The Effect of Oral Hygiene Education of Care-Aides
Combined With Periodontal Debridement on the Gingival Health
of Institutionalized Elders.

by

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Objective: This randomized controlled trial tested the effectiveness of educational programs for care-aides combined with periodontal debridement of institutionalized elders on the gingival health of the elders. Methods: the UBC Gingival Bleeding Index (UBC GBI) was calculated following an oral examination by a dental hygienist of 113 elderly residents of 14 long-term care facilities. Care-aides in one randomly selected group of seven facilities received instruction and continuous guidance on oral hygiene care from a nurse-supporter in each facility, while the care-aides in the other group received similar instruction from a dental hygienist visiting each facility on one occasion without involving a nurse-supporter. The two groups were then randomly assigned to a “treatment” group who received full periodontal debridement, or a “non-treatment” group who did not receive periodontal debridement. Results: No significant difference in the mean UBC GBI of the four groups at baseline and 3-months was found, but gingival bleeding following periodontal debridement in the nurse-supported/treatment group (UBC GBI=23) was significantly lower than in the nurse-supported/non-treatment group (UBC GBI=58, t=3.488, p=0.002), the Care-aide/treatment group (UBC GBI=47, t= 2.274, p=0.031) or the Care-aide/non-treatment group (UBC GBI=76, t=6.547, p=0.000). Conclusions: The gingival health of institutionalized elders can benefit from an oral hygiene nurse-supported educational program offered to care-aides combined with periodontal debridement.
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Chapter 1

INTRODUCTION

The oral hygiene of institutionalized elders is poor (Gift, 1988; Berkey et al, 1990). This population exhibits an increased risk to oral diseases particularly gingivitis, caries and periodontal disease (Frenkel et al, 2001; Kiyak 1993; Wyatt, 2002 a,b; Berkey, 1996; Helgeson and Smith, 1996; Holst et al, 1997; Greenstein and Lampster, 2000). This may be attributed to a lack of assistance with daily oral hygiene by care-providers, limited access to oral healthcare services, the prevalence of systemic illnesses that can compromise oral health, and a poor diet creating nutritional inadequacies.

As well, due to physical and mental disabilities that affect institutionalized elders’ ability to perform adequate daily oral hygiene, this population is susceptible to high levels of plaque and calculus. There is an association between bacteria, plaque and calculus that, if left alone, can result in gingivitis and/or periodontal disease and caries. Plaque is a sticky, colorless deposit of bacteria that continuously forms on teeth. Over time, plaque mineralizes into calculus, which due to its rough surface provides a haven for additional growth of plaque. Plaque initiates inflammatory changes in the gingival tissue including bleeding on probing, loss of contour and consistency of the gingival marginal tissues. In addition, the plaque bacteria attached to the tooth surface produce acids when exposed to fermentable carbohydrates, which can result in coronal and root surface caries.

Reducing plaque accumulation can prevent gingivitis, periodontal disease and can help control caries. In determining effective methods to improve and maintain good oral hygiene for institutionalized elders, researchers who concentrate on oral hygiene education programs alone for Long-term Care (LTC) staff have encountered some obstacles. Previous studies have shown
that nursing care-staff have acknowledged that the mouth needs attention, however, also claim that it is difficult to provide daily oral hygiene care for residents among the many conflicting priorities in the residential care setting (MacEntee et al, 1999). The primary care-givers or care-aides readily acknowledge their own insecurities in regards to providing daily mouth care for residents. Care-aides feel inadequately trained due to the minimal exposure to oral hygiene education they receive in their programs of study and that time is a very limiting factor in the daily routine of a facility (MacEntee et al, 1999). Several problems have been identified with oral hygiene education programs for LTC provided by an external dental hygienist. First, the frequent turnover of staff in facilities, especially among the care-aides, limits the effectiveness of the hygienists’ educational endeavors (MacEntee et al, 1999). As such, it is difficult to sustain a level of daily oral care for the residents when those care-aides that have been educated on the provision of daily mouth care have left the facility and new care-aides have not been educated. Second, administrators identify cost as a factor in maintaining the services of an external dental hygienist. Third, facilities regularly hold resident care conferences to discuss the needs of each resident. Care conferences can be a key component to the establishment of a successful dental presence by educating other disciplines on the importance of daily mouth care (MacEntee et al, 1999). However, external dental personnel are not always permitted to attend the conferences due to concerns over resident confidentiality. As well, an external dental hygienist may not be available to attend the conferences at their scheduled time. To address these concerns, an alternative strategy to providing oral hygiene education for LTC staff can be considered. This strategy involves an external dental hygienist educating a LTC staff registered nurse on oral hygiene, who would then be responsible for relaying this information to the care-aides. The nurse would provide on-going support and guidance on oral hygiene and would regulate and reinforce the delivery of daily oral hygiene care for the residents. As a member of the LTC staff, a nurse is aware of comprehensive resident care needs, institutional protocol and the numerous daily
responsibilities of the care-aides. Despite a high turnover of care-aides in LTC, the nurse would be able to educate new care-aides as needed and also be available to address oral care concerns by existing care-staff on a regular basis. As well, administrators would not have to be concerned with the additional cost of employing an external dental hygienist nor would confidentiality or availability to attend care conferences be an issue. No study to date has evaluated the effectiveness of a facility oral hygiene nurse-supporter to regulate and reinforce the need for daily oral hygiene to care-aides in addition to providing periodontal debridement for the elders in order to improve the gingival health in this population. Previous studies have shown significant reduction in gingival bleeding following just one episode of periodontal debridement (Lundgren et al, 2001; Schwartz et al, 2001; Pedrozolli et al, 1991). These studies, however, involved healthy, younger adult populations with and without periodontal disease. The effectiveness of periodontal debridement for a frail, dependent elderly population has not yet been evaluated. The purpose of the present study is to determine the effectiveness of a nurse-supported oral hygiene education program for care-aides in combination with periodontal debridement to improve the gingival health of institutionalized elders. The first half of the study will determine the effect of an educational intervention, while the second half of the study will determine the effect of periodontal debridement.
Chapter 2
Review of the Literature

2.1. LONG-TERM CARE

The Canadian population is aging; not only are people living longer but older adults are making up an increasingly higher percentage of the population. In 1961, those individuals aged 65 and older comprised 7% of the Canadian population, but by 1999 this figure rose to 11.6% or 3.2 million people (Statistics Canada, 2001). By the year 2021, those individuals aged 65 and older, will comprise approximately 16% of the total population. It is also expected that the proportion of individuals 85 years of age and older will rise at least threefold during the same period (Statistics Canada, 2001).

The increasing number of seniors will create a number of challenges for all health care professionals. Dental professionals will be seeing more elders who will have an increased need for a full range of dental services (Holst et al, 1997; Kilmartin, 1994; Fiske et al, 1990). This can be attributed to a decline in edentulism rates primarily due to the use of fluorides, better dental care, and heightened dental awareness (Demers et al, 1986). In an attempt to provide the most complete care for these patients, the dentist and dental hygienist should be aware not only of the patient’s dental needs and how they can be met, but also how the patient’s general medical health may affect the provision of this care (Kilmartin, 1994).

Approximately 7% of Canadians aged 65 years and over are residents of long-term care institutions (Health Canada, 1998). Long-Term Care (LTC), publicly or privately funded, provides a range of services that addresses the health, personal care and social needs of
individuals who lack some degree of self-care (Berkley, 1996). There are several different types of LTC facilities in British Columbia:

1. **Family Care and Group Homes** are either single-family residences with facilities to assist one or two residents or apartment complexes with facilities to assist four to six residents. The residents receive assistance as needed, including personal hygiene, dressing and housekeeping.

2. **Intermediate Care Homes** offer full-time care, supervision, nursing and recreational activities for small or large populations of residents. They operate as private (for profit) or public (non-profit) facilities and they are licensed and regulated under the Community Care Facility Act (1996).

3. **Private Hospitals, Extended Care Units and Special Care Units** provide full-time nursing care with medical supervision. Extended care and special care units are usually associated with an acute care hospital, with the special care units offering a secure environment for residents with cognitive and behavioral problems. They may operate as private (for profit or non-profit) or public (non-profit) facilities, but they are all licensed and regulated under the Hospital Act (1979).
2.2. ORAL CONDITIONS AND THE INSTITUTIONALIZED ELDERLY

Minimal access to regular dental care compounded by poor oral hygiene practices places institutionalized elderly individuals at a high risk for the development of caries, periodontal disease, and gingivitis (Kamen, 1996; Johnson et al, 1989).

2.2.1. CARIES

Poor oral hygiene and a poor diet increases an elderly individual’s susceptibility to coronal and root caries. Caries is the major cause of tooth loss in all age groups (Wyatt and MacEntee, 1997), however, caries in the elderly usually occurs on root surfaces due to gingival recession exposing root surface area, medications with xerostomic side effects, and high levels of plaque (Helgeson and Smith, 1996; Ablah and Pickard, 1998; Budtz-Jorgensen, 1994). Caries is a substantial problem for the institutionalized elderly since consumption of refined carbohydrates, particularly sucrose, is commonplace in LTC facilities (Wyatt and MacEntee, 1997; Berkley, 1996; Krasse, 1985).

In comparison to elderly individuals who live independently, institutionalized elders appear to be more prone to caries (Billings et al, 1985; Phipps and Stevens, 1995; Hand et al, 1988; MacEntee et al, 1997). Longitudinal studies have revealed that coronal and root caries infect, on average, over half of the institutionalized elders and close to one third of the independent dentate elders (MacEntee et al, 1994).

Prevention of dental caries among institutionalized elders is far more cost effective than the provision of dental treatment (Wyatt and MacEntee, 1997). Preventive strategies to help reduce the incidence of caries, and possible subsequent tooth loss, should include dietary control.
of refined carbohydrates, improved oral hygiene practices and regular applications of remineralizing and antimicrobial agents (Wyatt and MacEntee, 1997).

2.2.2. CHRONIC PERIODONTITIS

The exact nature of periodontal disease progression among the elderly remains unclear (Shilpi and Anaimo, 2001). Many institutionalized elders present with signs of periodontal destruction (attachment loss and bone loss) however, this does not necessarily imply active disease progression (Kamen, 1996). Historically it was believed that periodontitis resulted in a slow, continuous, and progressive deterioration of the periodontium, however, this did not account for patterns of destruction that developed quickly, or for observed periods of remission (Greenstein and Lamster, 2000). One model of disease progression suggests that periodontitis occurs as episodic bursts of activity with periods of remission (Greenstein and Lamster, 2000). Some studies have evaluated the progression of periodontal disease among elderly subjects in the absence of surgical and non-surgical periodontal therapy and found minimal attachment loss over a period of up to 6 years (Lindhe et al, 1983; Page, 1984; Persson et al, 1994). It should be clarified that aging itself does not cause periodontitis (Abdellatif and Bull, 1987; Axellson and Lindhe, 1978; Kitamura et al, 1986;), however, several factors may place an elderly individual at risk for developing periodontal disease including poor general health, diminished immune status making it difficult to fight off infection, diminished salivary flow, functional and cognitive impairments hindering adequate daily oral hygiene practices, and changes in financial status limiting the ability to acquire dental care (Burt, 1994; Johnson et al, 1989; MacEntee et al, 1994). Nonetheless, when good oral hygiene is maintained, susceptibility to periodontal destruction is reduced (Johnson et al, 1989; Johnson, 1989).
With active periodontitis, the gingival tissue often appears red or reddish blue in color and shows signs of inflammation including bleeding on probing and possibly suppuration. The coronal margin of the soft tissue may be located at any level apical to the cemento-enamel junction and probing depths in the range of 4mm or greater are evident. A light microscopic view of periodontitis would display large numbers of inflammatory cells at the base of the sulcus and bone loss is evident. When probing, the tip of the probe may rest within the connective tissue and the junctional epithelium shows evidence of further deterioration. There has been proliferation of the cells of the junctional epithelium into the area formally occupied by connective tissue and a space (the periodontal pocket) filled with inflammatory cells and debris is evident. Plasma cells and lymphocytes are the predominate inflammatory cells in this lesion. The connective tissues of the gingiva have been destroyed and in some areas replaced by masses of inflammatory cells or unorganized scar-like fibrous tissue. Alveolar bone has been destroyed and is located more than 2 to 3 mm apical to the cemento-enamel junction (Wilson and Kornman, 1996).

### 2.2.3. GINGIVITIS

The term gingivitis has been defined as "inflammation of the marginal gingiva" (American Academy of Periodontology, 1992). Several types of gingivitis have been identified such as acute necrotizing ulcerative, hormonal, drug-induced, desquamative gingivitis, and plaque-associated gingivitis, which is widespread among the general population and among institutionalized elders. With gingivitis, the gingival tissue often appears red or reddish blue in color and shows signs of inflammation including bleeding on probing, loss of contour, and changes in tissue consistency. The coronal margin of the soft tissue is also located at or slightly coronal to the cemento-enamel junction and probing depths range mainly from 1-3 mm except in instances of gingival hyperplasia where probing measurements may be higher. A light
microscopic view of gingivitis would display large numbers of inflammatory cells at the base of the sulcus and the alveolar bone still located 2 to 3 mm apical to the base of the junctional epithelium. When probing, the tip of the probe would rest within the connective tissue. As well, the connective tissues of the gingiva that supported the junctional epithelium have been destroyed (Wilson and Kornman, 1996).

In comparison to diseased tissue, healthy gingival tissue appears pink in color, stippled and shows no signs of inflammation as indicative of bleeding upon probing. The coronal margin of the soft tissue is located at or slightly coronal to the cemento-enamel junction and probing depths range from 1-3 mm. A light microscopic view of healthy tissue would display few inflammatory cells at the base of the sulcus and the alveolar bone located 2 to 3 mm apical to the base of the junctional epithelium. When probing, the tip of the probe would ideally rest at the bottom of the clinical sulcus and the junctional epithelium would appear intact and in close contact with the tooth surface”(Wilson and Kornman, 1996).

It is generally accepted that the main causative agent in the development of gingivitis is undisturbed accumulation of supra-gingival plaque in the dentogingival area (Loe et al, 1965; Theilade et al, 1966). Supra-gingival plaque flora associated with healthy tissues, i.e. no clinical gingivitis or caries, consists mainly of gram-positive, coccal-shaped organisms. Gingival changes, consisting of exudation of crevicular fluid and increased emigration of leukocytes, become apparent at about 3 days as plaque flora becomes more gram-NSCGative. Clinically detectable gingivitis is seen between 7 and 21 days and results in the establishment of a more complex plaque flora consisting of increasing numbers of fusobacteria and filamentous organisms as well as spirochetes and spirilla. Also, the amount of plaque has been found to correlate directly with the extent and severity of gingivitis (Loe and Kleinman, 1986).

