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An Investigation of the Relationship of Dental Implants to Diet and General Health

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AN INVESTIGATION OF THE RELATIONSHIP OF DENTAL IMPLANTS

TO DIET AND GENERAL HEALTH

by

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VITA

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TABLE OF CONTENTS

Page

LIST OF TABLES AND FIGURES

CHAPTER I

INTRODUCTION

The design and implantation of replacement teeth represents a major portion of modern dentistry. While efforts at prevention, both primary and secondary, have grown in importance, most of the major surgical interventions of dentistry involve the implantation of false teeth for both the purpose of restored eating and appearance.

If a person wishes to maintain his/her chewing abilities, the primary alternative to implants are dentures. Rather than inserting 'artificial roots' to hold replacement teeth in place, dentures are placed in intimate contact with the gum tissue. Suction is obtained, when possible, for holding. If a firmer hold is desired, special adhesives and powders may be used.

This thesis is designed to explore the association between the implantation of replacement teeth and diet. How we choose to fuel our bodies has significance for our health and well-being. A balanced diet with caloric intake consistent with activity is optimal for maintaining health. Excepting liquids, all food intake is first bitten and/or chewed by the teeth. If there are no teeth, or if the function of the teeth is dramatically impaired, it is probable that patterns of food intake will change (Pellet, 1987).

As we age, the likelihood of dental problems increases. Dental caries (i.e. decay), seldom a childhood health problem in the era of fluoridated water, often begin to develop in adolescence and early adulthood. In the absence of injury or disease, tooth loss generally does not begin to occur until middle age and after. However, by age 65, half of all Americans are expected to lose teeth (Yearick, 1978). When a tooth is lost, a person has several choices. One could decide to do nothing and work to "chew around" the missing tooth. Alternatively, one could replace the tooth. When many teeth are lost, the choices of replacements include dentures, bridges, and implants. These additional options are thought to have had a significant impact on the quality of life of persons whose original teeth were lost (Schwerin et al. 1982).

CHAPTER II

REVIEW OF THE LITERATURE

<u>The History of Dental Implants</u>

Since recorded history, humans have attempted to restore lost teeth. The fact that teeth decay very slowly after death, has allowed for a rather detailed history of the art of implantation. In ancient Egypt, the cradle of modern civilization, mummy skulls were found with two gold wired teeth to hold another tooth loosened by gum deterioration. The Israelites, in 300 B.C. used gold and silver to create false teeth to replace ones that had been lost. The Etruscans, artful goldsmiths, developed a technique of preparing dental applications by wiring artificial tooth replacements to existing healthy teeth (Steflik & McKinney, 1991).

The Romans practiced the methods developed by the Etruscans. In ancient Rome it was quite normal to replace missing teeth. In fact, the Romans were perhaps the first to produce partial dentures. Although these rudimentary offerings were not always aesthetically appealing, they served to facilitate chewing and maintaining the basic structure of the jaw. The Roman poet Martialus wrote of two women, one with white teeth one with black saying that "One buys what the other has herself". Thus, the woman with the white teeth created a demand for

more natural looking replacements (Steflik & McKinney, 1991).

Other early civilizations also produced evidence of early efforts at implantation. In Honduras, a pre-Columbian dental implant of carved stone was found in a skull from about 600 A.D where implants of carved shells placed into the socket of the missing teeth have been observed. X-ray study of these shell teeth suggests that these implants were successful, since there was compact bone formation found around two of the implants. Other materials were also used for dental work. An Arabian surgeon used ox bone around 1000 A.D. Japanese surgeons in the 15th and 16th centuries inserted pins into the root canal and placed wooden crowns over decayed teeth (Steflik & McKinney, 1991).

The first modern mention of implantation was quite negative (Bourdet, 1780). Bourdet wrote of "irresponsible persons" who "claim to make a socket and implant into it a tooth". Thirty years later, Maggiolo (1809) reported the successful insertion of gold posts to hold pivot teeth. Implantation rapidly became fashionable. However, since it was performed without sterile precautions, complications to these non-sterile conditions were the rule. This form of implantation was discontinued quite soon after its introduction.

Not until 1860, with Lister's discovery of anti-sepsis (sterile) methods did interest in surgical operations return. In fact, the history of implantation begins to accelerate quickly with reduced risks of infection. In 1887, in what begins to sound much like modern practice, Harris inserted a platinum pin which held a porcelain crown. One year later, Berry (1888) reported tapping lead roots into decayed tooth sockets. In 1890, Lewis inserted platinum and gold tooth implants.

4

Znamenski (1891) used porcelain in much the same way.

By the beginning of the 20th century, the scientific method was taking firm hold within the medical field. In perhaps one of the first prospective studies in dental surgery, Greenfield (1913) reported a successful 6-month follow-up of an irradio-platinum implant.

This century is marked by numerous innovations in terms of the choice of materials and the design of both artificial teeth and the means by which to secure them into the patient's mouth. Bricke (1920) used ivory. Strock (1937) used vitallium screws into the alveolus to hold a crown with a successful 15 year follow-up. Dahl (1940) was the first to accomplish a maxillary subperiosteal (i.e., under the tissue but over the bone) implant in Sweden while Gershkoff and Goldberg in 1948 completed the first mandibular subperiosteal implant in the United States. Around this time, Formiggini (1947), who is sometimes referred to as the 'Father of Modern Dental Implantology' developed the single helix wire spiral implant made of stainless steel.

