THE MANDIBULAR IMPLANT OVERDENTURE VERSUS THE MANDIBULAR CONVENTIONAL DENTURE: IMPACT ON THE NUTRITIONAL STATUS

Katia Muller

Faculty of Dentistry
McGill University, Montreal
Quebec, Canada

December, 1999

A thesis submitted to the Faculty of Graduate Studies and Research n partial fulfilment of therequirements of the degree of Master on Dental Sciences

ABSTRACT

There is an ongoing and increasing interest in the significant and essential role that food plays in the health and survival of all people. As masticatory efficiency diminishes drastically in edentulous patients, many researchers in the past two decades have been studying how dietary intake varies when different types of oral rehabilitation are provided. Since the use of implants to support prostheses in edentulous mandibles has been shown to significantly improve masticatory performance, the question remains as to whether this improvement will influence nutritional status. In the present study, we used several nutritional markers to compare the nutritional status of edentulous patients who randomly received either mandibular conventional dentures or implant-supported overdentures one year previously. Although the conventional denture wearers reported having more difficulty chewing hard foods, no significant differences were detected in any of the nutritional markers. Therefore, even though chewing is more difficult for the patients wearing conventional dentures, it appears that the nutritional status of these two groups is similar.

RÉSUMÉ

Un intérêt soutenu et sans cesse grandissant est porté au rôle essentiel que joue la nutrition dans la survie et la santé des gens. Puisque l'efficacité masticatoire diminue drastiquement chez les patients édentés, plusieurs chercheurs ont, au cours des deux dernières décennies, étudié la façon dont l'apport nutritif varie en fonction des différents moyens de réhabilitation buccale utilisés. Bien que l'emploi d'implants supportant les prothèses dentaires mandibulaires a démontré une amélioration significative de la performance masticatoire, la question demeure de savoir si cette amélioration se répercutera sur le statut nutritionnel. Pour la présente étude, nous avons utilisé plusieurs indices nutritionnels afin de comparer le statut nutritionnel de patients édentés qui avaient reçu au hasard des prothèses mandibulaires conventionnelles ou des prothèses supportées par des implants une année auparavant. Bien que les patients portant des prothéses conventionnelles ont rapporté avoir plus de difficulté à mastiquer des nourritures dures, aucune différence significative n'a été détectée pour chacun des indices nutritionnels. Par conséquent, même si la mastication est plus difficile pour les patients portant des prothèses conventionnelles, il semble que statut nutritionnel des patients des deux groupes est similaire.

ACKNOWLEDGMENTS

I would like first of all to express my gratitude to my supervisor Dr. J. Feine and co-supervisor Dr. J. Morais for giving me the opportunity to develop this work, as well as for guiding me through all of the difficulties.

I would like to recognize the effort of Josianne Boudreau and Mylene Roy, for dealing with the mechanical part of the data collection and of Andre Savard and Manon Savard, for using their French to help to communicate with the patients. They saved me a lot of trouble! To my friend Etidal Basri, my appreciation for the good humor and some nice laughs, which made the heavy times not so heavy.

Finally, I thank my parents for the support and for always believing in me, my son Bruno for his hugs, kisses and unconditional love, and most of all, my husband Rubens for his precious advises and encouragement.

TABLE OF CONTENTS

I - INTRODUCTION

1.1 - Edentulism and Nutrition

Fifteen years ago in the USA approximately 41% of the population over 65 years old had lost all of their teeth (National Center for Health Statistic: Edentulous Patients, 1974). Since then, a marked decrease in edentulism has occurred in many western countries (Hunt et al., 1985; Burt et al., 1985; Oral Health of United States Adults; 1987). A study conducted in Sweden on a population aged 16-74 years showed a decline in total tooth loss from 15% in 1975 to 6% in 1988/89, and the prognosis for the year 2000 is even lower: 3-4% in the age group of 45-64 years (Osterberg et al., 1995). The expected percentage of edentulousness for those 75 years and older is predicted to decrease by about 50% over the 35-year period from 1990 to 2025 (Thompson & Kreisel 1998). In spite of that, Brodeur et al., (1996) have recently reported rates of edentulism in Quebec at 15% for ages 35-44 years, 22% for age 45-54 years, 37% for ages 55-64 and 58% for the population over 65 years. As Lewis (1998) and MacEntee & Walton (1998) point out,

the demand for treatment of the edentulous jaw will continue for many decades in Canada.

Moreover, the elderly segment of the American society, which is composed of people over 60 years of age, has been growing faster than any other age group. It has increased from 4.9 million in 1900 to nearly 29.1 million in 1985, and in 2020 this group is expected to represent 20% of the total population (National Center for Health Statistic: Edentulous Patients, 1974). Factors that strongly contribute to this situation are an increased life expectancy and the maturing of the large "baby boom" generation (Douglass & Furino, 1990). With an increased interest in the role of specific nutrients in the pathogenesis of common age related diseases, the nutrient content of the diet of edentulous people with different types of oral rehabilitation is of particular concern. Furthermore, many of these older adults have healthy and active post-retirement lives and they expect social pleasures to continue throughout advanced life. The ability to eat comfortably with others, to be free from pain as well as from oral problems that may cause embarrassment, is an important part of healthy aging. Therefore, the demand for more complex dental services to meet the needs and expectations of this population is increasing (Truhlar et al., 1997).

Nutrition plays a crucial role in maintaining quality of life through enhanced health benefits (Blumberg, 1992). Nutritional health is maintained by a state of equilibrium in which nutrient intakes and requirements are balanced. Malnutrition is a continuum that begins when the patient fails to eat enough to meet the requirements and then progresses through a series of functional changes (Jeejeebhoy, 1998). Currently, there is little

evidence that nutrient needs for healthy elderly people differ significantly from those of younger adults (Goodwin, 1989). However, in his review (Kerstetter et al., 1993) points out that great heterogeneity of older adults makes developing general guidelines or nutritional standards very difficult, if not impossible.

Aging is accompanied by a variety of economic, psychological, and social changes that can compromise nutritional status. In addition, it also produces physiologic changes that alters the need for several essential nutrients (Blumberg, 1997).

1.2 - Requirements and deficiencies in the diet of the elderly

The nutrient needs of older persons are determined by their rate of aging, health status and level of physical activity. Thus, it is difficult to generalize about energy, proteins, vitamin and mineral requirements appropriate for the population. Depending on level of body functioning, an individual may need greater or lesser amounts of nutrients than the Recommended Dietary Allowance (RDA).

The RDAs are a result of a long and careful analysis by the National Academy of Sciences-National Research Council, which was appointed by the Food and Nutrition Board in 1940 to establish a set of figures for human needs in terms of specific nutrients. These allowances were derived by taking the average requirement according to age, sex, caloric intake and physiologic attributes, so that persons with higher than average requirements would be included within the "allowances". Thus, the Daily Allowances are neither "minimum", "average" nor "optimal" requirements, but "allowances" of various nutrients that will provide to groups of people levels of nutrients now considered

satisfactory for all normal persons included in that group. Since 1943, when the RDA was first published, these have been revised many times as new research data become available (Mitchel et al, 1978).

a) Energy: It has long been accepted that energy intake declines with aging because of decreased physical activity and resting metabolic rate. The latter is associated with a decreased lean body mass that is replaced by fat (Blumberg, 1997; Zheng & Rosenberg, 1989; Kerstetter et al., 1993). Cross-sectional surveys show that the average energy consumption in people over the age of 65 is lower than the mean RDA for that age. When caloric intake is low, foods of high nutrient density (such as meat, vegetable soups, fruit desserts, dairy foods and whole grain bread and cereal) must be consumed. Since there is no evidence that nutrient density (nutrient per kcal) of the diet improves with age, the risk of deficiency of nutrients such as zinc, chromium, calcium and vitamin D is increased (Rudman & Feller, 1989; Suter & Russell, 1987).

b) Protein: Because physiologic stresses are associated with age-related degenerative diseases, the protein needs of older adults are thought to be slightly higher than that for younger persons. Although protein intake is not usually a problem in healthy noninstitutionalized older persons (Horwath, 1989), a range of 0.8 to 1.0 g/Kg body weight or 12% to 14% of daily caloric intake is recommended as a safe level for healthy older persons (Henderson, 1990). Thorslund et al., (1990) found a 5% prevalence of protein-energy malnutrition in elderly people living at home in a degree shown to impair prognosis at hospital (Weinsier et al., 1979; Bienia et al., 1982). However, a study of

institutionalized elderly patients found a 33% prevalence of low protein intake (Rudman & Feller, 1989). The protein intake of denture wearers was found to be lower than that of dentate adults, but above the 1980 RDA (Faine, 1990). Protein malnutrition leads to inadequate immune response and lower muscle mass, resulting in decreased ability to tolerate periods of physiological stress (Young, 1990).

c) Fiber: Water-insoluble fibers (e.g., wheat, rye, corn, legume hulls) are not fermented by colonic bacteria and increase fecal bulk by virtue of their water-holding capacity, therefore reducing intraluminal colonic pressure and transit time (Jenkins & Lilly, 1989). On the other hand, water-soluble fibers (e.g. guar, pectin, legumes, oats and barley) have little effect on fecal bulk but they reduce absorption of cholesterol. The ingestion of both types of dietary fibers has been associated with reduced risk of colon and rectum cancer and reduced risk of coronary heart disease. They are also a useful adjunct to the dietary management of elevated plasma cholesterol. Because elderly people are particularly prone to decreased bowel mobility, they should be encouraged to increase their dietary fiber and fluid, and to exercise to improve bowel function. Fiber and fluid must be addressed together because excess fiber without adequate fluid causes dehydration and constipation {Hull et al., 1980). There is no RDA for fiber per se, however the National Cancer Institute recommends daily intakes of 25 to 35 g/day. This amount is achievable with five servings of fruit or vegetables plus a supplement of bran (Kerstetter et al., 1993).

d) Vitamins: Vitamins deficiencies in the elderly are likely to be subclinical, but any bodily stress may result in an individual's developing detectable symptoms. Individuals who have low caloric intake, ingest multiple drugs, or have disease states that cause malabsorption are at greater risk of hypovitaminosis. Vitamin D deficiency may occur in elderly persons who are housebound and who receive minimal exposure to sunlight. Vitamin D is crucial for adequate calcium metabolism and its primary source is from dairy foods. Vitamin B_{12} is found in animal products. Anemia and neurologic damage result from a vitamin B_{12} deficiency. Diseases such as pernicious anemia and achlorhydria cause decreased B_{12} absorption. Deficiencies of thiamin, niacin, pyridoxine and folate (all B complex vitamins) are commonly seen in poor, institutionalized and alcoholic elderly and are reported to be rare in people who are well nourished and economically secure.

Although vitamin C intakes in elderly people are generally high, low plasma levels of ascorbic acid have been reported (Drinka & Goodwin, 1991). Heavy smokers, alcohol abusers or persons who take large amounts of aspirin have higher requirements for vitamin C. Foods rich in this vitamin are citrus fruits, berries, melons, tomatoes, broccoli and peppers.

Aging alters the absorption and metabolism of vitamin A, so that body stores are maintained even though intakes are lower than recommended. Well-nourished persons are usually at low risk of a vitamin A deficiency. Vitamin A is found in two forms: retinol, in animal foods, and beta-carotene or pro-vitamin A found in deep green and yellow fruits and vegetables.

e) Minerals: Aging does not significantly alter requirements of mineral and trace elements. One of the exceptions for this is iron, for which the needs of women decline at menopause. The other exception is calcium, whose absorption significantly decreases after age 60 in both sexes. Although younger people can withstand marginal or low calcium intakes by an increasing in the efficiency of absorption, older adults cannot. The RDA for calcium is 800 mg, but several investigators have recommended that the intake of calcium should be increased to 1000 mg a day or higher in women over 50 years and in men over 60 years to prevent negative calcium balance.

Mild zinc deficiency is suspected to occur among some U.S. elderly, with reported intakes below the RDA and serum levels lower than in younger adults. Wound healing, immune function and taste and smell are affected by zinc status. Good sources of bioavailable zinc are in animal products, such as meat, poultry or fish.

Deficiencies of copper and chromium have also been reported, although their detection is usually technically difficult, and clinical symptoms may be buried in the abundant signs and symptoms of disease, medication or age (MacLaughlin & Holick, 1985; Horwath, 1989; Faine, 1990; Kerstetter et al., 1993; Knapp, 1989; Morrisson, 1997)

1.3 – Nutritional assessment in older adults

The evaluation of nutritional status is a broad topic, and to be of clinical importance, the ideal method should be able to predict the occurrence of nutrition-associated complications and thus, predict outcome.

a) Anthropometric Assessment: Assessment of nutritional status based on body composition by clinical anthropometry involves detecting the loss (or gain) of body components relative to previous measurements, as well as by relating the values in a given patient to normal standards. Measurements are simple to perform, noninvasive, inexpensive and reasonably sensitive because they are adjusted to sex, age, weight and height when appropriate (Morley et al., 1995).

Body weight is a simple measure of total body components and is compared with an ideal or desirable weight. Values for age, sex and height are available from epidemiological studies, although limited data exists for persons over 65 years of age (Frisancho, 1984). Height alone is not a criterion to define the nutritional status but is widely used in conjunction with weight to formulate the Quetelet or body mass index (BMI).

Body circumferences and skinfold thickness measurements have also been employed extensively in nutritional assessment in adults and older persons. The indices most often utilized are mid arm circumference and triceps skinfold thickness. From these two measurements, one can determine mid arm muscle area (MAMA) which is an indicator of fat free mass (Frisancho, 1981). Other standardized sites for circumference measurements are neck, shoulder, chest, waist, abdominal, hip, thigh, knee, calf, ankle, forearm and wrist (Heyward & Stolarczyk, 1996). Anthropometric prediction equations should be selected based on gender, age and level of body fatness of the individual (Lohman, 1992). Skinfold is a measure of the thickness of two layers of skin and the underlying subcutaneous adipose tissue by a caliper. As with circumference measurements, there are standardized body sites and techniques to be followed when measuring skinfold

thickness. Research has demonstrated that the mean subcutaneous fat, assessed by skinfold measurements at 12 sites, is similar to the value obtained from ultrasound. However, at some specific sites, the skinfold yields significantly lower values compared to magnetic resonance imaging (Hayes et al., 1988). There are over 100 population-specific equations to predict body density from various combinations of skinfolds, circumferences and bony diameters and, as they were developed for relatively homogeneous populations, these predictions are assumed to be valid only for individuals having similar characteristics (Heyward & Stolarczyk, 1996).

A simple approach to the above is the calculation of BMI. BMI is calculated as weight in kilograms divided by height in meters squared. A BMI of 14 to 15 kg/m^2 is associated with significant mortality, and the value considered normal is a BMI ranging from 20 to 25 kg/m^2. Older persons with values outside the range of 22 to 30 are defined as thin or obese and are at an increased risk of mortality (Tayback et al., 1990; Cornoni et al., 1991). In a review of the literature, Anjos (1992) concludes that the BMI index, is a valuable indicator of nutritional status in epidemiological studies, despite the fact that it is correlated with height, fat-free mass and legs/trunk ratio (McLaren, 1987; Garn et al., 1986).

