	106.53	62.96	106.53	64.52	102.41	63.95	104.15	58.60	118.49	58.80	118.48
27	52.49	103.67	52.35	103.63	59.80	96.49	59.86	96.70	60.25	101.41	60.08	101.38	58.19	105.90	57.19	104.71	58.61	99.65	57.96	101.37	52.22	115.90	52.15	115.24

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.63	22.01	36.41	23.65	34.76	32.80	35.02	32.97	32.10	29.11	32.28	29.14	29.49	19.67	29.83	21.09	35.30	47.60	35.30	48.05	33.66	14.18	33.69	11.83
7	42.28	17.29	42.65	17.19	42.16	27.89	42.15	27.92	38.07	24.28	37.98	24.52	37.04	18.36	37.20	19.28	42.02	44.72	42.18	44.93	40.40	8.68	40.14	6.44
8	50.44	13.68	50.16	13.44	47.23	23.45	47.09	23.37	44.44	18.10	44.39	18.48	45.47	14.43	45.35	15.64	47.17	41.17	47.55	41.12	48.00	3.85	48.35	1.44
9	59.12	13.75	58.80	13.43	56.95	23.38	56.70	23.16	54.06	18.85	53.57	18.96	53.87	13.34	53.65	14.63	56.01	40.83	55.60	40.96	57.69	3.50	57.76	1.19
10	66.34	17.88	66.42	17.84	62.34	27.84	62.34	27.93	61.78	22.86	61.64	22.94	61.69	15.94	61.78	17.33	62.09	43.53	62.40	43.63	66.35	7.71	66.23	5.39
11	72.14	24.37	71.85	24.16	69.51	32.34	69.62	32.62	67.69	27.04	68.16	27.57	69.37	19.07	68.87	19.80	67.10	47.47	67.84	47.21	72.00	12.21	71.82	9.87
22	63.86	90.49	64.80	89.22	68.59	86.43	68.32	85.07	68.21	82.99	67.10	83.40	66.17	85.00	67.52	85.45	67.24	108.49	67.07	109.07	64.44	102.91	66.90	98.48
23	59.08	92.76	59.05	92.79	63.63	84.80	63.79	85.15	62.76	84.98	62.39	85.70	61.35	86.56	61.10	87.92	60.87	111.15	61.00	111.32	59.84	103.71	59.82	101.55
24	52.44	94.11	53.20	94.52	58.00	87.42	58.11	87.36	57.00	88.90	56.63	89.08	55.71	87.71	55.40	89.00	56.04	113.42	56.19	113.47	53.89	105.68	53.82	103.53
25	47.74	93.75	47.87	93.58	52.19	87.18	52.33	87.25	51.85	87.86	51.73	87.81	50.01	88.07	49.96	89.09	50.53	113.45	50.58	113.33	47.79	105.14	47.82	102.92
26	41.45	91.93	41.69	91.98	47.26	84.09	47.11	83.62	45.44	86.95	45.63	87.11	44.30	86.68	44.25	87.94	45.03	111.45	45.26	111.50	41.74	102.91	41.72	100.70
27	37.33	87.83	0.00	0.00	41.65	82.13	41.65	81.61	39.43	84.71	39.78	85.58	38.62	85.96	38.40	87.32	39.45	108.82	39.65	108.8	34.87	100.42	37.16	99.02

Area Data Report - F3

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	7.86	7.89	4.56	5.25	4.22	6.80	0.00	0.00	10.67	10.87	5.71	6.45
7	7.08	7.31	11.33	10.21	8.57	8.17	14.71	14.77	5.62	5.91	10.67	9.55
8	12.30	16.29	14.31	11.58	12.44	12.10	17.35	17.43	7.71	10.52	17.92	11.33
9	9.15	9.18	13.94	11.27	18.18	16.60	13.82	13.02	12.16	11.41	17.15	15.11
10	7.25	7.43	8.14	7.74	7.83	6.45	15.51	15.60	4.85	3.64	10.52	12.59
11	9.46	9.41	8.20	9.20	5.48	6.16	8.97	8.95	9.75	6.42	11.76	10.06
22	8.17	9.00	8.89	6.80	9.84	9.69	11.67	12.99	3.78	4.99	15.31	6.45
23	8.54	7.37	4.70	3.84	5.42	7.20	7.91	5.42	4.65	5.82	6.54	6.94
24	5.68	5.71	8.54	7.94	9.32	8.00	7.25	7.11	5.13	4.19	7.03	6.85
25	6.02	5.39	8.03	7.57	7.60	7.57	8.69	7.20	4.85	4.93	7.71	7.60
26	5.85	5.96	9.69	6.94	7.97	6.94	8.00	7.77	6.34	5.10	9.29	9.35
27	6.31	8.95	12.36	11.07	2.38	9.06	4.22	4.53	7.66	8.34	5.99	7.74

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	15.83	8.83	14.48	9.84	11.76	10.12	0.00	0.00	11.90	6.19	13.94	8.17
7	12.04	9.63	19.38	18.44	17.61	15.97	21.99	21.96	13.10	13.62	16.37	11.67
8	19.76	15.66	23.57	23.97	19.99	21.25	27.56	26.52	19.44	16.80	21.22	19.44
9	17.66	17.29	23.40	21.39	24.8	25.41	22.97	21.08	15.20	15.05	21.22	19.81
10	17.52	11.41	19.04	14.85	12.62	10.41	21.02	16.95	8.26	8.52	15.71	15.20
11	18.52	9.09	11.35	14.91	13.10	13.71	16.89	10.24	5.85	6.62	14.51	15.54
22	9.49	10.44	24.83	6.74	7.74	8.23	9.78	5.94	11.84	8.17	6.54	6.25
23	15.68	15.97	14.62	12.36	14.88	10.35	13.82	13.30	12.39	15.48	8.11	9.06
24	9.63	12.76	15.25	13.65	14.08	17.81	10.44	12.82	9.98	11.76	8.97	8.89
25	8.63	12.3	15.51	11.76	11.73	14.05	9.15	12.87	10.49	10.47	7.48	10.95
26	10.38	13.42	13.48	7.48	12.22	13.05	13.91	12.22	10.61	12.33	10.18	10.04
27	15.05	10.70	19.81	6.34	5.51	6.59	15.89	6.91	13.59	16.69	9.72	7.11

Position Data Report - F3

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.77	38.68	53.22	38.65	52.82	46.90	52.88	46.82	51.84	44.90	51.81	45.28	0.00	0.00	0.00	0.00	54.51	39.46	55.01	39.45	50.28	28.78	50.34	28.86
7	58.67	33.09	59.05	32.98	60.54	42.24	60.52	42.28	57.73	40.71	57.88	40.75	54.33	37.68	54.21	37.82	61.03	37.64	61.41	37.60	56.71	23.41	56.79	23.41
8	66.97	29.48	67.24	29.50	65.81	37.75	65.89	37.80	64.85	34.24	64.82	34.28	62.64	33.98	62.62	34.15	67.21	34.02	66.71	33.80	65.06	18.92	64.60	18.97
9	75.90	29.63	75.77	29.65	74.19	37.69	73.85	37.61	73.53	34.90	73.68	34.96	70.39	33.00	70.52	33.15	74.36	33.47	74.25	33.51	74.70	18.74	74.73	18.73
10	82.78	33.99	82.68	34.07	79.49	42.45	79.47	42.47	81.60	39.04	81.91	39.01	78.83	35.67	78.82	35.82	80.25	36.17	81.29	36.49	82.58	22.49	83.07	22.97
11	88.03	40.19	87.88	40.21	86.84	47.12	86.77	47.10	87.80	43.53	87.90	43.48	86.25	38.16	85.91	38.13	86.11	39.99	86.23	39.37	88.36	27.64	88.50	27.72
22	80.93	104.99	80.73	105.11	85.20	100.34	85.16	100.49	87.05	99.13	87.23	99.11	84.03	103.71	84.21	103.76	84.96	101.77	85.37	101.70	82.80	115.90	82.25	116.84
23	75.59	108.81	75.70	108.80	81.02	99.82	81.14	99.63	82.46	101.71	82.13	101.93	78.30	106.32	78.59	106.42	79.38	104.40	79.93	104.43	76.21	119.35	76.16	119.33
24	69.27	110.56	69.03	110.60	75.71	102.08	75.81	102.09	76.45	105.15	76.65	105.18	72.74	107.26	72.73	107.40	74.40	106.33	74.76	106.28	70.33	121.23	70.39	121.23
25	64.41	109.70	64.15	109.87	69.81	101.64	69.92	101.67	71.83	103.88	72.02	103.88	67.09	107.58	67.12	107.62	69.31	106.33	69.74	106.43	64.27	120.72	64.24	120.72
26	57.64	107.95	57.42	108.03	65.10	99.06	65.08	99.19	65.55	103.53	65.63	103.54	61.30	106.46	61.28	106.63	64.01	104.52	64.63	104.30	58.43	118.37	58.42	118.36
27	52.71	104.30	52.40	104.07	59.96	96.79	59.94	96.78	59.87	101.72	60.49	102.03	56.08	105.84	56.24	106.21	58.37	101.76	58.38	101.60	51.97	115.93	52.14	115.94

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.36	22.80	37.10	22.27	35.30	32.05	33.10	32.47	31.73	28.98	31.48	29.38	0.00	0.00	0.00	0.00	34.95	47.82	35.46	46.67	34.11	13.45	33.63	11.56
7	42.46	16.87	42.28	16.64	42.29	27.87	40.66	27.74	38.01	24.13	37.98	24.38	37.32	19.60	37.05	19.31	43.05	44.75	43.3	44.38	40.08	8.40	40.04	6.07
8	50.55	13.75	50.40	13.75	47.72	23.22	45.87	23.25	44.73	17.97	44.45	18.21	45.55	15.90	45.16	15.88	47.88	41.02	48.05	40.99	48.59	3.67	48.70	1.55
9	59.41	13.72	58.99	13.51	56.65	23.23	54.84	23.12	54.08	18.51	53.94	18.70	53.78	14.51	54.06	14.46	56.09	40.55	56.39	40.66	57.61	3.56	57.67	1.34
10	66.44	17.61	65.94	17.85	62.31	27.99	60.12	27.99	61.74	22.74	62.11	22.83	61.47	17.12	61.79	16.95	62.52	43.86	62.57	43.82	66.60	7.54	66.27	5.36
11	72.09	24.23	72.62	23.73	69.74	31.81	67.52	32.81	67.97	27.23	68.14	27.69	69.33	19.88	68.76	19.62	67.45	46.32	67.93	46.24	72.42	12.38	72.04	10.26
22	64.24	90.42	64.34	90.26	68.45	85.36	65.71	86.24	67.15	82.94	67.45	83.37	66.71	86.17	65.79	86.13	66.99	109.05	66.74	108.9	65.59	101.45	66.04	99.14
23	59.46	92.84	59.49	93.00	63.60	85.46	61.70	85.23	62.34	85.52	61.70	86.22	61.04	87.61	61.07	87.86	61.31	111.51	61.27	111.46	59.83	103.88	59.70	101.69
24	52.85	94.54	53.28	94.39	58.05	87.40	55.99	87.40	56.74	89.02	56.67	89.13	55.30	88.62	55.56	88.83	56.02	113.46	56.17	113.52	53.67	105.81	53.98	103.54
25	48.05	93.7	47.66	93.60	52.11	87.11	50.32	87.14	51.82	87.67	51.70	87.89	49.97	88.61	49.90	89.31	50.70	113.62	51.02	113.58	47.78	105.27	47.81	103.11
26	41.74	92.03	41.66	92.03	47.34	83.90	45.95	84.41	45.73	86.84	45.96	87.33	44.00	88.11	44.90	88.01	45.57	112.09	44.99	111.42	42.00	102.95	41.88	100.79
27	36.44	88.01	36.97	88.41	42.07	82.16	40.32	82.73	39.98	85.40	40.41	85.48	38.47	87.42	39.12	87.7	40.44	109.40	39.59	108.73	35.79	100.82	35.56	98.91

Area Data Report - F4												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	4.96	4.96	4.85	4.85	8.32	16.92	7.11	7.74	12.16	0.60	5.51	8.00
7	10.55	9.32	9.35	12.07	13.08	10.81	23.11	20.85	11.27	12.67	13.51	11.24
8	22.42	21.62	12.76	12.36	17.35	17.03	23.83	24.29	13.91	8.97	19.13	16.97
9	15.51	13.33	10.64	9.92	25.18	25.43	20.85	23.00	15.83	16.83	14.39	21.42
10	13.91	10.92	7.91	8.00	9.69	9.84	22.77	23.83	5.39	7.97	14.82	11.93
11	12.93	8.95	11.07	8.20	10.35	9.89	12.24	12.22	9.12	9.03	13.22	11.15
22	7.40	13.76	7.03	2.90	8.83	8.26	8.57	7.74	6.25	7.80	7.34	8.14
23	13.68	13.33	2.81	4.33	11.27	10.78	9.72	10.75	7.83	6.91	7.77	9.09
24	7.66	10.29	8.89	7.48	12.65	13.30	11.87	11.35	8.69	8.57	9.49	9.26
25	10.67	10.61	7.23	7.43	11.67	12.10	11.93	12.67	9.89	8.52	9.98	9.35
26	10.81	10.75	6.51	8.43	10.98	8.60	13.33	11.58	7.28	7.46	11.61	7.48
27	8.49	8.80	10.21	11.76	5.82	6.82	16.29	5.85	9.06	10.41	5.16	5.42
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	31.25	15.80	14.45	23.80	20.59	20.82	45.99	28.73	22.85	25.03	18.52	25.46
7	24.63	13.96	22.77	25.61	20.79	19.90	29.71	20.67	19.61	26.81	19.47	23.05
8	34.29	31.08	24.43	34.81	26.12	22.22	45.45	31.60	28.13	28.24	21.59	45.65
9	32.11	26.12	24.26	36.82	31.37	27.33	36.85	31.23	21.53	21.48	23.43	47.11
10	23.51	18.55	19.33	29.39	16.14	13.71	32.40	27.21	8.37	16.20	16.03	25.98
11	13.08	20.70	24.29	21.16	23.11	17.92	23.14	23.63	11.30	26.64	17.49	24.20
22	12.24	15.97	10.81	24.66	8.14	15.05	23.89	16.92	17.75	17.03	23.97	24.11
23	22.68	17.20	24.40	21.08	19.93	16.97	17.52	16.83	14.71	18.98	13.05	30.22
24	21.36	16.43	21.33	22.19	19.44	18.90	20.13	19.18	13.22	13.94	10.06	24.46
25	19.73	13.42	21.59	20.73	15.14	14.31	18.61	19.50	12.30	13.05	12.42	22.48
26	22.16	14.94	23.40	23.05	13.99	19.21	20.65	18.44	18.27	19.07	15.54	23.66
27	25.75	29.56	25.09	25.46	16.37	18.98	23.28	20.10	21.10	17.78	26.35	24.92