It has been shown that supra-gingival plaque plays a primary role in the development of gingivitis, and plaque-removal reverses gingival inflammation and returns the gingiva to health
Therefore, the practice of daily oral hygiene is of significant importance to help improve and maintain gingival health. Preventive strategies for gingivitis should include adequate daily oral hygiene practices to maintain gingival health (Axellson and Lindhe, 1978; Lindhe and Axellson, 1973; Suomi et al, 1971; Lightner et al, 1971). This protocol may seem simple and plausible for an independent population with the potential for modifiable oral hygiene practices and access to dental services. However, for the dependent, frail, institutionalized elders, many barriers mitigate against the provision of daily mouth care (Gift 1988; Berkey et al, 1990). Debilitating physical and mental disabilities in combination with manual dexterity problems affect an elderly individual’s ability to perform adequate daily mouth care. As well, care-givers may be faced with potential barriers to providing care such as serious medical concerns, socio-economic issues and reluctance to treating residents within the confines of their rooms or beds (Ellis, 1999; Johnson et al, 1997; Henry, 1995; MacEntee et al, 1999).

As a result of poor oral hygiene, plaque accumulates and subsequently mineralizes to form calcified deposits (calculus). Such deposits are plaque retentive and their removal is required to provide the individual with access to maintain the dentogingival area free of plaque. Calculus may attach to the tooth by mechanically locking into cracks, restorations, carious lesions, and other defects of the tooth surface (Selvig, 1970). Calculus deposits require instrumentation with hand instruments and/or ultrasonic devices for removal. Clinically, periodontal debridement or supragingival and subgingival removal of calculus leads to less bleeding, less discomfort, and less edema and hence improvements in gingival health (Wilson and Kornman, 1996).

This then presents the question of whether periodontal debridement or the removal of calculus from tooth and root surfaces has a greater impact on reducing gingival inflammation than the removal of plaque alone. Tagge et al. (1975) and Cerek et al. (1983) evaluated the soft tissue response of periodontal pockets after periodontal debridement and oral hygiene (brushing...
and flossing) versus oral hygiene alone. The researchers found that periodontal debridement accompanied by oral hygiene measures resulted in a statistically greater improvement than did oral hygiene alone. Morrison et al. (1980) examined the effects of periodontal debridement on the clinical severity of periodontitis in pockets varying from 1-7 mm. They found that the removal of the calculus deposits (and plaque) resulted in a significant reduction in gingival inflammation as measured by a reduction in pocket depth and gingival bleeding. Chawla et al., (1975) examined the effect of different dental prophylaxis regimens on periodontal disease in 1600 subjects over a 2-year period. They found that periodontal debridement plus instructed oral hygiene at 6-month intervals provided the maximum benefit. They concluded, “the removal of calculus was directly correlated with the improvement in periodontal and gingival health. The removal of plaque alone, however, did not indicate such a correlation.” The researchers also stated that tooth brushing in combination with periodontal debridement was most effective in treating gingivitis and loss of epithelial attachment.

Although there is substantial intra and inter-individual variation in the accumulation of calculus overtime (Muhler and Ennever, 1962; Statistics NCH, 1966; Suomi et al, 1971), it is generally suggested that biannual visits to a dental hygienist or dentist for calculus removal (and good home care practices) is sufficient to maintain good oral hygiene. However, for institutionalized elders, accessing these services can be problematic. Many studies have shown that even a single episode of periodontal debridement can result in significant improvements in gingival health and concomitant reduction in gingival bleeding ranging from 20-90% (Pedrozzoli et al, 1991; Schwartz et al, 2001; Bollmer et al, 1986; Tessier et al, 1993; Cerek et al, 1983; Hammerle et al, 1991; Proye et al, 1982, Lundgren et al, 2001). Therefore, there stands a great need to improve the access to oral health care services for this population.
2.2.3.1. Indices Used to Assess Gingival Inflammation

Indices are attempts to quantify clinical conditions on a graduated scale, thereby facilitating comparison among populations examined by the same criteria and methods (Spolsky, 1999). However, indices can relay inaccurate estimates (underestimates or overestimates) of a true clinical condition, since they estimate only the relative prevalence of a clinical condition i.e. the proportion of individuals affected by a disease at a specific point in time.

A good index must be easy to use, permit the examination of many people in a short period of time, define clinical conditions objectively, be highly reproducible when used by one or more examiners, and be amenable to statistical analysis (Spolsky, 1999). Index calibration or standardization by an examiner or examiners is imperative to ensure reliability of the data.

There are several commonly used indices to assess gingival inflammation. The Papillary-Marginal-Attachment Index (Schour and Massler, 1948) was originally used to count the number of gingival units affected with gingivitis. This approach was predicted on the belief that the number of units affected correlated with the degree or severity of gingival inflammation. The facial surface of the gingiva around a tooth was divided into three gingival scoring units: the mesial dental papilla (P), the gingival margin (M), and the attached gingiva (A). The presence or absence of inflammation on each gingival unit was recorded as 1 or 0 respectively and a PMA index score for each individual was tabulated. The index was modified to include a severity component for assessing gingivitis; the papillary units (P) were scored on a scale of 0 to 5, and the marginal (M) and attached (A) gingiva were scored on a scale of 0 to 3 (Schour and Massler, 1948).

Another index used to assess gingival inflammation is the gingivitis component of the Periodontal Disease Index (PDI). The PDI measures the presence and severity of periodontal disease by combining the assessments of gingivitis and gingival sulcus depth on six selected
teeth (#16, 21, 24, 36, 41, 44) referred to as Ramfjord teeth, which have been tested as reliable indicators for the various regions of the mouth. Calculus and plaque are also examined to assist in formulating a comprehensive assessment of periodontal status (Ramfjord, 1959). A numerical score for the gingivitis component of the PDI is obtained by adding the values for all of the gingival units and dividing by the number of teeth present. On a scale from 0 to 3, where 0 reflects the absence of inflammation; 1 reflects mild to moderate inflammation gingival changes not extending around the tooth; 2 reflects mild- moderate gingivitis extending around the tooth; and 3 indicative of severe gingivitis, the presence and severity of gingivitis can be determined.

The Gingival Index (GI) by Loe and Silness, 1963 was developed solely for the purpose of assessing the severity of gingivitis and its location in four possible areas. The tissue surrounding each tooth is divided into four sites: the distofacial papilla, the facial margin, the mesiofacial papilla, and the entire lingual gingival margin. To minimize examiner variability in scoring, the lingual surface is not sub-divided because it will most likely be viewed indirectly with a mouth mirror. A periodontal probe is used to assess the bleeding potential of the tissues. A score of 0 indicates normal gingival; a score of 1 indicates mild inflammation, slight change in color, slight edema and no bleeding on probing. A score of 2 indicates moderate inflammation, redness, edema, and bleeding on probing. A score of 3 indicates severe inflammation, marked redness and edema, ulcerations and possible spontaneous bleeding. Totaling the scores per tooth and dividing by the number of teeth examined yields the GI score per person. A score between 0.1-1.0 indicates a mild degree of gingivitis; 1.1-2.0 indicates a moderate degree of gingivitis; and 2.1-3.0 indicates a severe degree of gingivitis.

Lobene et al, 1986, created a modified GI (MGI) by eliminating the bleeding criterion, making the MGI a noninvasive index. By redefining the criteria for mild and moderate inflammation, the MGI is thought to increase sensitivity of the scoring scale. The MGI is scored on a 0-4 scale, where score 1 and 2 are now two different criteria for mild inflammation.
The Sulcus Bleeding Index (SBI) combines clinical estimates of inflammation and bleeding by using bleeding on gentle probing as the first criterion for indicating gingival inflammation. This index was also modified to include a 0 to 5 scale for assessing sulcular bleeding (Muhlemann and Mazor, 1958).

Indices that use ordinal scales (increasing amounts of the measured characteristic are associated with higher values) such as the PMA, PDI, MGI and SBI are not without their own problems. One major consideration in evaluating ordinal scale data is the number of categories. If the number of categories is small, the scale will be crude and will not be able to detect subtle differences. On the other hand, if there are many divisions and the categories are not well-defined, there will be poor agreement between observers (Brunette, 1996).

The Gingival Index used by the National Institute of Dental Research (NIDR) uses the presence or absence of gingival bleeding to assess gingival inflammation. Two sites per tooth (mesial-buccal interproximal and mid-buccal on all teeth excluding the molars; and mesial-buccal interproximal and mid-buccal of the mesial root of molars) on one half of the maxillary arch and the contralateral half of the mandibular arch are assessed after excess moisture is dried with air. The decision of starting at either the right or left half of the maxillary arch is decided randomly. The NIDR probe (a periodontal probe that is graduated in 2mm increments, with alternating increments colored in black) was gently inserted up to 2 mm into the gingival sulcus at the midpoint of the buccal and then drawn gently into the mesial-buccal interproximal area. After all the sites in both halves of the arches are probed, the bleeding sites are counted. This number is divided by the total number of sites assessed and then multiplied by 100 to yield the percentage of sites with gingival bleeding (Carlos and Brunelle, 1991).

The Bleeding Points Index determines the presence or absence of gingival bleeding interproximally and on the facial and lingual surfaces of each tooth. A periodontal probe is
drawn horizontally through the gingival crevice of a quadrant and the gingiva is examined for bleeding after 30 seconds (Lenox and Kopczyk, 1973).

The Interdental Bleeding Index (IBI) utilizes a triangle-shaped toothpick made of soft pliable wood to stimulate the interproximal gingival tissue. The presence or absence of bleeding with a specific stimulus permits the examiner and the individual to monitor interproximal gingival health. The toothpick is inserted horizontally between the teeth from the facial surface, depressing the interproximal papilla by up to 2 mm. The toothpick is inserted and removed four times and the presence or absence of bleeding within 15 seconds is noted. The IBI score is determined by dividing the number of bleeding sites by the number of sites evaluated (Caton and Polson, 1985).

The Gingival Bleeding Index by Carter and Barnes, 1974 assesses the presence or absence of gingival bleeding, but only at the interproximal spaces and using unwaxed dental floss. The floss is thought to assess a larger area more quickly than a periodontal probe, and both the professional and the client can use it when the latter is instructed to perform self-evaluation in a control program.

The Gingival Bleeding Index (GBI) by Anaimo and Bay (1975) was developed as an easy and suitable way for an examiner to assess gingival inflammation. The presence or absence of gingival bleeding is determined by gentle probing of the gingival crevice at four points (mesial, facial, distal and lingual) with a periodontal probe. The appearance of bleeding within 10 seconds indicates a positive score. This GBI is calculated by dividing the number of teeth that bled by the total number of teeth examined, and multiplying by 100 to determine a percentage.

The use of gingival bleeding indices is desirable because bleeding is a more reliable indicator of gingival inflammation than early gingival color changes and provides evidence of recent plaque exposure (Spolsky, 1999). The dichotomous criteria of the Anaimo and Bay (1975) GBI, presence or absence of bleeding, seems to fulfill the criteria of a good index. This index can
be considered easy to use, permits the examination of many individuals in a short period of time, reliably defines the presence or absence of bleeding, is highly reproducible by one or more examiners, and is amenable to statistical analysis. Hence, a modified version of this index (UBC GBI) described in the Methods and Materials section, represents the index of choice for this study.

2.3. ORAL HYGIENE EDUCATION

Oral hygiene education has been considered to be an important and integral part of dental health services and has been delivered to individuals and groups in settings such as dental practice, schools, the workplace, and residential settings for older adults (Brown, 1994). The educational interventions used have varied considerably from the simple provision of information to the use of complex programs involving attitudinal and behavior change strategies (Kay and Locker, 1996). However, the increasing pressure on allocation of healthcare resources means that questions arise about the costs and effectiveness of all forms of health service provision. This is also the case with respect to preventive interventions since they have long been presumed to reduce disease, and therefore lower the demand for health services and the resultant costs (Kay and Locker, 1996).

2.3.1. ORAL HYGIENE EDUCATION PROGRAMS FOR LTC

One way of educating LTC staff to provide daily oral hygiene is through oral hygiene education programs, incorporating demonstrations, seminars, audio-visual aids, handouts and group discussions (Quinn, 1988; Herriman and Kerschbaum, 1990). A dental hygienist may be the most qualified individual to deliver the presentations and supervise demonstrations and
hands-on training with residents (Quinn, 1988). Oral hygiene education programs, provided by a
dental hygienist, can serve to raise the profile of oral hygiene, support the integration of oral
hygiene into overall care, and allow an opportunity to explain oral care procedures to a variety of
caregivers. If permitted to attend, dental hygienists can also participate in care conferences where
specific oral hygiene concerns for each resident could be addressed and recommendations for
improvements suggested. Ideally, the hygienist should deliver oral hygiene education training on
a regular basis to help ensure appropriate standards of oral hygiene care are being met and to
address concerns from staff and the residents themselves (Ettinger and Miller-Eldridge, 1985;
Ablah and Pickard, 1998; CDHBC LTC information booklet, 1999).

Oral hygiene education programs must be modeled differently for personnel with high
and low levels of healthcare education. A study by Paulsson et al., 1998 found that nurses who
were considered to have a “high level healthcare education” favored theoretical aspects of an oral
hygiene education program. Nursing assistants and care aides, who have a “low level healthcare
education” favored practical procedures. It seems beneficial to direct theoretical information
such as diseases and prevention of diseases to the nurses, and direct the practical portion, such as
tooth brushing techniques to the care aides, who are more involved in the daily oral hygiene of
the resident. For example, a video could help demonstrate the proper techniques for cleaning
dentures, brushing and flossing teeth of functionally dependent residents, independent residents,
uncooperative, aggressive and resistive residents, and unconscious residents. An informational
manual should also be provided which would include: accompanying text for the visual
information presented in the video, information on plaque (as it relates to the development of
gingivitis, periodontal disease, and caries), xerostomia and increased risk of caries with dry
mouth, management strategies for xerostomia, infection control, importance of denture labeling,
role of diet (particularly in relation to the development of caries), diagrams or photographs for
correct positioning of caregiver and resident during treatment, relevant intraoral and extraoral
photographs, evaluation and comment section, a short quiz to facilitate retention of information and re-emphasize key points. Hands on demonstration with residents and role-playing would also be beneficial (Altani and Wyatt, 2002; ELDERS Education Manual, 1998).

Nurses play a key role in the success of an oral hygiene program. Nurses are best suited to regulate and enforce oral hygiene delivery by care aides (Paulsson et al, 1998). Communication should remain open between nurses and care aides to address and resolve any oral hygiene issues. Care aides should feel comfortable expressing their opinions and potential barriers to providing care should be addressed.

The success of an oral hygiene education program requires an effective instructional regime for facility staff and a commitment and cooperation among all staff involved. Administrative support is essential in terms of prioritizing, funding and implementation of the oral hygiene program itself. Funding should cover supplies such as toothbrushes, fluoridated toothpaste, alcohol free mouthwash, aids for xerostomic conditions, denture containers and brushes, denture cleaners and labeling kits.