Another method of estimating body composition that is safe, noninvasive and portable is the bioeletrical impedance analysis (BIA). It has shown to be a reliable and precise estimation of adiposity in humans when a standardized technique is used (Kushner, 1992; Heitmann, 1994). The principle of the method is that the resistance of an electric current is proportional to the amount of fat-free mass (FFM), i.e., the amount of water and

electrolytes (Deurenberg et al., 1990). The whole-body resistance is measured with four surface electrodes placed on the right wrist and ankle, which capture the opposition force of the body to the passage of a weak (<1μA), alternating current. The values given are resistance, which is directly due to tissues, and reactance due to capacitance or storage of the electrical charge by the cell membranes. The drop of voltage between the two electrode sites determines the impedance (Houtkooper et al., 1996). This technique has been validated in numerous studies against criterion methods such as hydrodensitometry, total body water by deuterium dilution and dual energy X-ray absorptiometry (DEXA) to predict FFM (Houtkooper et al., 1996; Deurenberg et al., 1990; Rising R, 1991; Deurenberg et al., 1988).

b) Hand Grip Strength: Insufficient protein or energy intake will lead to impaired function before changes in anthropometric variables can be observed (Jeejeebhoy, 1994). With a use of a special apparatus, Russel (1983) has shown that neuromuscular performance is very sensitive to malnutrition, and restoration of its function precedes nitrogen repletion. Less sophisticated and non-invasive techniques of muscle strength assessment, such as handgrip strength with a dynamometer, have also been shown to be sensitive enough to demonstrate change following a period of increased protein intake in a group of elderly women (Castaneda et al., 1995). The handgrip strength test has also been shown to be effective for predicting postoperative complications in a group of malnourished surgical candidates (Windsor & Hill, 1988).

c) Biochemical Indices: Serial measurements of blood components are useful to monitor the impact of nutrition therapy and in targeting those at risk of malnutrition (Collinsworth & Boyle, 1989). Burritt & Anderson (1984) states that laboratory tests have several advantages in nutritional assessment: they are rapid, easy to perform and analytically precise; they are sensitive enough that malnutrition can be prevented before the appearance of more profound changes; and they provide accurate information of metabolically functional nutritional status. Laboratory values of hemoglobin, hematocrit, albumin, total iron binding capacity and leukocyte count are standard laboratory tests. In studies using these biochemical indicators to detect malnutrition, no differences were found among age groups or by gender (Kemm & Allcock, 1984; Awad et al., 1982).

Serum albumin is widely used as an indicator of protein/energy malnutrition. In several studies it was found to be the most sensetive marker of malnutrition for all age-groups and a reliable indicator of malnutrition in the elderly (Walker et al., 1991; Beaumont et al., 1989). The serum level of albumin is a stable value reflecting long term nutritional habits, and low levels have been associated with increased medical complications, prolonged length of hospital stay and increased mortality. Low lymphocyte count, in the absence of immunologic, neoplastic or bone marrow depression from any cause, is associated with malnutrition. Low hemoglobin levels can be attributed to many causes, with protein-energy malnutrition being one of them. Ferritine is the major circulating plasma protein that reflects iron stores. The level of serum carotene is a marker for the nutritional status of total fat-soluble vitamin A. Vitamin B_{12} and folate are hydro-soluble vitamins and a low plasma level could be indicative of dietary deficiency. (Herrmann et al., 1992; Corti et al., 1994; Agarwal et al., 1988).

d) Dietary Intake Assessment: Dietary assessment is the foundation for nutrition counseling and intervention, as well as for detecting both poor and desirable food habits. It allows the collection of accurate information on total daily intake of specific nutrients. However, even the most accurate methods are imprecise if not carefully executed, and intake may be altered by the effect of the assessment itself. To date, most of the data obtained for older persons have been collected through 24 hours recalls and three to seven day food records (Beaton et al., 1979).

The Willett semiquantitative food frequency questionnaire has been validated against one-week diet records taken at four sessions. It consists of an extensive list of foods containing nutrients hypothesized to alter the occurrence of cancer and heart disease (Willett et al., 1985).

1.4 – The absence of teeth and its relation to malnutrition

The mouth is the normal pathway for nourishment. Pain from irritated gums or chewing difficulties because of ill-fitting dentures may profoundly influence one's desire and ability to eat properly. It has been suggested that these factors can lead to an unbalanced diet and deficient nutrient intake (Krehl, 1974; Wayler et al., 1984). On the other hand, there have been studies showing that good chewing ability is not essential for good nutrition (Bates et al., 1971).

A study comparing the dietary patterns and adequacies of 34 edentulous patients who wore dentures and 38 subjects with natural teeth showed that edentulous people were more likely to claim that they had difficulty chewing their food. Although edentulous

people were not more likely to select easy-to chew foods, the dentate group tended to have lower fat and cholesterol consumption and a higher consumption of vitamins and minerals (Greksa et al., 1995).

After reviewing many studies about the relationship between dietary patterns and dentition, Ettinger (1998) concludes that improving masticatory function makes chewing hard foods easier, but that patients do not seem to change their dietary intake patterns.

Rissin et al., (1978) demonstrated that 90% of food chewed with natural teeth fitted through a no. 12 sieve. This was reduced to 79% in patients wearing overdentures and to 58% in patients wearing complete dentures. It has also been shown that digestion is less efficient when food is not properly chewed since the rate of digestion is directly related to the surface area of the food, which is exposed to intestinal enzymes (Fulmer, 1977).

Smith & Sheiham (1979) carried out a socio-dental investigation among 254 elderly people living at home. Patients were interviewed and examined, and the data revealed that the dental status of the sample was generally poor. Seventy four percent were edentulous and many of these had poorly fitting dentures. They found that 30% were limited in their ability to chew some foods. Twelve percent had changed the composition of meals and their methods of cooking so that their food could be chewed more easily. If elders avoid meats, fresh fruits and vegetables, protein intake may be insufficient and bowel problems may also result.

In a very detailed report, Makila (1968) found that blood vitamin C levels were significantly lower in edentulous subjects when compared to levels in dentate subjects. As might be expected, he also found that soft foods, such as porridge, were eaten more

frequently by those without teeth, and that hard and fibrous food were eaten less frequently. The latter included fruit, raw vegetables, cheese, meat and sausage. A tendency to avoid meet due to lack of teeth was also reported by Bender & Davies, (1968).

A study conducted in 1980 looked at the nutrient intake of 23 edentulous persons aged 60 to 82 years by means of a 4-day food diary used before and after treatment (Baxter, 1980). After patients had fully adjusted to their new conventional dentures, intake of calories, carbohydrate, fat, sodium, iron and cholesterol had increased significantly. However, even with new dentures, the nutrient intake of several of the subjects was lower than 67% of the Recommended Dietary Allowances (RDA) for calcium, thiamin, vitamin A, iron and vitamin E, and virtually all subjects were comparably deficient in magnesium and folic acid.

Brambilla et al., (1996) compared the nutritional status of a group of 60 institutionalized elderly people (mean age 78.4 years), who were divided into 3 groups: dentate, partially dentate and edentulous. Anthropometric measures and blood sample analyses were used as parameters. The authors concluded that lack of oral health does not seem to be related with impairment of nutritional status. However the sample size was small.

The relationship among dental status and diet in adults was also studied by Papas et al. (1998), who recruited 247 volunteers with all types of oral conditions, but with at least 6 teeth. They verified that, as the number of teeth declined, vitamin A, crude fiber and calcium declined, while cholesterol rose. The method used to assess dietary intake was the 3-day food diary and food-frequency questionnaire.

Shatenstein (1986) measured the difficulty in chewing certain hard foods before and after oral rehabilitation on patients with severe denture. It was found that, in addition to fruits and vegetables, meats, crusty bread and hard biscuits were also consumed in greater quantity following improvement of the dentures. Patients also reported that, after treatment, there was no need to chop hard foods into small pieces before eating, nor feel embarrassed while eating in public, as they did when their dentures did not fit properly.

With the objective of analyzing the dental health of elderly people and to determine the relation of dental health with diet, Dana et al., (1985) examined 60 institutionalized patients (mean age 76.5 years). A questionnaire about dietary daily preferences was administered and patients underwent an oral examination. The author presented descriptive statistics of the findings, which showed a high prevalence of edentulism, poorly fitting dentures and generally poor oral health. The authors pointed out that 40% of the patients reported not eating any raw vegetables and only ground beef, because of difficulty chewing foods. Fruits were prepared by stewing, grinding or juicing. The authors concluded that oral conditions are of great importance in the food selection of elderly people.

In a cross-sectional study, Mojon et al. (1999) evaluated the association between oral health status and malnutrition in frail older adults. A dentist examined and evaluated the quality of dentures and overall oral health of 324 institutionalized elderly people. The findings were then correlated with serum levels of albumin and BMI taken from medical data. The investigators found that: presence of less than six occluding pairs of teeth was one of the best predictors of malnutrition, and the absence of dentures was strongly

associated with a low BMI, although neither BMI nor albumin levels were lower in the edentulous than the dentate group. The authors concluded that compromised oral functional status seems to be related with nutritional deficiencies.

Chen & Lowenstein, (1984) studied the relationship between masticatory handicap, socioeconomic status and dietary intake among 8,350 adults, aged 25-74 years. Data on masticatory handicap were based on questions related to the difficulty of chewing apples, corn-on-the-cob, meats and other foods. Nutrient data were estimated from a 24-hour dietary recall. The data were corrected for age, gender and BMI, and the results showed that adults with a masticatory handicap in the low socioeconomic group had significantly lower intakes of calories and some nutrients and also had a higher probability of developing hypertension, heart attack and diabetes mellitus than the non-handicapped.

In summary, the review of some of the reported studies in recent years suggests that:

1) Changes in dentition, such as loss of teeth have a negaive influence on individuals' lives and cause decreased masticatory efficiency and function.
2) If teeth are replaced, there is an increased masticatory function, but despite this increased masticatory function and improved chewing ability, the number of persons who significantly change their dietary intake is small.

1.5 – Treatment options

a) Conventional Therapy

The conventional complete denture is by far the most commonly used treatment for edentulism and its problems and advantages have been widely described and debated for

over a century (Jacob, 1998; Petola, 1997; Carlsson, 1998; Smith et al., 1963). A complete denture replaces the natural teeth and their adjacent structures by an acrylic resin base with artificial teeth, which covers the residual ridge. It is retained in the mouth by a number of forces and factors such as:

- Adhesion: achieved when saliva wets and sticks to the basal surface of dentures and to the mucous membrane of the basal seat;
- Cohesion: which is the physical attraction of similar molecules for each other and is achieved when the layer of saliva between the dentures and the mucous membrane is thin;
- Capillary attraction: developed because of surface tension, which makes the space filled with a thin film of saliva act like a capillary tube and help retain the denture;
- Atmosphere pressure: supplied by the weight of the atmosphere which is effective if a perfect seal around the entire border of the prosthesis is reached (Zarb et al., 1997);
- Oral and facial musculature: which is obtained when the buccal and lingual musculature fits perfectly against the denture borders (Fløystrand, 1986).

Accurate impression procedures are necessary in order to properly define the placement of selective pressures by the denture base and the form of its borders and, therefore, achieve the maximum of the potential of the retaining forces described above.

Every attempt is made to achieve maximum potential. However, in reality, this is rarely possible. In most instances, patients experiencing difficulties with their complete denture have identifiable causes (Brunello & Mandikos, 1998). The clinician attempts to

duplicate the ridge structure with accurate impression and other records so that the dental technician can determine the true functional sulcus depth and width. That allows a precise determination of where to extend the denture base, where to place the teeth so that the denture is in muscle balance and what teeth to use to reach a satisfactory appearance (Basker et al., 1993).

As Boos (1959) has stated that often edentulous patients must be treated surgically. The objectives for these surgical procedures usually are to correct conditions that preclude optimal prosthetic function (i.e. epulis fissuratum, frenular attachments and discrepancies in jaw size relationship) and enlargement of denture-bearing area (i.e. vestibuloplasty).

A very important factor in the retention of complete dentures is the shape and size of the residual ridge. When a mandibular ridge in atrophied, it usually lies at the same level as the floor of the mouth. Muscle attachments are located close to each other at the top of the resorbed ridge. Retention in these cases is difficult to obtain because the denture rests on movable muscle tissue. During mastication the tender oral mucosa is compressed by the forces transmitted through the denture base. This is often painful and the denture wearer is able to exert only low forces of mastication (De Hernández & Bodine, 1970).

Changes in the bone supporting the basal seat continue as long as the patient lives. Jackson & Ralph, (1980) stated that, even after 30 years of denture wearing, bone resorption can occur. On the other hand, Brehm & Abadi, (1980) found statistically insignificant overall changes in residual ridges over a period of 10 years in a group of 35 edentulous people. Although not proven, the author attributed as possible causes the fact

that patients were treated with the application of sound basic prosthodontics principles, periodic recall appointments and that patients were relatively young.

Continuous alveolar bone resorption following tooth removal may eventually result in an impaired bearing area for full dentures (Tallgren, 1972). The effect will be a decrease on denture stability and retention which causes increased discomfort, including pain and problems with basic functions such as speech and mastication.

Besides the anatomical and technical components of a successful treatment, the patient's experience with and appreciation of his dentures are determined by his specific attitude toward their adaptation and use. This attitude, in turn, is influenced by social factors such as sex, age, education, vocation, social status, home environment and vocational environment (Carlsson et al., 1967; Marbach, 1985).

In order to achieve increased retention of both upper and lower complete dentures in cases of severe ridge resorption, several methods have been applied. Stafford (1970) reported that denture adhesives were extensively used by denture wearers in the western world, while Karlsson & Swartz, (1981) reported a positive effect of the adhesive on vertical loosening/drops of the upper denture of patients with moderate ridge resorption. The same author (Karlsson, 1983) reached a similar conclusion with respect to upper dentures retained by pelottes, which are placed into two subnasal ducts folded by a skin transplant. However, these cause a reasonable amount of discomfort and a risk of creating trauma-induced tissue injuries. The use of magnets either implanted in the jaw (Behrman, 1960) or tooth-borne has also been reported (Gillings, 1984).

While a large part of the edentulous population can be successfully treated through routine clinical procedures, many edentulous patients cannot wear dentures at all. The reasons that may contribute to the inability to wear dentures have been shown to be both physiologic and psychologic (Blomberg & Lindquist, 1983).

b) Implant Therapy

The implantation of tooth substitutes has been studied since 1965, and the technique basically consists of the insertion of cylindrical screw-shaped titanium implants into mandibular and maxillary edentulous sites. These are then used to support a variety of prostheses (Zarb et al., 1997). By respecting strict atraumatic surgical procedures, the method results in a firm, direct and lasting connection between vital bone and implants of defined finish and geometry-fixtures, with no ingrowth of connective tissue. This is the probable reason for the absence of infection and for the fact that the implant is not rejected (Adell et al., 1981; Brånemark et al., 1977).

There can be three clinical options for implant therapy in edentulous patients: the fixed prosthesis, the removable prosthesis supported solely on implants (long-bar overdenture) the removable prosthesis that rest partly on the implants and partly on the mucosa (hybrid overdenture). The fixed prosthesis is attached with screws to implants by the clinician and thus, the patient cannot remove it. The removable long-bar overdenture can be cleaned outside the mouth by the patient, and the implant abutments and the bar on which the overdenture is attached by clips, also can be easily reached for cleaning purposes. The removable hybrid prosthesis, supported by two implants in the anterior jaw, can be attached by clips to a bar that joins the two implants, or it can have 2 female parts

imbedded in the acrylic into which the male parts on the implant abutment (ball attachments) fit. While the fixed prosthesis is considered to be the most stable, providing the most natural function (Beumer et al., 1993; Hobo & Takayama, 1989), the removable prosthesis, also called an implant overdenture, provides many practical advantages (Misch, 1993). Fewer implants are required to support a removable prosthesis because soft tissue areas may provide additional support and thus cost less (Truhlar et al., 1997). To allow proper oral hygienic procedures in the fixed prosthesis, ample space must be provided beneath the prosthesis and between the fixtures, sometimes causing aesthetic and phonetic problems and difficulty in mastication (Caswell & Clark, 1991). Home maintenance and hygienic conditions are facilitated with a removable overdenture because of improved access to the patient, and access for professional evaluation of hard and soft tissues and performance of routine procedures (Misch, 1993).

In a crossover clinical trial, Feine et al. (1994) compared mandibular fixed and removable long-bar implant prosthesis. Although no difference was found in patients general satisfaction with the two types of prostheses, patients reported that the fixed prosthesis is significantly easier for chewing hard foods. Patients who preferred the removable prosthesis rated ease of cleaning as the most important factor in their decision.