Position Data Report - F4

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.11	38.39	53.11	38.05	52.85	46.88	52.85	46.71	51.93	44.82	53.09	44.81	51.22	37.82	51.25	37.85	54.35	39.87	53.34	40.13	49.93	28.70	50.37	28.86
7	58.12	33.28	58.60	32.87	60.52	42.26	59.98	42.16	57.53	40.88	58.10	40.52	56.20	37.87	56.09	38.07	61.53	37.49	61.09	37.15	56.58	23.35	56.56	23.60
8	66.42	29.95	66.97	29.54	66.14	37.79	66.05	37.61	65.11	34.26	64.47	34.15	64.47	34.18	64.35	34.19	66.59	33.66	65.10	33.50	64.44	18.85	64.19	19.04
9	74.37	29.55	75.45	29.55	73.57	37.77	73.74	37.41	73.61	34.90	73.72	34.90	72.52	33.11	72.50	33.04	74.26	33.42	73.36	33.50	74.73	18.89	74.65	18.90
10	82.14	34.23	82.24	34.22	79.47	42.43	79.50	42.27	81.79	38.97	81.97	38.97	80.61	35.84	80.57	35.84	81.42	36.47	80.30	36.32	82.42	22.56	82.66	22.48
11	87.64	40.51	87.85	39.75	86.48	46.99	86.84	46.95	87.69	43.45	87.88	43.46	87.96	38.16	87.96	38.16	86.43	40.00	85.75	39.97	88.26	27.57	88.83	27.80
22	80.07	106.33	80.39	104.8	85.17	100.48	85.28	100.52	86.98	99.35	87.14	99.33	85.10	104.80	85.03	104.8	85.54	101.64	84.72	101.74	82.28	116.67	82.28	116.76
23	75.21	109.04	75.20	108.69	80.60	99.71	80.95	99.55	82.05	101.96	82.34	101.92	80.38	106.34	79.85	106.52	79.63	104.40	79.28	104.35	76.21	119.21	76.25	119.23
24	69.43	111.07	68.97	110.52	75.63	102.07	75.95	101.97	76.42	105.26	76.67	105.19	74.63	107.46	74.51	107.43	74.84	106.31	74.12	106.40	70.53	121.07	70.33	121.16
25	64.18	110.12	63.68	109.67	69.94	101.72	69.72	101.56	71.64	103.95	71.86	103.90	68.90	107.64	68.96	107.65	69.64	106.37	69.28	106.53	64.34	120.60	64.24	120.65
26	57.20	108.40	57.19	108.05	65.25	99.27	64.91	98.78	65.09	103.2	65.79	103.55	63.11	106.60	62.98	106.51	64.14	104.29	63.83	104.33	58.32	118.21	58.46	118.57
27	52.42	104.62	52.46	104.24	59.91	96.75	59.96	96.64	59.94	101.81	60.24	101.90	57.54	105.26	57.68	105.55	59.02	102.16	58.36	102.26	51.86	115.97	51.94	116.03

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.92	24.42	35.96	23.11	35.51	31.87	36.11	32.22	32.27	28.73	32.44	28.94	30.67	22.51	30.45	21.06	36.18	47.15	35.96	47.40	34.06	13.41	34.14	13.91
7	42.87	17.50	42.52	17.31	42.25	28.25	42.15	28.12	37.84	23.82	37.62	24.49	37.74	20.42	36.93	19.96	42.01	45.31	41.36	43.81	39.87	8.73	40.02	8.93
8	49.74	14.32	50.34	13.34	48.06	23.30	47.30	23.79	44.59	18.47	44.05	18.38	45.26	17.04	45.15	16.44	47.52	41.56	47.77	41.36	48.06	3.68	48.25	4.86
9	58.83	14.42	58.90	13.60	57.42	23.31	57.28	23.96	53.95	19.07	54.35	18.98	54.03	15.92	53.91	15.51	56.39	41.05	55.94	40.97	58.28	3.53	58.15	4.69
10	65.68	17.79	66.02	17.69	62.84	28.01	62.45	28.56	61.77	23.09	61.96	22.98	61.68	18.49	61.72	18.08	62.41	43.76	61.93	44.06	66.63	7.56	66.30	8.19
11	72.35	24.67	71.80	24.32	69.66	32.66	68.78	31.71	67.41	27.40	67.51	27.11	68.95	21.05	68.53	20.87	67.03	45.70	67.08	47.08	72.65	12.64	71.84	12.81
22	64.41	90.47	64.61	89.38	67.36	86.03	68.47	86.05	66.19	84.83	66.68	83.96	67.19	86.62	66.40	86.66	67.16	108.78	66.79	108.97	66.08	100.60	66.25	100.18
23	59.25	92.93	58.87	92.60	63.75	86.01	63.46	85.72	62.29	85.22	62.35	85.47	61.46	88.96	61.18	88.69	61.50	111.61	61.40	111.34	59.77	103.55	59.84	102.29
24	53.15	94.25	53.07	94.20	58.23	88.04	58.20	88.06	56.58	89.30	56.63	89.16	56.14	90.09	55.66	90.00	56.18	113.61	56.28	113.57	53.80	105.67	53.78	104.81
25	47.30	93.74	47.48	93.51	52.18	87.59	52.22	87.52	51.96	87.74	51.98	87.78	50.04	90.29	49.74	90.03	50.86	113.68	50.82	113.60	47.95	105.18	47.98	104.14
26	41.53	92.50	41.41	92.04	46.94	85.01	47.20	84.90	45.53	87.11	45.48	87.13	44.36	89.29	44.28	88.83	45.52	111.72	45.37	111.63	41.66	102.76	41.92	102.18
27	36.54	87.33	36.15	86.53	42.52	82.17	42.18	82.31	41.08	85.60	40.75	86.30	38.66	88.10	38.42	88.29	39.74	108.85	39.71	109.05	35.07	98.84	35.32	99.23

Area Data Report - F5												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	9.15	4.59	10.92	11.15	12.73	12.73	5.79	0.00	10.32	12.70	8.95	8.75
7	7.17	9.58	22.16	14.80	11.27	11.87	19.07	30.8	10.15	10.55	10.95	17.03
8	18.75	17.09	13.51	15.14	12.30	15.05	10.01	18.21	15.46	13.99	16.69	15.89
9	15.60	12.90	13.96	14.51	21.48	22.97	20.19	20.50	21.94	13.08	15.37	14.60
10	7.83	12.93	15.14	11.30	7.46	10.49	19.70	18.18	8.29	5.48	13.94	9.46
11	15.23	10.29	13.39	12.96	11.10	9.00	14.28	11.07	8.52	9.18	13.05	30.60
22	19.87	10.90	5.79	9.92	10.44	6.71	16.06	13.85	9.46	8.80	7.43	4.33
23	9.43	9.66	11.41	9.58	9.58	9.92	12.50	11.93	5.28	5.25	7.86	8.34
24	9.95	11.27	16.43	11.38	12.36	12.36	12.16	7.05	6.31	6.85	7.80	8.00
25	9.98	11.44	12.79	10.75	9.35	8.29	12.01	12.19	6.97	7.46	8.60	9.12
26	7.51	8.34	11.35	6.05	6.39	5.39	7.97	7.43	7.37	8.20	7.54	7.11
27	11.64	7.00	14.82	12.01	9.03	29.82	6.14	8.72	7.17	10.44	8.14	15.14
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	20.85	26.41	21.53	14.28	17.03	21.51	18.04	17.86	24.00	20.67	18.35	15.89
7	22.51	21.85	24.43	21.76	18.12	18.84	28.70	20.56	15.94	16.80	16.95	15.31
8	28.16	28.44	28.24	25.23	21.68	23.34	32.49	28.19	22.19	26.32	34.49	33.09
9	23.89	24.54	32.43	26.18	28.82	27.70	31.34	26.61	11.27	19.24	36.82	39.14
10	29.51	22.31	25.26	19.56	14.85	15.28	25.58	23.11	11.04	12.67	22.22	24.23
11	22.68	23.43	20.22	12.56	19.96	19.73	19.76	19.27	7.40	9.18	18.12	19.81
22	7.11	6.62	17.03	32.75	29.88	28.04	14.28	21.02	18.87	12.62	13.71	15.34
23	17.09	8.23	17.26	23.48	18.58	18.15	12.47	17.72	15.66	15.00	14.42	14.16
24	3.33	13.88	14.85	23.43	18.98	17.69	16.86	17.72	12.47	12.07	13.62	12.22
25	7.05	11.73	18.61	18.49	14.68	13.73	12.24	16.49	13.94	12.65	12.39	12.42
26	17.69	17.29	21.30	17.61	14.82	15.77	16.09	16.72	16.92	18.70	12.62	14.19
27	22.51	18.24	27.27	20.36	36.65	24.14	20.10	24.83	19.44	21.33	16.63	18.58

Position Data Report - F5

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.69	38.51	53.15	37.86	53.65	45.90	53.66	46.23	52.80	44.82	52.80	44.82	50.93	37.54	0.00	0.00	54.18	39.86	54.42	39.79	50.60	28.87	50.08	28.87
7	58.77	33.11	58.54	32.73	61.53	41.59	60.53	42.04	57.89	40.57	57.82	40.65	55.69	37.57	54.86	38.88	61.39	37.38	61.48	37.30	56.84	23.47	56.19	24.12
8	66.42	29.92	66.2	29.39	65.74	37.18	65.66	37.53	65.36	34.12	64.79	34.23	63.31	33.51	62.87	34.03	66.48	33.93	66.72	33.92	64.66	18.86	64.19	18.82
9	74.48	29.68	74.96	29.38	73.88	37.14	73.86	37.51	73.58	34.96	73.55	35.02	72.13	32.78	70.87	32.98	74.09	34.14	73.88	33.61	74.55	18.82	73.87	18.72
10	82.02	33.65	82.04	33.67	79.39	41.74	79.55	42.26	81.62	39.63	81.56	39.08	80.25	35.53	79.04	35.73	80.49	36.45	80.81	36.38	82.42	22.71	82.35	22.50
11	87.55	40.43	87.64	39.94	86.48	46.48	86.50	46.80	87.13	43.32	87.63	43.45	87.35	37.95	86.12	38.02	86.30	40.14	86.26	40.12	88.43	27.72	87.36	28.74
22	80.05	104.62	80.41	104.87	85.19	100.11	85.19	100.26	87.07	99.15	87.02	99.34	85.63	103.41	84.16	103.68	85.16	101.56	84.98	101.67	82.37	116.86	82.10	116.99
23	75.95	108.76	75.74	108.31	81.17	99.60	81.18	99.72	82.05	101.98	82.06	101.98	79.85	106.38	78.58	106.56	79.46	104.44	80.74	104.28	76.28	119.30	75.82	119.29
24	69.56	110.79	69.71	110.24	75.97	101.87	75.74	101.95	76.50	105.16	76.50	105.16	74.39	107.23	72.87	107.30	74.59	106.28	74.59	106.27	70.49	121.20	70.08	121.21
25	63.97	110.09	63.27	109.64	69.96	101.49	69.87	101.65	71.83	104.06	71.84	104.11	68.54	107.57	67.27	107.58	69.33	106.29	69.34	106.29	64.39	120.73	63.90	120.72
26	57.37	108.46	57.19	107.98	65.17	98.58	65.33	99.05	65.85	103.72	65.94	103.78	62.40	105.95	61.48	106.15	64.14	104.22	64.12	104.25	58.61	118.55	58.04	118.56
27	52.32	104.26	52.37	104.15	59.97	96.23	59.92	96.62	60.06	101.92	60.69	100.08	57.64	105.78	56.39	106.03	58.84	102.17	58.42	101.66	52.15	115.96	51.36	114.97

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	35.25	23.72	35.85	22.92	34.63	33.32	34.28	33.18	31.73	29.05	31.45	29.68	30.15	20.49	30.14	20.29	35.57	47.32	35.81	47.60	33.18	14.12	33.73	13.41
7	42.29	17.51	42.48	17.10	42.06	28.09	42.14	27.96	37.61	24.26	37.59	24.24	37.59	19.55	37.28	19.28	42.06	44.80	42.42	44.88	39.84	8.57	39.70	8.55
8	49.69	13.97	50.29	13.46	47.38	23.52	47.49	23.38	44.17	18.13	43.96	18.46	45.56	16.01	45.37	15.86	47.15	41.15	47.49	41.23	48.39	4.30	47.94	4.25
9	59.13	14.55	59.15	13.78	57.17	23.73	57.22	23.41	54.56	18.92	54.05	19.09	54.15	14.87	53.94	14.64	56.53	40.38	56.65	40.82	58.61	4.28	58.38	4.33
10	66.01	18.65	66.01	18.20	62.47	28.28	62.51	28.01	61.73	22.90	61.72	23.05	61.96	17.46	61.65	17.47	62.28	43.93	62.30	43.99	66.71	8.17	66.34	8.02
11	71.20	24.53	71.58	24.07	69.27	32.42	69.31	31.50	67.45	27.32	67.37	27.35	69.54	20.24	69.20	20.09	66.78	45.01	67.19	45.26	72.37	12.59	72.09	12.71
22	64.58	90.97	64.52	90.20	67.98	86.44	67.60	84.64	65.84	81.83	65.59	81.92	67.27	86.37	66.75	85.56	66.92	108.55	66.90	109.32	66.80	101.11	66.69	101.05
23	58.56	93.53	59.76	92.83	63.32	85.27	63.41	86.08	62.22	85.61	62.40	86.16	61.74	88.40	61.25	88.27	61.34	111.56	61.33	111.65	60.41	103.36	59.91	103.59
24	52.76	95.68	53.10	94.77	57.76	87.52	58.16	88.11	56.56	88.90	56.69	89.11	56.48	89.44	55.79	89.28	56.19	113.51	56.20	113.51	54.12	105.68	53.95	105.84
25	47.04	94.77	47.44	93.77	51.98	87.49	52.31	87.66	51.94	87.67	51.95	87.91	49.93	89.11	49.77	89.28	50.44	113.40	50.81	113.53	47.71	105.19	47.66	105.18
26	41.34	92.46	41.33	92.16	47.21	84.33	47.54	84.65	45.71	87.12	45.28	87.17	43.91	88.60	44.12	88.20	44.97	111.50	45.15	111.42	41.47	102.82	41.52	102.76
27	35.92	87.42	36.05	87.90	41.61	81.87	42.51	82.33	40.21	84.63	42.36	84.54	38.18	86.75	38.07	86.55	39.43	108.70	39.55	108.44	34.93	99.68	34.92	99.49

Area Data Report - F6												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.06	2.81	4.96	5.65	5.91	5.02	0.00	0.00	2.72	2.67	6.28	5.96
7	3.67	3.99	10.01	12.79	4.82	6.22	9.84	14.05	6.39	5.82	3.61	8.11
8	7.66	9.92	6.62	13.48	6.22	12.76	2.12	17.06	6.97	12.73	5.71	15.23
9	3.10	9.26	12.01	13.88	16.09	18.92	12.62	15.25	9.23	8.06	6.88	15.91
10	3.61	7.68	7.80	7.68	3.10	9.15	2.70	16.26	3.50	2.92	4.27	10.24
11	5.48	6.22	10.15	7.00	5.79	5.45	7.23	6.54	5.76	4.13	7.23	8.40
22	8.34	10.44	3.47	5.79	4.13	4.62	4.19	4.62	1.41	2.81	1.75	4.27
23	5.05	7.68	4.27	4.44	5.76	6.45	2.58	9.38	2.87	2.75	6.51	8.60
24	5.82	6.45	3.04	10.21	9.03	9.26	5.96	6.45	4.85	4.13	6.62	7.03
25	6.39	5.51	7.03	9.75	4.30	8.63	7.08	7.60	4.99	4.62	7.03	7.57
26	5.53	4.44	3.53	6.08	3.18	8.92	3.90	7.97	4.87	3.61	5.62	9.09
27	4.16	2.87	2.15	2.29	3.01	3.01	3.78	3.76	5.10	4.39	3.76	5.10
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	4.76	4.65	9.61	9.35	5.51	9.12	0.00	0.00	9.43	9.72	11.53	11.53
7	9.61	12.13	21.45	17.49	12.10	13.76	21.73	22.14	20.62	10.35	17.72	12.33
8	20.01	19.87	21.79	22.48	19.73	16.20	26.09	26.15	16.14	16.34	21.51	18.92
9	15.43	17.23	21.25	22.08	25.92	24.23	21.79	23.05	16.34	13.94	20.01	18.95
10	13.82	17.55	20.24	18.12	12.93	13.56	25.29	23.57	8.77	7.37	17.75	14.94
11	8.92	8.20	14.42	14.71	11.30	9.09	12.70	9.78	3.30	3.58	15.23	14.80
22	6.97	3.76	4.39	6.48	5.73	8.06	8.63	4.62	9.92	4.24	8.06	11.70
23	14.60	13.91	9.46	11.70	13.91	13.71	15.25	12.76	10.58	7.83	11.27	9.86
24	10.70	13.59	14.28	14.48	15.77	15.46	11.90	11.84	10.78	10.90	10.55	9.75
25	11.47	11.41	12.27	14.37	14.11	12.53	12.39	11.87	12.13	10.29	12.76	12.53
26	13.13	12.22	10.47	9.72	13.71	13.56	14.80	14.28	17.35	12.27	13.33	11.64
27	4.10	3.27	3.27	4.01	3.47	5.16	12.93	5.48	17.38	13.36	12.16	6.94