Many studies have concluded that educational programs alone, directed toward nursing and care-aide staff, have had mainly short-term effects (MacEntee et al, 1999; Weeks and Fiske, 1999; Kaz and Schuchman, 1988; Brown, 1994). Kay and Locker concluded that dental health education intervention programs, which focused on improving knowledge and attitudes among LTC nursing and care-aide staff on the importance of daily oral care, resulted in consistently raised knowledge levels, but that the effects on attitudes tended to be short-lived (Kay and Locker, 1996). These results call attention to the need for further studies that can provide information about the effectiveness of oral hygiene education programs in LTC.
2.3.2. THE ROLE OF AN ORAL HYGIENE NURSE-SUPPORTER IN LTC

One of the essential elements necessary for the implementation of an oral hygiene educational program in LTC is the ability to achieve an understanding and mutually supportive relationship between the oral hygiene professional(s) and the institutional staff (Murphy, 1996). This will depend in great measure on the ability to be fully aware of the priorities of both the nurses and care-aides in their approach to treatment. As a member of the LTC staff, a facility nurse is aware of comprehensive resident care management procedures, interdisciplinary priorities particularly the daily responsibilities of the care-aides, and institutional protocol. As well, a facility nurse, by virtue of his/her training, has an understanding of the conditions of the medically compromised, the effects of various medications, medication protocol etc. This understanding of residents’ needs, including the need for daily oral hygiene, and understanding of the complex issues of working in residential care, places a facility nurse in a unique position to act as a liaison between an oral hygiene professional and the care-aides. As part of the LTC staff, a facility nurse will have established a rapport with the care-aides and with the residents. This rapport is favorable to help create an environment of mutual understanding of the need to provide daily oral hygiene for the residents.

By maintaining inter-staff communication, a facility nurse can help to reinforce and regulate the need for daily oral hygiene for the residents and can help incorporate this need into the daily responsibilities expected of care-aides. Lastly, having an in-house oral hygiene educator allows the facility nurse to identify operational problems with the program and can suggest modifications to enhance care-aide participation and compliance.
2.4. SUMMARY

With increasing age, many individuals suffer sensory and motor impairments, which reduce the effectiveness of their performance of self-care (Holst et al, 1999; Chohayeb, 1985; Huland and Sigal, 2000). Hence, the majority of institutionalized elders depend on care-aides' assistance with all aspects of personal hygiene care, including daily oral hygiene (Frenkel et al, 2001; Kiyak et al, 1993; MacEntee et al, 1991; Kilmartin, 1994; Ettinger and Miller-Eldridge, 1985). However, care-aides receive minimal if any education concerning oral hygiene (Weeks and Fiske, 1994). As well, care-aides face many barriers to providing daily oral hygiene for residents including: combative or non-compliant residents; time limitations; and lack of knowledge concerning oral hygiene techniques (Berkley, 1996; Helgeson and Smith, 1996; Ellis, 1999; Quinn, 1988; Thomson and Cautley, 1996; Lester et al, 1998). Furthermore, a lack of perceived need for oral care, care-aide attitudes towards oral care and the psychological barriers of working in another person’s mouth also significantly impact the provision of daily oral hygiene in the institutionalized setting (Wardh et al, 1997).

In general, care-aides have the sense that the quality of oral hygiene care that they provide for residents could be improved if they were properly trained (Weeks and Fiske, 1994). In developing a program appropriate to the needs of care staff, an understanding of their role, attitudes, actions and experiences is necessary (Weeks and Fiske, 1994).

The literature points to a need among the institutionalized elderly for greater access to oral health care services (Ablah and Pickard, 1998; Berkey et al, 1991). Reports have demonstrated that up to 80% of functionally dependent elderly have immediate dental treatment needs (Ettinger and Miller-Eldridge, 1985; Kiyak et al, 1993) and approximately 79% of elders with natural teeth exhibiting caries (Wyatt, 2002 a,b), however, dental treatment available within
LTC facilities is limited usually to emergency care (MacEntee et al, 1999; Lester et al, 1998; MacEntee et al, 1991; Thomson and Cautley, 1996; Smith and Sheiham, 1980).

The association between poor oral health and poor general health is not always made. The higher incidence and greater severity of oral infection among institutionalized elders result from greatly elevated levels of pathogenic microorganisms in the oral cavity and oropharyngeal fluid (Limeback, 1988). Unchecked oral diseases in an older person can have systemic implications (Ellis, 1999). Institutionalized elders experience a high rate of systemic infection, respiratory infection being the most common (Russel et al, 1999; Limeback, 1998; Jackson and Fierer, 1985; Yoshikawa and Norman, 1995; Nicolle et al, 1996). This is compounded by an age-associated decline in host resistance creating increased vulnerability to respiratory illnesses (Brangan, 1995). Institutionalized elders who exhibit poor oral hygiene may have a greater risk of oral colonization of respiratory pathogens that may be aspirated into the lower respiratory tract where they may multiply and cause infection (Scannapieco and Mylotte, 1996; Scannapieco et al, 1992). By improving oral hygiene among institutionalized elders, this may serve to decrease oropharyngeal colonization by microorganisms that may be aspirated, thereby reducing the risk of respiratory infections (Civan et al, 1995; Coalson, 1995; Jones, 1990).

Poor oral hygiene also places an individual at higher risk for nutritional deficiency (Elbon and Karp, 1987). Institutionalized elders with poor teeth take little pleasure in eating a diet primarily consisting of soft, pureed or mashed foods (Lamy et al, 1999). This can result in self-imposed restrictions in food selection that can in turn contribute to a low intake of essential nutrients leading to a state of under nutrition (Keller, 1993; Ettinger, 1998; Rapin and Bruyere, 1994). Several factors contribute to poor nutrition including xerostomia, which affects the ability to chew and form a food bolus as well as age-associated physiological changes affecting digestion, absorption and taste perception (Dormenval et al, 1998; Loesche et al, 1995; Sheiham
et al, 1999), all of which have a NSC Gative impact on food selection and appetite (Mattes et al, 1990; Locker, 1993).

Some evidence has also been provided for an association between masticatory efficiency and nutritional status (Dormenval et al, 1995; Chem et al, 1984; Gunne et al, 1982; Gunne and Wall, 1985; Lundquist et al, 1986; Slagter et al, 1992) Dentate individuals have significantly better chewing efficiency than denture wearers (Helkimo et al, 1977; Haraldson et al, 1979; Kapur and Soman, 1964). Decreased chewing ability leads most edentulous people to preferentially consume more soft processed foods rich in carbohydrates and saturated fats (Demers et al, 1986; Slade et al, 1996; Griep et al, 1996; Cleary and Hutton, 1995). Most of these soft, easy to chew foods contain a lower nutrient density, placing the individual at risk for nutritional inadequacies (Chauncey et al, 1984).

Often, persons with inadequate dentition, who have difficulty with incising and masticating food, will refuse to eat with other people to avoid potential embarrassment (Epsein, 1987). Dental disabilities can seriously undermine institutionalized elders' desire to eat publicly and can lead to social isolation. Social interaction is an important predictor of nutritional health and subsequent general health (Papas et al, 1998). Conversely, elders who have maintained their oral hygiene have a better self-image and may engage in more health-promoting behaviors (Papas et al, 1998). Thus, by improving oral hygiene and maintenance of the dentition, this should positively affect institutionalized elders' ability to chew a wide variety of foods, which may lead to a greater intake of essential nutrients and improvements in nutritional status, and in turn positively affect overall health.

For nearly three decades, researchers have documented the poor state of oral hygiene among institutionalized elders. Subsequently, many research studies have been conducted to raise awareness of oral health for LTC residents and to assist care-providers in overcoming barriers to providing daily oral hygiene in the institutionalized setting. Oral hygiene education
programs, provided by a dental hygienist and directed at nurses and care-aides, can serve to raise the profile of oral hygiene within the institution, support the integration of oral hygiene into the overall care of residents, and allow an opportunity to educate caregivers about daily mouth care (Quinn, 1988). However, there exists some problems related to this particular oral hygiene educational strategy utilizing an external dental hygienist which relates to the high turnover of care-aide staff and the inaccessibility of the dental hygienist to educate new care-staff, the additional cost of maintaining the services of a dental hygienist, and the issues of confidentiality by permitting access for the dental hygienist at resident care conferences. In addition, an external dental hygienist would have to operate under institutional time constraints which would limit oral hygiene presentation time and availability to deal with care-aide concerns or questions pertaining to daily oral hygiene for the residents, which may in turn limit staff support (Murphy, 1996). To address these concerns, a nurse-supported oral hygiene educational program will be evaluated.

Although prevention of oral disease is optimal, often the treatment of dental disease is necessary in order to improve an individual’s oral health status. Many institutionalized elders present with large amounts of calculus in addition to high levels of plaque. Professional periodontal debridement, which constitutes the removal of calcified deposits above and below the gingival margin as well as smoothing of roughened root surfaces, has been shown to significantly reduce gingival bleeding and inflammation (Wilson and Kornman, 1996). As well, the literature supports a greater impact in reducing gingival inflammation from even a single episode of periodontal debridement than simply the removal of plaque alone (O’Leary, 1986; Lundgren et al, 2001, Schwartz et al, 2001; Pedrozolli et al, 1991; Tessier et al, 1993; Cerek et al, 1983).

To conclude, plaque related problems, particularly gingivitis, caries and periodontal disease, are prevalent among the residential care populations. Yet, despite a widespread need for
oral hygiene care services, there exists a void in delivering treatment beyond the traditional confines of dental practice. A nurse-supported oral hygiene education program offered to care-aides in combination with periodontal debridement for institutionalized elders should significantly improve the gingival health of the elders. In doing so, this may help reduce the incidence of oral infection, possibly reduce the incidence of systemic infection and improve nutritional status. Improving oral hygiene among this age group would serve to improve the general health and wellness of the individual, improve their quality of life, self-esteem and relationships with others.

2.5. RESEARCH QUESTION

Is the mean UBC Gingival Bleeding Index (UBC GBI) of residents of LTC facilities receiving a nurse-supported oral hygiene education program for care-aides as well as periodontal debridement LOWER than the mean UBC GBI of residents of LTC facilities receiving the non-nurse supported oral hygiene education program and no periodontal debridement? The effects of the oral hygiene education and periodontal debridement will be investigated using sub-group analysis.
Chapter 3

METHODS AND MATERIALS

The fourteen participating long-term care facilities (coded facilities #1-14) were distributed randomly between two groups of seven facilities (Table 1). An educational intervention was employed for the first half of this study whereby care-aides in one of the randomly selected group of seven facilities received instruction and continuous guidance on oral hygiene from a nurse-supporter in each facility (Nurse-Supported Care-aide Group), while the care-aides in the other group received similar instruction from a dental hygienist visiting each facility on one occasion without involving an oral hygiene nurse-supporter (Care-aide Group). In the second half of this study, the two groups of seven facilities were separated randomly again to produce a "treatment" group of residents who received full periodontal debridement, and a "non-treatment" group who did not receive periodontal debridement. The UBC GBI was measured at baseline, 3-months, 15-days post-treatment and 6-months.
FIGURE 1: FLOWCHART FOR DESIGN OF STUDY

Baseline Exams

NSCG → 3-Month Exam → Treatment

CG → 3-Month Exam → Treatment

No Treatment → No Treatment

NSCG = Nurse-Supported Care-Aide Group
CG = Care-Aide Group

The method of randomization of the facilities was determined by the hygienist, who delivered the oral hygiene education presentations to the oral hygiene nurse-supporters and care-aides respectively, and was based on previous dental professional influence and size of the facility. The hygienist ensured that large facilities and those with previous dental professional influence would not all be grouped together since this would compromise the validity of the study. The remaining facilities were allocated into each group by randomly choosing folded paper identifying a facility. The original sample size consisted of 113 elderly residents. Residents were excluded who were completely edentulous, those who were severely medically or mentally
compromised, those who required antibiotic pre-medication, or those who refused to participate or who were unable to provide consent for treatment. A dental hygienist reviewed the medical charts and physician-diagnosed medical conditions as well as physician-prescribed medications. A copy of the resident’s medical status, past and present, including prescribed medications was placed in UBC patient charts for reference. The subjects were interviewed, with the help of relatives and care providers, to obtain information about oral hygiene practices and the use of professional dental services. The Canadian Pharmacists Association’s Compendium of Pharmaceuticals and Specialties (CPS, 2000) was used to identify medications as potentially causing xerostomia and hence those subjects with deficient salivary flow.

**TABLE 1: Facility Information**

<table>
<thead>
<tr>
<th>Facility # Codes</th>
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<th>Total # of residents per facility</th>
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<td>6</td>
<td>6</td>
<td>188</td>
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<tr>
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<td>176</td>
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<td>8</td>
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</table>
3.1. ORAL HYGIENE EDUCATION

In the Nurse-Supported Care-aide Group (NSCG), a facility administrator identified a full time registered nurse, with a minimum of three years clinical experience, as the supporter most capable and willing to help care-aides. The dental hygienist presented a 1-hour oral hygiene seminar to the nurse, who was then responsible for relaying this information to the care-aides. The oral hygiene nurse-supporter offered continuous guidance on oral hygiene to the care-aides as needed. The oral hygiene nurse-supporter was also permitted to consult with the dental hygienist as needed to deliver the program over the next 3-months.

In the Care-aide Group (CG), the oral hygiene education was directed solely to the care-aides, without involving an oral hygiene nurse-supporter, and consisted of a similar 1-hour seminar provided by the same dental hygienist. Consultation between the external dental hygienist and the care-aides was not permitted in this group following the seminar.

3.1.1. ORAL HYGIENE EDUCATION: TEACHING CONTENT AND STYLE

The content of the oral hygiene education was based on the manual “Mouth Care for Persons in Residential Care” (Wyatt and MacEntee, 1998). This manual has been used since 1998 to provide oral hygiene education to various LTC facilities across Canada. The dental hygienist was instructed to present the information in the manual and supplemented by use of educational supplies and oral hygiene aides (electric and manual toothbrushes, dental floss, toothpaste, mouth props). The dental hygienist used a flipchart, based on a power point presentation, at each facility as a visual aid and to promote ad-hoc informal discussions (during and after the presentation) prompted by routine and on-going interactions between the nurse(s) and/or care-aides. Each facility also received hands-on demonstrations involving residents for
instruction on the use of certain oral care aides, such as toothbrushes or a bite block. The hygienist was provided with guidelines to follow in the delivery of the oral hygiene presentations. The oral hygiene presentation itself was approximately 1-hour in length however, the informal discussion period varied between facilities and was based on nurse(s) and care-aide motivation, attentiveness and interest. The hygienist was also instructed to provide one follow-up phone call to each facility after the presentation to address any additional concerns.