The greatest advantage in using dental implants to support a prosthesis is in the potential maintenance of bone height and width. The bone under an overdenture may lose as little as 0.6 mm vertically over a 5-year period, and long-term resorption may remain at 0.1 mm per year (Adell et al., 1981). In a review of the long-term efficacy of dental implants,

Alberktsson et al., (1986) found a 1 mm bone loss in the first year after loading and less than 0.2 mm yearly thereafter.

Furthermore, an implant-supported prosthesis provides enhanced proprioception, retention and stability allowing the patient increased ability to eat and to speak more confidently. Harle & Anderson, (1993) found in a survey that the most significant difference between implant and conventionally treated patients was associated with improved chewing ability for those with implant prosthesis. Implant patients reported fewer problems concerned with chewing, speaking, swallowing, kissing, laughing, etc.

Therefore, the literature suggests that implant prostheses provide good function for edentulous patients.

1.6 – Comparing implant and conventional dentures for edentulous patients

The complex dental needs of the aging dentate and edentulous population present a formidable challenge to the dental profession. Older people sometimes are inclined to withdraw from social interaction when they sense a problem in the mouth, whereas a comfortable mouth contributes to an optimistic perspective of life (MacEntee et al., 1997). Returning patients to oral health in a predictable manner has always been the goal of dentistry.

Studies have shown that a high prevalence of patients receiving new and technically well made dentures are generally satisfied with the treatment (Berg, 1993; Turbyfill, 1989). However, clinical experience confirms the existence of a large number of patients with "varying degrees" of prosthetic success and a smaller number with no success at all.

Among the outcomes used to assess the problem are patient satisfaction, absence of pain, aesthetics and masticatory ability (Awad & Feine, 1998; Kalk & de Baat, 1990; Peltola et al., 1997) and, although the removable conventional denture reduces the disabilities and handicaps of edentulism, certainly it does not fully meet the needs of all patients (Kent, 1992; Zarb, 1983).

Boerrigter et al., (1995) compared treatment results in two groups of patients with severe problems related to impaired functioning of the lower denture. A group of 157 patients were randomly assigned to either a group treated with an implant-retained overdenture or a group treated with high-quality new conventional dentures. Assessment of treatment satisfaction was made with a questionnaire prior to treatment and 1 year after insertion of the new prostheses. The group that received the conventional dentures had significantly lower scores than the group treated with implants. The authors concluded that for patients with severely resorbed mandibles, overdentures retained by implants appear to provide a more satisfactory solution.

In a study conducted to analyze the effects of dietary habits and food selection with two different prosthetic treatments, Sandström & Lindquist, (1987) found a slight increase in intake of fresh fruit and crisp bread after patients were provided with a fixed prosthesis on tissue-integrated implants. The sample was composed of a group of 23 edentulous patients, who first received complete dentures and then the fixed prostheses. Dietary selection was evaluated from 4-day records taken before and after treatment. The authors infer that oral function alone can not influence the diet considerably.

Gunne & Wall, (1985) conducted a similar investigation into how the transition from old to new complete dentures affected: 1) masticatory efficiency (by sieving and measuring chewed particles); 2) subjective experience of masticatory performance (by a questionnaire) and 3) the dietary intake (with a 4-day dietary record). Forty-three completely edentulous patients were tested on 3 occasions: with their old dentures, with their new complete dentures and 4 months after insertion of their new dentures. The results demonstrated that changing from poor quality complete dentures to new ones increases the ability to comminute food, and patients reported improved chewing ability. However, these improvements did not appear to influence dietary habits for this population.

Sebring *et al.* (1995) conducted a non-randomized study to examine whether the nutrient content of the diet of edentulous patients changed after they received either new implant-supported prostheses or new complete conventional dentures. A convenience sample of 71 patients, who had previously been wearing dentures for at least one year, was recruited and divided in two treatment groups. Subjects kept food records for three days before treatment and semiannually for three years after treatment. No significant changes in nutrient intake between and within groups were detected.

Being unable to enjoy certain foods, to speak clearly or to decline social activities often disables edentulous people. Kent, (1992) reviewed the literature about the psychological and social well being effects of oral rehabilitation with osseointegrated implants. Some studies showed strong evidence of a positive effect, while others presented weaker, but still positive effects. In 1994, the same author reported on a study in which he measured

the psychological and social wellbeing of patients who received replacement of conventional dentures and of those who received implant prostheses. The results suggested that the implant rehabilitation appeared to have a more positive effect on well being than complete denture treatment. His results were in accordance with findings of Albrektsson *et al.*, (1987).

Cibirka *et al.*, (1997) conducted a study to measure patients' subjective feelings about their complete dentures and new implant prostheses. The main conclusion was that the latter significantly contributed to a better quality of life for these patients who were unsatisfied with their conventional dentures.

Grogono *et al.*, (1989) measured patients' attitudes to their implant prosthesis by making them to rate their status before and after therapy. The questionnaire was mailed to 95 persons who previously wore complete dentures, and addressed functions such as eating and speaking. Psychological factors were also measure using a three-point Likert-type scale. The results suggested that patients' attitudes towards their dental health became more positive, and the major improvement after implant therapy was in eating ability.

Patient satisfaction and chewing ability were compared with edentulous patients treated in three different ways by Boerrigter *et al* (1995).. Ninety patients, who were severely dissatisfied with their lower dentures, were randomly assigned to be treated either with implant-retained overdentures, new complete dentures after vestibuloplasty and deepening of the mouth floor or with complete dentures alone. The assessment focused on subjective appreciation based on a self-administered questionnaire, and the patients' overall satisfaction with their dentures was expressed on a 10-point rating scale, before

and one year after treatment. The results obtained were more favorable in the group that received implant-retained overdentures, followed by the group who received preprosthetic surgery. The ratings of the group who received complete dentures alone were lower than the other groups.

Geertman *et al* (1994) conducted a randomized clinical trial in which mandibular conventional dentures and two types of mandibular implant prostheses were compared: an overdenture supported both by implants and the mucosa and an overdenture that is supported completely by implants. The primary outcome was the ability to pulverize a standardized artificial test food at one year after treatment. The overall results showed that food was better pulverized with both of the implant supported mandibular overdentures than with new conventional dentures. The author also suggests that the degree of support by implants or mucosa does not determine an individual's ability to comminute food.

A comparison between the efficacy of implant-supported overdentures and conventional dentures was also conducted among 89 diabetic patients in a randomized clinical trial (Kapur *et al.*, 1998). Although the difference in success rate was not statistically significant, a higher percentage of patients with overdentures reported improvements in chewing comfort and moderate to complete overall satisfaction. In a second part of the same study, Garrett *et al.*, (1998) reported no significant advantage in masticatory functional effectiveness between the two treatments, but this could be explained by the fact that patients had higher than average pre-treatment functional levels.

This review suggests that patients are more satisfied with implant prosthesis than with conventional dentures, and that their ability to chew food is improved. However, what is not known is whether improvement in ease of chewing will also improve the dietary intake.

1.7 - Objective

Therefore, the objective of this study was to compare the nutritional status of patients who had randomly received either mandibular conventional dentures or prostheses supported by two implants one year previously. At a 2-month post-treatment assessment, the group with the implants reported significantly greater ease in chewing (Awad et al, submitted). In the present study, a multidimensional approach was used to assess the nutritional condition. This included a food-frequency questionnaire, anthropometric and body composition measurements and biochemical parameters.

We also evaluated the patients' impressions about the quality of their masticatory function using a self-administered questionnaire.

II - METHODS

2.1 - Subject Recruitment

The patients who participated in the present study were previously participants of a randomized clinical trial to compare conventional dentures and prosthesis supported by two implants attached to a short-bar. For the previous study, all subjects were edentulous, between the ages of 35 and 65 years and responded to an advertisement in a French newspaper targeting individuals desiring replacement of their current complete dentures. The inclusion criteria specified that subjects must have been edentulous for at least 10 years and were currently wearing their conventional dentures regularly. Of the 470 persons who responded to the advertisement, 220 attended the information sessions where they were informed about the procedures of the study. Thirty patients refused to enter the study for reasons such as fear of surgery, refusal to accept randomization to a particular treatment and unavailability. After the clinical examination, 88 subjects were excluded according to the following criteria: insufficient mandibular bone available for placement of two implants, presence of bruxism and clenching and presence of a tempromandibular disorder. Ultimately, 102 subjects were accepted and randomized using a computer

program for generation of random numbers All subjects signed informed consent that was approved by the McGill University Ethics Committee. They received either conventional dentures or the 2-implant supported prosthesis. All patients received new conventional dentures for the maxilla.

The present study:

A research assistant contacted by telephone the 102 patients who had participated in the previously described randomized clinical trial. They were informed of the beginning of a new research study in which the nutritional status of people with the two different treatments would be evaluated and compared. They were told that an appointment taking approximately two hours would be needed for blood drawing, weight, height, body composition and handgrip strength measurements, plus an interview with a nutritionist. Any questions concerning the tests were promptly answered.

2.2 - Data Collection

a) Consent Form

Fifty-three subjects agreed to participate and were scheduled for an appointment at the Royal Victoria Hospital Clinical Investigation Unit between 08h00 and 10h00 and told to come in a fasted state (not having eaten or drunk for the last 12 hours). After reading and signing an informed consent that was approved by the McGill University Ethics Committee, twenty-five dollars were given to each patient to compensate them for their expenses related to their participation in the study.

b) Laboratory analysis:

A registered nurse drew 50 cc of venous blood from an antecubital vein, which was then immediately taken to the hospital's laboratory for analysis. The laboratory profile includes a complete blood count for hemoglobin level, red blood cell indices and lymphocyte count, serum levels of albumin, ferritine and carotene, and plasma levels of vitamin B12 and folic acid. This profile was chosen because represents an evaluation of the different types of food ingested. Measurements were made at the hematology and biochemistry laboratories of the RVH by automated methods and commercial immunoplates.

c) Anthropometric measurements:

A clinical technician measured body weight in light clothing and without shoes to the nearest 100 grams on a Scale-Tronix digital scale (Ingram and Bell-Meditron, Le Groupe Inc, Don Mills, Canada). Body height also without shoes was measured to the nearest 0.1 cm using a stadiometer. BMI was determined as Kg/m^2. This index is an alternate measure of body fatness, which increases with aging. After the above measures were taken, subjects were encouraged to have a cup of coffee with milk and/or to eat something.

d) Body Composition Assessment:

The assessment of body composition is an important tool in determining nutritional status. Skinfold thickness measurements and bioeletrical impedance analyses are simple methods to assess body composition.

Circumference measurements of the arm, chest, smallest waist, umbilical waist, hip and thigh were taken with non-elastic tape, and skinfold thickness of triceps, biceps, subscapular, suprailiac and umbilical areas were measured with a Lange caliper according to standardized techniques (Lohman *et al.*, 1988). All skinfold thickness measurements were taken at least twice for each site on the dominant side of the body, and only the two values closest to 1mm were averaged. The mid-arm muscle area was calculated as defined by Frisancho, (1984). The sum of the above first four skinfold thickness measurements was used to estimate % body fat according to Durnin & Womersley (1974). The calculation is as follows:

$$SFT + SFB + SFS + SFI = \% \text{ body fat}$$

STF: skinfold of triceps
STB: skinfold of biceps
SFS: skinfold of subscapular
SFI: skinfold of suprailiac

From that percentage and body weight, body fat mass is calculated.

$$BFM = \frac{\% BF \times BW}{100}$$

BFM: body fat mass
% BF: percentage body fat
BW: body weight

Lean body mass (LBM) was calculated by subtracting body fat mass from body weight.

$$LBM = BW - BFM$$

LBM was also measured by bioelectrical impedance analysis using the RJL-101A Systems instruments (Detroit). Resistance and reactance were measured on the dominant side of the body according to Lukaski et al., (1985). The average of the two measurements was used for the calculation of LBM, by applying the sex-specific formula of Lukaski (1987). These procedures were carried out by a trained clinical technician.

e) Functional Assessment

The measurement of handgrip strength is a non-invasive technique for evaluation muscle strength, which does not require a sophisticated apparatus. It was done with the help of the Jamar[tm] dynamometer (Model PC5030J1 - Therapeutic Equipment Corporation, Clifton, NJ). The patient was asked to seat comfortably on a straight back chair without arm rests. The shoulder was abducted and neutrally rotated, with the elbow flexed at 90°, forearm in the neutral position and wrist in slight extension. The patient exerted maximum grip using the dominant hand. The test was repeated three times, and the average result was recorded in Kg of force.

f) Dietary Intake Assessment:

Usual dietary intake of calories, protein and micronutrients was assessed with the Willett food-frequency questionnaire (Willett *et al.*, 1985), which was administrated by a

research dietitian. A specified portion size from all of the food-groups is listed and participants are asked to indicate how often they consume that amount. The questionnaire includes information on the type of food and its preparation method. In addition, it provides the option for open-ended additions to the standard food list. This questionnaire records dietary information over the past 12-month period.

g) Food-Habit Questionnaire:

Since there was no available validated tool which measures the patients' impressions about the quality of masticatory function, this self-administered French language questionnaire was developed by a dietitian at Universite de Montreal for the purpose of this study. It consists of 7 general questions about weight gain or loss, loss of appetite, presence of a diet, intake of supplements and presence of allergies; 2 items about frequency of symptoms like heart-burn, regurgitation, nausea, and cramps and ingestion of medication related to those symptoms; and 29 questions related to frequency and ease of chewing different types of foods. (See Appendix 5.2)

After the above data were collected, patients were informed by the research assistant that they would receive by mail the blood test results. The subjects were then thanked for their participation and dismissed.

2.3 - Statistical Analysis

Subjects' characteristics were first summarized by means and standard deviations for age and sex. The analysis of the data collected for the nutritional assessment was performed

using the SPSS for MS Windows, version 6.1 statistical package. After descriptive statistics were applied to all data, differences in means between groups were analyzed using ANOVA for body circumference and skinfold thickness measurements and for the components of the dietary intake. Significance of the differences between the two groups was determined with the Student-Neuman Keuls post-hoc test. For the above analyses, the results were corrected for age and gender. Independent t-tests were performed to compare the laboratory results for albumin, vitamin B12, carotene, cholesterol, ferritin, hemoglobin, lymphocytes, red blood cells, RBC folate and serum folate, as well as to compare some of the daily dietary intake between the two groups.

Data from the Food Habit Questionnaire were analyzed using the Chi-square Test for items 1 to 7. For the remaining categorical items, the Wilcoxon rank-sum test was used and each item was compared between the two groups for differences in medians. Statistical significance was set at $p<0.05$.

III – RESULTS

3.1 - Subjects Characteristics

Of the 102 patients that previously were randomized to receive either treatment, only 53 agreed to participate in this assessment of nutritional status. Reasons for non-involvement were varied, although the most frequent were 1) unavailability because of job responsibilities, 2) unwillingness to participate or 3) impossibility to locate or contact subjects. Table 1 displays the characteristics of study participants at baseline according to treatment group. The sample as a whole was comprised of 31 males (58%) and 22 females (42%), with a mean age of 53 years ranging from 41 to 70. Twenty-four of the patients (16 males, 8 females, mean age 53) wore the conventional dentures (CD group) and the other 29 (15 males, 14 females, mean age 52) wore the implant prostheses (IP group). Nine people in the CD group and 12 in the IP group were taking vitamin or mineral supplements most of which was calcium. Differences between the groups for sex and supplementation were not statistically significant.