Position Data Report - F6

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.05	37.90	52.93	37.90	52.86	46.87	52.96	46.62	52.08	44.88	52.09	44.84	0.00	0.00	0.00	0.00	53.89	39.37	53.88	39.38	50.31	28.88	50.31	28.80
7	58.74	32.49	58.50	32.55	60.48	42.26	60.45	42.05	58.30	40.22	58.29	40.27	54.38	38.00	54.45	37.80	60.93	37.56	60.90	37.59	57.12	22.94	56.84	23.23
8	67.28	29.29	65.87	29.16	65.15	37.49	65.68	37.53	64.90	33.90	65.28	34.25	63.46	33.55	62.89	34.19	66.38	33.77	66.29	33.99	64.66	18.44	64.71	18.89
9	74.87	29.03	75.13	29.45	73.91	37.68	74.03	37.50	73.71	34.77	73.63	34.93	70.82	33.01	70.74	33.01	73.39	33.53	73.33	33.51	74.90	18.31	74.67	18.66
10	81.94	33.10	82.05	33.79	79.47	42.46	79.48	42.30	81.55	38.60	81.79	39.08	78.28	35.27	78.99	35.84	80.61	36.40	80.53	36.36	82.18	22.13	82.57	22.46
11	87.84	39.60	87.62	39.63	86.59	47.03	86.98	47.19	87.95	43.52	87.98	43.53	86.09	38.11	86.38	38.16	85.96	40.06	85.91	39.79	89.08	27.98	88.89	27.80
22	80.41	104.88	80.22	104.8	85.18	100.73	85.21	100.33	87.17	99.27	87.18	99.27	83.16	104.82	83.36	104.82	84.58	102.14	84.56	101.99	82.90	116.83	82.46	116.92
23	75.46	108.36	75.16	108.47	80.99	99.79	81.04	99.61	82.27	101.98	82.23	101.98	78.70	106.95	78.45	106.61	78.94	104.49	79.39	104.40	76.20	119.24	76.20	119.19
24	68.79	110.37	68.67	110.32	76.32	102.11	75.67	102.00	76.62	105.14	76.62	105.14	72.67	107.45	72.81	107.44	74.20	106.28	74.28	106.28	70.36	121.14	70.35	121.23
25	63.82	109.54	63.67	109.54	69.98	101.75	69.86	101.65	72.09	104.17	71.95	103.93	67.12	107.63	67.24	107.62	69.20	106.37	69.08	106.29	64.34	120.67	64.38	120.75
26	57.05	107.77	56.72	107.68	65.59	99.38	65.38	99.07	65.03	102.99	65.78	103.49	61.00	106.47	61.37	106.58	64.09	104.33	63.91	104.30	58.49	118.55	58.43	118.38
27	52.42	104.16	52.36	104.20	59.95	97.49	60.01	97.36	60.09	101.73	60.09	101.73	56.10	106.06	56.26	106.05	58.69	102.23	58.82	102.31	51.91	116.00	51.93	115.92

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.48	19.16	37.06	22.20	32.76	30.72	32.62	30.94	31.46	28.82	31.51	29.25	0.00	0.00	0.00	0.00	35.03	47.78	35.17	47.81	34.23	13.12	34.29	10.87
7	42.10	14.55	42.46	17.05	39.97	26.59	40.29	26.43	37.99	24.54	37.88	24.47	37.39	17.68	36.91	17.70	40.45	43.26	42.87	44.91	39.89	8.62	39.54	6.46
8	50.29	10.77	50.05	13.56	45.34	21.93	45.40	21.98	44.55	18.14	45.17	18.02	45.47	14.14	45.35	13.99	47.70	41.08	47.98	40.94	47.80	3.74	48.34	1.47
9	59.52	10.88	59.38	13.73	54.06	21.97	54.20	22.02	54.19	18.78	53.99	18.80	53.61	12.98	53.49	12.82	55.65	40.71	55.87	40.56	58.07	3.39	58.05	1.26
10	66.45	15.14	66.47	17.76	60.18	26.84	59.75	26.63	61.77	22.93	61.79	22.99	61.76	15.81	61.69	15.68	62.59	43.79	62.50	43.58	66.31	7.56	66.58	5.44
11	72.09	21.11	72.24	23.89	67.11	31.81	66.64	30.79	67.88	27.00	68.02	27.58	69.04	17.94	68.90	17.92	67.61	46.34	67.72	46.52	71.96	12.19	72.03	10.11
22	63.95	87.52	64.34	90.19	65.31	84.59	64.83	85.18	67.31	83.12	67.18	83.13	66.11	84.78	66.03	84.60	66.60	109.29	66.43	109.56	65.91	101.94	67.47	97.88
23	59.45	89.89	59.53	92.73	61.15	83.85	60.89	83.72	62.36	85.65	62.28	85.73	61.38	86.42	61.40	86.32	61.58	111.76	61.95	111.52	59.99	103.66	59.95	101.71
24	53.47	91.70	53.21	94.47	55.59	86.24	55.46	86.25	56.55	89.18	56.78	89.10	55.77	87.20	55.58	87.22	56.09	113.74	56.22	113.57	53.84	105.78	53.88	103.71
25	47.88	90.75	47.83	93.64	49.83	85.97	49.64	85.97	51.89	87.81	52.08	87.70	50.17	87.46	50.13	87.37	50.55	113.58	50.99	113.59	47.90	105.18	47.90	103.17
26	41.56	89.19	41.65	91.98	45.01	82.73	44.58	82.75	45.67	87.20	45.67	87.00	44.30	86.44	43.89	86.43	45.28	111.65	45.63	111.55	41.92	102.89	41.70	100.84
27	37.89	85.69	37.32	89.17	40.89	82.76	39.78	81.74	40.00	85.30	39.95	85.36	39.20	86.35	38.92	85.48	39.75	109.02	39.65	108.79	35.85	100.59	35.74	98.73

Area Data Report - F7												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	1.78	1.84	4.96	4.85	3.44	6.42	3.18	7.11	4.04	4.42	5.16	5.13
7	3.87	4.01	8.83	5.30	4.39	4.19	3.15	3.56	5.39	5.62	10.61	6.65
8	8.29	9.09	4.90	4.44	7.91	7.00	3.99	10.98	5.85	9.38	13.36	12.85
9	5.62	5.79	10.81	9.61	14.14	15.48	13.73	14.60	7.68	8.83	13.99	6.22
10	7.23	7.08	7.91	7.74	5.39	5.96	4.30	14.31	2.21	2.72	10.61	9.38
11	4.76	5.16	9.95	7.08	5.28	5.79	6.22	9.09	5.30	4.27	6.39	7.57
22	5.53	7.60	3.47	2.18	9.15	5.94	10.84	3.41	5.42	2.90	3.99	5.13
23	6.42	6.39	4.76	3.01	5.39	5.65	5.56	4.33	2.90	2.67	6.74	5.88
24	4.36	4.36	5.91	6.16	7.40	7.40	6.71	5.25	2.55	2.52	6.80	6.51
25	3.35	4.70	8.20	6.02	4.22	3.90	6.08	6.97	3.53	4.01	7.11	7.05
26	2.75	3.35	2.72	6.28	2.92	2.70	5.96	4.87	3.90	2.67	6.51	5.19
27	1.43	2.92	2.04	11.24	2.35	2.38	3.90	3.24	6.14	5.62	6.54	5.45
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	15.23	11.35	16.77	10.27	17.12	14.22	12.65	15.83	13.08	14.22	14.16	13.19
7	16.95	18.06	21.48	18.75	13.30	13.79	21.02	21.62	13.59	16.32	14.19	17.03
8	22.39	27.96	23.05	20.53	20.56	20.90	28.39	25.41	22.51	23.86	30.05	18.75
9	17.32	20.70	22.68	20.82	29.19	26.47	23.57	23.86	22.91	21.08	29.22	21.45
10	17.89	16.43	18.21	16.26	13.25	14.42	24.26	26.32	7.89	10.61	23.00	19.35
11	10.92	9.09	17.58	10.92	15.20	14.60	14.16	15.57	13.10	13.65	16.86	12.99
22	9.92	10.78	20.65	9.23	13.25	10.27	11.76	9.78	12.33	15.14	14.39	10.75
23	12.85	12.50	21.53	12.04	10.95	13.79	15.25	12.65	15.46	14.45	13.25	12.44
24	16.37	14.60	22.19	14.88	16.29	15.80	11.99	12.39	13.08	12.76	11.07	10.78
25	13.85	12.07	20.44	15.37	12.96	13.59	10.01	8.86	14.74	12.39	12.87	10.81
26	15.63	17.63	21.10	13.76	14.71	15.40	14.25	12.42	17.61	18.95	13.05	12.10
27	9.41	11.56	25.63	11.41	7.11	18.78	16.54	13.96	12.44	20.19	15.71	11.93

Position Data Report - F7

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.83	38.09	52.99	38.11	52.86	46.70	52.85	46.88	51.83	44.84	51.66	45.45	51.76	37.56	51.48	37.86	53.96	39.85	53.88	40.13	50.03	29.05	50.31	28.96
7	58.35	32.84	58.39	32.96	60.39	42.12	60.13	42.22	58.09	40.26	58.29	40.24	56.37	37.53	56.17	37.47	61.01	37.67	61.20	37.64	56.55	23.67	56.79	23.55
8	65.74	29.27	65.87	29.27	64.83	37.26	64.84	37.42	64.28	34.25	64.03	34.03	65.11	33.73	64.35	34.06	65.53	33.66	66.37	33.78	64.47	18.87	64.49	18.73
9	75.37	29.56	75.11	29.58	73.73	37.47	73.69	37.61	73.62	35.03	73.66	34.78	73.30	33.07	72.74	33.08	73.42	33.51	73.66	33.54	74.53	18.66	74.95	18.28
10	82.13	34.06	82.30	34.04	79.47	42.27	79.42	42.42	81.68	38.94	81.93	39.05	81.12	35.38	81.13	35.84	80.76	36.38	81.04	36.53	82.59	22.73	82.74	22.54
11	87.42	40.13	87.86	39.77	86.60	46.85	87.00	47.38	87.84	43.55	87.95	43.52	88.92	38.16	88.26	38.15	86.26	40.11	86.23	39.69	89.23	27.99	88.97	27.87
22	80.44	104.40	80.46	104.88	85.18	100.56	85.46	100.27	87.05	99.15	87.43	98.79	86.75	103.81	85.55	104.84	85.61	101.49	85.26	101.69	82.44	116.90	82.53	116.69
23	75.17	108.67	75.36	108.66	81.04	99.65	80.85	99.76	82.04	102.01	82.27	101.98	80.94	106.45	80.74	106.47	79.90	104.25	80.41	104.11	76.21	119.24	76.34	119.27
24	68.45	110.52	68.62	110.52	75.47	102.01	76.14	102.11	76.48	105.21	76.64	105.21	75.27	107.39	75.02	107.44	74.33	106.28	74.38	106.25	70.32	121.13	70.47	121.14
25	63.19	109.88	63.79	109.74	69.89	101.62	70.05	101.73	71.79	103.79	71.97	104.19	70.09	107.63	69.49	107.62	69.68	106.52	69.62	106.40	64.30	120.66	64.40	120.66
26	57.29	108.38	56.80	107.79	65.10	98.23	64.76	99.06	65.58	103.41	65.64	103.38	63.69	106.68	63.46	106.80	64.34	104.32	64.03	104.22	58.55	118.46	58.62	118.52
27	52.32	104.10	52.32	104.34	59.93	97.30	59.95	96.80	59.86	101.71	60.02	101.69	58.82	106.06	58.30	105.75	58.20	101.68	58.68	101.92	52.04	115.86	52.00	115.65

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.46	22.68	36.65	22.47	35.25	32.17	35.17	31.73	31.63	29.04	31.98	28.65	29.42	20.19	29.42	20.14	35.13	46.85	34.95	47.68	34.14	13.18	33.91	13.16
7	42.54	17.11	42.11	17.38	42.01	27.88	41.76	27.8	37.87	23.88	37.82	24.54	37.08	19.35	37.40	19.12	42.96	44.63	42.91	44.73	39.87	8.34	40.02	8.44
8	50.07	13.70	50.13	13.19	47.38	23.21	47.69	23.05	44.67	18.00	44.75	18.22	45.35	15.74	45.35	15.68	47.60	41.07	47.66	41.02	47.89	4.11	47.92	3.51
9	59.23	13.82	58.93	13.31	56.97	23.22	56.73	23.08	54.28	18.85	54.08	18.95	53.73	14.52	53.89	14.43	56.00	40.85	56.40	40.74	58.12	3.81	58.47	3.47
10	66.26	17.78	66.19	17.51	62.51	27.85	62.53	27.96	61.71	22.77	61.52	22.79	61.78	17.28	61.61	17.38	61.59	43.31	61.97	43.59	66.41	7.98	66.51	7.75
11	71.43	23.97	71.87	23.51	69.54	32.27	69.07	32.35	67.82	27.02	67.66	27.04	69.02	19.54	68.57	19.57	66.96	45.61	67.32	45.83	72.03	12.30	71.71	12.00
22	64.63	90.24	64.69	89.82	67.88	86.07	67.21	85.85	66.73	83.81	66.57	83.77	66.45	85.84	66.03	86.05	66.82	109.22	67.08	108.82	66.46	101.07	65.82	101.77
23	59.19	92.85	59.38	92.87	63.29	86.34	63.77	85.26	62.14	85.68	62.26	85.72	61.27	87.96	61.07	87.75	61.30	111.63	61.61	111.59	59.61	103.63	59.71	103.65
24	53.39	94.28	53.36	94.46	58.05	88.11	57.97	87.42	56.48	89.13	56.52	89.24	55.56	88.75	55.52	88.74	55.93	113.42	56.03	113.39	53.89	105.75	53.82	105.75
25	47.62	93.65	47.95	93.65	52.14	87.64	52.12	87.05	51.93	87.65	51.95	87.96	50.23	88.79	49.65	88.73	50.31	113.27	50.92	113.53	47.74	105.17	47.49	105.29
26	41.64	92.15	41.79	92.12	47.51	85.02	47.46	84.11	45.55	87.09	45.35	87.10	44.32	87.94	44.18	87.81	44.85	111.41	45.37	111.53	41.48	102.8	41.56	102.92
27	37.18	87.80	37.24	88.26	42.04	82.75	42.32	81.55	40.84	85.62	39.26	85.46	38.59	87.49	38.24	86.70	40.20	109.46	39.58	108.63	35.01	99.78	34.84	100.02