Until the 1960's, dentists were both designing and fabricating the prosthetic devices. In 1966, Linkow made the first commercially available blade implant with a variety of designs and types. James redesigned the subperiosteal implant in 1969 to avoid vertical loading. In 1970, Roberts introduced the Ramus Frame implant.

The 1970's saw rapid development of implantation. Cranin introduced the anchor or shoulderless implant. Ashman attempted the acrylic resin tooth implant in 1971. In 1974, Edelman and Viscido made a submerged predictive implant to

5

allow healing in a passive state. Kawahara (1977) used polycrystal alumina implants. In 1981, Branemark introduced a two-piece, threaded, pure titanium root-form implant system to the United States followed by Niznick's (1982) concept of a titanium-alloy, vented, root-form implant. Approximately twenty other varieties of root form implants were subsequently manufactured with different configurations, designs, and surface textures (e.g., hydroxylapatite coating, plasma spray coating). Today, a wide range of implant choices exist.

Implants versus Dentures

The sequence of eating is biting, chewing, and swallowing. Teeth play a central role in the first two functions. If replacement teeth are not secure, preferences develop for food intake that requires less biting and chewing. Swallowing requires the creation of a food mass sufficiently small to allow passage through the esophagus.

Conventional dentures have been tolerated by many for decades (Smith, 1979). Some patients with dentures function well in chewing all types of foods, and their is little impact of their denture wear on the quality of their life. However, for others, problems of denture fit and changing gum and jaw structure over time can result in chewing and biting problems (Akagawa et al. 1988). These problems can lead to a selection of relatively soft foods.

There are several reasons why denture wearers might prefer food that can be swallowed without the use of their teeth. First, biting or incising food involves the actual tearing a portion away by the incisor teeth. This motion requires both a wide opening of the mouth, which can dislodge dentures, and a lateral movement of the jaw which can apply significant torque to the denture adhesives. Biting is thus the most disruptive stage of eating for replacement teeth. Existing evidence suggests that few denture wearers have a sufficiently good fit. Most experience little or no pain (Smith, 1979).

Implants, on the other hand, will anchor and support a bridge or denture

to be held in place. Patients who had dentures may return to previously preferred food that require biting and chewing. Thus, the potential dietary impact of implants relative to dentures could be significant. Denture wearers often try to avoid fruits, breads, cheese, and legumes (Blomberg & Lindquist, 1983). Particularly in older adults, the absence of these foods from one's diet can result in constipation and other medical conditions secondary to diet. There is also evidence to suggest that the caloric intake of older people who wear dentures is less than those who have natural teeth (Bowman & Rosenberg, 1982).

The primary reasons that biting and chewing are often avoided by denture wearers is that slippage of dentures can cause pain and laceration to the oral mucosa; adhesive can leave an unpleasant after taste; and, small particles of food can become lodged under the denture causing additional pain during chewing (Smith, 1979). Whole grains can be particularly problematic and painful for denture wearers.

It is mainly the elderly who need dentures and implants. Older adults' appetites in most cases are diminished which lessens food intake (Yearick, 1978), even more so when the food is unappetizing or unusual looking. When biting or chewing is not possible, blending becomes one means of preparing food for swallowing. While blended food often looks unappealing, it maintains its nutritional value. Unfortunately, blended food is often ingested too rapidly which can cause gastric distress and flatulence, further reducing peoples' preference for this medium of food intake.

Even without tooth loss, the elderly appear particularly at risk for nutritional

deficits (Bowman & Rosenberg, 1982; McGandy et al. 1966; Gordon, 1989). Older adults are often constipated because the tone of their intestinal smooth muscles is diminished (Bowman & Rosenberg, 1982). Therefore, foods of high fiber content such as raw fruits and raw vegetables are an important dietary component.

It has been recently recognized that there are some psychological advantages to implants over dentures. Loss of body organs long has been known to be traumatic (Drellich, 1956; Gyllenskold, 1973). In the past decade, total edentulism has been reported to elicit strong psychological reactions (Blomberg & Lindquist, 1983). One potential advantage of implants over dentures is that implants feel as if they are part of the patient's body rather than a prosthesis. Patients generally report feeling like implants are part of their body rather than a removable prosthesis. This experience is not common with dentures which generally must be removed daily for maintenance and sleeping. The implant patient never looks in the mirror and witnesses the absence of their teeth.

Also, loneliness, particularly in old age, can be a source of ill health. Eating alone often removes the incentive to have a varied, well-balanced diet. People who have difficulty chewing often avoid taking their meals in the company of others due to their embarrassment. This isolation can exacerbate loneliness and depression further reducing food intake (Jacobson, 1971).