Table 1 - Number of subjects in each treatment group with their mean age and one standard deviation

	Conventional			Implant		
	n	mean	sd	n	mean	sd
Male	16	58.90	7.90	15	51.80	7.20
Female	8	48.60	5.20	14	53.40	6.40
Total	24	53.75	7.28	29	52.60	1.13
Overall Total n =53						

Table 2 - Mean values for anthropometric, body composition and functional assessmen according to treatment group

	Conventional n=24 (16M,8F)		Implant n=29 (15M,14F)		
	mean	SD	mean	SD	p value
Weight (Kg)	79.07	13.93	76.48	12.21	0.79
Height (cm)	170.88	7.51	167.79	9.07	0.86
BMI (Kg/m^2)	26.58	3.63	27.35	8.88	0.54
Handgrip strength (Kg)	38.69	8.21	36.70	9.75	0.57
Body composition					
LBM (Kg)[1]	57.84	10.38	53.00	9.64	0.56
LBM (Kg)[2]	53.19	11.42	50.89	9.42	0.42
% Fat mass	31.17	6.81	33.05	9.87	0.92

M: number of males F: number of females
BMI: Body Mass Index
LBM: Lean Body Mass
(1) by BIA
(2) by skinfold

3.2 – Anthropometric Measurements

The mean values for anthropometric measurements were compared between the groups and results are presented in Table 2. The mean weight was 79 ±14 kg for the CD group and 76 ±12 kg for the IP group (p=0.8). The difference in mean height values between the groups was also not significant (171 ±6 cm CD and 168 ±9 cm IP). There was no significant difference between groups for BMI values (p=0.54). All subjects, except for 2

in the CD and 3 in the IP group had values above the cut off of 22 kg/m^2 for normality, although none of the five was under 18 Kg/m^2.

Table 3 shows the mean values obtained from the measurement of body circumference with the respective p values. None were significant, although there was a trend (p=0.11) for those in the implant group to have greater abdominal circumference than those in the conventional group.

Table 3 - Mean values of body circumference according to type of treatment

	Conventional (CD)		Implant (IP)		
	mean	**SD**	**mean**	**SD**	**p value**
Arm	32.56	2.89	32.99	3.96	0.70
Thorax	100.00	22.15	100.87	8.82	0.75
Waist	91.80	13.49	90.69	11.39	0.75
Abdomen	94.03	22.04	101.17	9.31	0.11
Hip	101.98	5.18	103.92	12.31	0.61
Thigh	57.28	4.46	60.18	6.70	0.24
Calf	37.34	2.48	38.07	3.28	0.47

Values for skinfold thickness measurements are shown in Table 4. The values for the abdominal site measurement for the CD and IP groups were 21 mm and 27 mm, respectively, and this difference was statistically significant.

3.3 – Body Composition Assessment

In Table 2, body composition results are summarized. Through the prediction equation developed by Lukaski (1987) for computing lean body mass (LBM) from BIA results,

which includes the values of resistance, reactance, weight and gender it was found that the mean LBM was 58 kg for the CD group and 53 kg for the IP group. This difference was not significant. The % fat mass derived from the skinfold thickness measurements is also shown. No significant differences are seen between groups.

Table 4 - Mean values of skinfold thickness according to type of treatment

	Conventional (CD)		Implant (IP)		
	mean	SD	mean	SD	p value
Triceps (A)	18.31	7.96	22.77	11.27	0.30
Subescapular (B)	19.06	6.63	20.27	9.97	0.76
Supra-iliaque (C)	18.48	6.99	22.76	8.84	0.16
Abdomen (D)	21.10	7.10	27.27	8.22	0.02
Sum (A,B,C,D)	66.32	21.45	77.58	33.64	0.42

3.4 - Dietary Intake

From the food-frequency questionnaire, the daily dietary intakes were established for each patient, and the mean values were compared between groups. Results are presented in Table 5. A significant percentage of subjects had an intake of calories higher than the Recommended Dietary Allowances (RDA) of 30 kcal/kg/day for men and 27 kcal/kg/day for women: 69% of subjects in the CD group and 54% in the IP group were above the RDA's values. All of the subjects in both groups had intakes of protein above the RDA (0.8 g/kg/day). Although the mean values for dietary fiber intake were inside the range recommended by the National Cancer Institute of 27 to 40 g/day, roughly half of the patients had lower values. Values of daily intakes for vitamins A, B_1, B_2, B_6, B_{12}, C, D, E, K, niacin and folate were all considerably above the RDAs in both groups. The *p* values

resulting from the test of the null hypothesis that there is no difference on the means between groups were always greater than 0.05.

Table 5 - Mean values for dietary intake according to type of treatment

	Conventional (CD)		Implant (IP)		
	mean	**SD**	**mean**	**SD**	**p value**
Calories	**2562.94**	726.75	**2745.45**	669.97	0.34
Proteins (g)	**102.70**	32.54	**101.16**	21.16	0.67
Cal/kg	**34.12**	11.25	**36.45**	9.38	0.58
Prot/kg	**1.36**	0.42	**1.34**	0.27	0.40
Dietary Fibers (g)	**28.91**	11.77	**27.03**	13.62	0.59
Vit. A (IU)	**17946.33**	10265.47	**20827.40**	12944.77	0.37
Thiamin-B1 (mg)	**1.96**	0.57	**2.03**	0.66	0.71
Ribof. B2 (mg)	**2.56**	0.99	**2.58**	0.74	0.92
Niacin Equiv.(mg)	**46.69**	13.24	**47.10**	12.23	0.91
Vit B6 (mg)	**2.63**	0.82	**2.52**	0.66	0.60
Vit B12 (mcg)	**9.73**	8.74	**8.48**	6.94	0.57
Vit C (mg)	**248.54**	149.71	**190.95**	106.07	0.12
Vit D (IU)	**204.56**	170.67	**190.31**	92.09	0.70
Vit E (IU)	**18.51**	7.17	**18.59**	7.99	0.97
Folate (mcg)	**448.14**	196.26	**403.64**	178.74	0.40
Vit K (mcg)	**145.91**	117.52	**175.52**	198.23	0.50

3.5 - Laboratory Results

Results from the analysis of the values of blood components are shown in Table 6. As can be seen, albumin levels fell into the normal range of 38-50 g/L for all subjects in the study. Eighteen subjects (75%) in the CD group and 22 subjects in the IP group (76%) had cholesterol levels above the limit considered normal (5.2mmol/L, if younger than 65 years and 6.2 mmol/L, if older), although the mean values for both groups were under 6.1mmol/L. The carotene levels were above normal in 13% of subjects in each group, while 25% (CD) and 45% (IP) had red blood cells counts above the normal range. Hemoglobin levels were found to be low in seven patients (29%) in the CD group and in

12 patients (21%) in the IP group. Finally, 21% (CD) and 33% (IP) had low ferritine levels. Lymphocyte counts were found to be normal (0.8 to 4.4·10^9 n/L) for all subjects in both groups, as well as lymphocyte counts, vitamin B12 levels, serum folate and red blood cell folate. After comparing the mean values of each group, no significant differences were found for any of the blood component values and all mean values were within the range considered to be normal.

Table 6 - Mean values and one standard deviation for blood components according to treatment group

	Conventional (CD)		Implant (IP)		
	mean	SD	mean	SD	p value
Albumin (*g/L*)	42.48	4.0	42.14	2.77	0.79
Cholesterol (*mmol/L*)	6.09	1.0	5.87	0.94	0.67
Carotene (*g/L*)	2.97	1.2	2.65	1.00	0.27
RBC (nx10^9)	4.90	0.5	4.80	0.42	0.37
Hemoglobin (*g/L*)	145.43	11.5	142.55	10.80	0.61
Lymphocytes (nx10^9)	1.62	0.6	1.60	0.41	0.76
Ferritin (*g/L*)	139.22	133.0	131.62	98.40	0.74
B12 (*pmol/L*)	295.13	113.73	259.76	78.79	0.19
Serum folate (*nmol/L*)	33.30	8.6	30.72	10.06	0.40
RBC folate (*nmol/L*)	875.70	179.1	907.48	188.09	0.52

3.6 - Functional Assessment

No significant difference was found between the mean values for handgrip strength measured with the Jamar^{tm} dynamometer. The mean value for the CD group was 39 ±8 kg of force and for the IP group 37 ± 9 kg of force. These results are summarized in Table 2.

3.7 - Questionnaire Results

Table 7 shows the results for those items in which significant between-group differences were found. Three patients from the CD group and 11 in the IP group reported having

gained weight in the last month. Five reported having lost appetite (CD group n=1) and all except one of those (IP group) lost weight. A very small number of subjects in both groups reported being on a diet or having an allergy to particular food. Of the items concerning the frequency of symptoms of indigestion and intake of drugs related to those symptoms, no significant difference was found between the groups. The great majority of subjects responded negatively to both items. On the sub-item that asks about ingestion of laxatives, there was only one person (IP group), who answered positively.

The items 10 to 18 (see appendix 2) referred to the amount of difficulty encountered when chewing pieces of beef, chicken, ground beef, hard raw vegetables, hard raw fruits, fruit with peel, crusted bread and nuts and seeds. The differences between the medians for those items were all highly significant, except for items number 15 (difficulty chewing hard fruits in pieces) and 16 (difficulty eating hard fruits with peel), which showed a tendency towards significance (p=0.06 and 0.08, respectively). Figure 1 and 2 show the variability of these responses.

Of the items concerning eating habits, the sub-item related to "having to remove one of the prostheses in order to eat", one subject alone in the CD group reported "rarely" in a 5 category scale ranging from "never" to "always". All the others responded "never". As could be expected, all subjects in the IP group answered "never". On the sub-items concerning the necessity of drinking or having to add water or sauce into the food in order to eat, the between-group mediums were not significantly different, although there was a larger percentage of subjects in the CD group (36%) that answered something other than "never" compared to the IP group (17%). Nevertheless, no subject answered "often" or

"always". A significant between-group difference was detected (p=0.004) for sub-item 23 which asks how often the prosthesis is the cause for limiting choice of food and. In addition, a significant difference (p=0.01) was detected for sub-item 24 concerning the frequency of having difficulty chewing with the prosthesis.

Table 7 - Between group differences in responses to questionnaire items on chewing ability and food choice

Items	p-value *
Difficulty chewing:	
In general	0.0100
Pieces of beef	0.0002
Hard vegetables	0.0020
Whole hard fruits	0.0040
Crusted bread	0.0100
Nuts and seeds	0.0200
Pieces of chicken	0.0300
Ground beef	0.0500
Food choice limitation	0.0040

* p-value of Wilcoxon signed rank test

The subsequent items in the questionnaire concerning how often meats, raw fruits and vegetables have to be cut down into small pieces or turned into puree in order to be eaten had all demonstrated a between-group tendency towards significance (p<0.1). Interestingly, the differences between the groups were found not to be significant (p>0.3) for the questions asking about the frequency of comsumption of meats, raw fruit or vegetables. In the Appendix 5.3 a table with the medians of the items 8 to 38 is shown.

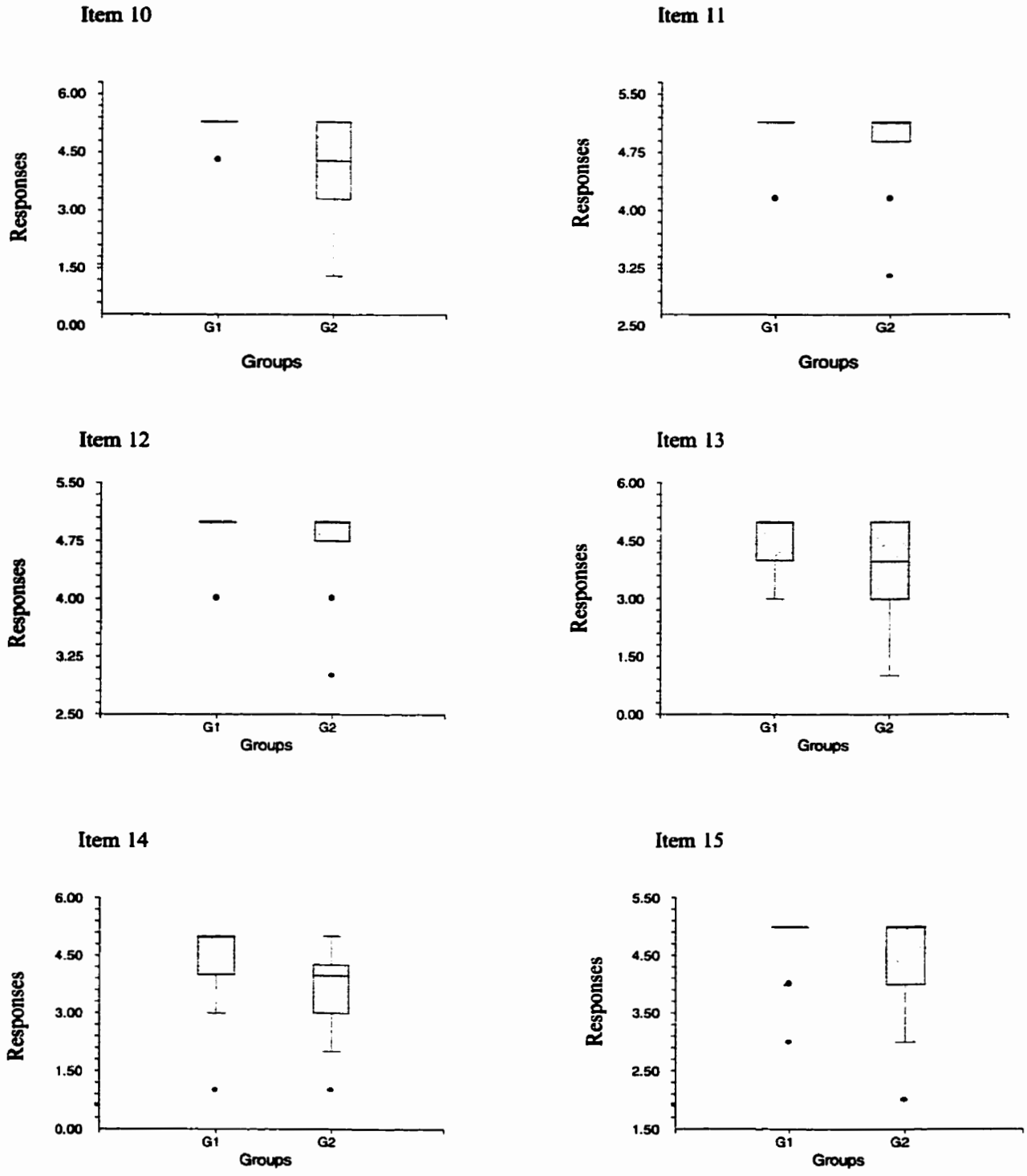

Figure 1: Box plots showing the distribution of responses on items in the Food-Frequency questionnaire, which revealed significant differences (except for item 15 for which there was tendency toward significance). Items 10-12, concerning difficulty eating meats; items 13-15, concerning difficulty eating hard fruits and vegetables. G1= Implant Group; G2= Conventional Group