Area Data Report - F8

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.67	5.79	4.65	4.96	5.91	3.76	0.00	0.00	5.68	3.18	6.31	6.54
7	2.67	1.55	9.95	9.66	2.92	0.49	4.24	10.35	5.59	5.94	4.67	10.27
8	1.23	3.01	4.90	7.03	8.00	5.91	3.13	2.12	6.88	6.94	3.73	9.29
9	2.04	2.06	9.61	8.77	16.11	16.52	2.87	5.30	7.89	6.62	5.16	6.82
10	4.62	3.70	3.18	7.91	1.81	4.99	4.22	2.64	2.52	2.44	2.47	2.87
11	6.37	3.78	8.11	7.34	5.28	5.79	5.48	7.74	4.59	4.30	5.19	9.32
22	3.30	2.41	1.84	2.35	3.64	4.01	4.01	4.07	1.41	2.04	1.63	16.77
23	3.27	3.30	3.33	3.84	5.56	5.73	2.58	2.72	2.87	2.78	6.71	6.02
24	5.05	2.47	6.42	4.99	3.13	7.37	5.71	6.37	3.04	3.13	5.91	6.57
25	5.42	2.47	3.44	4.67	3.76	4.59	6.74	1.89	4.36	4.70	6.19	7.00
26	3.70	3.56	0.63	0.34	1.98	2.24	4.30	5.76	2.95	3.67	1.92	1.92
27	3.53	3.13	1.98	1.84	2.38	2.38	3.38	2.70	4.82	4.16	3.18	3.56

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	6.08	8.77	6.48	6.42	7.00	10.15	0.00	0.00	11.96	7.71	8.46	8.77
7	8.09	9.38	8.86	19.18	7.20	13.05	18.58	11.04	13.76	15.20	10.52	16.95
8	20.5	19.70	12.76	21.76	7.83	18.84	13.08	7.97	19.61	19.73	13.76	14.22
9	15.66	15.97	14.65	21.16	19.67	24.49	21.28	15.68	17.69	17.41	14.11	12.53
10	14.39	14.54	17.15	17.72	10.98	12.85	16.14	10.67	8.11	5.91	6.97	13.05
11	12.73	8.77	12.22	10.06	8.43	11.27	13.59	13.71	4.59	5.22	13.53	16.54
22	7.40	8.54	4.04	3.33	4.96	9.23	7.28	3.50	13.62	9.12	10.58	13.08
23	14.82	18.55	8.11	0.00	11.99	12.90	14.62	7.91	12.76	8.40	10.72	14.45
24	10.38	14.48	12.24	12.96	14.31	15.8	9.75	2.98	11.15	10.67	11.47	11.87
25	11.53	12.10	12.44	12.30	10.41	10.67	11.96	8.72	15.34	11.47	13.13	12.82
26	11.58	12.36	7.05	5.30	13.30	15.25	12.13	8.54	14.37	13.10	5.73	14.34
27	4.42	6.97	7.57	10.58	5.25	5.13	11.04	5.36	18.61	13.96	7.48	16.2

Position Data Report - F8

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.10	37.56	53.34	37.85	52.83	46.89	52.86	46.87	53.49	44.32	51.85	44.88	0.00	0.00	0.00	0.00	54.21	39.95	53.94	39.61	50.32	28.79	50.36	28.85
7	57.27	33.10	59.79	31.63	60.49	42.25	60.52	42.27	57.14	40.84	59.00	40.77	54.28	37.20	54.32	37.67	61.37	37.64	61.07	37.59	56.69	23.52	56.68	23.48
8	65.23	29.55	67.95	29.27	64.83	37.43	65.19	37.50	64.44	34.02	64.70	33.90	62.61	33.54	61.74	34.16	66.68	33.71	66.35	34.09	63.07	18.34	64.43	18.99
9	77.67	29.72	72.82	29.04	73.70	37.60	73.59	37.58	73.06	34.96	73.52	34.85	72.00	32.11	71.80	32.39	73.83	33.50	74.18	34.05	74.84	18.18	74.90	18.31
10	82.65	34.35	82.21	33.46	79.95	42.81	79.46	42.45	81.08	38.38	81.63	38.85	78.69	35.19	78.49	35.27	80.93	36.30	80.53	36.26	82.81	22.10	82.77	22.21
11	87.78	39.31	87.95	39.40	86.82	47.11	86.89	47.14	87.33	43.55	87.78	43.52	86.64	38.02	86.22	38.12	86.44	39.92	86.08	39.82	89.39	27.98	88.28	27.70
22	80.04	105.48	80.02	105.88	85.44	100.46	85.40	100.47	86.51	99.27	87.00	99.25	83.49	104.65	83.33	104.81	85.09	102.14	84.67	102.14	82.89	116.83	82.71	115.77
23	73.93	109.01	73.89	109.35	80.97	99.76	80.96	99.79	81.66	101.94	82.08	102.00	79.04	106.78	78.85	106.94	79.50	104.40	79.10	104.50	76.20	119.23	76.24	119.27
24	68.64	110.01	69.74	110.63	75.61	102.25	76.23	102.13	74.90	105.80	76.45	105.21	73.01	107.27	72.85	107.45	74.75	106.28	74.50	106.28	70.40	121.15	70.39	121.13
25	63.89	109.21	62.92	109.76	70.39	102.33	70.13	101.75	71.39	104.21	71.87	104.14	67.43	107.45	67.26	108.05	69.69	106.35	69.30	106.32	64.28	120.68	64.31	120.68
26	56.98	107.42	57.00	107.78	66.73	100.42	66.73	100.03	65.78	104.04	66.19	103.97	61.64	106.71	61.19	106.76	64.10	104.20	64.43	104.41	59.97	119.08	59.97	119.08
27	52.42	103.87	52.38	104.21	59.93	97.44	59.92	97.45	59.36	101.72	59.85	101.69	56.39	105.86	56.18	106.00	59.23	102.26	59.00	102.33	51.86	116.01	51.87	115.99

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.86	22.08	36.93	22.18	35.32	32.39	35.15	32.38	31.50	29.14	31.58	29.23	0.00	0.00	0.00	0.00	35.29	47.56	34.91	47.39	33.95	11.33	33.96	11.36
7	42.75	17.12	42.29	17.09	42.47	27.47	42.68	27.67	38.26	23.84	37.67	24.37	37.62	19.38	37.97	18.96	42.66	44.86	42.69	44.38	39.99	6.66	39.77	6.78
8	50.12	13.65	50.47	13.47	47.72	22.80	48.14	23.19	46.88	18.31	44.74	18.09	46.76	15.21	46.98	15.98	47.55	40.99	47.51	40.94	48.16	2.34	49.31	1.58
9	59.52	13.70	59.52	13.78	56.08	22.94	56.50	23.15	54.18	18.50	53.81	18.66	53.73	14.36	53.04	14.85	55.47	40.54	55.39	40.50	58.43	2.24	58.05	1.38
10	66.27	17.95	66.34	17.58	61.80	27.85	61.99	27.82	61.71	22.77	61.80	22.91	62.16	17.66	62.15	17.66	62.49	43.96	62.78	43.76	66.08	5.33	66.15	5.40
11	71.71	24.70	71.93	24.03	69.27	32.76	69.40	32.37	68.18	27.16	68.16	27.48	68.44	19.34	68.38	19.45	67.46	46.36	67.48	46.14	71.75	9.69	72.26	10.56
22	64.03	90.28	64.21	90.33	67.53	86.60	67.67	85.79	67.22	82.49	66.84	83.82	65.68	86.18	66.34	86.34	66.43	108.65	66.59	108.42	66.70	97.75	66.96	97.78
23	59.45	92.69	59.07	92.68	63.37	84.87	0.00	0.00	62.20	85.65	62.06	86.02	61.51	88.17	60.95	87.84	61.04	111.07	60.74	111.07	59.83	101.23	59.93	101.68
24	52.38	94.43	53.16	94.43	58.10	87.47	57.94	87.3	56.62	88.78	56.63	89.05	55.76	88.76	56.17	89.11	55.45	113.41	55.54	113.34	54.06	103.43	54.14	103.96
25	47.73	93.63	47.67	93.66	52.36	87.15	52.20	87.32	52.17	87.70	51.98	87.82	50.17	88.85	50.03	89.06	50.17	113.22	50.66	113.48	47.77	102.72	47.85	103.32
26	41.61	92.08	41.61	92.06	48.14	84.85	48.09	84.84	45.66	87.09	45.52	87.13	44.24	87.88	44.70	87.97	44.62	111.11	45.27	111.01	40.61	100.31	41.69	100.88
27	37.64	88.08	37.56	88.10	42.52	81.46	42.17	81.45	39.86	85.39	39.85	85.21	39.10	88.00	39.19	87.68	39.36	108.43	39.23	108.30	35.41	98.28	34.74	97.39

Area Data Report - S1												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.38	5.28	5.42	4.96	4.62	4.44	25.58	5.28	6.59	2.35	5.88	12.53
7	4.10	4.13	10.24	9.72	4.42	4.90	2.47	4.07	5.88	5.30	3.78	5.05
8	4.67	3.30	4.7	7.34	9.23	5.16	0.86	3.78	7.91	4.33	10.21	4.13
9	2.58	7.71	8.89	10.58	16.54	3.81	15.37	1.95	8.06	6.48	9.81	6.65
10	4.50	4.50	7.05	7.68	5.45	5.05	13.76	15.97	2.38	2.35	4.36	3.21
11	7.17	4.73	7.11	8.06	6.05	5.85	7.74	6.05	4.19	4.87	10.52	10.47
22	2.84	4.85	15.20	3.27	3.87	4.62	3.93	3.41	1.41	3.47	5.42	14.94
23	3.41	3.41	3.87	4.13	5.56	1.84	3.58	3.53	0.86	1.58	3.78	6.22
24	5.13	6.05	3.61	3.33	8.97	9.03	6.05	3.99	1.63	1.55	6.65	7.05
25	5.45	5.45	6.59	4.67	2.21	2.35	7.31	6.14	3.84	4.33	7.08	7.31
26	1.06	3.81	1.92	2.49	3.13	3.53	3.73	3.33	1.75	4.04	4.96	5.62
27	1.32	3.30	1.69	1.61	2.64	2.38	3.96	3.61	4.13	4.82	5.65	3.47
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	13.02	13.62	6.65	13.59	9.06	9.86	17.58	17.23	7.31	15.14	4.01	7.48
7	12.93	20.10	16.17	20.24	8.52	11.15	17.89	19.47	10.49	15.17	15.23	12.07
8	15.83	19.18	20.79	21.65	17.06	18.04	22.57	24.43	14.45	21.22	18.95	15.20
9	15.83	15.37	21.65	22.71	22.39	23.34	15.08	19.47	14.14	20.19	16.69	15.46
10	15.25	9.15	15.40	19.41	10.75	10.29	23.46	20.76	6.82	8.43	8.72	12.19
11	5.68	5.85	8.32	9.63	11.93	9.89	16.11	12.62	3.04	15.89	4.42	6.28
22	13.82	7.57	5.59	3.18	4.16	2.90	7.46	9.89	6.54	12.53	4.07	10.84
23	16.54	16.00	10.67	14.42	13.59	12.87	13.76	13.56	8.72	13.53	9.38	11.04
24	11.41	9.78	13.36	13.19	14.88	13.25	12.27	11.30	9.95	12.04	8.37	11.10
25	10.61	10.32	11.38	12.22	13.28	9.41	10.06	12.65	8.86	14.37	8.46	12.07
26	14.14	13.68	12.01	12.07	8.83	4.87	14.39	14.54	10.72	16.95	11.38	14.14
27	12.87	14.51	8.66	19.01	3.70	2.41	17.69	20.04	12.56	15.63	5.88	12.22

Position Data Report - S1

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.77	37.88	53.30	37.86	52.91	46.81	52.86	47.04	51.93	44.79	51.87	44.69	51.61	39.56	51.32	37.79	54.65	38.89	53.83	39.48	50.28	28.69	51.93	29.03
7	57.85	33.02	57.99	33.18	60.47	42.27	60.50	42.43	58.11	40.24	58.12	40.06	59.06	38.81	55.85	37.18	61.07	37.59	60.82	37.69	57.06	22.81	56.79	23.63
8	67.27	29.27	67.78	29.95	66.53	38.10	64.86	37.66	64.60	34.28	64.73	33.77	65.84	34.28	62.78	33.56	66.21	33.96	66.61	33.74	64.60	18.87	63.37	18.51
9	74.89	29.05	74.59	29.30	73.59	37.59	73.76	37.75	73.55	34.88	74.08	34.44	73.77	33.02	74.57	31.85	74.20	33.98	74.58	33.07	74.46	18.75	75.15	18.30
10	82.32	34.65	82.66	34.65	79.09	42.28	79.46	42.62	81.67	39.07	81.69	39.03	81.97	35.84	80.65	35.66	80.50	36.23	80.32	36.21	82.25	22.06	82.97	22.18
11	87.37	39.90	87.89	39.56	86.90	47.16	86.84	47.29	87.76	43.50	87.79	43.35	89.29	38.12	88.08	38.00	86.08	39.83	85.91	39.87	88.48	27.55	88.82	27.73
22	79.67	105.86	80.35	105.11	85.53	99.70	85.21	100.87	87.01	99.25	87.01	99.11	86.37	104.82	85.04	104.68	84.75	102.14	84.70	101.58	82.17	116.59	83.13	115.89
23	73.68	109.21	74.02	109.21	80.96	99.78	81.00	99.96	82.17	101.94	83.27	100.93	81.97	106.94	80.63	106.78	79.69	103.80	78.84	104.52	76.40	118.76	76.49	119.35
24	68.21	110.33	68.78	110.34	76.37	102.06	75.20	101.98	76.44	105.15	76.45	104.97	75.85	107.44	74.61	107.33	73.57	106.04	73.71	106.26	70.43	120.94	70.66	121.23
25	63.44	109.53	63.78	109.53	70.02	101.78	70.13	101.92	73.08	103.96	71.34	103.25	70.27	107.63	69.22	107.47	69.61	106.50	69.19	106.36	64.35	120.51	64.58	120.74
26	56.29	107.21	57.12	107.90	65.41	99.10	65.71	99.63	64.84	102.94	65.93	103.61	64.51	106.32	63.20	106.11	64.84	104.55	63.95	104.29	58.25	117.83	58.66	118.55
27	52.28	104.14	52.37	104.19	59.99	97.51	59.96	97.67	59.88	101.70	59.85	101.52	59.33	106.06	57.91	105.85	58.44	102.12	58.72	102.26	52.12	115.70	52.18	116.09

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.31	23.24	36.91	22.32	35.45	31.07	35.21	32.01	31.07	29.33	32.34	28.43	29.97	20.34	29.87	20.22	34.64	45.73	35.11	46.17	33.51	10.29	33.47	11.59
7	42.59	17.34	42.55	17.37	41.99	27.78	42.06	27.89	38.15	24.27	38.07	24.42	37.41	18.99	37.54	19.02	42.78	44.80	42.70	44.65	39.92	6.22	39.91	6.48
8	50.25	13.77	50.34	13.82	47.78	23.07	47.97	23.18	44.71	17.79	44.59	18.20	45.65	15.54	45.54	15.63	47.58	40.92	47.31	41.00	48.39	1.31	48.50	1.60
9	59.37	13.77	59.06	13.83	56.88	23.13	56.63	23.20	53.90	18.54	53.58	18.77	54.10	14.03	53.16	14.71	56.29	40.58	55.71	40.81	57.78	1.05	58.17	1.40
10	66.32	17.68	66.26	18.19	61.98	27.98	62.91	28.11	61.84	22.83	61.99	22.93	61.77	17.49	61.72	17.36	62.48	43.63	62.76	43.89	66.87	5.05	66.50	5.58
11	72.17	23.55	71.36	24.03	69.47	33.17	69.33	32.81	67.68	26.86	68.07	27.49	68.86	19.64	68.28	19.42	67.45	46.16	67.84	46.25	72.56	9.15	72.25	9.77
22	64.16	88.42	64.34	90.38	67.60	84.96	67.74	86.55	67.31	83.69	67.09	83.17	65.76	86.50	66.19	86.80	66.75	109.49	66.75	109.18	65.95	100.04	65.94	100.03
23	59.11	92.72	59.24	92.62	63.42	85.66	63.63	85.01	62.25	85.59	62.31	85.80	61.36	87.96	60.89	87.73	61.30	111.69	61.13	111.49	59.71	101.58	60.06	101.87
24	53.19	94.39	53.26	94.32	57.86	87.31	57.82	87.30	56.75	88.77	56.73	89.25	55.69	88.78	55.51	88.74	56.02	113.63	56.29	113.52	53.88	103.51	53.89	104.08
25	47.88	93.61	47.75	93.65	51.95	87.05	52.20	87.00	51.74	87.60	52.06	87.95	50.24	88.81	50.00	89.01	50.48	113.87	50.47	113.34	47.87	103.01	47.95	103.46
26	41.32	91.98	41.49	92.02	47.45	84.35	47.57	84.32	45.47	86.60	45.95	87.09	44.36	87.95	44.17	88.02	45.28	112.00	45.00	111.46	41.77	100.61	41.68	101.10
27	36.67	86.26	36.34	87.03	42.94	83.72	42.16	82.48	39.84	84.94	40.03	85.25	38.42	86.52	38.25	86.63	39.45	109.18	39.69	108.98	34.05	97.40	35.19	98.52