Each facility participating in this study was given a scheduled time in which the oral hygiene education would be delivered by the dental hygienist. The manner in which this was determined was based on availability of the oral hygiene nurse-supporter, the care-aides, and the dental hygienist. Generally, one facility per week received the oral hygiene education. For the 6 facilities that were part of the NSCG (facilities #9-14), the oral care presentations were provided to the registered nurse in privacy. The other 8 facilities that were considered part of the CG (facilities #1-8), received their oral care presentations in locations within the facility convenient to hold the care-aides (and nurses if available). For example, in facility #8, the oral care presentation was held in the facility boardroom; in facility #1, in the activity room; in facility #13, in the extended care dining room area; in facility #5, in the main lounge area on the 3rd floor; in facility #11, in an activity room on the 2nd floor; in facility #3, in the extended care lounge area; and in facility #10, in a sun room area on the 1st floor. Because the vast sizes of some of the facilities in the CG, many of the care-aides were not present during the scheduled oral care presentation time. To account for this, the hygienist made additional visits to the facilities to ensure each care-aide had an opportunity to attend the seminar. For example, facility #1 required 5 visits with 2 presentation times, one in the morning and one in the afternoon. Facility #3, facility #10, facility #11, and facility #13 each received 2 visits by the hygienist. Facility #5 only required one visit.
3.1.2. INTERVIEW WITH DENTAL HYGIENIST EDUCATOR

A telephone interview was conducted with the dental hygienist responsible for providing the oral hygiene education to all facilities. The interview was conducted by the dental hygienist who provided the periodontal debridement for the residents. The purpose of this was to firstly, assess the impact of the education on nurses and care-aides as determined by the dental hygienist. Secondly, to determine differences (such as interests in particular oral care topics) between the NSCG and the CG and between the larger and smaller sized facilities based on the hygienist’s experiences. Thirdly, to determine whether the oral hygiene presentations were standardized or if modifications were made to the teaching style and/or content during the period in which presentations were provided to the facilities. A telephone interview was chosen as the mode of interviewing due to inaccessibility of the hygienist for an in-person interview as well as time limitations. This mode of interviewing was however, sufficient in satisfying the objective of the interview.

3.2. PERIODONTAL DEBRIDEMENT

The treatment group was comprised of 6 facilities and 37 residents (3 NSC/treatment and 3 Care-aide/treatment groups). The non-treatment group was comprised of 8 facilities and 48 residents (4 NSC/non-treatment and 4 Care-aide/non-treatment groups). A second dental hygienist, who was blinded to the type of education provided in each facility and to previous dental examinations, provided all of the treatment. Prior to any treatment, the resident’s medical and dental histories were reviewed and the periodontal pockets probed.

The periodontal debridement constituted removal of supragingival and subgingival calculus deposits with the intent to debride all existing teeth, as thoroughly as possible,
irrespective of the number of appointments or time required to do so. Each resident was informed of this intent prior to the treatment and was given the option to cease treatment if there were problems with fatigue or sensitivity. Each resident was also given frequent breaks during the treatment. For all the residents, only hand held scaling instruments were used that included a mirror, 11/12 explorer, anterior and posterior sickles and Gracey curettes. No ultrasonic or mobile suction/water unit was used due to the difficulty in transporting the unit. No coronal polishing or fluoride application was provided for any of the residents.

Each resident was provided with protective eyewear. A portable halogen light was also used and infection control equipment including disinfectant, container to transport used instruments, mask, gloves, bibs, gauze, cotton rolls, and plastic table covers. Local anesthetic was not used, despite the incidence of root sensitivity experienced by five residents.

Standard dental chairs were available in 5 facilities and were utilized, providing the resident could be transferred safely. If no dental chair was available, the treatment was performed with privacy (only the clinician and resident in the room) and ensuring comfort, either at bedside, in a wheelchair, or on a couch or reclining chair in the resident’s room. If, during the treatment, it was found that a referral was required for additional periodontal therapy, a recommendation was made to the dentists involved in the study, to the care-staff at the facility and to the resident, and this recommendation was documented in the resident’s chart. The referral was made based on the complexity of periodontal therapy required.
3.3. UBC GINGIVAL BLEEDING INDEX

The UBC Gingival Bleeding Index (UBC GBI) is a modification to the Anaimo and Bay GBI (1975) and was measured at baseline and at 3-months (following the educational intervention) for the NSCG and CG in the first half of the study. In the second half of the study, the UBC GBI was re-assessed at 15 days after periodontal debridement for the treatment groups (NSC/treatment group and Care-aide/treatment group) and at 6-months from baseline for the non-treatment groups (NSC/non-treatment group and Care-aide/non-treatment group). A third dental hygienist performed all of the oral assessments. The UBC GBI measures the extent of gingival inflammation as a reflection of bleeding gingiva following gentle probing of the gingival sulcus. The dichotomous criteria of the UBC GBI (no bleeding = 0, bleeding = 1) determined the presence or absence of bleeding. The tip of a periodontal probe was run around the sulcus of each tooth present using light pressure. The examiner was advised to place the periodontal probe to the depth of the sulcus at the mesiofacial aspect of the tooth, then to run the probe along the depth of the facial sulcus to the distofacial. Then the probe was to be placed on the mesiolingual and to run the probe along the depth of the lingual sulcus to the distolingual. If the gingival tissues bled at any point in the probing process, the tooth was immediately scored as bleeding. For each resident, all existing teeth were scored except fractured teeth (greater than half of the tooth missing) and roots. The teeth were scored in the following manner: 0 represented no bleeding upon probing and 1 represented bleeding upon probing. The number of teeth that exhibited bleeding was divided by the total number of teeth assessed and then multiplied by 100 to yield the percentage of teeth with gingival bleeding.

The modification made to the UBC GBI included running the probe around the depth of the sulcus from the mesial to the distal, both facially and lingually instead of assessing gingival bleeding at four different locations of the tooth (mesial, facial, distal and lingual) as is required.
by the Anaimo and Bay (1975) GBI. This meant that the probe needed to be re-inserted into the sulcus only once on the lingual aspect with the UBC GBI instead of four times as with the Anaimo and Bay (1975) GBI. With multiple insertions of the probe, this may increase the chance of piercing the junctional epithelium, which may in turn alter the bleeding response of the tissue (Anaimo and Anaimo, 1985).

The dental hygienist’s intra-examiner clinical reliability was tested before the first set of examinations, prior to the 3-month re-examinations and prior to the periodontal debridement. The hygienist re-examined 10 residents one week apart to estimate the error of diagnostic measurement. Percent agreement was used to assess the examiner’s consistency in determining the number of bleeding teeth, and was found to be 98%. In addition, a computer at chair-side, operated by an assistant, was used to enhance the integrity and efficiency of data entry.

3.4. SAMPLE SIZE CALCULATION

Fourteen facilities participated in this study and originally consisting of 113 residents in total. The final sample size, accounting for the dropout rate was 85 residents. From recent published data, it was estimated that periodontal debridement would be clinically beneficial if it reduced the UBC GBI by approximately 35% (O’Leary, 1985; Lundgren, 2001, Schwartz et al, 2001; Pedrozolli et al, 1991; Tessier et al, 1993; Cerek et al, 1983). This figure was obtained from a literature review of healthy adult populations and adult periodontal patients, since no data was available for a population of institutionalized elders. At significance level 0.05, a two-sided test achieves power=80% with 72 residents (18/group). This information was derived in the following manner:

The standard deviation was determined from baseline data to be 37%; the smallest difference between the two groups of clinical interest was determined to be 35%. The level of significance
or alpha chosen was 0.05 for which the corresponding Z alpha for a two-sided test corresponds to 1.96. This significance level (Type I error) identifies the risk that the two treatments are falsely declared as different. The Type II error or beta identifies the risk that the two treatments are falsely declared as not different. The power of the study, 1-beta, is the probability of correctly declaring the treatments as different. At 80% power, the corresponding Z beta is 0.84. Using this information, the following calculation was used to determine an approximate sample size:

\[ N = \frac{(1.96 + 0.84)^2 (2) (37)^2}{(35)^2} = 18 \text{ subjects per group} \]

3.5. STATISTICAL ANALYSIS

The Statistical Package for the Social Sciences (SPSS) (SPSS Inc., Chicago, Ill.) was used to analyze the data. Percent agreement was used to verify the examiner’s reliability in assessing UBC GBI scores. Two-tailed t-tests were used to test for significant differences between mean UBC GBI scores and chi-square analysis was used to assess the number of residents showing an increase or decrease in gingival bleeding. Probability of 5% was defined as significant for all statistical tests in this study.

3.6. ETHICAL APPROVAL: was obtained from the University of British Columbia Behavioral Research Ethics Board (B02-0018).
Chapter 4

RESULTS

4.1. Study Population

Most of the subjects were Caucasian (86.0%), their mean age was 78.0 years (SD 11.2). The study population consisted of 47 women (55.3%), whose mean age was 82.3 years (SD 8.5), and 38 men (44.7%), whose mean age was 72.6 years (SD 12.0); 50 (58.8%) of subjects were older than 80 years. The mean age of subjects in the NSCG and CG was 77 years and 79 years respectively.

TABLE 2: Demographic Characteristics of the Study Population

<table>
<thead>
<tr>
<th></th>
<th># Subjects at start</th>
<th># Subjects at end</th>
<th>Mean Age</th>
<th># Drop Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>46</td>
<td>38</td>
<td>72.6</td>
<td>9</td>
</tr>
<tr>
<td>Women</td>
<td>67</td>
<td>47</td>
<td>82.3</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>85</td>
<td>78.0</td>
<td>28</td>
</tr>
</tbody>
</table>

The number of participating residents per facility ranged from 3-11. The total number of residents that completed the study was 85. At the commencement of the study, there were 113 subjects, 28 (25.0%) of whom accounted for the drop-out rate due to reasons of death (9 or 33.3%), illness (6 or 22.2%), refusal to continue with participation (7 or 25.9%) or being discharged from the facility (5 or 18.5%). Of the 28 subjects, 16 (57.1%) were part of the NSCG and 12 (42.9%) were part of the CG.

Medical records revealed that all 85 subjects (100%) had been diagnosed with at least one significant medical condition. The mean number of medical conditions per subject was 3.4 (SD
The mean number of prescription and non-prescription medications per subject per day was 6.0 (SD 3.4, range 0-14). The mean number of medical conditions and medications per day for subjects in the NSCG was 3.0 and 6.0 respectively and for subjects in the CG was 4.0 and 5.1 respectively. A total of 60 subjects (70.6%) were taking medications with xerostomic side effects, most of whom were part of the CG. Of the 50 total subjects in the CG, 40 (80.0%) were taking medications with xerostomic side effects whereas only 20 (57.1%) of the total 35 subjects in the NSCG were taking medications with xerostomic side effects. There were 13 (15.3%) subjects in total taking medications (anti-convulsants and calcium channel blockers) that sometimes cause gingival enlargement. Five (14.3%) of the subjects were from the NSCG and 8 (16.0%) were from the CG. The total mean UBC GBI scores for the 13 subjects was 51.4 where 1 of the 5 subjects in the NSCG and 3 of the 8 subjects in the CG had mean UBC GBI scores of 100.

Most of the subjects had a neurological condition (74.1%), however, cardiovascular conditions (52.9%) and disorders of the muscles, joints and bone were also prevalent (42.3%) (Table 3). There were 14 (16.5%) subjects in total diagnosed with diabetes (Type I or II); 6 (17.1%) from the NSCG and 8 (16.0%) from the CG. There were 29 (34.1%) subjects diagnosed with depression; 12 (34.3%) from the NSCG and 19 (38.0%) from the CG. Eighteen (21.2%) of subjects had particular neurological conditions (dementia, Schizophrenia and Alzheimer's) that may have affected their ability to perform daily oral hygiene. The mean UBC GBI score of these 18 subjects was 86.8. Eight (22.9%) of these subjects were from the NSCG and 10 (20.0%) were from the CG. Of the 8 in the NSCG, 5 of the subjects had mean UBC GBI scores of 100 and 7 of the 10 in the CG had mean UBC GBI scores of 100.

Tobacco and alcohol consumption was fairly low; 9 (10.6%) of the subjects admitted to smoking tobacco and 7 (8.2%) to consuming alcohol daily. Of the 9 subjects that smoked, 8 (16.0%) were from the CG and only 1 (2.9%) was from the NSCG. The mean UBC GBI score
for the smokers and non-smokers was 97.3 and 60.1 respectively. Seven of the 9 smokers had UBC GBI scores of 100 indicating the presence of bleeding for all of the teeth examined. The number of teeth remaining for these 9 individuals ranged from 8 to 25.

Also, since the smokers showed a greater bleeding response than that reported in the literature, when performing the categorical analysis, exclusion of the smokers reveals a greater proportion of residents showing a “reduction” in the number of bleeding teeth both from baseline to 3-months and from baseline to final exam for 3 of the 4 sample groups. Due to an already small sample size, eliminating these individuals does affect the significance levels in a chi-square statistical analysis.

From baseline to 3 months: 21.3% of residents in the NSC/treatment group showed a reduction in gingival bleeding. There were no smokers in this particular sample group, hence the percentage of subjects showing a reduction in gingival bleeding is unaffected. For the Care-aide treatment group, 11.8% of residents showed a reduction in gingival bleeding at 3 months. Exclusion of smokers in this group reveals a greater reduction in gingival bleeding per resident, 13.3% since the smokers show a greater bleeding response. As for the NSC/non-treatment group, 38.1% of residents in total showed a reduction in gingival bleeding compared to 40.0% for non-smoking residents. Lastly, for the Care-aide non-treatment group, 33.3% of residents in total showed a reduction in gingival bleeding compared to 40.7% for non-smoking residents.

From baseline to final exam: 64.3% of residents in the NSC/treatment group showed a reduction in gingival bleeding following periodontal debridement. This number is unaffected since there were no smokers in this group. For the Care-aide treatment group, 47.1% of residents in total showed a reduction in gingival bleeding post-periodontal debridement compared to 40.0% for non-smoking residents. For the NSC/non-treatment group, 42.9% of residents in total showed a reduction in gingival bleeding compared to 45.0% for non-smoking residents. Lastly,
for the Care-aide non-treatment group, 27.3% of residents in total showed a reduction in gingival bleeding compared to 29.6% for non-smoking residents.

TABLE 3: Most frequent and most significant medical conditions in 85 elderly residents of long-term care facilities in the Vancouver area.