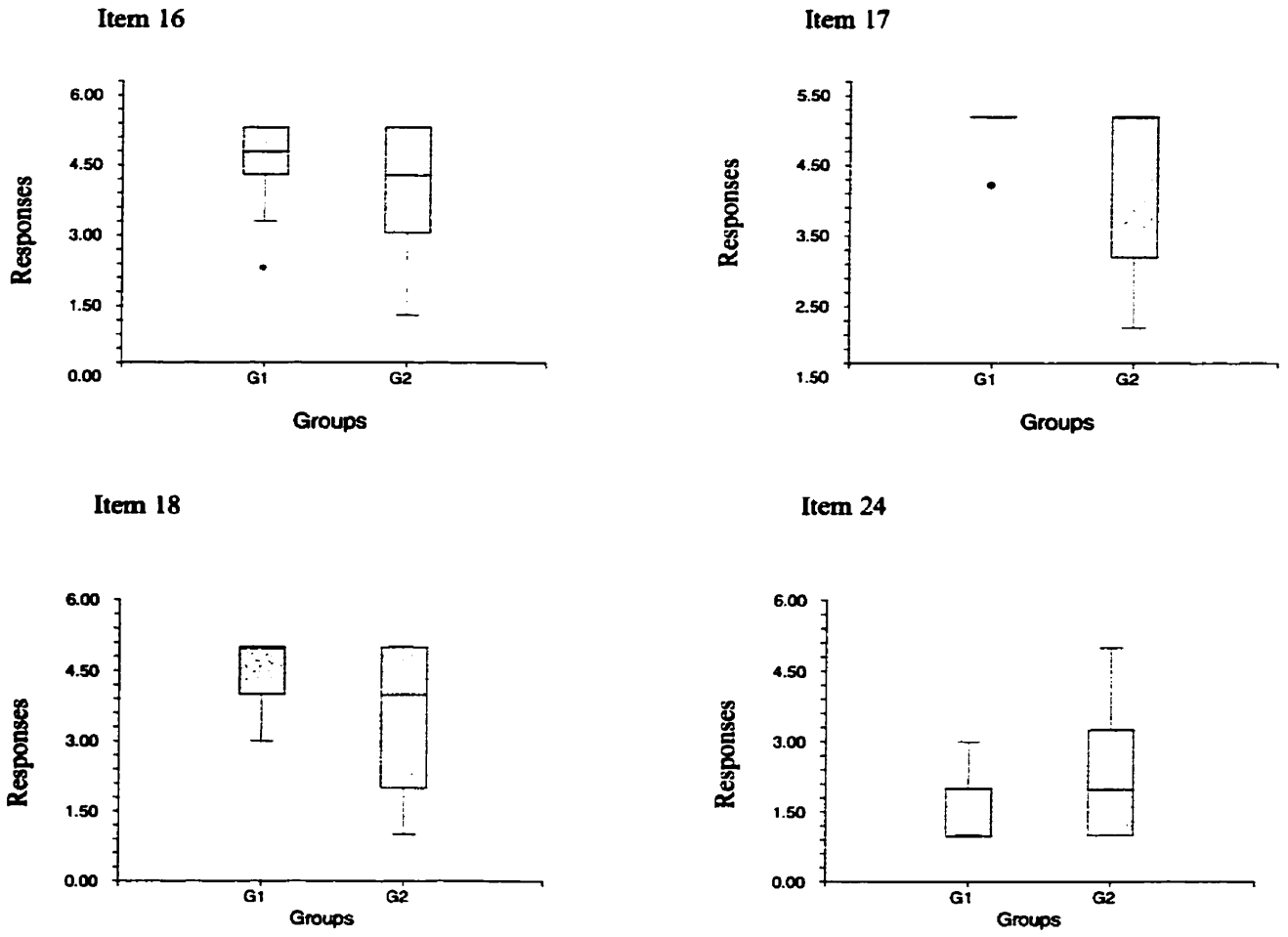

Figure 2: Box plots showing the distribution on responses of items of the Food-Frequency questionnaire, which showed significant differences (except for item 16, for which there was a tendency towards significance). Item 16 asked about the difficulty eating the peels of fruits; item 17 involved difficulty eating hard bread; item 18 concerned the difficulty eating nuts and item 24 was about difficulty eating, in general. (Appendix 5.3) **G1**= Implant Group; **G2**= Conventional Group

IV - DISCUSSION

A review of the literature shows us many studies that were conducted with the objective of identifying differences in dietary intake and nutritional status among groups that received different types of oral rehabilitation. However, nutrition may also be influenced by a variety of social and health factors. It is also known that patients with implant overdentures rate their satisfaction and quality of life significantly higher than those with conventional dentures and complain of fewer gastric symptoms. Therefore, in this study we used a large spectrum of anthropometric and laboratory measurements to determine at one year after oral rehabilitation if patients who were randomized to implant overdenture treatment had a better diet and nutritional status than those who received conventional dentures.

a) Anthropometric Measures

The mean values for height were 171cm for the CD group and 168cm for the IP group. This difference found was not significant and was most likely related to the fact that there were twice as much men than women in the CD group, which is responsible for a higher

value. Weight was very similar and roughly stable for the month prior to the assessment in both groups. Most studies use values of weight and height for the calculation of body mass index to assess the nutritional status of adults or elderly persons. In our study, BMI values were statistically not significant and 50/53 subjects were within the normal range of 20-27kg/m^2. Anthropometric indexes, such as BMI and waist-to-hip circumference ratios have been used extensively to identify individuals at risk for disease and mortality (Garn *et al.* 1986; Deurenberg *et al.* 1991) as well as to assess nutritional status of community-dwelling healthy people (Burns *et al.* 1986).

Differences in measurements of body circumferences were also found not to be significant, although there was a tendency for the IP group to have a greater abdominal circumference. The same conclusion applies to measurements of skinfold thickness, with the exception of the abdominal site that was statistically significant (CD=21mm, IP=27mm). Because one measure alone can not define the nutritional status, the difference observed in the abdominal circumferences is clinically not relevant in the context of having no difference in all of the other measurements. Subcutaneous fat stores play an insignificant role in the daily body metabolism, but depletion of this component of body composition does often reflect chronic nutrient deprivation and inadequate intake. However, because fat, to a certain extent is dispensable tissue, a depletion of fat stores does not correlate with loss of function. Furthermore, protein-calorie malnutrition cannot be diagnosed solely by skinfolds determination (Gurney & Jelliffek, 1973). According to Heyward & Stolarczyk (1996), estimation of skeletal muscle mass, based on mid arm muscle area, is only indicative of body protein stores because individual

variation in humeral diameter and skin compressibility are not accounted for in the equations. Because of these limitations, it was used BIA to determine lean body mass.

b) Body Composition

The results of the BIA for computing lean body mass also yielded no significant between –group differences. Whole-body BIA is widely used by researchers and clinicians as a noninvasive and safe method to estimate body composition and body water volume for individuals of all ages in both health and disease (Kushner, 1992; Ravaglia et al., 1999; Robert et al., 1993; Holt et al.. 1994). The values obtained in this study revealed this sample to be within average weight and fatness standards, confirming the good nutritional status of our sample.

c) Dietary Intake

In our sample, a high percentage of people had values above the RDA for intake of calories and proteins, and roughly half had lower values for fibers. In a study comparing pretreatment and post-treatment dietary habits between partial removable prosthesis and partial fixed prosthesis supported by implants, Garrett et al. (1997) found similar results in a group of 218 people. Our finding is in accordance with other studies of nutrient intake among healthy adults, which shows a tendency for higher intakes of calories and proteins and lower intakes of fibers (Descovich et al., 1983; Brown, 1990; van Dokkum et al. 1990; Nakamura et al., 1995).

As for micronutrients, which are present in large amounts in fresh fruits and vegetables, subjects of both groups were found, on average, to be above the recommendations. This

could signify that, although patients wearing conventional dentures have a decreased masticatory ability, they are able to adapt to new ways of chewing and preparing food in order to maintain a good dietary intake.

d) Laboratory analysis

Approximately two thirds of both groups had higher than normal cholesterol. This could be the result of less than the recommended intakes of fibers by almost half of the sample. Biochemical markers have been used in some studies to compare nutritional status of people with different types of dentition (Brambilla et al., 1996; Makila, 1968), but differences in blood nutrients between groups have been found, if at all, to be small. The other blood components that were analyzed were all within the recommended levels, indicating that the subjects in our study had no major nutritional deficiency, independent of the type of prostheses. Although the group wearing conventional dentures probably experiences less retention and stability of their prostheses, this does not appear to restrain proper intake.

e) Functional Assessment

Differences between treatment groups through the measurement of handgrip strength were found to be not significant. Results were also within normal limits for age and sex, confirming the absence of malnutrition. One would expect to find differences in muscle function only when other markers of malnutrition are evident. Regardless, we included this outcome because muscle function is very sensitive to malnutrition and recovery of

muscle dysfunction following a nutritional intervention precedes improvement of blood levels of most parameters related to nutrition.

Considering that no other similar study has been conducted using anthropometric, body composition and functional analysis, we were unable to compare our results with other investigations.

For all the previously described outcomes, no significant between-group differences were found. The number of subjects who agreed to participate in the present study was half the initial group to whom treatment was given. The period of time (1 year) between the treatment and this study could have contributed to the low number of participants. Regardless, for each variable tested, the sample size was large enough to have a power of approximately 0.8. This suggest, then, that the non-significant findings are true reflections of outcome and that lack of significance was not due to an inadequate sample size.

f) Questionnaire

Although the questionnaire used in this study has not been validated, it did demonstrate the capability to identify some important between group differences. The items concerning difficulty in chewing harder foods yielded significant differences. This is probably due to the greater stability and retention of the implant overdenture. These results are supported by many studies that compared patients chewing ability with conventional and implant prostheses (Awad & Feine, 1998; Boerrigter et al., 1995; Geertman et al., 1994; Gunne & Wall, 1985). The questionnaire was also able to show that patients wearing conventional dentures did not avoid harder foods, even though they reported more chewing difficulties. One could infer from the results of this questionnaire

that: 1) conventional dentures were well made and well adapted in order to allow chewing; 2) dietary intake may be influenced by a variety of sociocultural factors and 3) changes in dietary patterns may not occur solely because the individual's chewing ability improves.

Although not significantly different, there was a tendency for patients wearing conventional dentures to cut or chop harder foods like apples, carrots and beef, more frequently than implant overdenture patients. These findings are consistent with those of previous studies, which measured masticatory performance in IP wearers (Rissin *et al.*, 1978; Geertman *et al.*, 1994; Feine *et al.*, 1998; De Hernández & Bodine, 1970; Cibirka *et al.*, 1997; Boerrigter *et al.*, 1995). These differences in food preparation could explain the fact that subjects from the CD group were eating the same types of foods as subjects from the IP group, and thus have a very similar nutritional status. However, the modifications needed to prepare food probably led to some inconvenience in life style. This might explain, in part, why patients' satisfaction ratings for implant prostheses were significantly higher (Awad et al, in press).

During the past 25 years, various approaches have been used to estimate nutrient intake and nutritional status of those with problems related to missing teeth. A study conducted by Sebring *et al.*, (1995) analyzed the dietary intake of subjects treated either with CDs or IPs using 3-day food records before and after treatment. Hartsook (1975) evaluated dietary adequacy with a 24-hour recall in 24 CD wearers. Lachapelle *et al.* (1992) assessed dietary adequacy in 310 CD wearers who completed food-frequency questionnaires. Baxter (1984) studied two groups of edentulous geriatric patients who completed 4-day food records before and after receiving new CDs. Sandström &

Lindquist, (1987) assessed dietary selection that was taken with the same method as Baxter (1984) did, from 23 edentulous subjects before treatment, after treatment with new CDs and after placement of an IP. Brambilla *et al.*, (1996) compared the nutritional status of patients with different types of dentition using BMI, skinfold thickness and blood tests. Some of the above studies reported significant differences, but the major conclusions were that different types of oral rehabilitation or different types of dentition do not seem to substantially interfere with nutritional status. The present study involved subjects who were randomized to treatment, a design not found in the other studies. This randomization should have controlled for confounds like socioeconomic and educational levels. Regardless, our findings concur with the studies previously mentioned that did not use randomization strategy.

4.1 - Study Limitations

The fact that the group selected for this study was relatively young (mean age of 53 years) and healthy, makes it more difficult to detect differences in markers of nutritional status. As discussed in the introduction section, older adults are more sensitive to reduced dietary intake and deficits may be more evident with an older population. It may be that younger, healthier people were elected to participate in the trial.

This study was conducted retrospectively. We did not assess subjective performance with the original dentures, nor nutritional status of subjects before treatment. Consequently, there is no indication of how much intra-individual change occurred with implant-

supported or new conventional dentures. It would have been interesting to analyze these potential changes, especially because the treatments were randomly assigned. For a definitive answer of whether patients wearing implant prostheses have a better nutritional status than those with conventional prostheses, a randomized prospective study would need to be performed with assessment done prior to intervention and at different periods following it. This is presently being done in a new trial.

4.2 - Conclusions

Within the limitations of our study, we were unable to verify significant differences in nutritional status between people who had been rehabilitated with conventional dentures and implant-supported overdentures one year after treatment. Despite this, we showed that people wearing conventional dentures found chewing harder foods to be more difficult. However, because we found no differences in nutritional state, the increased chewing difficulty may not have prevented them from eating harder foods.

V – REFERENCES

1. National Center for Health Statistics: Edentulous persons. 1974. Washington, DHEW Publ. No. (HNA) 74-1516 (Government Printing Office).

2. Oral Health of United Sates Adults. Department of Health and Human Services. NIH Publication No. 87-2868. 1987. Bethesda, MD.

3. Adell R, Lekholm U, Rockler B, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int.J.Oral Surg.* 1981;10:387-416.

4. Agarwal N, Acevedo F, Leighton LS, Cayten CG, Pitchumoni CS. Predictive ability of various nutritional variables for mortality in elderly people [see comments]. *Am.J.Clin.Nutr.* 1988;48:1173-1178.

5. Alberktsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. *Int.J.Oral Maxillofac.Implants.* 1986;1:11-25.

6. Albrektsson T, Jacobsson M. Bone-metal interface in osseointegration. *J Prosthet.Dent* 1987;57:597-607.

7. Anjos LA. [Body mass index (body mass.body height-2) as indicator of nutritional status in adults: review of the literature]. *Rev.Saude.Publica.* 1992;26:431-436.

8. Awad MA, Feine JS. Measuring patient satisfaction with mandibular prostheses. *Community.Dent Oral Epidemiol.* 1998;26:400-405.

9. Awad MO, Barford AV, Grindulis KA, Montgomery RD, Sammons HG. Factors affecting the serum iron-binding capacity in the elderly. *Gerontology* 1982;28:125-131.

10. Basker RM, Ogden AR, Ralph JP. Complete denture prescription--an audit of performance. *Br.Dent J* 1993;174:278-284.

11. Bates JF, Elwood PC, Foster W. Studies relating mastication and nutrition in the elderly. *Gerontol.Clin.(Basel.)* 1971;13:227-232.

12. Baxter JC. The nutritional intake of complete denture patients: a computerized study. *J Indiana.Dent Assoc* 1980;59:14-17.

13. Baxter JC. The nutritional intake of geriatric patients with varied dentitions. *J Prosthet.Dent* 1984;51:164-168.

14. Beaton GH, Milner J, Corey P, McGuire V, Cousins M, Stewart E, de Ramos M, Hewitt D, Grambsch PV, Kassim N, Little JA. Sources of variance in 24-hour dietary recall data: implications for nutrition study design and interpretation. *Am.J.Clin.Nutr.* 1979;32:2546-2549.

15. Beaumont D, Lehmann AB, James OF. Protein turnover in malnourished elderly subjects: the effects of refeeding. *Age.Ageing* 1989;18:235-240.

16. Behrman SJ. The implantation of magnets in the jaw to aid denture retention. *Prosthetic Dentistry* 1960;10:807

17. Bender AE DL. Milk comsumption in the elderly. *Geriat Prac* 1968;5:331

18. Berg E. Acceptance of full dentures. *Int.Dent J* 1993;43:299-306.

19. Beumer J, Hamada MO, Lewis S. A prosthodontic overview. *Int.J Prosthodont.* 1993;6:126-130.

20. Bienia R, Ratcliff S, Barbour GL, Kummer M. Malnutrition in the hospitalized geriatric patient. *J Am.Geriatr.Soc.* 1982;30:433-436.

21. Blomberg S, Lindquist LW. Psychological reactions to edentulousness and treatment with jawbone-anchored bridges. *Acta Psychiatr.Scand.* 1983;68:251-262.

22. Blumberg J. FDA-proposed reference daily intake: a downgraded food- label standard? [editorial]. *Nutrition.* 1992;8:197

23. Blumberg J. Nutritional needs of seniors. *J.Am Coll.Nutr.* 1997;16:517-523.

24. Boerrigter EM, Stegenga B, Raghoebar GM, Boering G. Patient satisfaction and chewing ability with implant-retained mandibular overdentures: a comparison with new complete dentures with or without preprosthetic surgery. *J Oral Maxillofac.Surg.* 1995;53:1167-1173.

25. Boerrigter EM, Geertman ME, van Oort RP, Bouma J, Raghoebar GM, van Waas MA, vant HM, Boering G, Kalk W. Patient satisfaction with implant-retained mandibular overdentures. A comparison with new complete dentures not

retained by implants--a multicentre randomized clinical trial. *Br.J Oral Maxillofac.Surg.* 1995;33:282-288.