Area Data Report - S2

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	7.31	4.70	4.50	6.74	5.42	4.70	10.81	11.35	5.25	6.34	7.34	10.04
7	4.76	5.85	11.01	9.46	7.31	5.22	8.77	12.93	5.19	4.85	10.49	11.99
8	16.09	7.20	10.52	9.26	9.26	11.01	16.75	5.62	9.09	8.23	9.81	9.20
9	6.62	6.22	8.57	10.47	8.77	8.54	13.10	9.00	7.89	9.00	13.96	5.51
10	7.86	5.65	8.11	7.28	5.42	6.42	10.90	7.68	2.78	2.72	8.97	7.40
11	6.77	8.20	9.63	7.08	6.88	6.77	6.80	8.43	7.08	5.13	7.74	9.98
22	11.04	8.00	5.96	7.89	8.49	11.15	11.41	9.92	4.39	4.62	17.35	15.54
23	7.60	6.39	3.07	3.41	5.88	5.42	6.82	4.79	3.64	4.30	4.76	7.11
24	3.81	4.30	7.77	7.20	7.17	7.74	5.10	3.96	2.27	2.38	6.34	4.85
25	5.82	4.04	5.79	6.59	4.13	6.59	5.79	2.01	2.95	3.53	6.80	5.79
26	5.10	3.90	4.42	6.59	5.65	4.62	4.27	4.50	2.67	3.73	5.48	8.72
27	3.93	9.63	4.24	12.07	5.45	8.69	6.71	3.56	3.67	5.73	13.16	10.29

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	12.30	16.57	12.67	12.5	15.77	11.47	16.00	15.2	14.08	18.35	11.64	14.68
7	14.34	16.34	19.38	21.71	14.77	13.19	22.82	19.93	22.88	14.82	15.68	13.99
8	20.56	24.11	24.23	22.91	21.08	19.33	26.44	23.48	21.65	24.75	33.32	19.87
9	16.66	26.32	23.51	23.60	24.00	25.35	22.91	21.08	17.66	17.46	34.58	19.35
10	17.00	17.84	19.38	16.97	13.99	16.20	21.94	19.07	8.97	7.71	13.56	15.91
11	12.47	11.41	19.21	16.26	9.95	8.97	15.34	12.59	17.00	14.62	13.28	14.74
22	9.89	7.31	15.74	17.69	27.07	10.90	14.31	7.63	10.38	10.64	11.84	18.47
23	13.76	13.71	11.24	17.81	16.09	10.06	12.24	13.05	15.94	14.91	11.96	12.76
24	7.74	9.86	15.89	17.15	15.57	16.77	10.24	10.81	11.58	13.05	10.18	11.56
25	9.72	10.29	12.73	16.14	13.76	11.73	11.30	13.10	11.61	15.63	9.84	12.33
26	10.70	16.75	11.41	16.09	15.03	15.97	12.36	15.11	16.26	17.32	12.22	13.02
27	9.35	17.55	20.59	20.07	35.56	15.20	15.80	14.37	16.86	16.95	12.42	15.89

Position Data Report - S2

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.79	38.94	52.56	38.56	52.83	46.89	52.92	46.52	51.78	45.17	51.85	45.04	51.27	38.29	51.37	38.32	53.80	39.89	54.41	39.36	50.17	29.69	50.03	29.80
7	58.79	33.07	58.77	33.01	59.90	42.27	60.62	42.24	57.78	40.85	57.62	40.91	57.98	37.03	57.17	37.77	61.00	37.67	61.01	37.70	56.99	23.86	56.56	24.40
8	67.58	29.61	66.05	29.41	65.83	37.80	65.31	37.65	64.78	34.15	64.77	34.28	65.71	33.95	64.82	34.03	66.18	33.78	66.26	33.89	64.76	19.07	64.71	19.13
9	75.51	29.72	76.08	29.53	73.59	37.59	73.83	37.59	73.65	34.87	73.74	34.94	73.24	32.92	73.08	33.22	73.58	33.45	73.99	33.39	74.88	18.75	75.47	18.37
10	82.76	34.19	82.43	33.87	79.79	42.56	79.59	42.42	81.80	39.04	81.71	38.96	81.74	35.70	82.18	36.06	80.77	36.40	80.76	36.41	83.11	22.73	83.18	22.66
11	88.20	40.34	87.90	40.29	86.53	46.97	86.99	47.35	87.47	43.33	87.57	43.08	89.50	38.23	88.95	37.97	86.13	39.90	85.82	39.10	89.28	28.03	89.06	27.82
22	80.86	105.12	80.81	104.74	85.20	100.52	85.17	100.46	87.22	99.21	87.10	98.34	87.11	103.68	87.01	103.77	85.56	100.86	85.92	100.61	83.15	115.94	83.38	116.00
23	75.87	108.79	75.98	108.44	80.79	99.78	81.12	99.83	82.18	101.98	82.20	102.04	81.52	106.36	81.63	106.23	79.70	104.33	79.57	104.31	76.66	119.47	76.80	119.37
24	68.64	110.66	68.88	110.45	75.75	102.1	75.79	102.12	76.71	105.18	76.73	105.13	75.71	107.28	75.25	107.16	74.12	106.29	74.24	106.29	70.84	121.31	71.08	121.27
25	64.41	109.86	64.36	109.66	70.04	101.71	70.08	101.82	72.17	104.12	71.94	103.92	70.29	107.5	70.27	107.47	69.44	106.39	69.65	106.51	64.74	120.83	64.89	120.86
26	57.56	108.09	57.20	107.81	65.19	98.74	65.05	99.11	65.39	103.24	65.63	103.32	64.33	106.71	64.26	106.69	63.95	104.27	64.15	104.23	58.98	118.72	58.75	118.36
27	52.70	104.23	52.05	103.55	59.33	96.17	60.04	96.88	59.63	100.76	60.24	101.73	58.25	104.48	59.16	105.90	58.93	102.31	58.27	101.63	51.95	114.84	52.17	114.61

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.97	22.68	36.05	22.89	34.88	32.43	35.11	31.97	31.88	28.85	31.49	28.90	29.96	18.65	29.79	20.44	34.51	46.95	34.02	47.35	34.11	11.46	33.28	13.76
7	42.73	17.07	41.97	17.48	42.18	27.71	41.92	27.82	37.80	24.24	37.71	24.40	37.22	18.02	37.64	18.98	40.22	43.24	40.61	44.96	40.16	6.56	39.87	8.37
8	49.66	13.66	49.86	13.59	47.68	23.24	47.57	23.17	44.50	18.07	44.34	18.12	45.48	14.36	45.50	15.65	46.74	40.99	45.63	41.16	48.38	2.61	48.09	3.60
9	59.46	13.65	58.60	13.68	56.95	23.24	56.76	23.25	53.58	18.55	53.90	18.74	53.54	13.18	53.34	14.50	55.28	40.65	54.44	40.74	57.88	2.38	57.63	3.20
10	66.15	17.85	66.10	17.59	62.74	28.12	62.71	28.03	61.35	22.64	61.54	22.96	61.90	16.11	61.54	17.21	61.46	43.59	61.01	43.64	66.25	5.71	66.15	7.49
11	72.15	24.14	72.21	22.08	69.55	32.48	69.35	31.92	67.81	26.60	67.92	26.74	69.14	18.32	69.14	19.56	67.50	47.07	66.22	46.08	72.23	10.63	72.35	12.28
22	64.65	90.24	64.86	90.38	67.84	86.66	68.23	86.12	67.47	81.24	68.40	82.12	66.60	84.21	66.85	86.93	66.79	109.07	65.29	109.44	66.00	99.50	66.51	100.87
23	59.43	92.73	59.54	93.03	63.81	84.93	63.37	85.66	62.33	85.43	61.76	86.34	61.14	86.45	61.22	88.10	60.68	111.56	59.68	111.67	59.91	101.70	59.96	103.51
24	54.36	94.60	53.47	94.48	57.83	87.61	58.24	88.00	56.57	88.88	56.72	89.11	55.92	87.36	55.65	88.99	55.33	113.53	54.73	113.44	53.86	104.01	53.96	105.81
25	47.88	93.74	48.06	93.65	52.33	87.36	52.46	87.52	51.88	87.58	52.07	87.68	50.28	87.55	49.87	89.12	49.99	113.60	48.89	113.2	48.07	103.29	47.94	105.20
26	41.55	92.19	41.10	92.45	47.61	84.3	47.43	84.55	45.66	87.17	45.73	87.21	44.53	86.59	44.21	88.12	44.65	111.72	43.37	111.37	41.82	101.08	41.62	102.78
27	36.10	88.39	36.05	87.43	42.19	82.07	42.13	82.40	40.77	83.20	40.11	86.13	38.95	86.52	38.74	87.82	39.00	109.09	38.11	108.84	35.31	98.65	35.58	100.06

Area Data Report - S3

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.95	2.67	4.99	5.22	7.23	5.96	0.00	0.00	5.96	6.39	5.96	7.14
7	5.94	5.28	12.44	12.39	5.48	8.80	14.74	15.20	5.82	5.65	9.49	8.92
8	8.92	12.13	12.99	13.48	11.81	12.30	17.95	17.95	12.44	11.01	13.48	12.30
9	8.57	8.75	13.51	14.22	17.43	16.72	16.46	15.43	13.08	10.98	13.08	13.88
10	8.20	9.29	8.06	8.03	8.20	8.00	15.74	16.23	3.21	3.30	9.81	10.52
11	7.17	6.59	7.34	8.20	6.34	5.65	5.96	7.20	4.90	4.90	8.37	7.48
22	10.41	8.75	4.82	4.47	4.44	4.65	12.33	4.82	5.39	3.87	5.85	5.71
23	7.77	8.03	4.42	4.90	6.65	6.14	6.22	6.28	3.76	2.98	7.00	6.71
24	6.57	7.03	8.54	7.71	9.06	9.09	7.48	7.51	3.61	4.16	6.91	7.00
25	5.79	5.91	7.40	7.05	8.26	8.06	7.68	7.97	4.50	5.16	7.54	7.60
26	6.77	6.02	6.19	5.33	6.02	7.17	8.66	8.86	4.16	4.13	6.91	7.05
27	4.96	4.36	6.71	7.17	2.61	8.06	4.36	8.09	7.97	4.87	6.08	7.08

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	8.95	15.20	8.00	14.82	13.59	12.76	13.88	17.84	9.98	14.91	11.33	18.01
7	12.67	13.85	18.06	19.99	13.28	14.74	21.51	24.66	13.68	12.10	17.06	17.26
8	20.04	19.76	21.51	22.16	17.92	20.30	25.86	26.52	16.17	17.69	18.35	18.41
9	15.71	15.89	20.82	22.51	25.29	26.90	22.45	22.39	13.79	15.25	18.32	18.12
10	13.59	14.05	15.43	17.55	12.44	13.19	23.83	23.46	7.25	9.55	15.94	14.62
11	7.25	12.59	10.32	14.14	15.28	14.28	17.52	18.06	7.31	10.81	14.60	14.14
22	5.79	15.05	5.62	21.39	13.68	11.41	12.16	19.21	16.26	12.70	17.98	7.40
23	12.53	14.82	8.20	12.22	12.36	12.07	13.65	14.68	10.72	8.75	12.50	10.09
24	11.35	12.47	13.53	13.88	14.37	14.48	12.76	11.56	11.10	10.78	10.81	9.75
25	11.15	12.30	12.90	12.90	8.46	8.60	12.65	12.22	9.89	9.69	11.70	9.95
26	13.56	13.28	11.56	9.46	13.05	11.47	14.28	13.68	13.71	11.47	11.87	10.87
27	9.92	16.83	5.68	15.40	15.71	13.71	12.96	20.93	15.80	15.14	16.63	8.20

Position Data Report - S3

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.11	37.88	53.10	38.07	52.86	46.86	52.88	46.83	51.92	45.14	52.10	44.86	0.00	0.00	0.00	0.00	54.25	39.86	54.26	39.8	50.31	28.80	50.43	28.81
7	58.28	32.85	58.42	32.98	60.47	42.22	60.53	42.22	58.28	40.20	57.89	40.72	54.55	37.86	54.65	37.76	61.41	37.59	61.36	37.67	56.78	23.30	56.81	23.27
8	66.63	29.37	66.24	29.45	66.16	37.81	66.04	37.78	64.99	34.21	64.99	34.23	62.98	34.17	62.78	34.15	66.67	33.90	66.67	33.85	64.49	18.66	64.18	18.63
9	75.27	29.39	75.48	29.63	74.28	37.66	74.30	37.69	73.69	34.91	73.76	34.83	71.00	33.05	70.72	33.02	73.91	33.75	74.36	33.42	74.55	18.47	74.50	18.50
10	82.24	33.85	82.17	34.01	79.48	42.46	79.49	42.46	81.79	39.03	81.80	39.05	79.14	35.84	78.96	35.83	81.04	36.35	81.04	36.36	82.61	22.45	82.58	22.49
11	87.71	39.90	87.77	39.86	86.89	47.14	86.84	47.12	87.89	43.47	87.98	43.53	86.58	38.17	86.26	38.12	86.42	39.90	86.41	39.71	88.89	27.80	89.03	27.88
22	80.39	104.79	80.40	105.01	85.20	100.58	85.16	100.65	87.17	99.30	87.18	99.28	84.40	103.86	83.35	104.85	85.42	101.43	85.25	101.82	82.30	116.84	82.31	116.84
23	75.28	108.44	75.23	108.69	81.05	99.78	81.03	99.81	82.26	101.96	82.21	102.00	79.12	106.65	78.98	106.70	80.09	104.31	79.50	104.47	76.23	119.33	76.21	119.34
24	69.13	110.34	69.01	110.47	75.71	102.08	75.77	102.05	76.62	105.14	76.61	105.14	72.90	107.41	72.91	107.42	74.8	106.29	74.77	106.28	70.36	121.23	70.34	121.23
25	63.87	109.55	63.78	109.70	69.99	101.77	69.98	101.76	71.99	103.92	71.91	103.87	67.39	107.63	67.23	107.64	69.76	106.38	69.64	106.38	64.34	120.75	64.34	120.74
26	57.40	107.91	57.16	107.97	65.24	98.88	65.64	99.25	65.64	103.4	65.55	103.37	61.59	106.57	61.42	106.59	64.53	104.32	64.58	104.34	58.50	118.60	58.48	118.53
27	52.29	103.74	52.39	104.31	59.61	96.38	59.72	96.54	60.04	101.69	60.24	101.89	56.43	106.03	56.19	105.97	58.52	101.58	59.31	102.33	51.92	115.90	52.04	115.93