<table>
<thead>
<tr>
<th>Condition</th>
<th>No. (and %) of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurological</td>
<td>63 (74.1)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>45 (52.9)</td>
</tr>
<tr>
<td>Muscles, joints, bone (mostly arthritis, osteoporosis)</td>
<td>36 (42.3)</td>
</tr>
<tr>
<td>Behavioural</td>
<td>29 (34.1)</td>
</tr>
<tr>
<td>Endocrine</td>
<td>24 (28.2)</td>
</tr>
<tr>
<td>Eye/Ear</td>
<td>22 (25.9)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>20 (23.5)</td>
</tr>
<tr>
<td>Lung</td>
<td>16 (18.8)</td>
</tr>
<tr>
<td>Kidney</td>
<td>13 (15.3)</td>
</tr>
<tr>
<td>Blood</td>
<td>10 (11.8)</td>
</tr>
<tr>
<td>Cancer</td>
<td>6 (7.1)</td>
</tr>
<tr>
<td>Liver</td>
<td>2 (2.4)</td>
</tr>
<tr>
<td>Systemic infection</td>
<td>2 (2.4)</td>
</tr>
</tbody>
</table>
4.2. DENTAL STATUS

At baseline, the mean number of teeth remaining per subject was 16.8 (SD 7.6, range 3-32), with a mean of 7.5 (SD 4.6) in the maxilla and 9.2 (SD 3.6) in the mandible. The number of teeth remaining per subject differed slightly between men and women; 17.7 (SD 7.4) for men and 16.0 (SD 7.8) for women. The majority of the subjects (70 or 82.4%) had teeth remaining in both dental arches; 15 (17.6%) subjects had a complete denture where 1 (1.2%) subject was completely edentate in the mandible and 14 (16.5%) were completely edentate in the maxilla. There were 23 (27.1%) subjects that had partial dentures; 16 (45.7%) in the NSCG and 7 (14.0%) in the CG. The mean UBC GBI score for the 23 subjects was 61.7. The mean UBC GBI for the 16 subjects in the NSCG was 61.2 and 62.1 for the 7 subjects in the CG. The mean number of missing teeth differed between jaws; 6.5 (SD 4.6) in the maxilla and 4.8 (3.6) in the mandible. The mean number of missing teeth also differed within jaws (Table 4) and between men and women; 10.4 (SD 7.3) for men and 12.0 (SD 7.8) for women. There were 36 (42.4%) subjects that had fractured teeth; 14 (40.0%) from the NSCG and 22 (44.0%) from the CG.

**TABLE 4: Mean number of missing teeth (SD) (excluding third molars)**

<table>
<thead>
<tr>
<th>Teeth</th>
<th>Maxilla (SD)</th>
<th>Mandible (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors</td>
<td>2.1 (2.4)</td>
<td>0.9 (1.6)</td>
</tr>
<tr>
<td>Premolars</td>
<td>2.2 (1.5)</td>
<td>1.4 (1.3)</td>
</tr>
<tr>
<td>Molars</td>
<td>2.2 (1.4)</td>
<td>2.5 (1.4)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.5 (4.6)</strong></td>
<td><strong>4.8 (3.6)</strong></td>
</tr>
</tbody>
</table>
Few of the subjects (14 or 16.5%) had seen a dentist within the previous year; 6 (17.1%) from the NSCG and 8 (16.0%) from the CG. As a result of this study, 72 (84.7%) of the subjects were referred to a dentist, many for the treatment of dental caries (35.3%), periodontal disease (49.4%), acute infection such as abscesses (3.5%), prosthodontic treatment (dentures or partial dentures) (2.4%), or other (20.0%), which included broken teeth. There were more subjects in the CG that were referred for both caries and periodontal treatment; 17 (34.0%) for caries and 22 (44.0%) for periodontal treatment whereas in the NSCG, 9 (25.7%) were referred for caries and 13 (37.1%) for periodontal treatment.

Most of the subjects (65 or 76.5%) did not receive assistance with daily oral hygiene; 31 (88.6%) from the NSCG and 34 (68.0%) from the CG, and only 3 (3.5%) received help from a care-provider. Nine subjects (10.6%) admitted to not performing any daily oral hygiene; 8 (16.0%) from the CG and only 1 (2.9%) from the NSCG. The information was not available for 8 subjects.

When asked about their daily oral hygiene practices, most subjects (53 or 62.4%) only brushed their teeth, 9 (10.6%) brushed and used a mouth rinse, 10 (11.8%) brushed and flossed, and only 3 (3.5%) brushed, flossed and rinsed daily. Nine subjects (10.6%) did not use toothpaste, 2 (2.4%) used a non-fluoridated toothpaste, and 67 (78.8%) used fluoridated toothpaste when brushing. Of the 23 subjects who used a mouth rinse daily, 3 (3.5%) used a fluoride mouth rinse, 2 (2.4%) used a chlorhexidine mouth rinse, and 18 (21.2%) used an over-the-counter product of their own choosing. Overall, the results show that subjects in the NSCG had better oral hygiene prior to any intervention. Of the 53 subjects that only brushed their teeth, 25 (71.4%) were from the NSCG and only 28 (56.0%) were from the CG. Of the 9 subjects that brushed and used a mouth rinse, 4 (11.4%) were from the NSCG and 5 (1.0%) were from the CG. Of the 3 subjects that brushed, flossed and used a mouth rinse, 2 (5.7%) were from the NSCG and 1 (2.0%) from the CG. Of the 67 subjects that used fluoridated
toothpaste, 30 (85.7%) were from the NSCG and 37 (74.0%) were from the CG whereas all 9 subjects that did not use toothpaste were from the CG. All 3 subjects that used a fluoride rinse were from the NSCG.

The mean oral debris index (ODI), a component of the Simplified Oral Hygiene Index (Greene and Vermillion, 1964), per subject was 1.3 (SD 0.5, range 0-3). Only 8 (9.4%) of the subjects had very clean mouths (ODI of 0), whereas 65 (76.5%) had mildly poor oral hygiene (ODI greater than 1, but less than 2), 11 (12.9%) had moderately poor oral hygiene (ODI greater than 2, but less than 3) and only 1 (1%) subject had extremely poor oral hygiene (ODI of 3). Men had poorer oral hygiene than women; mean ODI for men 1.4 (SD 0.6) and for women 1.2 (SD 0.4). The mean ODI for the NSCG was 1.1 and 1.4 for the CG.

4.3. EDUCATION AND GINGIVAL BLEEDING

The mean UBC GBI of the NSCG and CG worsened from baseline to 3-months, but showed no statistically significant difference. Both groups show an increase in mean UBC GBI scores from baseline to 3-months (indicative of more gingival bleeding) however, the NSCG shows less of an increase than the CG. The mean UBC GBI score for the NSCG at baseline was 59.1 and at 3-months was 61.2; a difference in mean UBC GBI scores of 2.1. The mean UBC GBI for the CG at baseline was 61.7 and at 3-months was 66.5; a difference in mean UBC GBI scores of 4.8.

By gender, males and females do not show much variation in mean UBC GBI scores; 67.6 for males and 63.9 for females, p>0.05. However, this variation is more pronounced when comparing male mean UBC GBI scores between the NSCG and CG. The mean UBC GBI scores for males in the NSCG and CG was 53.2 and 82.0 respectively, p<0.05. The mean UBC GBI scores for females in the NSCG and CG was 69.6 and 58.2 respectively, p>0.05.
As with the analysis of mean UBC GBI scores, the categorical analysis of the number of residents showing either a reduction or increase in gingival bleeding showed no significant differences between the NSCG and CG from baseline to 3-months (Table 5). Although not statistically significant, the same trend indicates that the NSCG shows a slightly greater number of residents showing a reduction in gingival bleeding (lower UBC GBI) than the CG, 31% and 26% respectively.

The following information was derived from the telephone interview with the dental hygienist who provided the oral hygiene education seminars:

One of the facilities (facility #11) originally determined to be in the NSCG was placed in the CG, which is a limitation of randomization of this study. All of the facilities were contacted well in advance prior to the commencement of the study to determine a participation rate. Simultaneously, a registered nurse, for the NSCG, was chosen and informed about the basic methods. However, the registered nurse at facility #11 decided against participation due to conflicting personal priorities. She claimed that the duration from initial contact of the facility to the commencement of the study was too lengthy thereby interfering with other personal commitments. The other registered nurses on staff also refused participation in light of rumors of facility closures. Since this facility no longer had an oral hygiene nurse-supporter willing to participate, for practical purposes, it was placed in the CG.

A second problem arose at another facility involving an oral hygiene nurse-supporter. All of the Registered nurses employed at facility #14 refused participation in the study therefore, a Licensed Practical Nurse (LPN) was appointed as the oral hygiene nurse-supporter as recommended by facility administrators. Due to unfortunate circumstances, this LPN fell ill shortly after she received the oral care presentation and was away from work for a number of weeks. After her return, she too, decided not to participate in the study. As a result, none of the care-aides at this facility had received the oral care presentation. Nonetheless, this facility was
not removed from the study since the exclusion of 5 subjects would reduce an already small sample size.

The hygienist also indicated differences in audience attentiveness and interests. She found that certain facilities were more intrigued with particular aspects of the oral care presentation as reflected in the informal discussion period. For example, the care-aides at facility #10 inquired more about denture care and denture related concerns. This was in part due to the fact that many of these care-aides wore dentures themselves and found the information relevant for their own personal oral hygiene as well as the residents. The care-aides at facility #1 were highly interested in information pertaining to minor aphthous ulcers and xerostomia, whereas the care-aides at facility #8 focused more on oral malodor.

TABLE 5: Categorical Analysis of the Reduction in Gingival Bleeding for Residents in the NSCG versus CG from Baseline to 3-Months.

<table>
<thead>
<tr>
<th>Reduced Bleeding</th>
<th>Yes (%)</th>
<th>No*(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSC</td>
<td>11 (31)</td>
<td>24 (69)</td>
</tr>
<tr>
<td>CG</td>
<td>13 (26)</td>
<td>37 (74)</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>61</td>
</tr>
</tbody>
</table>

χ²=0.299, df=1, p=0.5842

* No: no change or increase in # bleeding teeth
4.4. PERIODONTAL DEBRIDEMENT AND GINGIVAL BLEEDING

In the analysis of the differences in mean UBC GBI scores post-periodontal debridement, the treatment groups (the NSC/treatment and Care-aide/treatment group) had a significantly lower mean UBC GBI than the non-treatment groups (NSC/non-treatment and Care-aide/non-treatment group), 36.5 versus 69.1 respectively (t = 4.562, df = 83, p <0.001). This represents a 33-point difference in gingival bleeding scores. Following periodontal debridement, the treatment groups showed 39% reduction in gingival bleeding, from a UBC GBI of 59.1 to 36.5, (t = 3.488, df = 30, p =0.002).

In the categorical analysis of the number of residents showing either a reduction or increase in gingival bleeding, the treatment groups (NSC/treatment and Care-aide treatment group) also showed a greater number of residents showing a decrease in gingival bleeding (indicative of a lower UBC GBI score) following periodontal debridement than the non-treatment groups (NSC/non-treatment and Care-aide/non-treatment group), 54.8% compared to 33.3% respectively ($\chi^2 = 3.76$, df= 1, p<0.05) (Table 6). Those residents who received periodontal debridement showed a 40% greater reduction in gingival bleeding than those residents that did not receive any debridement.
TABLE 6: Categorical Analysis of the Reduction in Gingival Bleeding for Residents in the Treatment versus Non-Treatment Groups from Baseline to Final exam.

<table>
<thead>
<tr>
<th></th>
<th>Reduced Bleeding</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (%)</td>
<td>No* (%)</td>
</tr>
<tr>
<td>Tx</td>
<td>17 (55)</td>
<td>14 (45)</td>
</tr>
<tr>
<td>No Tx</td>
<td>18 (33)</td>
<td>36 (66)</td>
</tr>
<tr>
<td></td>
<td>35 50 85</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 3.758, \text{ df}= 1, p=0.0525(2\text{-sided}) \]

The average duration of the periodontal debridement for the NSC/treatment group compared to the Care-aide/treatment group was virtually the same, 67.1 minutes compared to 68.5 minutes respectively (\( t = 0.146, \text{ df} = 29, p = 0.885 \)). On average, each resident received approximately the same amount of periodontal debridement. Hence, differences in mean UBC GBI scores between the NSCG and CG should investigate other confounding variables and not the duration of periodontal debridement time for each resident, which may have influenced the UBC GBI scores.

* No: no change or increase in # bleeding teeth
4.5. EDUCATION/PERIODONTAL DEBRIDEMENT AND GINGIVAL BLEEDING

In the analysis of the differences in mean UBC GBI scores, results showed that gingival bleeding following periodontal debridement in the NSC/treatment group was significantly lower than in the NSC/non-treatment group, the Care-aide/treatment group, or the Care-aide/non-treatment group. First, a significant difference was found when comparing the mean UBC GBI of the NSC/treatment group and the mean UBC GBI of the NSC/non-treatment group, 23.2 and 58.3 respectively (t = 3.434, df = 33, p = 0.002). This reflects approximately a 35-point difference in gingival bleeding scores. Although all of these residents resided in facilities that received the oral hygiene education from a nurse-supporter, those residents who also received the periodontal debridement had significantly less gingival bleeding when re-evaluated than those residents that did not receive the periodontal debridement. Second, a comparison between treatment groups shows that the NSC/treatment group had a significantly lower UBC GBI than the Care-aide/treatment group, 23.2 and 47.4 respectively (t = 2.274, df = 29, p = 0.031). Following the periodontal debridement the NSC/treatment group showed a 61% reduction in gingival bleeding (from 59.1 to 23.2). The Care-aide/treatment group showed a reduction in gingival bleeding of 24% (from 61.7 to 47.4). This reflects a 37% greater reduction in gingival bleeding for the NSC/treatment group than the Care-aide/treatment group. Third, the greatest difference in gingival bleeding was found between the NSC/treatment group compared to the Care-aide/non-treatment group, 23.2 and 75.9 respectively. This reflects a 53-point difference in gingival bleeding scores. A highly significant difference was found (t = 6.547, df = 45, p=0.000). Residents that received periodontal debridement and who were residing in facilities that received the oral hygiene education from a nurse-supporter had significantly less gingival bleeding than those residents that did not receive any periodontal debridement and who were residing in facilities that did not have an oral hygiene nurse-supporter.
Using the categorical analysis and the chi-square statistic, the NSC/treatment group showed a significantly greater number of residents with less gingival bleeding than the NSC/non-treatment group, the Care-aide/treatment group or the Care-aide/non-treatment group. This result is also evident from the analysis of mean UBC GBI scores. First, a significant difference was found when comparing the number of residents showing a reduction in gingival bleeding in the NSC/treatment group and the NSC/non-treatment group, 64.3% and 42.9% respectively ($\chi^2 = 3.76$, df=1, $p<0.05$) (Table 7).

### TABLE 7: Categorical Analysis of the Reduction in Gingival Bleeding for Residents in the NSC/Treatment versus NSC/Non-Treatment Group from Baseline to Final exam.