26. Boos R. Preparation and conditioning of patients for prosthetic treatment. *J.Prosthet.Dent.* 1959;9:4-10.

27. Brambilla E, Cerati M, Ferrieri G, Gagliani M. [Oral health and nutritional status: an analysis of a sample of the institutionalized elderly]. *Ann.Ig.* 1996;8:229-237.

28. Brånemark PI, Hansson BO, Adell R, Breine U, Lindström J, Hallén O, Ohman A. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. *Scand.J.Plast.Reconstr.Surg.Suppl.* 1977;16:1-132.

29. Brehm TW, Abadi BJ. Patient response to variations in complete denture technique. Part IV: Residual ridge resorption--cast evaluation. *J Prosthet.Dent* 1980;44:491-494.

30. Brodeur JM, Benigeri M, Naccache H, Olivier M, Payette M. [Trends in the level of edentulism in Quebec between 1980 and 1993]. *J.Can.Dent Assoc* 1996;62:159-6.

31. Brown WV. Dietary recommendations to prevent coronary heart disease. *Ann.N.Y.Acad.Sci.* 1990;598:376-388.

32. Brunello DL, Mandikos MN. Construction faults, age, gender, and relative medical health: factors associated with complaints in complete denture patients. *J Prosthet.Dent* 1998;79:545-554.

33. Burns R, Nichols L, Calkins E, Blackwell S, Pragay D. Nutritional assessment of community-living well elderly. *J.Am.Geriatr.Soc.* 1986;34:781-786.

34. Burritt MF, Anderson CF. Laboratory assessment of nutritional status. *Hum.Pathol.* 1984;15:130-133.

35. Burt BA, Ismail AI, Eklund SA. Periodontal disease, tooth loss, and oral hygiene among older Americans. *Community.Dent.Oral Epidemiol.* 1985;13:93-96.

36. Carlsson GE, Otterland A, Wennström A, Odont D. Patient factors in appreciation of complete dentures. *J Prosthet.Dent* 1967;17:322-328.

37. Carlsson GE. Clinical morbidity and sequelae of treatment with complete dentures. *J Prosthet.Dent* 1998;79:17-23.

38. Castaneda C, Charnley JM, Evans WJ, Crim MC. Elderly women accommodate to a low-protein diet with losses of body cell mass, muscle function, and immune response. *Am.J.Clin.Nutr.* 1995;62:30-39.

39. Caswell CW, Clark AE. Dental Implant Prostodontics. Philadelphia: J.B. Lippincott Company, 1991:

40. Chapman KM, Ham JO, Pearlman RA. Longitudinal assessment of the nutritional status of elderly veterans. *J Gerontol.A.Biol.Sci.Med.Sci.* 1996;51:B261-B269

41. Chen MK, Lowenstein F. Masticatory handicap, socioeconomic status, and chronic conditions among adults. *J.Am.Dent.Assoc.* 1984;109:916-918.

42. Cibirka RM, Razzoog M, Lang BR. Critical evaluation of patient responses to dental implant therapy. *J Prosthet.Dent* 1997;78:574-581.

43. Collinsworth R, Boyle K. Nutritional assessment of the elderly. *J.Gerontol.Nurs.* 1989;15:17-21.

44. Cornoni HJ, Harris TB, Everett DF, Albanes D, Micozzi MS, Miles TP, Feldman JJ. An overview of body weight of older persons, including the impact on mortality. The National Health and Nutrition Examination Survey I--Epidemiologic Follow-up Study. *J.Clin.Epidemiol.* 1991;44:743-753.

45. Corti MC, Guralnik JM, Salive ME, Sorkin JD. Serum albumin level and physical disability as predictors of mortality in older persons [see comments]. *JAMA* 1994;272:1036-1042.

46. Dana F, Chiarabaglio M, Turbiglio E. [Relation between oral conditions and diet in the elderly. A clinical study]. *Minerva.Stomatol.* 1985;34:481-484.

47. De Hernández CJ, Bodine RL. Masticatory force: implant dentures compared with conventional dentures. *Dent Clin.North Am* 1970;14:117-123.

48. Descovich GC, Cavallo G, Mannino G, Lenzi S. [The Brisighella survey: a study of dietary habits]. *Minerva.Med.* 1983;74:547-555.

49. Deurenberg P, Weststrate JA, Paymans I, van der Kooy K. Factors affecting bioelectrical impedance measurements in humans. *Eur.J.Clin.Nutr.* 1988;42:1017-1022.

50. Deurenberg P, van der Kooij K, Evers P, Hulshof T. Assessment of body composition by bioelectrical impedance in a population aged greater than 60 y. *Am.J.Clin.Nutr.* 1990;51:3-6.

51. Deurenberg P, Weststrate JA, Seidell JC. Body mass index as a measure of body fatness: age- and sex-specific prediction formulas. *Br.J Nutr.* 1991;65:105-114.

52. Douglass C, Furino A. Balancing dental service requirements and supplies: epidemiologic and demographic evidence. *J.Am Dent Assoc* 1990;121:587-592.

53. Drinka PJ, Langer EH, Voeks SK, Morrow FD. Hypovitaminosis in a control subject. *South.Med.J.* 1991;84:1368-1369.

54. Ettinger RL. Changing dietary patterns with changing dentition: how do people cope? *Spec.Care Dentist.* 1998;18:33-39.

55. Faine MP. Communicating with the patient. In: Reinhardt R, Steube M, eds. Prosthodontic Treatment for Edentulous Patients. 10 Ed. St. Louis: 1990:100-122.

56. Feine JS, de Grandmont P, Boudrias P, Brien N, LaMarche C, Taché R, Lund JP. Within-subject comparisons of implant-supported mandibular prostheses: choice of prosthesis. *J.Dent.Res.* 1994;73:1105-1111.

57. Feine JS, Dufresne E, Boudrias P, Lund JP. Outcome assessment of implant-supported prostheses. *J.Prosthet.Dent.* 1998;79:575-579.

58. Fløystrand F. Vestibular and lingual muscular pressure on complete maxillary dentures. *Acta Odontol.Scand.* 1986;44:71-75.

59. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. *Am.J.Clin.Nutr.* 1981;34:2540-2545.

60. Frisancho AR. New standards of weight and body composition by frame size and height for assessment of nutritional status of adults and the elderly. *Am.J.Clin.Nutr.* 1984;40:808-819.

61. Fulmer T. If elderly patients can't chew. *Am.J Nurs.* 1977;1615

62. Garn SM, Leonard WR, Hawthorne VM. Three limitations of the body mass index [editorial]. *Am.J Clin.Nutr.* 1986;44:996-997.

63. Garn SM, Leonard WR, Hawthorne VM. Three limitations of the body mass index [editorial]. *Am.J Clin.Nutr.* 1986;44:996-997.

64. Garrett NR, Kapur KK, Hasse AL, Dent RJ. Veterans Administration Cooperative Dental Implant Study- -comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. Part V: Comparisons of pretreatment and posttreatment dietary intakes. *J Prosthet.Dent* 1997;77:153-161.

65. Garrett NR, Kapur KK, Hamada MO, Roumanas ED, Freymiller E, Han T, Diener RM, Levin S, Chen T. A randomized clinical trial comparing the efficacy of

mandibular implant-supported overdentures and conventional dentures in diabetic patients. Part II. Comparisons of masticatory performance. *J Prosthet.Dent* 1998;79:632-640.

66. Geertman ME, Slagter AP, van Waas MA, Kalk W. Comminution of food with mandibular implant-retained overdentures. *J Dent Res.* 1994;73:1858-1864.

67. Gillings BR. Magnetic denture retention systems: inexpensive and efficient. *Int.Dent J* 1984;34:184-197.

68. Goodwin JS. Social, psychological and physical factors affecting the nutritional status of elderly subjects: separating cause and effect. *Am J.Clin.Nutr.* 1989;50:1201-1209.

69. Greksa LP, Parraga IM, Clark CA. The dietary adequacy of edentulous older adults. *J.Prosthet.Dent.* 1995;73:142-145.

70. Grogono AL, Lancaster DM, Finger IM. Dental implants: a survey of patients' attitudes. *J Prosthet.Dent* 1989;62:573-576.

71. Gunne HS, Wall AK. The effect of new complete dentures on mastication and dietary intake. *Acta Odontol.Scand.* 1985;43:257-268.

72. Gurney JM, Jelliffe DB. Arm anthropometry in nutritional assessment: nomogram for rapid calculation of muscle circumference and cross-sectional muscle and fat areas. *Am.J Clin.Nutr.* 1973;26:912-915.

73. Harle TJ, Anderson JD. Patient satisfaction with implant-supported prostheses. *Int.J Prosthodont.* 1993;6:153-162.

74. Hayes PA, Sowood PJ, Belyavin A, Cohen JB, Smith FW. Sub-cutaneous fat thickness measured by magnetic resonance imaging, ultrasound, and calipers. *Med.Sci.Sports Exerc.* 1988;20:303-309.

75. Heitmann BL. Impedance: a valid method in assessment of body composition? *Eur.J.Clin.Nutr.* 1994;48:228-240.

76. Henderson CT. Nutrition. In: Cassel CK.Reisenberg DE.Sorensen LB.Walsh JR, ed. Geriatric Medicine. New York: 1990:535-544.

77. Herrmann FR, Safran C, Levkoff SE, Minaker KL. Serum albumin level on admission as a predictor of death, length of stay, and readmission [see comments]. *Arch.Intern.Med.* 1992;152:125-130.

78. Heyward VH, Stolarczyk LM. Applied Body Composition Assessment. Champaign, IL: Human Kinetics, 1996:

79. Hobo S, Takayama H. Effect of canine guidance on the working condylar path. *Int.J Prosthodont.* 1989;2:73-79.

80. Holt TL, Cui C, Thomas BJ, Ward LC, Quirk PC, Crawford D, Shepherd RW. Clinical applicability of bioelectric impedance to measure body composition in health and disease. *Nutrition.* 1994;10:221-224.

81. Horwath CC. Chewing difficulty and dietary intake in the elderly. *J.Nutr.Elder.* 1989;9:17-24.

82. Horwath CC. Dietary intake studies in elderly people. *World Rev.Nutr.Diet.* 1989;59:1-70.

83. Houtkooper LB, Lohman TG, Going SB, Howell WH. Why bioelectrical impedance analysis should be used for estimating adiposity. *Am.J.Clin.Nutr.* 1996;64:436S-448S.

84. Hull C, Greco RS, Brooks DL. Alleviation of constipation in the elderly by dietary fiber supplementation. *J.Am.Geriatr.Soc.* 1980;28:410-414.

85. Hunt RJ, Beck JD, Lemke JH, Kohout FJ, Wallace RB. Edentulism and oral health problems among elderly rural Iowans: the Iowa 65+ rural health study. *Am.J.Public Health* 1985;75:1177-1181.

86. Jackson RA, Ralph WJ. Continuing changes in the contour of the maxillary residual alveolar ridge. *J Oral Rehabil.* 1980;7:245-248.

87. Jacob RF. The traditional therapeutic paradigm: complete denture therapy. *J Prosthet.Dent* 1998;79:6-13.

88. Jeejeebhoy KN. Clinical and Functional Assessment. In: Shils ME, Olson JA, Shike M, eds. Modern Nutrition in Health and Disease. Phiadelphia: 1994:805-811.

89. Jeejeebhoy KN. Nutritional assessment. *Gastroenterol.Clin.North Am.* 1998;27:347-369.

90. Jenkins DJA R-MCJA. Dietary fibre. In: Horowitz A MDMHSNSBWT, ed. Nutrition in the Elderly. Oxford: Oxford University Press, 1989:94-108.

91. Kalk W, de Baat C. Patients' complaints and satisfaction 5 years after complete denture treatment. *Community.Dent Oral Epidemiol.* 1990;18:27-31.

92. Kapur KK, Garrett NR, Hamada MO, Roumanas ED, Freymiller E, Han T, Diener RM, Levin S, Ida R. A randomized clinical trial comparing the efficacy of mandibular implant-supported overdentures and conventional dentures in diabetic patients. Part I: Methodology and clinical outcomes. *J Prosthet.Dent* 1998;79:555-569.

93. Karlsson S, Swartz B. Denture adhesives - their effect on the mobility of full upper dentures during chewing. A cineradiographic study. *Swed.Dent J* 1981;5:207-211.

94. Karlsson S. Denture mobility and bolus position during mastication in patients wearing conventional and pelotte-retained full upper dentures: a cineradiographic study. *J Oral Rehabil.* 1983;10:65-74.

95. Kemm JR, Allcock J. The distribution of supposed indicators of nutritional status in elderly patients. *Age.Ageing* 1984;13:21-28.

96. Kent G. Effects of osseointegrated implants on psychological and social well-being: a literature review. *J Prosthet.Dent* 1992;68:515-518.

97. Kerstetter JE, Holthausen BA, Fitz PA. Nutrition and nutritional requirements for the older adult. *Dysphagia.* 1993;8:51-58.

98. Knapp A. Nutrition and oral health in the elderly. *Dent.Clin.North Am.* 1989;33:109-125.

99. Krehl WA. The influence of nutritional environment on aging. *Geriatrics.* 1974;29:65-71.

100. Kushner RF. Bioelectrical impedance analysis: a review of principles and applications. *J.Am.Coll.Nutr.* 1992;11:199-209.

101. Lachapelle D, Brodeur JM, Simard PL, Vallée R, Moisan J. Masticatory ability and dietary adequacy of elderly denture wearers. *J Can Diet Assoc* 1992;53:145-150.

102. Lewis DW. Optimized therapy for the edentulous predicament: cost- effectiveness considerations. *J.Prosthet.Dent* 1998;79:93-99.

103. Lohman TG, Roche AF, Martello R. Anthropometric Standardization Reference Manual. Human Kinetics Books, 1988:

104. Lohman TG. Advances in body composition assessment. Champaign IL: Human Kinetics Publishers, 1992:

105. Lukaski HC, Johnson PE, Bolonchuk WW, Lykken GI. Assessment of fat-free mass using bioelectrical impedance measurements of the human body. *Am.J Clin.Nutr.* 1985;41:810-817.

106. MacEntee MI, Hole R, Stolar E. The significance of the mouth in old age. *Soc.Sci.Med.* 1997;45:1449-1458.

107. MacEntee MI, Walton JN. The economics of complete dentures and implant-related services: a framework for analysis and preliminary outcomes. *J.Prosthet.Dent* 1998;79:24-30.

108. MacLaughlin J, Holick MF. Aging decreases the capacity of human skin to produce vitamin D3. *J.Clin.Invest.* 1985;76:1536-1538.

109. Marbach JJ. Psychosocial factors for failure to adapt to dental prostheses. *Dent Clin.North Am* 1985;29:215-233.

110. Mäkilä E. Effect of complete dentures on dietary habits and serium thiamine riboflavin and ascorbic acid levels in edentulous persons. *Suom Hammaslaak Toim* 1968;64:107-152.

111. Mitchel HS, Rynbergen HJ, Anderson L, Dibble MV. Nutrição Rio de Janeiro: Editora Interamericana Ltda, 1978.

112. McLaren DS. Three limitations of the body mass index [letter]. *Am.J Clin.Nutr.* 1987;46:121

113. Misch CE. Contemporary Implant Dentistry. St. Louis: Mosby-Year Book, 1993:

114. Mojon P, Budtz-JørgensenE, Rapin CH. Relationship between oral health and nutrition in very old people. *Age and Aging* 1999;28:463-468.

115. Morley JE, Glick Z, Rubenstein LZ. Geriatric Nutrition - A comprehensive Review. second Ed. New York: Raven Press Ltd, 1995:

116. Morrisson SG. Feeding the elderly population. *Nurs.Clin.North Am.* 1997;32:791-812.

117. Nakamura T, Takebe K, Tando Y, Arai Y, Yamada N, Ishii M, Kikuchi H, Machida K, Imamura K, Terada A. Serum fatty acid composition in normal Japanese and its relationship with dietary fish and vegetable oil contents and blood lipid levels. *Ann.Nutr.Metab.* 1995;39:261-270.