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.34	19.39	36.14	23.15	35.10	31.10	35.35	30.92	31.52	29.12	32.31	28.60	30.82	17.99	30.39	19.88	34.46	47.53	35.29	47.47	34.12	11.13	33.46	11.82
7	42.29	14.72	42.33	17.21	42.76	26.47	42.22	26.54	37.93	24.45	37.88	24.43	37.43	17.81	37.36	19.31	42.48	44.51	43.12	44.60	39.80	6.60	39.73	6.79
8	50.06	11.16	50.07	13.69	47.68	21.94	47.77	21.97	44.71	17.85	44.98	18.16	45.62	14.31	45.50	15.74	47.15	41.00	47.72	40.98	48.06	1.46	48.18	1.46
9	59.52	11.20	59.59	13.72	56.49	21.92	56.73	21.99	53.79	18.57	53.96	18.90	53.68	13.12	53.46	14.55	55.19	40.47	55.57	40.61	57.80	1.19	58.04	1.20
10	66.30	15.24	66.30	17.78	61.97	26.63	62.15	26.76	61.63	22.67	61.68	22.90	61.75	16.01	61.60	17.29	61.99	43.68	62.43	43.70	66.34	5.43	66.37	5.41
11	72.17	21.22	71.97	24.26	69.39	31.56	69.32	31.48	68.16	27.40	68.21	27.61	68.90	18.42	68.86	19.87	67.17	47.01	67.64	46.07	72.00	10.14	71.81	10.21
22	64.05	87.59	64.57	89.05	67.67	85.24	68.03	84.04	67.58	82.67	67.42	82.69	66.34	84.49	67.05	85.11	66.81	108.39	67.40	107.98	66.50	98.49	65.64	99.36
23	59.45	90.16	59.39	92.79	63.71	83.72	63.42	83.82	62.52	85.57	62.42	85.73	61.32	86.54	61.20	87.90	60.80	111.43	61.52	110.49	60.02	101.48	59.79	101.68
24	53.15	91.91	53.32	94.52	57.92	86.12	57.97	86.19	56.66	88.75	56.70	88.95	55.76	87.49	55.59	88.73	55.46	113.56	56.45	113.63	53.82	103.65	53.90	103.72
25	47.68	91.00	47.62	93.64	52.13	85.85	52.21	85.96	52.05	87.88	52.19	88.04	50.19	87.66	49.91	88.98	50.37	113.65	51.10	113.77	47.79	103.04	47.83	103.22
26	41.45	89.58	41.46	92.01	47.36	82.79	47.73	83.13	45.40	86.87	45.47	87.04	44.29	86.62	44.05	88.01	44.82	111.40	45.54	111.46	41.60	100.79	41.88	100.92
27	37.23	84.38	35.95	87.34	42.23	81.45	42.30	81.06	39.73	85.01	39.80	85.24	38.65	85.96	38.24	86.63	38.92	108.78	39.64	108.68	34.86	97.44	35.80	98.52

Area Data Report - S4												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.49	2.67	5.30	4.85	4.39	5.16	2.98	4.04	5.68	5.71	6.02	5.82
7	3.99	4.16	9.72	8.09	4.93	4.90	4.01	4.59	5.62	5.53	9.52	7.97
8	4.19	4.39	12.79	8.03	12.42	7.74	17.06	16.54	5.73	6.37	15.80	10.78
9	3.33	8.80	13.53	11.73	16.75	16.54	12.93	14.82	8.00	7.89	9.78	9.43
10	4.53	8.06	5.94	7.83	5.48	5.39	14.68	9.72	2.47	3.10	5.25	4.96
11	6.08	7.11	8.20	8.83	5.13	5.79	7.14	11.15	4.10	4.76	11.47	6.80
22	3.44	3.44	8.03	4.65	3.73	3.93	4.56	3.87	2.95	3.58	3.93	16.77
23	7.08	6.25	4.76	3.64	6.22	5.76	5.76	5.94	3.04	2.09	6.91	6.88
24	5.08	5.76	8.60	6.91	8.97	7.91	6.37	5.25	2.55	2.95	7.00	6.71
25	5.53	5.45	7.66	6.88	6.39	4.47	7.31	7.28	4.24	3.93	7.60	7.34
26	3.53	3.87	9.61	6.11	5.71	3.07	7.66	7.71	3.81	2.98	7.80	4.76
27	3.50	3.07	11.87	9.81	2.95	2.61	2.98	4.13	5.39	5.30	3.44	3.56
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	4.01	10.92	14.54	7.46	8.72	7.08	6.08	0.00	7.48	0.00	10.18	7.83
7	11.47	14.37	17.35	18.15	12.96	11.67	20.44	22.22	13.59	12.85	16.46	18.01
8	17.69	18.67	18.35	23.43	19.53	17.75	27.41	25.32	17.89	17.32	18.32	17.58
9	16.66	20.24	20.19	21.88	25.06	22.68	22.51	23.28	17.09	15.68	18.61	18.58
10	15.31	13.65	17.18	17.03	11.61	10.87	22.37	23.11	8.09	7.23	17.15	18.24
11	7.74	11.96	10.32	10.52	8.43	9.98	15.43	15.05	7.46	6.42	15.43	14.65
22	5.88	11.07	6.91	3.56	5.19	6.31	4.85	6.62	16.89	18.75	13.28	9.63
23	14.62	14.14	10.06	8.72	14.74	13.65	12.85	16.32	16.00	15.74	11.21	10.52
24	12.59	11.90	10.21	14.14	16.00	15.71	11.87	13.28	12.24	11.90	10.06	11.07
25	11.73	10.98	11.04	13.16	12.87	12.76	12.27	13.45	13.42	11.15	12.16	11.30
26	14.48	10.29	9.75	12.22	13.33	13.16	13.62	14.71	16.69	14.88	12.44	11.56
27	11.24	14.60	13.82	6.42	2.95	3.96	12.85	13.30	16.86	16.72	9.86	8.23

Position Data Report - S4

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.92	38.11	52.93	37.90	52.89	46.82	52.85	46.71	51.86	44.87	51.49	45.59	51.02	37.88	51.13	37.84	54.21	39.95	54.03	39.96	50.30	28.70	50.28	28.68
7	58.12	33.08	57.68	33.19	60.50	42.26	60.36	42.11	58.11	40.22	58.29	40.23	54.85	37.63	54.93	37.68	61.37	37.64	61.20	37.65	56.80	23.24	56.76	23.17
8	66.56	29.44	65.36	29.37	65.99	37.73	65.36	37.39	64.71	34.31	64.93	34.03	64.18	34.15	64.38	34.17	66.69	33.67	66.48	33.68	64.67	18.76	64.48	18.83
9	74.89	29.03	75.06	29.43	74.28	37.66	73.90	37.49	73.57	34.83	73.69	34.87	72.32	33.00	72.31	33.00	73.83	33.51	73.66	33.50	74.59	18.88	74.38	18.72
10	82.64	34.61	82.08	33.89	79.62	42.59	79.47	42.28	81.65	38.94	81.65	39.21	80.31	35.84	80.03	35.74	80.90	36.28	80.89	36.36	82.69	22.19	82.70	22.29
11	87.81	39.63	87.52	39.97	86.84	47.12	86.50	46.97	87.85	43.56	87.95	43.52	88.09	38.47	87.54	38.18	86.42	39.78	86.25	39.92	88.36	27.56	89.16	27.81
22	80.04	105.83	79.87	105.83	85.17	100.45	85.14	100.48	87.01	99.28	87.17	99.25	84.72	104.82	84.85	104.81	85.58	101.58	85.89	100.46	82.45	116.85	82.71	115.61
23	75.48	108.34	75.31	108.32	81.06	99.81	80.97	99.60	82.08	101.97	82.27	101.98	80.20	106.49	79.90	106.56	80.24	104.29	79.83	104.37	76.24	119.16	76.21	119.06
24	68.65	110.31	68.73	110.38	75.70	102.08	75.68	102.06	76.50	105.12	76.66	105.18	74.20	107.45	74.49	107.40	74.65	106.29	74.58	106.29	70.35	121.06	70.39	120.96
25	63.85	109.54	63.59	109.53	69.98	101.71	69.91	101.55	71.78	103.94	72.08	104.15	68.58	107.63	68.75	107.63	69.70	106.36	69.80	106.51	64.33	120.58	64.32	120.49
26	56.98	107.8	56.94	107.88	65.15	99.08	65.13	99.06	65.74	103.44	66.16	103.83	62.81	106.64	63.03	106.63	64.62	104.34	63.91	104.19	58.20	118.22	58.32	117.86
27	52.42	104.21	52.30	104.28	59.95	96.81	59.91	96.59	59.92	101.72	60.04	101.69	57.59	106.04	57.86	106.12	58.81	101.89	58.81	102.05	51.88	115.92	51.87	115.82

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.33	22.30	36.42	24.18	36.08	31.54	35.24	32.36	31.84	29.03	31.71	29.39	32.60	19.19	0.00	0.00	34.99	47.70	0.00	0.00	34.09	13.29	33.94	13.50
7	42.35	17.41	42.22	17.27	42.60	27.68	42.37	27.80	37.97	24.37	38.00	24.69	37.48	19.12	37.15	19.27	43.20	44.33	43.37	44.42	39.78	8.57	39.71	8.74
8	50.24	13.68	50.25	13.67	48.10	23.2	47.89	23.21	44.56	17.98	44.94	18.02	45.50	15.67	45.44	15.73	47.81	40.99	48.22	41.05	48.25	3.47	48.18	3.45
9	59.45	13.78	58.99	14.18	56.63	23.11	56.56	23.18	53.73	18.62	53.58	18.56	53.64	14.53	53.43	14.58	55.51	40.72	55.66	40.69	58.02	3.30	57.87	3.29
10	66.36	17.91	66.44	17.99	62.26	27.86	62.40	27.88	61.64	22.65	61.93	22.91	61.88	17.34	61.70	17.35	62.59	43.83	62.48	43.66	66.53	7.63	66.36	7.66
11	72.07	24.05	71.76	24.90	69.53	32.35	69.47	32.76	68.04	27.42	67.99	27.53	68.63	19.52	68.43	19.50	67.70	47.19	67.90	47.00	71.83	12.09	71.93	12.08
22	63.98	90.42	64.73	89.90	68.67	85.31	67.86	86.33	67.21	82.90	67.07	83.23	66.31	86.82	65.83	86.50	67.38	108.29	67.42	108.01	66.25	100.54	66.52	100.13
23	59.33	92.80	59.51	92.80	63.78	85.61	63.56	85.00	62.29	85.63	62.21	85.64	61.62	88.12	61.22	88.17	61.11	111.50	61.00	111.58	59.94	103.64	59.76	103.72
24	53.28	94.36	53.34	94.37	58.39	87.64	57.89	87.37	56.74	89.05	56.71	89.15	55.72	88.86	55.45	88.96	56.01	113.52	56.08	113.51	53.75	105.72	53.87	105.75
25	47.82	93.64	47.82	93.53	52.46	87.55	52.18	87.16	51.90	87.54	51.90	87.71	50.12	89.06	50.01	89.11	50.33	113.34	50.85	113.46	47.85	105.17	47.92	105.19
26	41.46	92.05	41.37	92.01	47.70	84.99	47.44	84.16	45.59	86.86	45.54	87.03	44.51	87.94	44.20	88.11	45.00	111.54	45.08	111.19	41.58	102.86	41.90	102.84
27	36.01	87.86	36.81	85.85	42.43	82.68	42.88	83.27	40.00	85.20	39.99	85.34	39.25	87.80	39.04	88.08	39.50	108.9	39.54	108.80	35.50	100.60	35.61	100.50

Area Data Report - S5

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.29	2.84	4.99	5.42	6.54	7.37	0.00	0.00	6.42	5.33	10.92	7.23
7	4.36	3.15	9.81	7.63	5.94	5.42	4.70	14.94	6.11	5.82	9.78	9.38
8	5.82	8.75	10.29	8.11	12.67	12.24	16.83	17.09	11.90	6.62	17.78	14.85
9	6.85	4.27	12.42	13.56	18.01	18.18	15.43	16.46	15.63	9.98	16.83	15.54
10	4.39	4.13	8.32	8.29	8.57	7.51	16.34	15.40	4.36	3.44	5.68	12.19
11	8.34	8.46	9.15	7.25	5.13	5.85	11.01	11.15	5.91	4.47	11.90	12.04
22	3.24	3.04	3.24	3.27	4.10	4.01	4.10	11.15	3.38	3.64	5.56	8.03
23	8.34	8.06	2.92	4.13	5.30	6.45	3.61	9.38	5.42	3.01	6.91	6.74
24	5.82	6.08	6.37	6.97	7.63	10.06	8.14	7.71	4.73	3.70	6.74	6.65
25	5.94	5.73	4.67	6.94	4.44	8.17	7.40	7.68	4.65	5.05	7.48	7.08
26	4.16	4.07	2.98	3.13	3.81	7.05	8.69	8.09	5.65	3.78	9.03	5.82
27	4.36	4.59	3.24	3.76	2.98	7.51	5.42	8.00	8.00	4.65	6.54	6.88

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	8.72	9.15	6.22	6.45	14.74	6.45	0.00	0.00	5.48	8.29	5.85	5.71
7	10.95	13.10	19.33	16.83	13.19	16.83	21.62	25.29	10.55	12.10	10.47	6.59
8	18.29	17.15	21.05	18.72	20.07	18.72	26.95	25.20	11.93	16.17	18.95	8.23
9	16.52	12.04	22.77	20.90	23.11	20.90	22.91	22.80	15.28	15.37	18.67	10.70
10	14.19	14.65	19.78	14.34	12.99	14.42	19.84	22.91	9.55	8.46	12.79	7.68
11	8.49	10.61	8.43	10.72	12.82	10.72	13.45	12.93	7.05	8.57	12.62	11.93
22	6.57	6.65	3.87	7.57	6.22	7.57	16.03	6.34	12.47	9.26	7.97	1.92
23	14.31	14.91	10.78	10.29	13.82	10.21	12.22	12.04	12.82	11.70	9.58	7.43
24	15.20	13.45	14.16	14.65	15.51	14.8	12.79	12.10	11.35	10.92	10.78	8.63
25	10.98	9.61	13.08	13.05	12.62	13.02	13.48	12.07	10.44	11.44	11.47	10.75
26	14.02	11.78	11.61	4.76	13.25	4.76	14.57	14.71	16.52	13.56	12.22	10.24
27	5.10	5.39	13.85	7.48	3.93	7.48	11.15	9.38	15.54	15.97	5.82	6.57