Both the experience of wearing dentures that slip and the psychology of having a prosthesis suggests that denture wearers might be susceptible to a loss of confidence in denture function. Any lack of such confidence by a patient can

increase problems related to poor eating habits or create new problems when nutritious food, previously enjoyed, is now avoided. Improper diet can increase resorption rate of supporting bone structure, further decreasing denture function. The soft foods often preferred by denture wearers, frequently do not include foods high in protein or roughage. These dietary insufficiencies have been shown to be related to increased incidence of gastro-intestinal problems as well as hard tissue degradation (Papas & Rounds, 1988).

There is a body of research on satisfaction with implants. Albrektsson et al. (1987) state that in a study of 189 patients, they all adapted well to the prosthesis, regarded the bridge as a part of their own body, and reported a reduction in psychosocial problems. Grogono et al. (1989) surveyed 61 implant patients and found that compared to their prior experience with dentures, the patients were significantly more satisfied with their implants. Hoogstraten & Lamers (1987) found similar results using a sample of 31 patients, even two years after implantation. More recently, Kiyak et al. (1989) studied 27 patients longitudinally and found that satisfaction was high even immediately post-surgery. In the largest study conducted to date, Tavares, Branch & Shulman (1990) studied 635 implant patients. Using a two-stage sampling strategy to target dental surgeons most likely to engage in implantation, the survey attempted to identify all patients receiving endosseous implants from participating dentists since 1980. In the first stage, 32.2% of eligible dentists agreed to participate. In the second stage, 68.9% of surveyed patients responded. Results from this study suggest that patients are quite satisfied with cylindrical implants and non-removable

10

prostheses.   It also appears that expectations prior surgery were the most powerful predictors of satisfaction.   It was observed that both ease of chewing and appearance influenced overall satisfaction.

Diet and Health

There is good reason to believe that diet is an important factor in maintaining good health. High salt and high fat diets have been linked to heart disease and some forms of cancer. Consumption of high fiber food is thought to facilitate the proper functioning of the gastro-intestinal tract.

Diet appears to influence dental health. Consumption of foods with high sugar content is linked to more rapid tooth decay. Papas et al. (1988) have reported that sucrose intake is much higher among patients with a greater number of root caries (i.e., decay). These data suggest that sucrose intake plays an important role in the development of tooth decay.

Since it is possible to convert any foodstuff into a liquid form, there is no theoretical reason to suspect that dental health will affect diet. However, if a person is in pain or discomfort, depressed, or anxious, diet generally suffers (Fordyce & Brockway, 1979). Thus, problems of dental health that lead to pain, particularly pain associated with chewing is likely to have a significant effect on food intake. For example, Stanek & Sempek (1990) have shown that knowledge about diet is not a particularly strong determinant of eating a healthy diet among the elderly. Diet knowledge was not related to the use of dietary supplements. Participation in government-sponsored nutrition centers was negatively associated with nutritional knowledge. These findings are consistent with the results reported by Thomas, Kendrick & Eddy (1990) that dietary knowledge had a weak (when

present) association with dietary adequacy in older adults. Thus, among the elderly, success in improving the quality of dietary intake is complex and likely involves more than education. That said, the reseach project described below was designed to investigate the role of dental fixtures in promoting good diets.

CHAPTER III

METHODS

This study represents an effort to study the effects of implantation on chewing and diet. Two studies were undertaken. The first study (Study A) consisted of a survey directed at evaluating patients' experiences with implantation. Study A was designed to identify whether patients perceived their implants as improving their chewing, their social confidence, and their dietary behavior.

The second study (Study B) compared dietary intake among persons who had received a dental implant and those wearing dentures. Comparing patients receiving an implant to those with dentures on dietary intake variables, permits examining the impact of implants on diet. In order to further develop this question, two implant groups were used. The three groups were as follows:

Group A: patients with an upper denture opposing four lower root-form (threaded and/or cylindrical) implants, bar and removable overdenture.

Group B: patients with an upper denture opposing a lower subperiosteal implant and removable over-denture.

Group C: patients who were edentulous (without teeth) and had full upper and lower dentures.

Specifically, the following hypotheses were tested in Study B:

1. There will be no differences between the implant and denture patients with respect to basic demographic variables (e.g., gender, age, occupation, and/or major physical illness). That is, Groups A, B, and C will be equivalent with respect to these variables.

2. Implant patients will eat meat significantly more often than denture wearers (i.e., Groups A and B will consume meat more often than Group C).

3. Denture wearers will drink liquids significantly more often than implant patients (i.e., Group C will consume more liquids than either Groups A or B).

4. Implant patients will have greater dietary adequacy than denture wearers (i.e., Groups A and B will have better dietary adequacy than Group C).

5. There will be no differences in diet between types of implants (i.e., Groups A and B will be equivalent with respect to their dietary assessments).

Materials

Study A

The first study consisted of a telephone survey of 229 patients who had recently received a dental implant from a dentist in private practice. This survey consisted of eight questions designed to assess the following domains:

primary reason for implants

perceived effects of implants on chewing

perceived effects of implants on social confidence

perceived effects of implants on eating healthier foods

perceived effects of implants on amount of food intake

weight prior to implant procedure

weight change following implant

perceived greatest negative aspect of implants

A copy of the survey can be found in Appendix A. The surveys were completed by contacting former patients by telephone. Each question was read to the respondents. Possible response categories were also read to the respondents. Most patients (220 of 229, 96%) contacted were willing to respond to this brief telephone survey.