118. Osterberg T, Carlsson GE, Sundh W, Fyhrlund A. Prognosis of and factors associated with dental status in the adult Swedish population, 1975-1989. *Community.Dent.Oral Epidemiol.* 1995;23:232-236.

119. Papas AS, Joshi A, Giunta JL, Palmer CA. Relationships among education, dentate status, and diet in adults. *Spec.Care Dentist.* 1998;18:26-32.

120. Peltola MK, Raustia AM, Salonen MA. Effect of complete denture renewal on oral health--a survey of 42 patients. *J Oral Rehabil.* 1997;24:419-425.

121. Ravaglia G, Forti P, Maioli F, Boschi F, Cicognani A, Gasbarrini G. Measurement of body fat in healthy elderly men: a comparison of methods. *J Gerontol.A.Biol.Sci.Med.Sci.* 1999;54:M70-M76

122. Rissin L, House JE, Manly RS, Kapur KK. Clinical comparison of masticatory performance and electromyographic activity of patients with complete dentures, overdentures, and natural teeth. *J Prosthet.Dent* 1978;39:508-511.

123. Robert S, Zarowitz BJ, Hyzy R, Eichenhorn M, Peterson EL, Popovich JJ. Bioelectrical impedance assessment of nutritional status in critically ill patients. *Am.J Clin.Nutr.* 1993;57:840-844.

124. Rudman D, Feller AG. Protein-calorie undernutrition in the nursing home. *J.Am Geriatr.Soc.* 1989;37:173-183.

125. Russell DM, Prendergast PJ, Darby PL, Garfinkel PE, Whitwell J, Jeejeebhoy KN. A comparison between muscle function and body composition in anorexia nervosa: the effect of refeeding. *Am.J.Clin.Nutr.* 1983;38:229-237.

126. Sandström B, Lindquist LW. The effect of different prosthetic restorations on the dietary selection in edentulous patients. A longitudinal study of patients initially treated with optimal complete dentures and finally with tissue-integrated prostheses. *Acta Odontol.Scand.* 1987;45:423-428.

127. Sebring NG, Guckes AD, Li SH, McCarthy GR. Nutritional adequacy of reported intake of edentulous subjects treated with new conventional or implant-supported mandibular dentures. *J.Prosthet.Dent.* 1995;74:358-363.

128. Shatenstein B. Tooth loss, mastication, and nutrition: an overview. *J Am Diet.Assoc* 1986;86:86-87.

129. Smith DE, Kydd WL, Wykhuis WA, Phillips L. The mobility of artificial dentures during comminution. *J Prosthet.Dent* 1963;13:462

130. Smith JM, Sheiham A. How dental conditions handicap the elderly. *Community.Dent Oral Epidemiol.* 1979;7:305-310.

131. Stafford GD. Denture adhesives--a review of their uses and compositions. *Dent Pract.Dent Rec.* 1970;21:17-19.

132. Suter PM, Russell RM. Vitamin requirements of the elderly. *Am J.Clin.Nutr.* 1987;45:501-512.

133. Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed-longitudinal study covering 25 years. *J Prosthet.Dent* 1972;27:120-132.

134. Tayback M, Kumanyika S, Chee E. Body weight as a risk factor in the elderly. *Arch.Intern.Med.* 1990;150:1065-1072.

135. Thompson GW, Kreisel PS. The impact of the demographics of aging and the edentulous condition on dental care services. *J.Prosthet.Dent.* 1998;79:56-59.

136. Thorslund S, Toss G, Nilsson I, von Schenck H, Symreng T, Zetterqvist H. Prevalence of protein-energy malnutrition in a large population of elderly people at home. *Scand.J.Prim.Health Care* 1990;8:243-248.

137. Truhlar RS, Casino AJ, Cancro JJ. Treatment planning of the elderly implant patient. *Dent.Clin.North Am.* 1997;41:847-861.

138. Truhlar RS, Casino AJ, Cancro JJ. Treatment planning of the elderly implant patient. *Dent.Clin.North Am.* 1997;41:847-861.

139. Turbyfill WF. Regaining pleasure and success with complete denture services. *Int.J Prosthodont.* 1989;2:474-482.

140. van Dokkum W, de Vos RH, Dukel F, Hilwig GN. Analysis of macrocomponents and fatty acids in the market basket of male adolescents in The Netherlands. *J Am.Diet Assoc* 1990;90:77-81.

141. Walker AR, Walker BF, Manetsi B, Molefe O, Walker AJ. Serum albumin levels in elderly rural Africans. *Int.J.Vitam.Nutr.Res.* 1991;61:339-345.

142. Wayler AH, Muench ME, Kapur KK, Chauncey HH. Masticatory performance and food acceptability in persons with removable partial dentures, full dentures and intact natural dentition. *J.Gerontol.* 1984;39:284-289.

143. Weinsier RL, Hunker EM, Krumdieck CL, Butterworth CEJ. Hospital malnutrition. A prospective evaluation of general medical patients during the course of hospitalization. *Am.J Clin.Nutr.* 1979;32:418-426.

144. Willett WC, Sampson L, Stampfer MJ, Rosner B, Bain C, Witschi J, Hennekens CH, Speizer FE. Reproducibility and validity of a semiquantitative food frequency questionnaire. *Am.J.Epidemiol.* 1985;122:51-65.

145. Windsor JA, Hill GL. Grip strength: a measure of the proportion of protein loss in surgical patients. *Br.J.Surg.* 1988;75:880-882.

146. Young VR. Amino acids and proteins in relation to the nutrition of elderly people. *Age.Ageing* 1990;19:S10-S24

147. Zambrano N, Quintero J, Falque L, Souki A, Arias N, Piñero M. [Food intake and biochemical variables: overall nutrition and metabolic status of a group of non-institutionalized elderly in Venezuela]. *Arch.Latinoam.Nutr.* 1996;46:196-202.

148. Zarb GA, Bolender CL, Carlsson GE. Boucher's prosthodontic treatment for edentulous patients. 11 Ed. St. Louis : Mosby: 1997:

149. Zarb GA. The edentulous milieu. *J Prosthet.Dent* 1983;49:825-831.

150. Zheng JJ, Rosenberg IH. What is the nutritional status of the elderly? *Geriatrics.* 1989;44:57-4.

APPENDICES

5.1 - Consent Form

INFORMED CONSENT:

IMPLANT PROSTHESES VS CONVENTIONAL DENTURES: EFFECT ON THE NUTRITIONAL STATUS

Doctors JS Feine and JA Morais have invited me to take part in a study on nutrition of people who have no natural teeth. My involvement in this study will require that I come to one appointment at the Unit of Clinical Investigation at the Royal Victoria Hospital.
The study includes:

1) At the time of my visit that I meet a dietitian that will evaluate my usual diet. For that purpose she will ask me the frequency and size of all different foods that I usually eat.

2) This visit will take place between 8 A.M. and 10 A.M. I shall not eat any food after 10 P.M. and not drink after midnight the day before my appointment.

3) A nurse will take a sample of 50 milliliters of blood (around 3 tablespoons) in order to know my level of cholesterol and serum albumin. This sample of blood will also serve to measure my haemoglobin concentration, red and white blood cells and levels of proteins, vitamins and iron. Risks associated with taking the blood sample are minimal. There is always a risk of bruising and a little pain at the time the blood is taken.

4) My body mass index will also be calculated by measuring my weight and my height. My body composition will be estimated with the help of bioelectrical impedance analysis (electric current of very weak intensity, painless and secure). This involves applying electrodes to my right wrist and ankle. Measurements of circumferences of my arm, thorax, waist, hip and thigh will be taken with a measuring tape, as well as measurements of my skinfold thickness in various areas. The skinfold thicknesss is done by gently pressing the skin with a Caliper.

5) An assessment of my hand grip strength will be made with the help of a specialized instrument (Jamar^{tm} dynamometer). To perform this, I will be seated on a straight back chair without arm rests. My shoulder will be placed along the body with the elbow flexed at 90^0 and I will be asked to squeeze on the handle of the instrument. Three measures will be taken with my dominant hand and a mean of the three values will be made.

6) The amount that I will receive for my involvement in this research ($25.00), will compensate for time lost and/or inconvenience.

7) It is not assured that I will gain any personal advantage from this study; however, I will contribute to the improvement of the quality of care to people who have similar problems as mine. **All information is kept confidential and it is not possible to identify any person when results are published.**

8) If I have questions or problems about my rights and conditions associated with my involvement to this project, I can communicate with the patient representative of the Royal Victoria Hospital at 842-1231 Local 5655. I can retire from the study at any time without incurring penalties.

I, _____ ,agree to participate in this study.

Montreal, the _____ 19____,

SUBJECT _____ _____
(Signature) (Print Name)

RESEARCHER _____ _____
(Signature) (Print Name)

5.2 - Willet Food-Frequency Questionnaire

ID:

1. Do you currently take multiple vitamins? (Please report individual vitamins under question 2.)

○ No ○ Yes → If yes. a) How many do you take per week? → ○ 2 or less ○ 5-9 ○ 3-5 ○ 10 or more

b) What specific brand do you usually use? → Specify exact brand and type

2. Not counting multiple vitamins, do you take any of the following preparations:

a) Vitamin A?

○ No ○ Yes, seasonal only ○ Yes, most months

If Yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 5,000 IU ○ 5,000 to 12,000 IU ○ 13,000 to 22,000 IU ○ 23,000 IU or more ○ Don't know

b) Vitamin C?

○ No ○ Yes, seasonal only ○ Yes, most months

If Yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 400 mg. ○ 400 to 700 mg. ○ 750 to 1250 mg. ○ 1300 mg. or more ○ Don't know

c) Vitamin B_6?

○ No ○ Yes → If yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs ○ Don't know

What dose per day? → ○ Less than 10 mg. ○ 10 to 39 mg. ○ 40 to 75 mg. ○ 80 mg. or more ○ Don't know

d) Vitamin E?

○ No ○ Yes → If yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 100 IU ○ 100 to 250 IU ○ 300 to 500 IU ○ 600 IU or more ○ Don't know

e) Selenium?

○ No ○ Yes → If yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 80 mcg. ○ 80 to 130 mcg. ○ 140 to 250 mcg. ○ 260 mcg. or more ○ Don't know

f) Iron?

○ No ○ Yes → If yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 51 mg. ○ 51 to 200 mg. ○ 201 to 400 mg. ○ 401 mg. or more ○ Don't know

g) Zinc?

○ No ○ Yes → If yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 25 mg. ○ 25 to 74 mg. ○ 75 to 100 mg. ○ 101 mg. or more ○ Don't know

h) Calcium? (Include Calcium in Dolomite.)

○ No ○ Yes → If yes. How many years? → ○ 0-1 yr. ○ 2-4 yrs. ○ 5-9 yrs. ○ 10+ yrs. ○ Don't know

What dose per day? → ○ Less than 400 mg. ○ 400 to 900 mg. ○ 901 to 1300 mg. ○ 1301 mg. or more ○ Don't know

i) Are there other supplements that you take on a regular basis? Please mark if yes:

○ Folic acid ○ Cod liver Oil ○ Iodine ○ Beta-Carotene ○ Other, please specify →
○ Vitamin D ○ Copper
○ B-Complex Vitamins ○ Omega-3 Fatty-acids ○ Brewer's Yeast ○ Magnesium

3. For each food listed, fill in the circle indicating how often on average you have used the amount specified during the past year.

DAIRY FOODS	AVERAGE USE LAST YEAR: Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Skim or low fat milk (8 oz. glass)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Whole milk (8 oz. glass)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Cream, e.g. coffee, whipped (Tbs)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Sour cream (Tbs)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Non-dairy coffee whitener (tsp.)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Sherbet or ice milk (½ cup)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Ice cream (½ cup)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Yogurt (1 cup)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Cottage or ricotta cheese (½ cup)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Cream cheese (1 oz.)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Other cheese, e.g. American, cheddar, etc., plain or as part of a dish (1 slice or 1 oz. serving)	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Margarine (pat), added to food or bread: exclude use in cooking	○	○	Ⓦ	○	○	Ⓓ	○	○	○
Butter (pat), added to food or bread: exclude use in cooking	○	○	Ⓦ	○	○	Ⓓ	○	○	○

Please turn to page 2

3. (Continued) Please fill in your average use, during the past year, of each specified food.

Please try to average your seasonal use of foods over the entire year. For example, if a food such as cantaloupe is eaten 4 times a week during the approximate 3 months that it is in season, then the average use would be once per week.

FRUITS	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Raisins (1 oz. or small pack) or grapes	○	○	ⓦ	○	○	Ⓓ	○	○	○
Prunes (1 cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Bananas (1)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Cantaloupe (¼ melon)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Watermelon (1 slice)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Fresh apples or pears (1)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Apple juice or cider (small glass)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Oranges (1)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Orange juice (small glass)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Grapefruit (½)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Grapefruit juice (small glass)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Other fruit juices (small glass)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Strawberries, fresh, frozen or canned (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Blueberries, fresh, frozen or canned (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Peaches, apricots or plums (1 fresh, or ½ cup canned)	○	○	ⓦ	○	○	Ⓓ	○	○	○

VEGETABLES	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Tomatoes (1)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Tomato juice (small glass)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Tomato sauce (½ cup) e.g. spaghetti sauce	○	○	ⓦ	○	○	Ⓓ	○	○	○
Red chili sauce (1 Tbs)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Tofu or soybeans (3-4 oz.)	○	○	ⓦ	○	○	Ⓓ	○	○	○
String beans (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Broccoli (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Cabbage or cole slaw (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Cauliflower (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Brussels sprouts (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Carrots, raw (½ carrot or 2-4 sticks)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Carrots, cooked (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Corn (1 ear or ½ cup frozen or canned)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Peas, or lima beans (½ cup fresh, frozen, canned)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Mixed vegetables (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Beans or lentils, baked or dried (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Yellow (winter) squash (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Eggplant, zucchini, or other summer squash (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Yams or sweet potatoes (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Spinach, cooked (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Spinach, raw as in salad	○	○	ⓦ	○	○	Ⓓ	○	○	○
Kale, mustard or chard greens (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Iceberg or head lettuce (serving)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Romaine or leaf lettuce (serving)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Celery (4" stick)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Beets (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Alfalfa sprouts (½ cup)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Garlic, fresh or powdered (1 clove or shake)	○	○	ⓦ	○	○	Ⓓ	○	○	○

EGGS, MEAT, ETC.	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Eggs (1)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Chicken or turkey, with skin (4-6 oz.)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Chicken or turkey, without skin (4-6 oz.)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Bacon (2 slices)	○	○	ⓦ	○	○	Ⓓ	○	○	○
Hot dogs (1)	○	○	ⓦ	○	○	Ⓓ	○	○	○

Please go to page 3

...in your **average** use, **during the past year**, of each specified food.