<table>
<thead>
<tr>
<th>Reduced Bleeding</th>
<th>Yes (%)</th>
<th>No* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSC-Tx</td>
<td>9 (64)</td>
<td>5 (36)</td>
</tr>
<tr>
<td>NSC-No Tx</td>
<td>9 (43)</td>
<td>12 (57)</td>
</tr>
</tbody>
</table>

Total: 18 17 35

$\chi^2 = 3.758$, df=1, $p=0.0525$ (2-sided)

*p=0.02625 (1-sided)

Sixty four point three percent of residents in the NSC/treatment group showed a reduction in gingival bleeding (lower UBC GBI) following periodontal debridement compared to 42.9% of residents in the NSC/non-treatment group who did not receive any debridement. As

* No: no change or increase in # bleeding teeth
with the assessment of mean UBC GBI scores, although all of these residents resided in facilities that received the oral hygiene education from a nurse-supporter, those residents who also received the periodontal debridement showed significant improvement in gingival health when re-evaluated than those residents that did not receive any periodontal debridement. Second, a comparison between treatment groups indicates the NSC/treatment group had a greater number of residents showing a reduction in gingival bleeding than the Care-aide/treatment group, 64.3% and 47.1% respectively ($\chi^2 = 2.52$, df = 1, p < 0.05) (Table 8).

**TABLE 8: Categorical Analysis of the Reduction in Gingival Bleeding for Residents in the NSC/Treatment versus Care-aide/Treatment Group from Baseline to Final exam.**

<table>
<thead>
<tr>
<th>Reduced Bleeding</th>
<th>Yes (%)</th>
<th>No* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSC-Tx</td>
<td>9 (64)</td>
<td>5 (36)</td>
</tr>
<tr>
<td>CG-Tx</td>
<td>8 (47)</td>
<td>9 (53)</td>
</tr>
</tbody>
</table>

$\chi^2=2.523$, df=1, p=0.11 (2-sided)  
p=0.055 (1-sided)

This reflects a 17% point difference between the NSC/treatment group and the Care-aide/treatment group. Lastly, and consistent with the assessment of mean UBC GBI scores, the greatest difference in the number of residents showing a reduction in gingival bleeding was found between the NSC/treatment group compared to the Care-aide/non-treatment group, 64.3%

* No: no change or increase in # bleeding teeth
and 27.3% respectively ($\chi^2 = 10.36$, df=1, $p<0.001$) (Table 9). The residents that received periodontal debridement and who were residing in facilities that received the oral hygiene education from a nurse-supporter showed a significant improvement in gingival health than those residents that did not receive any debridement and who were residing in facilities that did not have an oral hygiene nurse-supporter.

**TABLE 9: Categorical Analysis of the Reduction in Gingival Bleeding for Residents in the NSC/Treatment versus Care-aide/Non-Treatment Group from Baseline to Final exam.**

<table>
<thead>
<tr>
<th>Reduced Bleeding</th>
<th>Yes (%)</th>
<th>No* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NSC-Tx</strong></td>
<td>9 (64)</td>
<td>5 (36)</td>
</tr>
<tr>
<td><strong>CG No Tx</strong></td>
<td>9 (27)</td>
<td>24 (73)</td>
</tr>
</tbody>
</table>

$\chi^2=10.362$, df=1, $p=0.001$ (2-sided)
$p=0.0005$ (1-sided)

In the categorical analysis, the treatment groups showed a greater number of residents with less gingival bleeding than the non-treatment groups from baseline to final exam, 55% and 33% respectively, a reduction of 40%. However, from 3-months to final exam, the treatment groups show an even greater number of residents with less gingival bleeding compared to the non-treatment groups, 68% and 20% respectively, a reduction of 71% (Table 10).

* No: no change or increase in # bleeding teeth
TABLE 10: Categorical Analysis of the Reduction in Gingival Bleeding for Residents in the Treatment versus Non-Treatment Groups from 3-Months to Final exam.

<table>
<thead>
<tr>
<th>Reduced Bleeding</th>
<th>Yes (%)</th>
<th>No* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tx</strong></td>
<td>21 (68)</td>
<td>10 (32)</td>
</tr>
<tr>
<td><strong>No Tx</strong></td>
<td>11 (20)</td>
<td>43 (80)</td>
</tr>
</tbody>
</table>

χ² = 18.827, df = 1, p < 0.001 (2-sided)  
p < 0.001 (1-sided)

* No: no change or increase in # bleeding teeth
CHAPTER 5

DISCUSSION

Optimally, researchers hope that the outcome measured in a study can be attributed to the intervention(s) alone and not to other known or unknown factors (Locker, 2002). Such factors, which may have influenced the outcome measure or UBC GBI scores, need to be considered and will either be discounted as an alternative hypothesis that may have influenced the differences in mean UBC GBI scores between the NSCG and CG or will be presented as a possible confounding variable.

5.1. Study Population

The mean number of medical conditions (3; range 1-7) and mean number of medications (6; range 1-14) taken per day was similar to results reported by other researchers (Table 11). Most of the subjects had a neurological condition (74.1%), where 18 (21.2%) of subjects presented with particular neurological conditions such as dementia, Schizophrenia, and Alzheimer’s, that may have affected their ability to perform daily oral hygiene as reflected by a high mean UBC GBI score of 86.8. Since it appears that being diagnosed with one of these conditions may affect mean UBC GBI scores, this must be considered to determine if there were a greater percentage of individuals with these conditions in one group or the other. The results, however, showed no statistically significant difference, p>0.05, between subjects in the NSCG and CG diagnosed with one of the above named conditions, 22.9% and 20.0% respectively. This then should not be considered a confounding variable for the higher mean UBC GBI scores seen with the CG.
Two other medical conditions need to be considered, diabetes and depression. Diabetes does not cause gingivitis or periodontal disease, but is thought to alter the response of the periodontal tissues to local factors such as plaque and calculus (Teng et al, 2002). Studies show a higher prevalence and severity of periodontal disease in individuals with diabetes than without (Teng et al, 2002; Grossi et al, 1996). Also, diabetics show an increase in loss of attachment, increased tooth mobility and increased gingival bleeding (Loë, 1993). In light of this, being diabetic could have influenced the mean UBC GBI scores (reflected as an increase in gingival bleeding) however, the results show no significant difference, p>0.05 between subjects diagnosed with diabetes in the NSCG compared to the CG, 17.1% and 16.0% respectively. This again, should not be considered a confounding variable to explain the higher mean UBC GBI scores seen with subjects in the CG.

Depression can affect one’s motivation to perform daily oral hygiene, which may result in more plaque accumulation, gingivitis, gingival bleeding and other oral effects (Ciancio, 2001). This must be considered to determine if there were a greater percentage of individuals in the CG diagnosed with this condition that may have contributed to the higher mean UBC GBI scores seen with subjects in this group. The results also showed no significant difference, p>0.05, with the number of subjects diagnosed with depression in the NSCG compared to the CG, 34.3% and 38.0% respectively. This too, should not be considered a confounding variable.

There were 13 (15.3%) subjects taking medications that could have affected the gingiva. Gingival enlargement is a well-known consequence of the administration of some anti-convulsants, immunosuppressants and calcium channel blockers. Drug-induced enlargement can occur in mouths with little or no plaque (Brown et al, 1991). However, the presence of the enlargement makes plaque control difficult. The resultant enlargement then becomes a combination of the increase in size caused by the drug and the inflammation caused by the bacteria and may result in an increased gingival bleeding response thereby affecting the mean
UBC GBI scores. Fifty percent of individuals who take phenytoin or dilantin, a common anti-convulsant used to treat epilepsy (except petit mal), show signs of gingival enlargement (Brown et al, 1991). The pathogenesis of the enlargement is not definitively known, but is thought to be linked to a decrease in collagen degradation by inactivation of collagenase (Brown et al, 1991).

Five (38.5%) of the 13 subjects were taking phenytoin and the remaining 8 (61.5%) were taking calcium channel blockers such as amlodipine, felodipine, nifedipine, and diltiazem. Calcium channel blockers are used to treat hypertension, angina, cardiac arrhythmias and coronary artery spasms. These drugs cause gingival enlargement in 20% of individuals who take them (Butler et al, 1987). The results showed no significant difference, p>0.05, with the number of subjects taking these medications in the NSCG compared to the CG, 14.3% and 16.0% respectively.

Since there wasn’t a significantly greater percentage of subjects taking these medications in the CG, this should not be considered a confounding variable that may have influenced the higher mean UBC GBI scores seen with subjects in this group.
Table 11: Summary and comparison of data in various studies.

<table>
<thead>
<tr>
<th>Variable</th>
<th>This study</th>
<th>Other studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean no. of medical Conditions</td>
<td>3.4</td>
<td>3.3 (Wyatt, 2002)</td>
</tr>
<tr>
<td>Mean no. of medications</td>
<td>6.0</td>
<td>5.3 (Wyatt); 6.4 (Knabe and Kram, 1997)</td>
</tr>
<tr>
<td>% of residents taking medications with xerostomic side effects</td>
<td>71</td>
<td>78 (Wyatt); 77 (Guivante-Nabet et al, 1998)</td>
</tr>
<tr>
<td>% of residents performing their own daily oral hygiene</td>
<td>77</td>
<td>87 (Wyatt, 2002); 98 (Frenkel et al, 2000)</td>
</tr>
<tr>
<td>% of residents not receiving or performing daily oral hygiene</td>
<td>11</td>
<td>4 (Wyatt, 2002); 59 (Knabe and Kram, 1997)</td>
</tr>
<tr>
<td>% of residents with moderately poor oral hygiene</td>
<td>86</td>
<td>76 (Wyatt, 2002); 82 (Frenkel et al, 2000)</td>
</tr>
<tr>
<td>% of residents with extremely poor oral hygiene</td>
<td>11</td>
<td>45 (Wyatt, 2002); 47 (Lee, 2000)</td>
</tr>
<tr>
<td>Mean no. of remaining teeth</td>
<td>16.8</td>
<td>16.4 (Wyatt); 16.6 (Guivante-Nabet et al, 1998); 15.5 (Galan et al, 1995); 14 (Lee, 2000)</td>
</tr>
<tr>
<td>% of residents attending a dentist in the past year</td>
<td>16.5</td>
<td>3.9 (Wyatt, 2002); 13.1 (Frenkel et al, 2000)</td>
</tr>
<tr>
<td>% of residents requiring dental treatment</td>
<td>84.7</td>
<td>68.6 (Wyatt, 2002); 100 (Galan et al, 1995)</td>
</tr>
</tbody>
</table>

5.2. DENTAL STATUS

The number of missing teeth per elderly subject in this study was very similar to that reported by Wyatt (2002a) (Table 4). The number of remaining teeth was higher for men than for women. However, Wyatt (2002a) reported a greater number of missing teeth for men and women than that reported in this study (Table 12). More teeth were retained in the mandible than in the maxilla. This result is consistent with that reported by
Wyatt (2002a) and Guivante-Nabet et al. (1998). The number of missing molars was similar in the maxilla and mandible, but the number of missing anteriors and premolars was higher in the maxilla.

Of the 23 (27.1%) of subjects that had a partial denture, 16 (45.7%) were in the NSCG and 7 (14.0%) in the CG. Partial dentures can harbor plaque around the abutment teeth and can contribute to an increase in gingival bleeding (Brill et al., 1977) and hence an increase in UBC GBI scores. The results showed no significant difference, p>0.05, between mean UBC GBI scores for subjects who had partial dentures in the NSCG compared to the CG, 61.2 and 62.1 respectively, and hence should not be considered a confounding variable.

**TABLE 12: Subject characteristics and dental status by sex**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Men (n=38)</th>
<th>Women (n=47)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>72.6 (12.0)</td>
<td>82.3 (8.5)</td>
</tr>
<tr>
<td>No. of remaining teeth</td>
<td>17.7 (7.4)</td>
<td>16.0 (7.8)</td>
</tr>
<tr>
<td>No. of missing teeth</td>
<td>10.4 (7.3)</td>
<td>12.0 (7.8)</td>
</tr>
<tr>
<td>ODI</td>
<td>1.4 (0.6)</td>
<td>1.2 (0.4)</td>
</tr>
</tbody>
</table>

The number of residents attending a dentist in the previous year (16.5%) was higher than that reported by both Wyatt (2002a) (3.9%) and Frenkel et al. (2000) (13.1%). Three (21.4%) facilities had a regular dentist employed to provide mobile dental services on demand. Subsequently, 84.7% of the residents were referred for dental care mostly for the treatment of dental caries (35.3%) and periodontal disease (49.4%). The estimation of dental caries in this study was far lower than that reported by Wyatt (2002a) (96.4%), however, the estimation of periodontal disease was much higher in this study than that reported by Wyatt (2002a) (2.0%).
The present study may have underestimated the incidence of dental caries, however, this may be because this was a healthier population group, all of whom took up residence in Intermediate Care Facilities. The less healthy population group in the Wyatt (2002a) study was sampled from both Extended Care and Intermediate Care facilities. As well, this population group had a lower ODI and greater access to dentists, which may also have contributed the lower incidence of caries.

Between the groups, the results did not show a significant difference, p>0.05, with the number of subjects who had seen a dentist in the previous year between the NSCG and CG, 17.1% and 16.0% respectively. Since there wasn’t a significantly greater percentage of subjects that accessed dental care in the NSCG, this should not be considered a confounding variable that may have influenced the lower mean UBC GBI scores seen with subjects in the NSCG.

There was a higher percentage of subjects referred for both caries and periodontal treatment in the CG compared to the NSCG, 17 (34.0%) for caries and 27 (44.0%) for periodontal treatment in the CG and 9 (25.7%) for caries and 13 (37.1%) for periodontal treatment in the NSCG. This would indicate that subjects in the CG had poorer oral hygiene than subjects in the NSCG and must be considered when interpreting the results of this study.

The facilities in this study were defined as Intermediate Level Care. The Intermediate care hospitals offer full time care, supervision, nursing and recreational activities (Wyatt, 2002a). Residents in Intermediate care hospitals however, are expected to need some assistance with their activities of daily living. In regards to oral hygiene, most residents (77%) stated that they perform their own daily oral hygiene. The majority (63%) claimed to brush their teeth with fluoridated toothpaste. The use of rinses containing fluoride or chlorhexidine was rare and 21% claimed to use an over-the-counter mouthrinse of their own choosing. Wyatt (2002a) reported similar results from the use of mouthrinses containing fluoride or chlorhexidine, but found that only 5 (1.4%) of 369 subjects used an over-the-counter mouthrinse of their own choosing. The
use of chlorhexadine has been proven effective in reducing gingival inflammation (Clarke et al., 1991; Keltjens et al., 1990; Donnelly et al., 2000), however, the 2 residents who claimed to use this antimicrobial rinse had similar UBC GBI scores to those who did not.