Study B

The second study involved a more in-depth analysis of dietary behavior using a cross-section of patients with implants or dentures. In this part of the study, no effort was made to study the change over time associated with implants. Rather, a comparison of the dietary experiences of people with implants or dentures was made at only one time point.

It should be noted that the survey instrument used for this study was intended to be a pilot assessment of diet history for a larger ongoing research project. This instrument, the Health and Nutrition Questionnaire (Appendix B), was devised by Mary Ellen Druyan, as a research tool for use in a large epidemiological study in the field of dental public health.

CHAPTER IV

RESULTS

Study A

Evaluation of Implants.

Figure 1 presents the results of the evaluation in graphic form. As noted above, patients receiving implants were asked a series of eight questions regarding their decision to undergo the implant procedure and the effects of the surgery on their lives. Most patients (78%) stated that their decision to seek implants was based on a desire to obtain better chewing ability. Twenty-two percent stated that psychosocial reasons (e.g. aesthetics, confidence) were related to their decision to seek implants.

Almost all patients (93%) reported that they chew better compared to when they wore dentures. Four-fifths (80%) of the respondents reported greater social confidence. A nearly equal number (78%) reported that they felt their diets had improved. About two-thirds (68%) reported that they ate more after implants, 20% reported eating the same amount, and 12% reported eating less following implants

The respondents were uniformly distributed with respect to their perceived weight prior to implants (40% reporting themselves to be overweight, 38% underweight, and 22% normal weight). About two-thirds (68%) reported a weight

gain following implantation, 18% reported a weight loss, and 14% reported no change in weight.

More than one-quarter of the respondents (29%) experienced no negative aspects related to the implantation. More than half (57%) reported that the expense was the primary negative aspect of the procedure; 12% said that the pain involved was the worst aspect; and 2% said that the time involved in the procedure was the most negative aspect related to the implantation procedure.
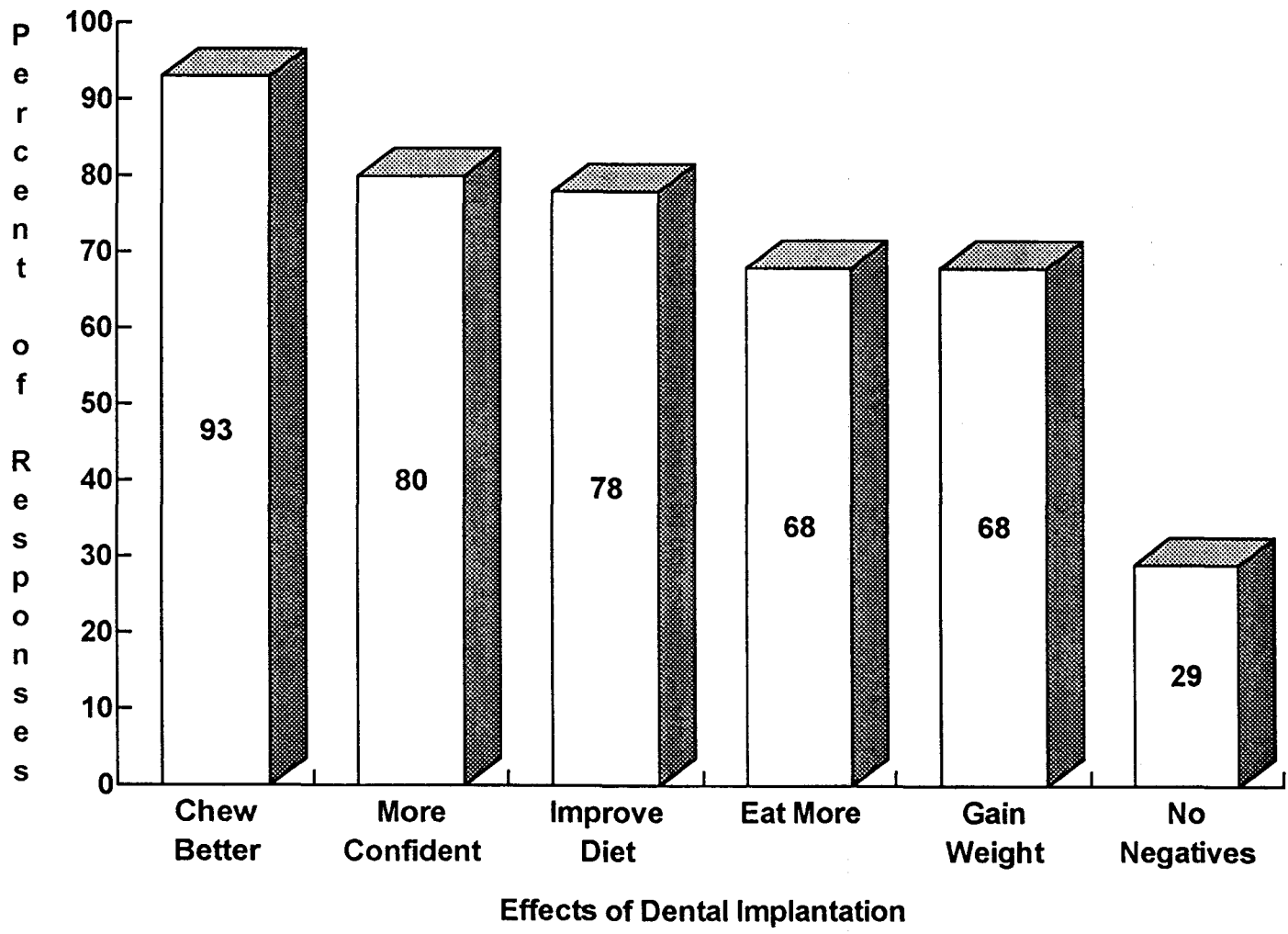
Figure 1. Evaluation of Dental Implants.