MEATS (CONTINUED)	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Processed meats, e.g. sausage, salami, bologna, etc. (piece or slice)	○	○	ⓦ	○	○	ⓓ	○	○	○
Liver (3-4 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Hamburger (1 patty)	○	○	ⓦ	○	○	ⓓ	○	○	○
Beef, pork, or lamb as a sandwich or mixed dish, e.g. stew, casserole, lasagne, etc.	○	○	ⓦ	○	○	ⓓ	○	○	○
Beef, pork, or lamb as a main dish, e.g. steak, roast, ham, etc. (4-6 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Canned tuna fish (3-4 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Dark meat fish, e.g. mackerel, salmon, sardines, bluefish, swordfish (3-5 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Other fish (3-5 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Shrimp, lobster, scallops as a main dish	○	○	ⓦ	○	○	ⓓ	○	○	○

BREADS, CEREALS, STARCHES	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Cold breakfast cereal (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Cooked oatmeal (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Other cooked breakfast cereal (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
White bread (slice), including pita bread	○	○	ⓦ	○	○	ⓓ	○	○	○
Dark bread (slice)	○	○	ⓦ	○	○	ⓓ	○	○	○
English muffins, bagels, or rolls (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Muffins or biscuits (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Brown rice (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
White rice (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Pasta, e.g. spaghetti, noodles, etc. (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Other grains, e.g. bulgar, kasha, couscous, etc. (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Pancakes or waffles (serving)	○	○	ⓦ	○	○	ⓓ	○	○	○
French fried potatoes (4 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Potatoes, baked, boiled or mashed (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Potato chips or corn chips (small bag or 1 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Crackers, Pretzels, Wheat Thins (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Pizza (2 slices)	○	○	ⓦ	○	○	ⓓ	○	○	○

	BEVERAGES	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
CARBONATED BEVERAGES Consider the serving size as 1 glass, bottle or can for these carbonated beverages.	Low Calorie (sugar-free) types: Low calorie cola, e.g. Tab with caffeine	○	○	ⓦ	○	○	ⓓ	○	○	○
	Low calorie caffeine-free cola, e.g. Pepsi Free	○	○	ⓦ	○	○	ⓓ	○	○	○
	Other low calorie carbonated beverage, e.g. Fresca, Diet 7-Up, diet ginger ale	○	○	ⓦ	○	○	ⓓ	○	○	○
	Regular types (not sugar-free): Coke, Pepsi, or other cola with sugar	○	○	ⓦ	○	○	ⓓ	○	○	○
	Caffeine Free Coke, Pepsi, or other cola with sugar	○	○	ⓦ	○	○	ⓓ	○	○	○
	Other carbonated beverage with sugar, e.g. 7-Up, ginger ale	○	○	ⓦ	○	○	ⓓ	○	○	○
OTHER BEVERAGES	Hawaiian Punch, lemonade, or other non-carbonated fruit drinks (1 glass, bottle, can)	○	○	ⓦ	○	○	ⓓ	○	○	○
	Decaffeinated coffee (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
	Coffee (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
	Tea (1 cup), not herbal teas	○	○	ⓦ	○	○	ⓓ	○	○	○
	Beer (1 glass, bottle, can)	○	○	ⓦ	○	○	ⓓ	○	○	○
	Red wine (4 oz. glass)	○	○	ⓦ	○	○	ⓓ	○	○	○
	White wine (4 oz. glass)	○	○	ⓦ	○	○	ⓓ	○	○	○
	Liquor, e.g. whiskey, gin, etc. (1 drink or shot)	○	○	ⓦ	○	○	ⓓ	○	○	○

Please turn to page 4

ID:

3. (Continued) Please fill in your average use during the past year of each specified food.

SWEETS, BAKED GOODS, MISCELLANEOUS	Never, or less than once per month	1-3 per mo.	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Chocolate (bars or pieces) e.g. Hershey's, M&M's	○	○	ⓦ	○	○	ⓓ	○	○	○
Candy bars [illegible]	○	○	ⓦ	○	○	ⓓ	○	○	○
Candy without chocolate (1 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Cookies, home baked (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Cookies, ready made (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Brownies (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Doughnuts (1)	○	○	ⓦ	○	○	ⓓ	○	○	○
Cake, home baked (slice)	○	○	ⓦ	○	○	ⓓ	○	○	○
Cake, ready made (slice)	○	○	ⓦ	○	○	ⓓ	○	○	○
Sweet roll, coffee cake or other pastry, home baked (serving)	○	○	ⓦ	○	○	ⓓ	○	○	○
Sweet roll, coffee cake or other pastry, ready made (serving)	○	○	ⓦ	○	○	ⓓ	○	○	○
Pie, homemade (slice)	○	○	ⓦ	○	○	ⓓ	○	○	○
Pie, ready made (slice)	○	○	ⓦ	○	○	ⓓ	○	○	○
Jams, jellies, preserves, syrup, or honey (1 Tbs)	○	○	ⓦ	○	○	ⓓ	○	○	○
Peanut butter (Tbs)	○	○	ⓦ	○	○	ⓓ	○	○	○
Popcorn (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Nuts (small packet or 1 oz.)	○	○	ⓦ	○	○	ⓓ	○	○	○
Bran, added to food (1 Tbs)	○	○	ⓦ	○	○	ⓓ	○	○	○
Wheat germ (1 Tbs)	○	○	ⓦ	○	○	ⓓ	○	○	○
Chowder or cream soup (1 cup)	○	○	ⓦ	○	○	ⓓ	○	○	○
Oil and vinegar dressing, e.g. Italian (1 Tbs)	○	○	ⓦ	○	○	ⓓ	○	○	○
Mayonnaise or other creamy salad dressing (1 Tbs)	○	○	ⓦ	○	○	ⓓ	○	○	○
Mustard, dry or prepared (1 tsp)	○	○	ⓦ	○	○	ⓓ	○	○	○
Pepper (1 shake)	○	○	ⓦ	○	○	ⓓ	○	○	○
Salt (1 shake)	○	○	ⓦ	○	○	ⓓ	○	○	○

4. How much of the visible fat on your meats do you remove before eating?
○ Remove all visible fat ○ Remove small part of fat
○ Remove majority ○ Remove none
○ Don't eat meat

5. What kind of fat do you usually use for frying and sautéing? (Exclude "Pam"-type spray)
○ Real butter ○ Vegetable oil ○ Lard
○ Margarine ○ Vegetable shortening

6. What kind of fat do you usually use for baking?
○ Real butter ○ Vegetable oil ○ Lard
○ Margarine ○ Vegetable shortening

7. What form of margarine do you usually use?
○ None ○ Stick ○ Tub ○ Spread
○ Low-calorie stick ○ Low-calorie tub

8. How often do you eat food that is fried at home? (Exclude the use of "Pam"-type spray)
○ Daily ○ 4-6 times per week
○ 1-3 times per week ○ Less than once a week

9. How often do you eat fried food away from home? (e.g. french fries, fried chicken, fried fish)
○ Daily ○ 4-6 times per week
○ 1-3 times per week ○ Less than once a week

10. How many teaspoons of sugar do you add to your beverages or food each day? ⟶ tsp.

11. What type of cooking oil do you usually use? ⟶ Specify type and brand

12. What kind of cold breakfast cereal do you usually use? ⟶ Specify type and brand

13. Are there any other important foods that you usually eat at least once per week?

Include for example: paté, tortillas, yeast, cream sauce, custard, horseradish, parsnips, rhubarb, radishes, fava beans, carrot juice, coconut, avocado, mango, papaya, dried apricots, dates, figs.

(Do not include dry spices and do not list something that has been listed in the previous sections.)

Other foods that you usually use at least once per week	Usual serving size	Servings per week
(a)		
(b)		
(c)		
(d)		

5.3 - Food Habit Questionnaire

#SUJET: _____ ____ 5

Code : _____ **Date RV:** ____/____/____ ____ ____
aa mm jj

#RV: _____ 11

Nom du superviseur du questionnaire : _____ 13

Nom du codeur : _____ 14 15

QUESTIONNAIRE D'ALIMENTATION

Ce questionnaire vise à évaluer votre choix d'aliments en fonction de votre capacité à mastiquer au cours des deux dernières semaines.

1. Avez-vous gagné du poids récemment ?
   ☐ -0 Oui ☐ -1 Non ___ 16

2. Avez-vous perdu du poids récemment ?
   ☐ -0 Oui ☐ -1 Non ___ 17

3. Avez-vous eu une perte d'appétit au cours des derniers mois ?
   ☐ -0 Oui ☐ -1 Non ___ 18

4. Est-ce que vous suivez une diète ?
   ☐ -0 Oui ☐ -1 Non ___ 19

Si oui, quel type ?

☐ 1 Hypocalorique ☐ 3 Arthrite rhumatoïde
☐ 2 Hyposodique ☐ 4 Autre _____ ___ 20

5. Concernant la préparation de vos repas :

   ☐ 1 Vous préparez vos repas
   ☐ 2 Quelqu'un d'autre prépare vos repas

___ 21

No SUJET _____

6. Prenez-vous des suppléments vitaminiques et/ou minéraux ?

❑ -0 Oui ❑ -1 Non

22

Si oui, lesquels et à quelle fréquence ?

NOM	FRÉQUENCE

23

7. Est-ce que vous êtes allergique à certains aliments ?

❑ -0 Oui ❑ -1 Non

Si oui, lesquels ?

_____

_____

8. À quelle fréquence avez-vous eu ces symptômes au cours des **2 dernières semaines** ?

24

	Tous les jours	4 à 6 jours/ Semaine	1 à 3 jours /Semaine	Moins d'une fois / Semaine	Jamais
Brûlures d'estomac, reflux	❑	❑	❑	❑	❑
Regurgitations	❑	❑	❑	❑	❑
Difficulté à avaler (dysphagie)	❑	❑	❑	❑	❑
Sensation de digestion lente	❑	❑	❑	❑	❑
Ballonnements	❑	❑	❑	❑	❑
Nausées/Vomissements	❑	❑	❑	❑	❑
Crampes	❑	❑	❑	❑	❑

25

26

27

28

29

30

No SUJET _____

9. Au cours des **2 dernières semaines**, à quelle fréquence avez-vous pris :

	Tous les jours	4 à 6 jours /Semaine	1 à 3 jours /Semaine	Moins d'une Fois/ Semaine	Jamais	
Anti-acides (Maalox, Diovol, etc.)	❑	❑	❑	❑	❑	31
Anti-diarrhéiques (Imodium, lomotil, etc.)	❑	❑	❑	❑	❑	32
Laxatifs (Ex-lax, etc.)	❑	❑	❑	❑	❑	33
Fibres artificielles (Métamucil, etc.)	❑	❑	❑	❑	❑	34
Anti-spasmodiques (Bentylol, etc.)	❑	❑	❑	❑	❑	35

Pour les questions suivantes, cochez la réponse qui est la plus appropriée :

ALIMENTATION-MASTICATION

	Trop	Beaucoup	Assez	Un peu	Aucune Difficulté	
						36
10. Avez-vous de la difficulté à mastiquer du bœuf coupé en morceaux de la grosseur d'un dé à coudre ?	❑	❑	❑	❑	❑	
❑ (Cochez ici si vous ne mangez pas de bœuf)						
11. Avez-vous de la difficulté à mastiquer du poulet coupé en morceaux de la grosseur d'un dé à coudre ?	❑	❑	❑	❑	❑	37
❑ (Cochez ici si vous ne mangez pas de poulet)						
12. Avez-vous de la difficulté à mastiquer dans la viande hachée ?	❑	❑	❑	❑	❑	38
❑ (Cochez ici si vous ne mangez pas de viande)						
13. Avez-vous de la difficulté à croquer dans des légumes durs, crus, entiers (ex :carottes) ?	❑	❑	❑	❑	❑	39

No SUJET _____

	Trop	Beaucoup	Assez	Un Peu	Aucune difficulté	
14. Avez-vous de la difficulté à croquer dans des fruits durs, crus, entiers (ex :pommes) ?	❑	❑	❑	❑	❑	40
15. Avez-vous de la difficulté à croquer dans des fruits durs, crus, en quartiers (ex :pommes) ?	❑	❑	❑	❑	❑	41

42

16. Avez-vous de la difficulté à manger la pelure des fruits durs, crus ?	❑	❑	❑	❑	❑
17. Avez-vous de la difficulté à mastiquer du pain croûté ?	❑	❑	❑	❑	❑
18. Avez-vous de la difficulté à mastiquer des noix et des graines ?	❑	❑	❑	❑	❑

HABITUDES

Au cours des **2 dernières semaines** :	Jamais	Rarement	À l'occasion	Souvent	Toujours
19. Avez-vous enlevé l'une ou l'autre de vos prothèses pour manger ?	❑	❑	❑	❑	❑
20. Avez-vous dû boire en mangeant pour mieux avaler ?	❑	❑	❑	❑	❑
21. Avez-vous ajouté de la sauce à vos aliments pour mieux avaler ?	❑	❑	❑	❑	❑
22. Avez-vous trempé les aliments dans un liquide pour mieux mastiquer et/ou avaler ?	❑	❑	❑	❑	❑
23. Votre choix de nourriture a-t-il été limité à cause de vos prothèses ?	❑	❑	❑	❑	❑
24. Avez-vous de la difficulté à mastiquer avec vos prothèses ?	❑	❑	❑	❑	❑
25. En général, les aliments que vous avalez sont-ils bien mâchés ?	❑	❑	❑	❑	❑

No SUJET _____

VIANDES

Au cours des **2 dernières semaines** :

Note : Si vous n'avez pas mangé cet aliment depuis 2 semaines cochez la Case prévue à cet effet N/A, signifiant non applicable.

	Jamais	Rarement	À l'occasion	Souvent	Toujours	N/A	
26. Avez-vous mangé du bœuf en morceaux de la grosseur d'un dé à coudre ?	❑	❑	❑	❑	❑	❑	52
27. A-t-il été nécessaire de hacher le bœuf avant de le manger ?	❑	❑	❑	❑	❑	❑	53
28. Avez-vous mangé du poulet en morceaux de la grosseur d'un dé à coudre ?	❑	❑	❑	❑	❑	❑	54
29. A-t-il été nécessaire de hacher le poulet avant de le manger ?	❑	❑	❑	❑	❑	❑	55

56

30. A-t-il été nécessaire de mettre la viande en purée avant de la manger ? ❑ ❑ ❑ ❑ ❑ ❑

FRUITS

Au cours des 2 dernières semaines :

Note : Si vous n'avez pas mangé cet aliment depuis 2 semaines cochez la Case prévue à cet effet N/A, signifiant non applicable.

	Jamais	Rarement	À l'occasion	Souvent	Toujours	N/A
31. Avez-vous croqué dans des pommes crues, entières ?	❑	❑	❑	❑	❑	❑
32. A-t-il été nécessaire d'enlever la pelure des pommes avant de les manger ?	❑	❑	❑	❑	❑	❑
33. A-t-il été nécessaire de couper les pommes en quartiers pour les mastiquer ?	❑	❑	❑	❑	❑	❑

No SUJET _____

	Jamais	Rarement	À l'occasion	Souvent	Toujours	N/A	
34. A-t-il été nécessaire de couper les pommes en morceaux de la grosseur d'un dé à coudre pour les mastiquer ?	❑	❑	❑	❑	❑	❑	60
35. A-t-il été nécessaire de mettre des fruits durs crus en purée pour les manger ?	❑	❑	❑	❑	❑	❑	61

LÉGUMES

Au cours des 2 dernières semaines :

Note : Si vous n'avez pas mangé cet aliment depuis 2 semaines cochez la Case prévue à cet effet N/A, signifiant non applicable.

	Jamais	Rarement	À l'occasion	Souvent	Toujours	N/A	
36. Avez-vous croqué dans des carottes crues entières ?	❑	❑	❑	❑	❑	❑	62
37. A-t-il été nécessaire de couper les carottes crues en morceaux de la grosseur d'un dé à coudre pour les mastiquer ?	❑	❑	❑	❑	❑	❑	63

64

38. A-t-il été nécessaire de mettre en purée les légumes durs pour les manger ? ❑ ❑ ❑ ❑ ❑ ❑

MERCI DE VOTRE COLLABORATION!

5.4 - Medians of items 8 to 38 of the Food-Habit Questionnaire.
G1 = Implants; G2 = Conventional

Items		*8.1*	*8.2*	*8.3*	*8.4*	*8.5*	*8.6*	*8.7*	*9.1*	*9.2*	*9.3*	*9.4*	*9.5*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
Medians	G2	5	5	5	5	4.5	5	5	5	5	5	5	5	4	5	5	4	4	5	4	5
	G1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	4	5

Items		*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*
Medians	G2	4	1	1	1	1	2	2	4	3	1	3	1	1	3.5	2	3	1	1	3	3	1
	G1	5	1	1	1	1	1	2	4	3	1	3	1	1	4	2	2.5	1	1	3	2.5	1