The results showed that subjects in the NSCG had overall better oral hygiene than subjects in the CG. This is reflective in a greater percentage of subjects that performed their own daily oral hygiene, brushed their teeth, used mouth rinses and fluoridated toothpastes. These oral hygiene practices may have also contributed to the lower incidence of caries and periodontal disease seen with subjects in the NSCG. Healthy gingival tissue and less gingival bleeding is apparent with good oral hygiene (Loe and Kleinman, 1986). Since subjects in the NSCG had overall better oral hygiene, this could be an important factor that may have influenced the lower mean UBC GBI scores seen with subjects in this group and should be considered a confounding variable.

There were also a greater percentage of subjects taking medications with xerostomic side effects in the CG compared to the NSCG, 80.0% and 57.1% respectively. These medications, which reduce salivary flow are important when considering the rate of caries and also the differences in mean UBC GBI scores between the NSCG and CG. With reduced salivary flow, this reduces the availability of bicarbonate, which acts as a buffering agent to help neutralize acids in the mouth that contribute to caries (Loesche et al., 1995). As well, a decrease in saliva means less availability of salivary defense factors, namely lactoferrin, lysozymes, peroxidase systems and IgA antibodies. These substances are involved in reducing supra-gingival plaque bacteria, which is the main causative agent in gingivitis (Loe et al., 1965). Hence, reduced salivary flow may contribute to an increased rate of caries and gingivitis. Since most of the subjects in the CG were taking medications with xerostomic side effects, this may have influenced the higher rate of caries and higher mean UBC GBI scores seen with subjects in this group and should be considered another confounding variable.
Only 8 (9.4%) of the subjects had clean mouths (ODI of 0), whereas 12 (14.1%) had an ODI greater than 2. If an ODI greater than 2 implies poor oral hygiene, then only 14.1% of the population in the present study have poor oral hygiene. This number is less than the 26% of 369 elderly residents with poor oral hygiene reported by Wyatt (2002a). It should be noted that the validity of the ODI may be affected since soft debris on the tooth surface may be reduced by toothbrushing, using a mouthrinse or antimicrobial rinse, therefore ODI results may be underestimated depending on when the examination was performed.

5.3. EDUCATION AND GINGIVAL BLEEDING

In the interview with the dental hygienist educator, the hygienist confirmed that the oral hygiene content was standardized from the beginning to the end of the educational component. There were some modifications made to teaching style, but not to the content. There was no additional emphasis placed on particular oral care topics from facility to facility. The most significant deviation to the presentation arose during the informal discussion period, which granted the audience control of topics they wished to discuss in further detail. The hygienist also confirmed that she maintained a confident demeanor for all presentations and that nervousness and hesitation did not play a role.

The hygienist indicated that one slight modification was made with the hands-on demonstration of the bite block. A bite block is an oral care aide that assists a caregiver in resident comfort and opening a combative or non-compliant resident’s mouth and maintaining intra-oral accessibility so that they may brush the resident’s teeth. With the first four facilities scheduled for the oral care presentation, the hygienist demonstrated the use of this bite block on a volunteer from the audience. This method involved stabilizing the resident’s head by standing behind a seated resident and cradling the individual’s head. With the other hand, the caregiver
could apply pressure to the chin area at a pressure point. In doing so, this would easily force the resident's mouth open allowing the bite block to be inserted. The hygienist found that there was confusion as to the location of this pressure point with the care-aides in the first four facilities. Therefore, with the remaining facilities, she modified this approach. In describing this procedure, she instructed the audience to locate the pressure point on themselves and then continued on with the demonstration using a volunteer. She found this to be more effective in facilitating an understanding of the use of a bite block for uncooperative residents.

The importance of this interview lies primarily with the scheduling of the facilities for both the oral hygiene education and periodontal debridement. As previously mentioned, the facilities were scheduled for oral hygiene presentations based on availability of the nurse-supporter and/or care-aides as well as being contingent on the hygienist's availability. As such, on average, one facility per week received the oral hygiene education. In the second half of the study, the facilities were further divided into the treatment and non-treatment group. The division was based on the previous scheduling of the oral hygiene presentations. That is, the facility order was kept the same and the last 6 facilities were considered to be the treatment group. Since the results indicated a significant difference between the mean UBC GBI scores of all four groups (NSC/treatment, Care-aide/treatment, NSC/non-treatment, and Care-aide/non-treatment) following periodontal debridement, the question arises as to whether the oral hygiene content was standardized and not modified in any way for the last half of the facilities. If in fact the content was not standardized to the end, this then would offer an alternative hypothesis as to the differences reported in mean UBC GBI scores between all four groups. However, assuming the hygienist's recollection of these events is accurate, it is clear that this is not the case and the significance of having standardized the oral hygiene content is that this would eliminate the possibility of attributing differences in the mean UBC GBI scores between the NSCG and the CG to differences in the content of the presentations themselves.
In assessing differences between the two different educational models, the CG shows a greater amount of gingival bleeding for each resident that the NSCG. In the CG, it was the sole responsibility of the care-aides to provide the residents with assistance in daily mouth care, whereas in the NSCG, the oral hygiene nurse-supporter was available constantly to observe and respond to care-aides, offer continuous guidance on oral hygiene, and regulate and reinforce the need for daily oral hygiene for the residents. The lack of supervision and reinforcement of the need for daily oral hygiene for the residents in the CG is reflective in the higher UBC GBI scores for both the Care-aide/treatment group and Care-aide/non-treatment group, 47.4 and 75.9 respectively, than the NSC/treatment group and NSC/non-treatment group. As mentioned, care-aides face many barriers to providing daily oral hygiene and in the absence of an oral hygiene nurse-supporter, who may assist in delegating daily responsibilities for the care-aides, oral hygiene becomes a low priority.

5.4. PERIODONTAL DEBRIDEMENT AND GINGIVAL BLEEDING

The results showed that the treatment groups (NSC/Treatment and Care-aide/treatment groups) had a significantly lower mean UBC GBI than the non-treatment groups (NSC/non-treatment and Care-aide/non-treatment groups), 36.5 versus 69.1 respectively, p<0.001. This showed that the residents that received the periodontal debridement had approximately 48% less gingival bleeding than the residents that did not receive the periodontal debridement. This result is by no means surprising since many studies have proven the effectiveness of periodontal debridement. Similar results were found by Tessier et al. (1993) (52%), Cerek et al. (1983) (35-45%), and Hammerle et al. (1991) (46.6%). This population, which involved disabled, frail elders, showed a comparable reduction in gingival bleeding as the healthy, young adult populations in the above mentioned studies. Although this population presented with numerous
medical conditions that may have affected their host defense systems in combination with age-associated decline in T and B-cell humoral immunity, which would affect a frail elder's ability to deal with infection, this did not seem to influence their response to the periodontal debridement.

The intent of the periodontal debridement was to debride all existing teeth of supra and sub-gingival calculus deposits for each resident, as thoroughly as possible, unless difficulties were encountered with root sensitivity or resident tolerance that would render the treatment incomplete. Generally, the results showed that the periodontal debridement itself was in fact standardized. The mean duration of the periodontal debridement for the NSC/treatment group was 67.1 minutes (SD = 27.0) and the Care-aide/treatment group was 68.5 minutes (SD = 25.8), p=0.885. The dental hygienist who performed the periodontal debridement was also blinded to the type of educational intervention employed in each facility. This indicates that since the periodontal debridement was standardized, this should not be considered a confounding variable.

In the categorical analysis, the treatment groups showed a greater number of residents with less gingival bleeding than the non-treatment groups from baseline to final exam, 55% and 33% respectively, a reduction of 58%. However, from 3-months to final exam, the treatment groups show an even greater number of residents with less gingival bleeding compared to the non-treatment groups, 68% and 20% respectively, a reduction of 71% (Table 10). The differences noted in the two time periods may be indicative of the influence of the oral hygiene education. In assessing the number of residents showing a reduction in gingival bleeding from baseline, this would include the educational component however, in assessing the number of residents showing a reduction in gingival bleeding from the 3-month point would show a greater influence of the periodontal debridement.

As previously mentioned, some of the facilities had dental chairs on site that were either donated or purchased by the facility. These facilities included: facility #1, facility #4, facility #5, facility #9, and facility #14. The dental chairs were only used permitting ease of transferability of
the resident and additional comfort. Despite greater intra-oral visibility and operator comfort, the facilities that had dental chairs do not appear to influence the mean UBC GBI scores.

Also, no coronal polishing or fluoride varnish was provided for any resident. Coronal polishing is a method of removing surface staining and/or soft debris such as plaque and material alba. It was decided that since soft debris and some extrinsic staining can be removed using hand instruments, in addition to the lack of scientific evidence available for the need for coronal polishing (Martin, 1998), the polishing procedure was not provided. On the other hand, the application of fluoride in a varnish form such as Durafluor, should have been used as a caries preventive agent and to assist with dentinal hypersensitivity, however, this was not considered until after a few residents had already been treated. Therefore, to avoid affecting the reliability of the study, it was decided that fluoride varnish would not be used.

Local anesthetic was not used, despite the incidence of root sensitivity experienced by five residents. Much of the periodontal debridement was provided for the residents on weekends and on statutory holidays to ensure the participating residents were present in the facility and not away on day trips. This meant that no medical professional was on site at the facility should an emergency arise with a resident’s reaction to the anesthetic, therefore, local anesthetic was not used for any resident. This did not prove to be a major limitation since only five residents would have benefited from the use of local anesthetic.

5.5. EDUCATION/PERIODONTAL DEBRIDEMENT AND GINGIVAL BLEEDING

In both the analysis of the differences in the mean UBC GBI scores and the analysis of the number of residents showing an increase or decrease in gingival bleeding, the NSC/treatment group shows the greatest reduction in gingival bleeding. As mentioned, the relative contribution
of each intervention, education and periodontal debridement, cannot be definitively determined. For logistical reasons (limited number of facility participation and small sample size), a control group that did not receive any intervention was not possible for this study, however, it should be considered for future studies.

The use of the full mouth recording technique for this study was deemed more realistic and plausible than a partial mouth recording technique utilizing only selected teeth for individual oral assessments. This is because the participating residents had fewer natural teeth remaining in their dentition, a range of 3 teeth to 32 teeth. Therefore, using selected teeth for assessments would have compromised the reliability of the study since every resident may not have had the selected teeth present for analysis. In light of this, it was decided to assess each tooth remaining in each resident’s dentition. The examiner in this study ran the probe around each tooth present and if during this process of probing bleeding was apparent, it was scored.

The UBC GBI incorporates the use of a probe as a measurement tool in evaluating gingival inflammation based on the presence or absence of gingival bleeding. There exists some potential sources of error with regards to the reliability of the use of a probe to assess bleeding and must be considered:

Usual sources of error related specifically to the use of bleeding indices include the teeth selected for measurement, the specific sites of the tooth selected for probing, the type of probe used, and inter and intra-examiner calibration (Mojon et al, 1995; Shaw and Murray, 1977; Anaimo and Anaimo, 1985; Gaengler et al, 1988; Winter, 1979). Firstly, in this study, all of the gingiva surrounding the natural teeth present was assessed for bleeding. Therefore, systematic underestimation or overestimation of the prevalence of a bleeding response is not a factor and should not be considered a confounding variable. Secondly, specific sites of the tooth were not selected for probing to assess bleeding, rather, the whole tooth was consistently probed by the examiner whereby the tip of the probe was run around the sulcus of each tooth using light
pressure from the mesial to the distal, both facially and lingually. This too, should not be considered a confounding variable. Thirdly, the UBC GBI assessment required that the examiner place the probe to the depth of the sulcus and to run the probe around the tooth using a light pressure. This is important because it has been found that marginal probing (just under the margin of the gingiva) elicits a different bleeding response than probing to the base of the pocket as specified for this assessment. Timmerman et al (1998) compared the bleeding tendency as elicited by probing the marginal gingiva (BOMP) and probing to the bottom of the pocket (BOPP) in two groups. The researchers concluded that there was a consistently higher bleeding score of approximately 10% by BOPP. Since the UBC GBI required the examiner to run the probe along the bottom of the pocket, this may have elicited a greater bleeding response than marginal probing, but would have appeared as a systematic error (Brunette, 1996) since this technique was used for all subjects. Therefore, this would not have influenced the difference in mean UBC GBI scores seen between the NSCG and CG. Fourthly, there are 11 examination kits which include a mirror, probe and explorer, that are consistently used by clinicians working in collaboration with the ELDERS Research team. These same probes were used for all initial assessments and reassessments and would not have influenced the UBC GBI scores. Lastly, the same examiner was used from the commencement of the study to completion, therefore, inter-examiner reliability is not of concern. Also, the examiner was calibrated on 3 separate occasions: prior to commencement of the study, prior to the 3-month re-examinations, and prior to the periodontal debridement. This was done to reduce variation by the same examiner (intra-examiner reliability).

Another potential source of error associated with the use of a probe related to validity might occur due to tissue change as a result of the act of probing. It has been suggested that repeated probing can cause an alteration of tissue response, which may affect the bleeding response (Anaimo and Anaimo, 1985). This however, was not an issue in this study due to the
nature of the two assessments conducted: the UBC GBI and the ODI. The ODI is an assessment of the amount of plaque and debris on the tooth surface and does not require penetration of a probe into the gingival sulcus. Therefore, the use of the probe to measure the bleeding response was only conducted once on each resident at the time of assessment and would not have affected the tissue response from repeated probing. However, with excessive bleeding, it would be difficult to determine whether the blood from the gingiva surrounding one tooth may have spread to adjacent teeth.

Another consideration is the use of ordinal scales in the assessment of oral conditions. Ordinal scales are commonplace with many indices. Ordinal scales both sort and order subjects, however there may be considerable doubt about equal intervals between the categories (Brunette, 1996). The categories may not be well defined and clear, which would affect the validity of the measurement. In this study, the UBC GBI has only two criteria: the presence or absence of bleeding. This index is considered a categorical scale and not an ordinal scale. The two categories are clear such that it is unlikely that the examiner would have mistaken the presence or absence of bleeding. This strengthens the reliability and reproducibility of this assessment and should not be considered a confounding variable.