Study B

Comparison of Two Implant Groups to Denture-Wearers.

The three groups were equivalent in terms of average age (61.5 years). Group C had significantly more males (30 of 64, 47%) than either Group A (29 of 78, 37%) or Group B (15 of 66, 23%) ($X^2 = 8.41$, df=2, p<.01).

A comparison of the three groups with respect to their major medical conditions is presented in Table 1. There were no significant differences found among the three groups as revealed through the use of chi squares. Comparisons of the two implant groups to the denture group also failed to reveal any differences. There was, however, an interesting trend revealed by the statistical analysis that gave some support for the notion that the denture group had less frequent urine or bladder infections than the implant groups (X^2=3.18, df=1, p<.08).

Table 1. A Comparison of the Medical Problems of Two Implant and One Denture Group (Proportions of Respondents)

	Group A	Group B	Group C	Chi Square (df=4)
Heart Disease	.11	.20	.20	7.34
Heart Attack	.04	.10	.09	3.51
Hypertension	.29	.40	.43	3.47
Stroke	.05	.02	.05	3.84
Tuberculosis	.01	.02	.04	0.81
Emphysema	.08	.05	.13	3.61
Asthma	.07	.08	.07	0.14
Hay Fever	.05	.12	.02	6.25
Diverticulosis	.05	.07	.07	3.03
Rectal Polyps	.04	.07	.04	2.18
Colitis	.04	.02	.04	2.80
Diabetes	.08	.03	.12	5.34
Thyroid Disease	.08	.19	.13	5.25
Kidney Disease	.00	.02	.00	4.45
Bladder Infection	.19	.18	.07	2.45
Cirrhosis of Liver	.00	.03	.02	4.71

Table 1. Continued

	Group A	Group B	Group C	Chi Square (df=4)
Hepatitis	.04	.02	.00	4.68
Stomach Ulcers	.17	.16	.09	4.12
Arthritis	.08	.15	.16	2.26
Osteoporosis	.01	.03	.04	2.20
Fractured Hip	.11	.14	.09	3.00
Prostate Trouble	.05	.03	.07	0.74
Skin Cancer	.04	.07	.02	1.77
Cancer	.09	.07	.04	1.62
Tremors	.03	.00	.03	4.14

The denture group reported less frequent grinding of teeth (X^2=2.84, df=1, p<.01). Grinding, however, appeared to be a greater problem among men (X^2=3.12, df=1, p<.05). When only women were studied, there was no difference found in grinding across dental fixture groups (X^2=1.77, df=1, N.S.).

There was no difference found in the proportion of respondents taking pain relievers across the three groups. In Group A, 28 of 78 (36%), reported taking pain medication compared to 30 of 65 (46%) in Group B and 26 of 64 (41%) in Group C. There were also no differences found in the frequency of the use of diuretics across the three groups. The percentage of respondents reporting diuretic use was 8% in Group A, 21% in Group B, and 17% in Group C.

There were few differences in drinking habits reported across the three groups. The only significant differences found were for chewing gum with sugar (X^2=7.42, df=5, p<.03) and for drinking coffee/tea at breakfast (X^2=10.5, df=5, p<.01). There were no differences found across groups in terms of other drinking habits at any meal or snack time or in aggregates across the entire day. There were no differences found in the amount of gum chewed per month. In terms of other eating habits, Table 2 presents the average intake of various foods across the three groups. Using ANOVA to compare the three groups, there were no differences found in the amount of meat, poultry, or fish eaten by the three groups. There were also no differences found across groups with respect to the number of snacks, meals, dietary supplements ingested, or amount of gum chewed.

Table 2. A Comparative Summary of the Average dietary intake of meat, poultry, fish, supplements, and gum across three groups of dental fixtures.