Position Data Report - S5

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	53.05	37.91	53.10	37.89	52.86	46.86	52.91	46.81	51.68	45.40	51.90	45.18	0.00	0.00	0.00	0.00	54.20	39.47	54.13	39.69	51.10	28.88	50.41	28.98
7	58.59	32.65	58.84	32.39	60.51	42.26	60.36	42.26	58.23	40.45	58.36	40.10	53.89	37.37	54.25	37.84	61.10	37.56	61.24	37.59	57.07	23.47	56.78	23.62
8	65.66	29.30	66.02	29.28	65.66	37.64	65.50	37.61	65.12	34.26	64.94	34.27	62.70	34.18	62.67	34.15	66.40	33.93	66.65	33.75	65.30	19.08	64.54	18.89
9	75.25	29.32	74.91	29.10	74.15	37.63	74.12	37.67	73.70	34.89	73.72	34.90	70.55	33.02	70.66	33.06	73.92	33.84	74.08	33.41	74.88	18.86	74.62	18.79
10	82.03	33.22	82.01	33.20	79.50	42.45	79.50	42.45	81.80	39.08	81.79	39.02	78.80	35.84	78.80	35.87	80.00	36.07	81.00	36.43	82.97	22.45	82.42	22.74
11	87.62	40.04	87.60	40.07	86.93	47.33	86.96	47.29	88.02	43.56	87.96	43.52	85.88	38.19	85.84	38.18	86.27	40.50	86.24	39.92	88.70	27.78	88.37	27.78
22	80.05	105.80	80.02	105.86	85.15	100.82	85.23	100.77	87.15	99.30	87.17	99.25	83.16	104.80	84.00	103.89	84.86	101.88	85.17	101.74	82.65	116.93	82.95	115.81
23	75.22	108.51	75.29	108.49	80.83	99.76	81.00	99.79	82.14	102.08	82.28	101.94	78.69	106.92	78.30	106.62	79.58	104.50	79.30	104.50	76.51	119.40	76.21	119.40
24	68.76	110.36	68.80	110.32	76.04	102.17	76.05	102.20	76.67	105.20	76.61	105.24	72.68	107.43	72.65	107.41	74.46	106.37	74.63	106.28	70.73	121.30	70.34	121.31
25	63.87	109.51	63.79	109.55	70.13	101.75	69.99	101.90	72.24	104.14	71.94	103.89	67.05	107.63	67.06	107.63	69.30	106.33	69.53	106.40	64.63	120.84	64.32	120.83
26	57.19	107.95	57.20	107.97	65.41	99.26	65.54	99.34	65.88	103.60	65.51	103.35	61.25	106.57	61.27	106.62	64.24	104.48	64.47	104.36	58.73	118.50	58.49	118.69
27	52.39	104.14	52.38	104.15	59.64	96.88	59.38	96.37	60.19	101.91	60.23	101.89	56.38	106.31	56.03	105.97	58.22	101.61	59.22	102.34	52.31	116.03	52.08	116.05

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.20	22.10	37.58	22.72	35.17	32.61	35.46	32.64	31.46	29.23	35.46	32.64	0.00	0.00	0.00	0.00	35.47	47.95	35.13	47.75	33.93	13.46	33.67	13.57
7	42.62	17.12	42.14	17.28	42.56	27.72	42.94	27.76	38.18	24.32	42.94	27.76	37.51	19.96	37.10	20.21	42.95	45.24	42.95	45.06	40.62	7.79	40.47	7.50
8	50.23	13.57	50.25	13.84	48.04	23.11	48.49	23.11	44.24	18.20	48.49	23.11	45.44	16.49	45.45	16.36	48.45	41.44	48.10	41.23	47.96	3.54	48.21	2.92
9	59.42	13.82	59.58	14.17	56.96	23.19	56.93	23.11	53.78	18.60	56.93	23.11	53.73	15.30	53.43	15.17	55.89	40.87	55.73	40.75	58.21	3.36	58.14	2.84
10	66.37	17.90	65.88	17.72	62.42	27.99	62.29	28.04	61.71	22.99	62.29	28.03	62.10	18.30	61.61	18.04	62.57	43.83	62.71	43.96	66.62	7.34	66.43	6.94
11	71.98	24.00	72.05	24.36	69.60	32.51	69.65	32.95	68.09	27.28	69.65	32.95	68.62	20.16	68.49	20.07	67.64	47.34	67.78	47.52	72.34	12.13	71.94	12.44
22	64.37	90.42	64.33	90.38	68.10	86.56	67.41	86.66	67.15	83.37	67.41	86.66	66.76	86.24	66.03	87.63	67.07	108.74	67.09	109.60	67.08	100.33	66.13	101.59
23	59.39	92.77	59.64	92.75	63.33	85.29	63.57	85.03	62.12	85.67	63.60	85.02	61.23	88.76	61.54	88.74	61.24	111.83	61.56	111.65	60.07	103.59	60.06	103.89
24	53.21	94.28	53.27	94.51	58.15	87.50	58.28	87.37	56.81	89.19	58.24	87.38	55.70	89.75	55.73	89.68	56.13	113.74	56.34	113.73	53.81	105.73	53.86	105.73
25	47.79	93.62	47.72	93.65	52.26	86.92	52.48	87.16	52.05	87.79	52.47	87.15	50.18	90.00	49.93	89.89	51.03	113.90	50.95	113.85	47.74	105.25	48.00	105.12
26	41.66	92.07	41.33	91.95	47.52	84.17	48.24	84.86	45.27	86.90	48.24	84.86	44.47	88.96	44.27	88.67	45.55	111.29	45.60	112.14	41.73	102.82	41.87	102.95
27	37.55	88.17	37.60	87.78	42.57	81.96	41.96	82.13	40.00	85.83	41.96	82.13	39.32	88.85	39.22	88.21	39.49	108.90	39.79	109.27	36.02	100.82	35.47	100.70

Area Data Report - S6												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	2.67	2.38	5.45	4.96	4.85	4.01	4.04	2.32	5.30	4.47	5.42	6.51
7	4.13	3.99	8.09	10.58	4.39	4.59	4.53	4.85	5.62	5.39	3.61	3.87
8	3.13	5.96	6.82	5.42	6.51	8.72	3.99	3.30	7.00	6.08	5.36	4.82
9	4.36	5.45	8.57	10.04	16.34	16.54	4.87	3.15	9.12	8.40	6.42	6.65
10	2.92	3.87	7.68	7.89	4.99	5.65	3.07	5.05	2.52	3.10	5.85	5.88
11	6.08	8.43	7.34	5.94	5.13	5.79	7.03	7.20	4.10	4.76	11.78	10.49
22	3.04	2.98	16.32	4.56	3.93	3.73	3.93	4.27	5.22	4.33	3.87	9.06
23	4.56	6.71	4.96	2.92	4.93	5.76	2.70	3.87	2.12	2.90	6.16	6.28
24	3.35	6.05	3.21	7.28	8.95	8.00	4.65	5.76	3.47	3.44	6.57	7.03
25	3.53	5.68	7.08	7.03	4.19	4.85	2.70	5.51	4.79	4.79	7.08	7.51
26	3.38	3.87	9.15	3.47	2.15	3.50	3.73	5.08	3.41	3.50	5.73	5.36
27	2.27	2.81	11.35	4.01	2.95	2.35	4.07	4.33	4.79	5.36	6.71	6.28
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	26.70	23.97	15.23	15.20	17.15	17.09	28.56	26.64	17.52	18.24	11.38	15.71
7	14.54	18.06	21.99	22.51	13.22	16.32	22.37	25.00	18.44	18.15	18.55	19.96
8	21.13	21.42	24.09	25.58	20.10	22.48	26.44	27.41	21.88	21.94	20.39	22.39
9	17.61	16.60	23.28	23.71	27.90	26.09	23.77	24.80	20.27	18.12	17.38	22.77
10	15.57	15.57	20.04	18.81	13.22	13.96	23.48	25.81	9.26	8.43	18.01	17.06
11	12.73	18.90	17.92	17.18	13.91	12.73	18.01	18.15	25.26	21.53	15.37	14.97
22	12.70	5.96	26.87	19.18	16.66	14.60	26.04	10.06	19.35	13.51	19.10	11.18
23	14.42	16.57	17.66	18.21	14.71	15.60	14.68	15.31	17.38	16.14	10.75	10.81
24	13.53	12.04	14.42	14.19	16.54	17.38	12.22	12.99	12.96	12.67	11.21	10.55
25	12.39	11.44	14.05	15.86	13.48	14.25	13.48	12.85	14.57	13.45	12.04	12.10
26	13.02	11.99	17.15	16.34	14.39	15.17	13.76	15.28	17.75	18.01	13.76	13.30
27	12.87	8.77	18.64	19.33	17.63	15.91	21.25	12.59	16.49	17.78	17.12	10.27

Position Data Report - S6

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.93	37.90	53.11	37.88	52.91	46.81	52.86	46.87	52.08	44.82	51.87	44.88	51.14	38.03	50.89	37.74	53.97	39.69	53.83	40.22	50.18	28.93	50.35	28.85
7	57.82	33.18	58.67	32.55	60.36	42.28	60.52	42.26	58.28	40.24	58.08	40.25	55.63	37.53	55.98	36.91	61.03	37.64	61.18	37.67	57.12	22.94	57.07	22.99
8	67.80	29.27	65.87	29.32	65.19	37.49	65.12	37.54	64.86	33.91	65.04	34.10	64.10	33.90	63.55	33.55	66.50	33.76	66.85	33.80	64.67	18.43	64.49	18.38
9	74.76	29.11	75.74	29.41	73.58	37.59	73.74	37.58	73.72	34.79	73.55	34.87	73.45	32.51	73.05	32.11	73.54	33.53	73.60	33.52	74.77	18.27	74.82	18.30
10	81.39	32.62	81.82	32.94	79.46	42.45	79.46	42.44	81.81	38.85	81.66	38.93	79.90	35.42	79.71	35.21	80.59	36.30	80.89	36.36	82.77	22.43	82.71	22.41
11	87.64	39.63	87.63	40.03	86.89	47.14	86.84	46.96	88.02	43.56	87.78	43.52	87.84	38.30	87.45	37.95	86.08	39.78	86.25	39.92	88.31	27.68	88.47	27.73
22	79.85	105.86	80.03	105.84	85.55	99.66	85.16	100.64	87.17	99.25	87.01	99.28	84.85	104.98	84.51	104.65	85.51	100.79	85.81	100.57	82.48	116.92	82.76	115.91
23	75.74	108.20	75.26	108.51	81.12	99.81	80.86	99.75	82.29	101.96	82.10	101.98	80.40	107.12	80.16	106.73	79.70	104.35	79.34	104.49	76.23	119.27	76.18	119.34
24	68.01	110.34	68.89	110.38	76.37	102.09	76.00	102.14	76.62	105.14	76.48	105.18	74.34	107.62	74.01	107.26	74.39	106.28	74.27	106.17	70.38	121.13	70.35	121.23
25	64.32	109.47	63.90	109.54	69.90	101.66	69.97	101.79	72.05	104.18	72.01	104.10	68.49	107.82	68.72	107.43	69.40	106.43	69.53	106.39	64.36	120.68	64.36	120.74
26	57.11	108.06	57.11	107.88	65.13	99.04	65.60	99.38	66.37	103.99	65.34	103.37	62.99	106.49	62.56	106.67	64.60	104.46	63.94	104.17	58.48	118.49	58.50	118.62
27	52.42	104.20	52.42	103.85	59.94	96.79	59.77	96.95	60.09	101.72	59.86	101.71	57.83	106.23	57.52	105.87	58.63	102.02	58.79	102.04	52.05	115.87	52.05	115.94

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.21	24.35	36.42	23.71	32.32	31.33	35.28	32.14	31.68	29.05	31.53	29.29	30.10	19.72	29.98	21.10	35.28	47.32	35.72	47.10	32.87	14.23	33.97	13.27
7	42.27	17.45	42.59	17.32	39.59	26.72	42.03	27.95	37.73	24.56	37.87	24.56	37.36	17.95	37.23	19.40	42.55	44.44	42.73	44.47	39.87	8.76	40.00	8.67
8	50.26	13.62	50.09	13.66	44.95	22.11	47.37	23.37	44.60	18.00	44.50	18.37	45.45	14.33	45.37	15.71	47.46	41.07	47.78	41.02	48.26	3.61	48.49	3.77
9	59.58	13.76	59.56	13.80	54.34	22.06	56.95	23.29	54.08	18.65	53.87	18.83	53.68	13.22	53.60	14.63	55.48	40.88	56.02	40.69	58.17	3.23	57.60	3.51
10	66.30	17.69	66.35	17.86	60.00	26.75	62.49	27.93	61.84	22.80	61.65	22.89	61.74	16.01	61.59	17.40	62.26	43.69	62.62	43.78	66.12	7.53	66.35	7.55
11	71.79	22.94	71.40	23.68	67.17	31.31	69.66	32.36	68.21	27.25	67.80	27.02	69.35	18.63	69.00	19.91	66.67	46.69	66.56	46.34	71.88	12.12	72.02	12.25
22	64.84	89.93	63.91	90.46	65.83	84.23	68.06	86.28	67.69	82.70	66.60	83.18	67.52	84.23	65.85	86.28	67.42	108.13	66.91	109.00	66.69	100.39	65.99	101.57
23	59.32	92.86	59.18	92.82	61.00	84.34	63.46	85.59	62.33	85.46	62.33	85.54	61.34	86.64	61.15	87.95	61.01	111.42	61.25	111.48	60.01	103.68	60.03	103.70
24	53.51	94.43	53.22	94.47	55.49	86.22	57.96	87.37	56.66	88.93	56.69	89.12	55.69	87.43	55.45	88.83	55.96	113.42	56.28	113.49	54.02	105.68	53.90	105.74
25	47.76	93.51	47.76	93.62	49.73	85.98	52.32	87.23	51.88	87.62	52.00	87.71	50.21	87.6	50.09	89.01	50.27	113.27	50.67	113.44	47.99	105.18	47.97	105.19
26	41.42	91.87	41.41	91.87	44.85	83.22	47.39	84.40	45.52	86.84	45.57	87.10	44.35	86.66	44.15	88.03	44.73	111.39	45.21	111.48	41.88	102.78	41.65	102.75
27	36.32	88.12	37.17	87.23	39.74	81.12	42.11	82.16	40.20	85.93	41.00	85.37	38.45	85.66	39.15	88.11	39.36	108.81	39.63	108.78	34.80	99.34	35.43	100.53

Area Data Report - S7

Technique A

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	5.19	2.55	4.50	4.85	5.36	6.08	0.00	0.00	5.10	5.71	6.02	7.60
7	3.18	4.50	10.90	11.27	4.73	4.36	10.06	12.99	5.19	6.74	3.35	8.83
8	9.18	8.63	7.08	8.26	11.38	6.54	15.34	10.18	6.31	6.74	5.51	12.10
9	5.68	5.45	12.90	10.58	15.28	5.65	14.65	11.78	7.80	8.95	6.82	6.65
10	5.65	5.94	8.23	7.89	5.39	5.73	15.91	4.67	2.87	3.33	8.75	5.73
11	5.51	5.39	9.49	9.98	5.48	5.08	6.94	7.37	4.67	3.99	10.81	5.08
22	7.48	2.35	2.21	2.44	3.93	4.65	12.19	11.53	4.59	3.64	15.48	3.76
23	6.31	6.97	3.13	4.42	5.62	6.02	7.20	8.17	3.53	3.18	6.85	6.82
24	5.36	3.67	8.26	7.23	6.80	8.00	6.65	6.82	3.84	2.70	6.77	6.51
25	5.13	4.27	7.28	7.00	3.84	4.04	7.51	7.74	4.30	4.53	7.46	7.05
26	3.53	2.58	5.88	2.61	3.58	2.47	7.94	8.43	3.07	3.64	5.68	5.79
27	3.99	2.29	2.41	2.09	3.27	2.95	8.80	3.78	6.85	6.39	9.29	6.34