5.5.1. CONFOUNDING VARIABLES

Several confounding variables have already been mentioned and should be considered when assessing the higher mean UBC GBI scores found with subjects in the CG compared to the NSCG. These included: the overall poorer oral hygiene seen with subjects in the CG and the greater percentage of subjects in the CG taking medications with xerostomic side effects. The point of considering confounding variables is to ascertain whether the outcome measured (UBC GBI scores) was due to the intervention(s) (oral hygiene education and periodontal debridement)
or due to known or unknown factors that may have influenced gingival bleeding and hence the UBC GBI scores. Other confounding variables must also be considered. The NSC/treatment group which included: facility #9, facility #11 and facility #14, show a variation in the baseline mean UBC GBI scores; 55.8, 55.4, and 24.2 respectively. From resident chart analysis and resident confirmation, it was found that 3 of the 5 residents at facility #14 had seen a dentist within the past year. This dentist is affiliated with the facility and provides residents with mobile dental services and may indicate that maintenance of oral hygiene is a priority in this facility. Although 4 of the 5 residents had medical conditions affecting the joints (arthritis, osteoporosis etc) and a mean number of medications of approximately 7, all of the 5 residents presented in good health with no manual dexterity concerns that would affect the provision of daily oral hygiene. Following the periodontal debridement, the mean UBC GBI score for facility #14 was the lowest of all of the participating facilities, 12.1. This perhaps can be attributed to the previous dental professional influence within the facility and the residents' priority with maintaining good oral hygiene. The low UBC GBI score for this facility cannot be attributed to the educational intervention since as mentioned previously, this facility did not follow through with the oral hygiene education. The LPN that received the oral hygiene presentation decided to withdraw from the program prior to delivering any of the information to the care-aides. Since facility #14 was part of the NSC/treatment group, exclusion of these 5 residents resulted in the mean UBC GBI score of this group increasing from 23.2 to 29.4. This affected the statistical significance when comparing the mean UBC GBI scores of the NSC/treatment group to the Care-aide/treatment group, p=0.18, but did not affect statistical significance when comparing the NSC/treatment group to the NSC/non-treatment group, p<0.05, or comparing the NSC/treatment group to the Care-aide/non-treatment group, p<0.001. The mean UBC GBI scores for facility #9 and facility #11 after the periodontal debridement were 31 and 27.5 respectively.
Some trends may be found when assessing the differences between the baseline and 6-month UBC GBI scores of the non-treatment groups. The NSC/non-treatment group which included facility #2, facility #4, facility #6 and facility #7, had baseline mean UBC GBI scores of 53.3, 60.6, 88.5, and 71.3, respectively. At the 6-month UBC GBI reassessment, both facility #4 and facility #2 had mean UBC GBI scores that increased to 68.6 and 61.8 respectively. Facility #7 and facility #6 both had mean UBC GBI scores at the 6-month period that decreased to 61.8 and 40.5 respectively. It is difficult to explain this result since all of the facilities in the NSC/non-treatment group are large, therefore, size of the facility most likely did not play a role. Also, there was no turnover of the RN’s in any of these facilities over the course of this study. It may be concluded that the effect of the education had continued up to at least the 6-month point for both facility #7 and facility #6, however there may have been a wash-out period apparent prior to the 6-month point for facility #4 and facility #2, hence resulting in a greater mean UBC GBI score at 6-months than at baseline. A wash-out period would indicate that any effect the intervention may have had on the UBC GBI scores was no longer apparent by the end of the study.

The Care-aide/non-treatment group included: facility #1, facility #3, facility #5 and facility #8. The baseline mean UBC GBI scores for these facilities were 25.5, 70.5, 99.4, and 43.4 respectively. The variation in these UBC GBI scores might be attributed to a number of factors. Firstly, through direct observation, many of the residents in both facility #5 and facility #3 presented as being in poor general health, and having manual dexterity problems that would affect the provision of daily oral hygiene. None of these residents had seen a dentist and or dental hygienist in many years. Also, three residents in facility #3 were placed in the special care unit due to advanced forms of neurological conditions. Hence, these factors may have contributed to the higher baseline mean UBC GBI scores. In addition, residents in facility #5 presented with the highest mean UBC GBI scores throughout the study of all of the participating facilities, the
highest ODI score (2.13), the highest percentage of smokers, the highest percentage of subjects referred for caries and periodontal treatment and the highest percentage of residents with depression. Excluding these 9 subjects did not affect the statistical significance seen when comparing the NSC/treatment group to the NSC/non-treatment group, the Care-aide/treatment group, or the Care-aide/non-treatment group. The exclusion of these residents resulted in the mean UBC GBI score for the Care-aide/non-treatment group to decrease from 75.9 to 69.6. The lower baseline UBC GBI scores for both facility #8 and facility #1 might be attributed to the previous dental professional influence in the facilities. Both of these facilities have participated on a number of occasions in long-term care research studies conducted by the UBC ELDERS Group. This dental influence may have served as a reminder to facility staff and residents of the importance of oral hygiene and may have affected the baseline mean UBC GBI scores.

The mean UBC GBI scores at the 6-month point for these facilities were 49.2 (facility #1), 73.8 (facility #3), 92.8 (facility #5), and 85.6 (facility #8). Only facility #5 showed a slight decrease in the mean UBC GBI scores from baseline to 6-months, from 99.4 to 92.8. The remaining facilities showed increase in the mean UBC GBI scores over the 6-month period indicating a wash-out period had occurred prior to the end of the study. Facility #8 showed a significant increase in the mean UBC GBI scores. Perhaps an explanation for this may be found at the administrative level. This facility was originally part of the treatment group. The consents for continuation of the study were obtained from all participating residents and from the RN responsible for involvement with the study. At the time the consents were obtained, the director of care was on holiday relief. The RN who gave consent on behalf of the facility was unaware of a facility ethical board that had been instituted to review any new research projects that would involve facility #8. Upon return of the Director of Care, the researchers were informed that the study would have to pass the facility ethical board requirements despite having received ethical approval from UBC Behavioral Ethical Review Board. All of the requested documents were
given to the facility physician in charge of reviewing the study in February 2002. Although treatment for residents was scheduled for April, it was delayed due to these unforeseen circumstances. The facility was placed in the non-treatment group, as removal of the 6 residents in the study would reduce an already small sample size. In July 2002, the facility physician contacted the project manager of the study and indicated that UBC had mistakenly approved a study that should have gone through a Clinical Ethical Board and not the Behavioral Ethical Board. The physician requested to correct the mistake and re-submit all documents for further revision by the facility. The UBC Behavioral Ethical Board disagreed because periodontal debridement is not a new and innovative procedure and hence was not required to go through the Clinical Ethical Board. For reasons of practicality and to avoid any further discontent, UBC researchers agreed that no treatment would be provided for the residents of facility #8 following the 6-month UBC GBI reassessments.

Various influences within the facility can also be considered confounding variables. Although all 14 facilities were Intermediate Care Homes, each facility had different resident populations, different numbers of facility staff, and different levels of administrative care. The priority of resident oral care may also have differed from one facility to the next. The oral hygiene nurse-supporters themselves may have shown a different level of enthusiasm and commitment to the study, as was apparent with facility #14. This is important when considering the generalizability of the findings. Since the ultimate goal of the study was to improve the gingival health of the elders and the responsibility of the oral hygiene nurse-supporters was to relay oral hygiene information to the care-aides in addition to providing continuing guidance and support, a lack of commitment to this initiative by oral hygiene nurse-supporters would compromise this goal. In addition, the initial recruitment of the 14 Intermediate Care Facilities may have favored those facilities with a bias toward oral health as reflected by their interest in the program. This must also be considered when assessing the generalizability of the results.
Although only dentulous subjects were included in the study, the number of teeth differed between residents. In calculating the UBC GBI, the number of bleeding teeth is divided by the total number of teeth present and a percentage determined. This means that the denominator in the calculation differs between residents. A UBC GBI score of 100 is indicative of all teeth bleeding, whether there was 3 teeth present or 32 teeth. However, this may not reflect identical states of oral hygiene. To avoid an additional threat to the validity of the results, it was determined to assess the number of residents showing an increase or decrease in gingival bleeding at baseline, 3-months, and final exam (15 days post-periodontal debridement and 6-months). In doing so, each resident serves as his/her own control, which minimizes the effects of differing numbers of teeth assessed and also minimizes facility influences. Each resident could only produce one of 3 outcomes: a reduction in the number of bleeding, no change in the number of bleeding teeth, or an increase in the number of bleeding teeth. This trichotomy would provide information on whether the resident’s oral hygiene had improved and by how much over the course of the study. This information also provides evidence, with certainty, that there exists a difference between the NSCG and CG.

Studies show that males in all age groups are more likely to have gingivitis than females (Loë and Kleinman, 1986). The reason for this is not known, however, poorer plaque control among males could explain the higher prevalence and extent of the disease. The results indicated that the mean UBC GBI score for males in the CG was much higher than the mean UBC GBI score for males in the NSCG, 82.0 and 53.2 respectively. The number of males in the CG was 17 and in the NSCG was 20. This may have influenced the higher mean UBC GBI scores seen with subjects in the CG and must be considered when interpreting the results of this study.

The phenomenon of observational reactivity or knowing that one’s actions are being monitored affects the behavior of an individual (Brunette, 1996) and may be apparent within the NSCG. The oral hygiene nurse-supporter was to provide on-going support and guidance on oral
hygiene for the care-aides in addition to reinforcing the delivery of daily mouth care for the residents. In doing so, the nurse acted as a constant presence who monitored the actions of the care-aides, thereby possibly affecting their behavior. This phenomenon may also help to explain why a difference between the two types of educational interventions were found in Part II of the study and not in Part I. Following the 3-month UBC GBI reassessments, the third dental hygienist was required to obtain new consents from all participating residents and from administrative staff prior to performing any periodontal debridement. The project objectives and methods was again reiterated to all participating subjects. This may have served as a reminder to all residents and staff of the importance placed on daily mouth care since additional efforts were being taken to continue on with the project. More importantly, the sheer presence of the dental hygienist may have prompted the residents and/or care staff to improve the oral hygiene care provided for the residents. In doing so, a significant difference between the NSC/non-treatment group and the Care-aide/non-treatment group was found at the 6-month period (58.3 and 75.9 respectively, p<0.05). However, in Part I, no significant difference was found between the NSCG and the Care-aide group at baseline (59.1 and 61.8 respectively, p=0.746) or at 3-months (61.2 and 66.5 respectively, p=0.480).

The measurement error of the examiner must be considered. Although it was required in the UBC GBI assessments that the probe be run around the tooth using a light pressure, this is difficult to assess given that the examiner’s ability to hold the probe steady, at a particular angle and method of applying a consistent amount of force was not measured. Therefore, this may have affected the gingival bleeding response.

In this study, there were 9 residents, or 10.6% of the study population, that admitted to smoking tobacco regularly. It has been found that smokers have a consistently lower bleeding response than non-smokers (Timmerman et al, 1998). This however, was not apparent in this study. The smokers in this population showed a far greater UBC GBI score than the non-
smokers, 97.3 and 60.4 respectively. In general, since the smokers showed a high bleeding response, excluding them reveals a greater percentage of subjects showing a reduction in bleeding response for those groups that included smokers.

In the assessment of the mean UBC GBI scores, exclusion of the 9 smokers affects the statistical significance between the NSC/treatment group compared to the Care-aide/treatment group, \( p=0.08 \), but not in the comparison of the NSC/treatment group to the NSC/non-treatment group, \( p<0.05 \), or the NSC/treatment group compared to the Care-aide/non-treatment group, \( p<0.001 \).

A randomized control trial (RCT) is considered the preferred and optimal method used in the design of a clinical trial. First, it involves assembly of a group of individuals at risk of disease or who have the oral disease in this case. Second, there is random allocation of the individuals to EXPERIMENTAL and CONTROL groups. Third, the experimental group is given the new intervention and the control group is given a placebo or an existing intervention or in some cases, nothing at all. Fourth, the groups are followed over time and outcomes measured. Lastly, differences are assessed for statistical and clinical significance (Locker, 2002).

The most important aspect of a RCT is randomization. This ensures that experimental and control groups are the same in terms of all known and unknown factors (other than the intervention), which may influence the outcome. Randomization ensures the internal validity of the study and allows the researcher to say that the outcome observed was the result of the intervention and the intervention alone (Locker, 2002). However, cost, ethical issues, and logistical problems may prevent a true randomization of subjects into appropriate groups. In the present study, logistical considerations affected the method of randomization of residents. First, each facility was considered a unit of analysis such that residents within each facility could not be separated without compromising the validity of the study. Recall, in Part I of the study, 14 facilities were divided into two groups of seven, the NSCG and the CG. The method of
randomization was determined by the hygienist, who delivered the oral hygiene education presentations to the oral hygiene nurse-supporters and care-aides respectively, and was based on previous dental professional influence and size of the facility. The hygienist ensured that large facilities and those with previous dental professional influence would not all be grouped together since this too would compromise the validity of the study. The remaining facilities were allocated into each group by randomly choosing folded paper identifying a facility. This method of randomization was deemed appropriate for this type of study.

Second, in Part II of the study, the NSCG and CG were further divided into treatment and non-treatment groups. This method of randomization was determined based on the time in which ethical approval was granted. On average, one facility per week received the oral hygiene education presentation. The periodontal debridement treatment was to be provided immediately following the presentation and 3-month reassessments. This meant that based on the scheduling of the educational presentations and date granted for ethical approval, only the last half of the facilities could be considered the treatment group. This, however, poses a threat to the validity of the study and must be considered when interpreting the results.

5.6 SUMMARY OF RECOMMENDATIONS FOR FUTURE RESEARCH

First, to help determine the relative contribution of each intervention i.e. oral hygiene education and periodontal debridement, a control group that does not receive any education should be considered. Second, the sample included smoking residents. This should be adjusted for since smoking affects the primary outcome measure or UBC GBI. Third, UBC ethics approval for the study was granted in February 2002, at a point when the first 8 facilities had already received their 3-month UBC GBI reassessment. As a result, the last 6 facilities were allocated to the treatment group. The treatment group received the periodontal debridement
immediately following the 3-month UBC GBI reassessment. These last 6 facilities had not received their 3-month exams at the time ethical approval was granted, therefore, in accordance with the project methods, this group was considered the treatment group. It was considered that this may have played a role in observing a difference between the NSC/treatment group and Care-aide/treatment group. The dental hygienist who provided the oral hygiene presentations to both the nurses and care-aides may have modified the content of the presentations such that additional emphasis on oral care issues may have been apparent in some facilities. However, this possibility was discounted following a telephone interview with the hygienist who provided assurance that the oral hygiene content was standardized from the beginning of the study to the end of the educational component. Fourth, an assessment of the amount of calculus present for each resident should have been done using an index such as the Calculus index, in order to make quantifiable comparisons at baseline and following the periodontal debridement. Since ethical approval was granted after baseline assessments had already been conducted, this index was not employed. Lastly, although there was no statistically significant difference found from baseline to 3-months with the mean UBC GBI scores or in the assessment of the number of residents showing an increase or decrease in gingival bleeding, a trend is apparent indicative of a difference in the two modes of education that may manifest itself as statistically significant with a larger sample size.
Chapter 6

CONCLUSION

The results of this study indicate that residents who were residing in facilities that received the nurse-supported oral hygiene education in combination with periodontal debridement showed the greatest improvement in gingival health. However, there are several confounding variables that may have influenced this result in addition to the education and/or periodontal debridement interventions. From literature reviews, it is known that periodontal debridement has a significant impact on reducing gingival bleeding. However, the same cannot be inferred for the impact of a nurse-supported oral hygiene educational intervention. Future research is recommended to determine the relative contribution of each type of intervention and its impact on the gingival health of institutionalized elders.
Chapter 7

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