Dietary Component	Group A		Group B		Group C	
	Mean	sd	Mean	sd	Mean	sd
Meals per day	2.5	0.6	2.4	0.7	2.5	0.7
Snacks per day	1.6	1.2	1.8	1.7	1.6	1.6
Meat per month	12.7	8.9	10.4	7.2	12.1	8.8
Poultry per month	9.8	5.1	11.3	6.4	9.8	6.0
Fish per month	6.7	5.0	6.5	6.8	7.0	9.8
Supplements per month	34.3	19.1	36.3	21.1	33.5	14.5
Gum per month	22.6	37.1	23.7	40.0	23.2	44.2

Influence of Pain on Diet

In order to determine whether dental pain was related to dietary intake, independent of the type of denture fixtures used, a comparison of those respondents taking pain medications for any purpose to those not taking pain medication was made. Respondents taking pain medications reported significantly more frequent jaw tightness or pain (x^2 =5.84, df=1, p<.02). This association was found despite the fact that the pain medication question did not specifically assess whether drugs were taken specifically to relieve dental pain or used to medicate pain associated with arthritis or pain of a different origin.

Table 3. presents the average monthly intake of various food groups for the pain versus no pain groups. The pain group took significantly more dietary supplements (t=2.08, df=87, p<.05) and ate more fish (t=2.64, df=201, p<.01). There were no differences found with respect to meat or poultry intake or for the amount of gum chewed between groups.

Table 3. A Comparative Summary of the Average dietary intake of respondents reporting taking medications for pain versus those who did not.

Dietary Component	With Pain		Without Pain	
	Mean	sd	Mean	sd
Meals per day	2.5	0.7	2.5	0.7
Snacks per day	1.7	1.4	1.6	1.6
Meat per month	11.9	8.9	11.8	8.0
Poultry per month	10.8	5.8	9.9	5.9
Fish per month	7.9**	8.5	5.9	6.2
Supplements per month	39.7*	25.3	31.3	11.3
Gum per month	21.8	42.9	24.2	37.5

*groups are different p<.05

**groups are different p<.01

CHAPTER V

DISCUSSION

The survey of patients receiving implantation reveals that most experience an improvement in chewing and social confidence. This is consistent with the reasons most people sought implants. Most people also reported an improvement in diet and an increase in weight. Thus, the findings of the first study support the results reported by Tavaras et al. (1990) and Grogono et al. (1989) that most patients are generally satisfied with dental implantation. Also, these satisfaction rates compare quite favorably to the level of satisfaction of patients with removable dentures (Akagawa et al. 1988).

However, despite these survey results and contrary to the hypotheses of this study, it does not appear that the use of implants had a significant impact on the actual dietary intake of older adults relative to denture-wearing peers. In fact, when actual food intake is reported, it does not appear that implants have much impact at all on this dimension. There was somewhat less chewing of gum with sugar and more coffee and tea drinking, but other than these findings, no differences were found across groups. Consistent with this, there were no differences found in health problems across groups that might be attributed to differential diet.

It does appear, however, that pain has some impact on what people eat. Respondents in the present survey who reported the need to take medication to treat pain, took more dietary supplements and ate more fish relative to other foods. Since pain medication was related to reported jaw tightness, it is reasonable to assume that some of the pain being medicated involved dental pain. Given the ease of chewing fish relative to meat and poultry, it is possible that dental pain resulted in a dietary shift for these individuals. It is important to note however, that a concomitant reduction in meat and poultry intake was not observed in the denture group. Thus, the association of dental pain to diet may not be dramatic except under more extreme circumstances.

It is recognized that there are a variety of factors that might threaten the validity of this study. First, factors other than the dental fixtures used might confound the comparisons and mask effects. The groups were equivalent in terms of age and overall health; however, men were more commonly represented in the denture group relative to the implant groups. However, when women were studied alone the only association that lost significance was grinding of teeth.

It is also possible that the rather dramatic differences between the findings of Study A and those of Study B might be explained at least in part by the differences in methodologies. Study A was a follow-up survey of patients who had received implants. Study B was a comparison of implant patients to denture-wearers. Since patients were not randomly assigned to implant versus denture, and no effort was made to control for dental health factors that might have been related to the decision to undergo implantation, it is quite possible that the three

groups assessed in Study B are simply not comparable. If people who have difficulties with their dentures decide to obtain implants, then the denture-wearing group might over-represent denture 'successes' and the comparability of diets might be a 'return to health' of the implant groups' whose diets were previously impaired by ill-fitting dentures. Given these findings, we are unable to rule out this alternative explanation.

The means of assessing dietary intake in Study B might also account for the absence of significant findings. It appeared that some respondents did not fully understand the survey questions and variations were noted with respect to how some questions were answered. These inconsistencies complicated and may have compounded the analyses (Medin & Skinner, 1988). For example, when asked about the specifics of their fish intake, some reported the type of fish (e.g., halibut, swordfish, etc.) while others reported the mode of preparation (e.g., baked, grilled, etc.).

It is not likely that insufficient statistical power could account for the current results. Although groups were not large, the nature of the observed effects were so minimal (or in the opposite direction than predicted) that it is very unlikely that the addition of more subjects would have resulted in a greater number of significant findings.

In sum, it appears that patients are quite satisfied with dental implantation. However, this procedure alone may not be associated with improved dietary intake among older adults. It may be that factors such as subjective pain and confidence mediate the effectiveness of implants.