Technique B

Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	16.34	14.14	14.94	15.25	19.35	17.49	0.00	22.88	15.46	17.46	10.87	16.32
7	16.29	14.48	17.46	18.98	15.40	14.31	21.05	27.07	14.19	9.29	15.11	18.09
8	22.77	18.75	22.28	21.99	23.31	20.99	26.24	23.51	18.12	19.04	18.78	19.61
9	18.18	17.20	22.16	22.48	29.56	26.41	21.96	23.54	16.09	16.32	18.01	19.35
10	15.00	16.14	17.18	17.75	14.42	12.01	23.25	17.78	7.48	8.46	17.95	17.43
11	8.32	11.93	16.06	14.82	17.95	16.32	16.77	13.51	14.14	16.63	15.20	15.60
22	12.33	8.40	8.46	11.56	20.10	9.95	9.92	13.85	17.26	16.63	14.02	18.81
23	15.37	14.14	9.78	10.41	17.98	12.73	14.54	11.27	11.18	14.22	9.72	11.96
24	14.54	12.96	9.15	14.11	17.63	15.86	8.80	12.50	11.15	12.01	10.49	10.21
25	12.16	9.98	12.50	13.91	14.22	13.48	11.30	13.88	12.99	14.34	11.73	12.13
26	17.00	12.73	11.90	15.77	16.29	11.99	12.99	20.65	15.28	17.81	12.36	13.45
27	14.14	10.84	20.13	15.74	15.37	10.78	20.99	22.88	16.80	16.46	15.48	14.11

Position Data Report - S7

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.28	38.52	52.76	38.29	52.83	46.89	52.68	47.22	51.69	45.29	51.87	45.14	0.00	0.00	0.00	0.00	53.96	39.74	54.26	39.83	50.30	28.87	50.52	28.83
7	58.15	33.21	58.34	32.89	60.58	42.19	60.39	42.57	58.28	40.24	58.28	40.23	54.23	37.93	54.32	37.78	61.00	37.67	61.45	37.52	57.16	22.92	56.80	23.35
8	66.24	29.18	66.25	29.36	65.09	37.47	65.33	37.94	65.00	34.20	64.88	33.91	62.89	34.02	63.07	34.22	66.48	33.76	66.74	33.73	64.63	18.44	64.37	18.80
9	75.96	29.41	75.66	29.58	74.05	37.68	73.59	37.92	73.66	34.99	73.29	34.26	70.22	32.94	70.27	33.07	73.42	33.51	73.87	33.54	74.90	18.31	74.82	18.30
10	82.39	33.61	82.11	33.86	79.57	42.43	79.30	42.78	81.85	38.91	81.89	39.05	78.62	35.65	79.14	35.54	80.82	36.47	81.20	36.45	82.64	22.46	82.74	22.41
11	88.00	39.64	87.68	39.76	86.62	47.00	86.43	47.36	87.97	43.53	88.04	43.58	86.37	38.27	86.17	37.96	86.06	39.70	86.42	39.76	88.43	27.74	89.41	28.06
22	80.59	104.74	80.07	105.90	85.37	100.55	85.21	100.84	87.17	99.25	87.20	99.34	83.93	103.66	84.23	103.69	85.90	100.43	85.35	101.62	82.79	115.93	82.51	116.92
23	75.42	108.54	75.24	108.59	80.87	99.77	80.88	100.12	82.18	102.04	82.20	102.01	78.40	106.39	78.49	106.30	79.82	104.27	80.33	104.27	76.23	119.34	76.22	119.23
24	69.00	110.38	68.32	110.46	75.66	102.10	75.84	102.48	76.57	105.27	76.65	105.18	72.49	107.27	72.81	107.28	74.31	106.22	74.65	106.18	70.39	121.24	70.42	121.13
25	63.99	109.54	63.68	109.72	69.92	101.74	69.79	102.12	72.12	104.21	72.08	104.19	66.92	107.46	67.22	107.46	69.40	106.39	69.66	106.34	64.34	120.75	64.34	120.68
26	57.17	107.78	56.67	107.86	65.28	98.92	65.02	99.34	66.10	103.77	66.28	103.91	61.07	106.45	61.49	106.43	64.50	104.42	64.76	104.39	58.41	118.55	58.50	118.54
27	52.48	103.87	52.12	104.10	59.71	97.14	59.79	97.83	60.13	101.79	60.09	101.72	55.43	105.18	56.27	105.89	58.38	101.73	58.75	101.76	51.28	114.94	52.02	115.84

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	36.25	23.19	36.33	22.80	34.82	32.51	34.86	32.54	31.68	29.26	31.66	29.31	0.00	0.00	37.07	19.36	35.03	47.67	35.21	47.87	33.1	11.56	33.24	12.26
7	42.44	17.28	42.50	17.17	42.63	27.69	42.58	27.71	37.91	24.27	37.84	24.54	37.43	17.85	45.34	15.67	43.13	44.46	42.93	44.93	39.95	6.33	40.08	6.80
8	49.85	13.64	50.24	13.65	47.82	23.14	47.79	23.15	44.43	18.22	44.55	18.22	45.55	14.32	53.44	14.61	48.05	41.05	48.06	41.04	48.10	1.47	48.29	1.85
9	59.46	13.73	59.54	13.73	56.74	23.17	56.66	23.18	54.33	18.86	53.75	18.75	53.69	13.18	61.61	17.33	55.40	40.63	55.68	40.74	57.95	1.18	57.75	1.52
10	66.29	17.83	66.51	17.75	62.07	27.78	62.11	27.82	61.70	22.83	61.64	22.88	61.86	15.93	69.02	19.92	62.55	43.64	62.55	43.67	66.20	5.48	66.46	5.91
11	72.21	23.69	72.18	23.70	69.60	32.48	69.36	32.47	67.75	27.13	68.30	27.85	69.32	18.52	66.35	85.54	68.18	46.92	68.18	46.85	72.71	10.47	71.91	10.46
22	64.83	89.93	64.95	90.01	68.45	85.42	68.19	85.60	67.66	82.70	67.50	82.95	66.71	84.29	60.99	87.85	67.21	108.46	67.33	108.56	66.71	98.82	66.72	98.87
23	59.55	92.69	59.45	92.81	63.35	84.75	63.2	84.91	62.30	85.42	62.17	85.73	61.57	86.68	55.43	88.67	61.50	111.58	61.43	111.68	59.79	101.7	59.75	101.94
24	53.20	94.57	53.27	94.39	57.82	87.02	57.84	87.37	56.71	88.89	56.78	89.12	55.88	87.16	50.02	88.99	56.08	113.55	56.18	113.48	53.98	103.65	53.81	104.02
25	47.89	93.46	47.82	93.66	52.20	86.83	52.16	87.12	52.00	87.59	51.95	87.76	50.17	87.54	44.34	87.89	50.64	113.4	50.53	113.33	47.95	103.18	47.96	103.45
26	41.64	92.12	41.71	92.19	47.51	83.94	47.32	84.30	45.55	86.92	45.82	87.14	44.60	86.53	38.43	87.14	44.98	111.21	44.95	111.41	41.62	100.68	41.78	101.02
27	36.85	87.63	36.58	87.49	41.96	82.05	42.27	82.39	40.24	85.78	39.73	84.67	38.61	85.88	37.07	19.36	39.48	108.92	39.48	108.78	34.88	97.63	35.29	98.14

Area Data Report - S8												
Technique A												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	8.26	8.11	10.09	11.76	11.47	10.78	0.00	0.00	8.80	10.58	9.84	11.76
7	7.66	8.69	12.65	14.37	9.43	9.12	15.05	15.40	5.79	5.62	9.09	9.46
8	14.11	13.79	14.88	14.71	12.99	12.53	17.23	17.75	12.04	12.56	14.39	18.35
9	9.29	9.72	14.91	13.65	18.92	18.78	14.62	16.63	12.13	14.11	14.77	16.11
10	8.77	8.75	9.69	9.63	8.09	8.77	14.68	16.17	4.07	4.13	9.81	10.64
11	11.01	10.27	11.81	13.39	15.57	11.78	14.42	13.91	9.15	11.35	15.28	13.39
22	9.00	8.89	3.18	11.04	9.84	9.86	12.30	13.08	8.60	7.71	13.82	16.11
23	8.23	8.23	5.62	10.24	8.23	8.14	8.72	9.69	5.73	5.71	8.83	9.00
24	6.25	7.00	8.86	9.20	9.41	9.12	7.03	7.94	4.30	4.59	8.20	7.37
25	6.19	5.62	9.29	8.34	8.26	8.14	7.66	8.09	4.70	4.76	7.34	8.43
26	5.85	6.11	9.43	9.09	8.34	8.26	6.94	9.00	6.51	5.51	9.09	9.23
27	9.95	6.14	11.76	10.29	7.57	10.41	9.35	9.49	7.63	8.32	13.39	11.87
Technique B												
Tooth #	Cast A		Cast B		Cast C		Cast D		Cast E		Cast F	
	1	2	1	2	1	2	1	2	1	2	1	2
6	12.53	11.67	13.59	12.19	12.30	15.91	12.30	0.00	13.28	9.95	12.65	16.06
7	13.19	11.87	17.66	17.15	13.05	13.33	19.21	19.73	12.56	11.33	15.89	13.76
8	20.87	20.19	19.56	21.36	19.04	19.13	26.38	25.66	18.87	13.68	17.52	17.72
9	15.77	15.83	21.91	21.45	23.83	24.37	21.82	20.93	15.14	12.04	18.41	17.46
10	13.91	14.25	17.03	18.92	14.65	13.56	22.82	23.43	8.40	8.49	15.97	16.63
11	12.67	12.87	11.76	10.06	16.54	15.28	17.58	15.60	20.27	12.33	10.32	14.60
22	11.01	8.17	11.90	8.57	10.84	9.18	12.33	10.29	12.62	12.30	9.03	7.97
23	12.99	13.48	10.87	10.55	15.34	11.58	14.74	13.82	11.76	10.58	10.18	9.78
24	11.76	10.98	13.16	12.85	15.68	13.62	11.96	11.61	11.35	7.31	10.09	9.46
25	10.67	10.75	13.08	12.24	13.96	11.10	11.30	12.30	10.47	9.18	12.24	11.33
26	12.70	11.90	6.65	6.85	14.22	12.44	14.45	13.99	12.85	9.18	12.50	11.64
27	15.51	10.70	9.18	9.15	11.18	9.15	10.35	7.83	16.60	12.93	9.95	8.43

Position Data Report - S8

Technique A

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	52.68	38.48	52.7	38.12	53.88	46.02	53.84	46.44	52.91	44.76	52.66	44.90	0.00	0.00	0.00	0.00	54.12	39.52	54.52	39.47	50.65	28.58	50.82	28.82
7	58.94	32.75	58.60	32.66	60.07	41.98	60.27	42.12	57.98	40.64	57.93	40.68	54.07	37.82	54.05	37.83	60.92	37.61	60.87	37.64	56.43	23.30	56.74	23.39
8	66.46	29.39	66.14	29.00	65.72	37.42	65.86	37.58	64.94	34.27	65.01	34.24	62.48	34.17	62.47	34.17	66.13	33.86	66.27	33.92	64.11	18.71	64.95	19.03
9	75.43	29.42	75.66	29.12	74.27	37.39	74.26	37.51	73.71	34.94	73.69	34.96	70.44	33.00	70.50	33.07	73.84	33.50	73.30	33.89	74.15	18.56	74.52	18.79
10	82.62	33.92	82.46	33.49	79.92	42.22	79.96	42.26	81.72	38.98	81.78	39.06	78.62	35.84	78.63	35.83	80.79	36.60	80.93	36.71	82.21	22.46	82.53	22.61
11	87.76	40.00	87.84	39.67	86.42	46.67	86.28	46.61	86.65	43.29	86.95	43.14	86.04	38.78	86.03	38.70	85.71	39.59	86.03	39.94	88.18	27.92	88.59	28.00
22	80.73	104.81	80.73	104.44	85.28	100.31	85.48	99.96	87.22	99.11	87.22	99.30	83.90	103.86	83.78	103.93	85.50	101.29	85.30	100.78	82.44	115.84	82.68	115.92
23	75.53	108.51	75.56	108.17	81.25	99.27	81.33	99.80	82.17	101.85	82.14	102.04	78.22	106.48	78.05	106.57	79.44	104.15	79.79	104.10	75.89	119.14	76.17	119.17
24	69.19	110.36	69.43	109.99	75.64	101.78	75.82	101.89	76.66	105.13	76.61	105.14	72.42	107.42	72.50	107.4	74.09	106.18	74.14	106.30	70.10	121.10	70.43	121.17
25	64.12	109.52	64.13	109.21	69.96	101.58	69.94	101.48	71.92	103.88	71.95	103.89	66.90	107.62	66.90	107.62	69.13	106.32	69.13	106.33	63.95	120.74	64.35	120.70
26	57.47	107.77	57.41	107.35	65.13	98.73	65.35	98.76	65.62	103.32	65.88	103.46	60.99	106.75	61.13	106.57	64.11	104.13	63.89	104.17	58.06	118.37	58.36	118.39
27	52.18	103.53	52.97	103.56	59.96	96.47	60.10	96.60	60.24	101.90	60.22	101.70	55.65	105.56	55.66	105.56	58.01	101.56	57.94	101.47	51.30	114.94	51.45	114.67

Technique B

Tooth #	Cast A				Cast B				Cast C				Cast D				Cast E				Cast F			
	1		2		1		2		1		2		1		2		1		2		1		2	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	37.30	18.85	36.48	22.55	34.73	31.56	34.76	32.41	32.08	28.22	31.81	29.02	30.61	18.01	0.00	0.00	35.15	47.02	35.56	46.48	33.48	13.33	33.35	11.75
7	42.84	14.23	42.44	17.25	42.66	26.49	42.43	27.76	38.15	24.10	38.00	24.54	37.36	17.95	37.69	19.04	42.73	44.79	43.10	44.53	40.28	8.25	40.50	6.01
8	50.10	10.94	50.13	13.63	48.09	22.04	47.95	23.15	44.90	17.93	44.72	18.10	45.61	14.36	45.42	15.61	47.83	41.03	47.68	40.88	48.03	3.44	48.05	1.42
9	59.15	11.05	59.40	13.72	56.73	21.98	56.71	23.14	53.71	18.45	53.86	18.78	53.68	13.17	53.63	14.39	55.33	40.69	56.16	40.39	57.87	3.15	57.97	1.16
10	66.35	15.24	66.35	17.92	62.10	26.60	62.19	27.96	61.70	22.85	61.65	22.94	61.73	16.10	61.77	17.42	62.16	43.50	62.57	43.67	66.59	7.57	66.44	5.57
11	71.96	21.45	72.00	23.74	69.80	30.73	70.05	31.96	67.73	27.02	67.96	27.35	69.22	18.56	69.15	19.82	65.90	46.20	68.07	46.19	72.39	11.83	73.29	10.96
22	64.83	87.37	64.80	90.48	69.01	85.17	68.43	86.82	68.33	83.03	67.92	84.15	67.76	85.17	67.79	86.60	67.31	108.51	67.61	108.05	66.49	101.33	66.13	99.71
23	59.55	90.07	59.49	92.73	63.63	83.87	63.76	85.18	62.21	85.44	62.17	85.79	61.53	86.71	61.31	88.00	61.32	111.45	61.63	111.40	59.86	103.73	59.90	101.66
24	53.22	91.89	53.09	94.63	58.04	86.40	58.01	87.35	56.77	88.79	56.64	89.01	55.82	87.47	55.40	88.76	55.95	113.54	56.34	113.59	53.89	105.70	53.74	103.70
25	47.82	91.09	47.89	93.68	52.21	86.17	52.27	87.31	51.95	87.61	51.90	87.92	50.12	87.6	49.97	89.16	50.89	113.72	51.01	113.68	47.83	105.18	47.79	103.25
26	41.36	89.34	41.37	92.07	48.31	83.71	48.24	84.77	45.16	86.55	45.46	87.14	44.09	86.64	44.28	88.20	45.55	111.61	45.51	111.37	41.60	102.83	41.76	100.84
27	35.79	84.800	36.10	88.46	42.17	81.99	41.33	82.70	39.06	85.79	39.53	86.29	38.64	86.33	38.91	88.46	39.58	108.90	39.53	108.67	35.10	100.41	35.06	98.51