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APPENDIX A

POST-OPERATIVE ORAL QUESTIONNAIRE
(for Dental Implant Patients)
Study A

Name:_____ **Date:**_____

1.) What was the primary reason you selected dental implants ?
   A.) Better chewing ability
   B.) Psycho/Social reasons

2.) Do you chew better with implants as opposed to dentures ?
   A.) Yes
   B.) No

3.) Has your social confidence improved ?
   A.) Yes
   B.) No

4.) Do you feel you eat healthier foods due to dental implants ?
   A.) Yes
   B.) No

5.) Do you eat *more* with dental implants as opposed to dentures ?
   A.) Yes
   B.) No
   C.) Same

6.) *Before* implants did you consider yourself overweight, underweight, or normal ?
   A.) Overweight
   B.) Underweight
   C.) Normal

7.) Did you gain, lose, or stay the same weight *after* dental implants ?
   A.) Gain
   B.) Lose
   C.) Same

8.) If any, which of these is the greatest *negative* aspect of dental implants?
   A.) None
   B.) Expense
   C.) Pain
   D.) Time

APPENDIX B

HEALTH AND NUTRITION HISTORY QUESTIONNAIRE

1. Demographic information:
   a. _____male _____female (check one)
   b. What is your date of birth?   ____/____/____
                                      month day year

   c. Where have you lived in the past
      15 years?

city/town	state	approx. no. of years/months

   d. What has your work history been?

job/occupation if unemployed or retired, please include	Full time? Yes/No	approximte number of years or months

2. Have you ever been or are you now being treated for any medical conditions? Please indicate by checking the appropriate box by each condition in the list below:

	1 NO	2 YES	3 DON'T KNOW
a. heart disease or angina			
b. heart attack			
c. high blood pressure			
d. stroke			
e. tuberculosis			
f. chronic bronchitis or emphysema			
g. asthma			
h. hay fever			
i. diverticulosis			
j. rectal/colon polyps			
k. chronic colitis			
l. diabetes			
m. thyroid condition			
n. kidney disease			
o. bladder or urine infection			
p. liver cirrhosis			
q. hepatitis			
r. stomach ulcers			
s. rheumatoid arthritis			
t. other arthritis			
u. osteoporosis			
v. fractured hip/bone			

	NO	YES	DON'T KNOW
w. prostate trouble			
x. skin cancer			
y. other cancer			
z. shaking (tremor)			

3. What precription medications are you taking for these or other conditions?

4. a. In addition to the medications mentioned in question 3, do you take or have you recently taken any diuretics (water pills)? ____Yes ____No If no, proceed to question 5.

   b. If Yes, which?

5. a. Do you ever take non-steroidal anti-inflammatory drugs or pain-relievers? ____Yes ____No If no, proceed to question 6.

   b. If Yes, how often?

   c. Which ones?

6. a. Do you use chewing tobacco? ____Yes ____No If no, proceed to question 7.

   b. If Yes, how much do you use per day? _____

7. a. Do you ever chew gum? ____Yes ____No If no, proceed to question 8.

   b. If Yes, what type of gum do you chew? ____regular ____sugar free

   c. How much gum do you chew? ____stick every ____day
                                                  ____week
                                                  ____month

8. When you wake up in the morning, do your jaws
   or the muscles in your face ever hurt or feel
   tight?   ____Yes   ____No

9. Are you aware of any tendency to grind
   your teeth?
                           ____Yes   ____No

10. How many meals to you have each day?   _____
                                              (number)

11. How many snacks do you have each day?   _____
                                              (number)

12. From the list below, indicate which
    beverages you usually have with a meal,
    snack or between meals:

	1 water	2 fruit or veget juice	3 soft drink reg.	4 soft drink diet	5 milk	6 coffee or tea	7 wine beer or other alohol	8 other
a. breakfast								
b. lunch								
c. evening meal								
d. snack morning								
e. snack afternoon								
f. snack evening								

13. a. Do you presently take any vitamin or mineral
       supplements?   ____Yes   ____No
       If no, skip to question 14.

    b. If yes, how often do you take them?
                           _____times each_____
                           (number)   day/week

    c. How long have you taken the supplement?

                           _____   _____
                           (number)   weeks/months/
                                          years

40

14. a. How often do you eat red meat?_____times each_____
                                    (number)   week/month

    b. How often do you eat poultry?_____times each_____
                                    (number)   week/month

    c. How often do you eat fish or seafood?
                            _____times each_____
                            (number)   week/month

    d. If/when you eat fish or seafood what kind do you prefer?

APPENDIX C

HEALTH AND NUTRITION HISTORY QUESTIONNAIRE

Please be as specific as possible when answering the questions,
and answer every question.

Date: ____/____/____

Place of interview: _____

Time of day: _____ AM

PM

1. Demographic information:

   a. Indicate gender (check one):
      0_____male
      1_____female

   b. What is your date of birth?
      _____/_____/_____
      month   day   year

   c. Where have you lived in the past 15 years? Start with your
   currrent city or town, and list as many cities/towns that may
   apply.

	city/town	state	approx. no. of years(example 6.5)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

d. Are you currently employed? ___Yes ___No

e. If you are currently employed is your work

_____ full time
_____ part time

f. What has your work <u>history</u> been? Start with current status (job or retired) and be as specific as possible. (Examples: NASA employee/electrical engineer or college teacher/research with virus)

job/occupation if unemployed or retired, please include	Full time? Yes/No	approximate number of years or months

2. Have you ever been or are you now being treated for any medical conditions? Please indicate by checking the appropriate box by each condition in the list below. **PLEASE BE SURE THAT YOU HAVE RESPONDED BY MARKING ONE BOX ON EACH LINE.**

	1 No	2 Yes	3 DON'T KNOW
a. heart disease or angina			
b. heart attack			
c. high blood pressure			
d. stroke			
e. tuberculosis			
f. chronic bronchitis or emphysema			

44

	1	2	3
	NO	YES	DON'T KNOW
g. asthma			
h. hay fever			
i. diverticulosis			
j. rectal/colon polyps			
k. chronic colitis			
l. diabetes			
m. thyroid condition			
n. kidney disease			
o. bladder or urine infection			
p. liver cirrhosis			
q. hepatitis			
r. stomach ulcers			
s. rheumatoid arthritis			
t. other arthritis			
u. osteoporosis			
v. fractured hip/bone			
w. prostate trouble (female, write F)			
x. skin cancer			
y. other cancer			
z. shaking (tremor)			

3. What prescription medications are you
    taking for these or other conditions?

4. a. In addition to the medications mentioned in
       question 3, do you take or have you recently
       taken any diuretics (water pills)?   ____Yes ____No

    If no, proceed to question 5.

    b. If Yes, which?

5. a. Do you ever take non-steroidal anti-inflammatory
       drugs or pain-relievers?   ____Yes ____No
    If no, proceed to question 6.

    b. If Yes, about how often?
                               _____each day
                               (number)
       If less than one a day, approximately how often?

                    _____

    c. Which ones?   number of times   check if
                              per day   less than
                                                 one a day

              ____Aspirin   _____   ____
              ____Tylenol   _____   ____
              ____Advil   _____   ____
              ____Motrin   _____   ____
              ____Ibuprofen   _____   ____
              ____Other   _____   ____

6. a. Do you use chewing tobacco?   ____Yes ____No
    If no, proceed to question 7.

    b. If Yes, how much do you use per day?_____

7. a. Do you ever chew gum?   ____Yes ____No
        If no, proceed to question 8.

    b. If Yes, what type of gum
       do you chew?   ____regular (with sugar)
                                 ____sugar free
                                 ____both regular
                                    and sugar free

    c. How much gum do you chew?
                        _____sticks every day/ week / month
                        (number)   (circle only one)

46

8. When you wake up in the morning, do your jaws or the muscles in your face ever hurt or feel tight? ____Yes ____No

9. Are you aware of any tendency to grind your teeth? ____Yes ____No

10. How many meals do you have each day? _____
(number)

11. How many snacks do you have each day?
(IF MORE THAN 5, FILL IN 6) _____
(number)

12. From the list below, indicate which beverages you usually have with a meal, snack or between meals:
PLEASE ENTER ZERO (0) IF NONE

	1 water	2 fruit or veget juice	3 soft drink reg.	4 soft drink diet	5 milk (as a bev- er- age)	6 coffee or tea	7 wine beer or other alcohol	8 other drink
a. breakfast								
b. lunch								
c. evening meal								
d. snack-morning								
e. snack-afternoon								
f. snack-evening								
g. other times								

13.   a. Do you presently take any vitamin or mineral
         supplement?   ____Yes   ____No
      If no, skip to question 14.

      b. If Yes, which ones? (Be as specific as possible)

      c. How often do you take them in a typical week?
                              _____times every day / week
                              (number)   (circle only one)

      d. How long have you taken the supplement?
                              _____ weeks/ months / years
                              (number) (circle only one)

14.   a. In a typical week, how often do you eat red meat?
                              _____times each day / week
                              (number)   (circle one)

                              _____less than once/week

      b. In a typical week, how often do you eat poultry?
                              _____times each day / week
                              (number)   (circle one)

                              _____less than once/week

      c. In a typical week, how often do you eat fish/seafood?
                              _____times each day / week
                              (number)   (circle one)

                              _____less than once/week

d. If/when you eat fish or seafood what kind do you prefer?

Please check (✔) those you like best

____cod
____tuna
____sardines
____perch
____catfish
____shrimp
____orange roughy
____clams
____squid
____sea bass
____ocean bass
____river trout
____lake trout
____lake whitefish
____other (specify)

_____
_____
_____

15. a. Do you like to eat fresh (raw) or slightly cooked (crunchy) vegetables?

____Yes   ____No

b. If you eat fresh (raw) or slightly cooked vegetables, how often?

____less than twice a week
____3-7 times a week
____more than 7 times a week

16. a. Do you eat fresh fruit?

____Yes   ____No

b. If you eat fresh fruit, how often do you eat it?

____less than twice a week
____3-7 times a week
____more than 7 times a week

49

APPROVAL SHEET

The thesis submitted by Linda M. Weinfield has been read and approved by the following committee:

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The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Science.

_____ 24, 1993
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