

**Treatment Effect on Social Engagement with
Mandibular Implant Overdenture Therapy**

BY

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THESIS

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This thesis is dedicated to edentulous patients worldwide, particularly the voluntary participants in my research project, without whom the completion of this study would not have been possible. As a dental health care provider and researcher, I vow to explore and provide the highest quality of care and research to increase patient satisfaction and quality of life.

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PJH

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LIST OF ABBREVIATIONS

COD	College of Dentistry
IRB	Institutional Review Board
N/A	Not Applicable
NS	Not Significant
OHIP	Oral Health Impact Profile
SD	Standard Deviation
SPSS	Statistical Product and Service Solutions
UIC	University of Illinois at Chicago
yo	Years old

SUMMARY

The purpose of this research study was to investigate if patients with conventional mandibular dentures became more socially engaged following mandibular two-implant overdenture therapy, to determine if gender differences exist regarding treatment effect on social engagement with mandibular two-implant overdenture therapy, and to investigate patient satisfaction post-treatment.

Edentulous patients had conventional maxillary and mandibular complete dentures fabricated at the UIC COD. After a minimum of four months of function, the patients underwent two-stage mandibular implant overdenture therapy. Two interforaminal implants were placed, and after a minimum of three months healing time, the two osseointegrated mandibular implants were uncovered and healing abutments were inserted. A minimum of two weeks later, the mandibular denture was converted chair-side into a two implant-retained mandibular overdenture with resilient attachments. Information on demographics was obtained and patients completed both pre- and post-treatment questionnaires on social engagement after functioning with each prosthesis for a minimum for four months. In addition, post-treatment semantic differential scales and modified version of Oral Health Impact Profile-14 were completed.

SUMMARY (continued)

Twenty-seven patients, 14 men and 13 women, with a mean age of 62 years (SD±12), participated in the study. Statistical software (SPSS v.20, Armonk, NY, USA) was used for descriptive and statistical analyses. Wilcoxon Signed Ranks Tests resulted in significant differences ($p<0.05$) for the overall sample for “*went on trips*” ($p=0.04$); “*visited*” ($p=0.03$); and “*engaged in leisure phone conversations*” ($p=0.02$). Significant differences were noted for women on “*did housework*” ($p=0.046$); “*smiled fully in social situations*” ($p=0.02$); and “*laughed fully in social situations*” ($p=0.02$). For men, a significant difference was found for “*went on trips*” ($p=0.03$). Significant differences were found for participants <60 years of age for “*smiled fully in social situations*” ($p=0.03$) and “*laughed fully in social situations*” ($p=0.02$). Significant differences were found for participants >60 years of age for “*engaged in leisure phone conversations with family*” ($p=0.05$), “*went to restaurants*” ($p=0.02$) and “*engaged in leisure phone conversations*” ($p=0.05$).

The overall median post-treatment semantic scale was nine, signifying a high level of post-treatment satisfaction and the overall median post treatment OHIP-14 was zero suggesting there was no interference by oral health with quality of life.

The results are consistent with a small treatment effect on social engagement due to implant-supported mandibular overdenture treatment. There may be differences related to gender and age. Patients had a high level of satisfaction

with treatment based on semantic differential scales and modified OHIP-14. Continuation of the current research study to obtain a larger sample size is recommended to further evaluate the treatment effect on social engagement with mandibular implant overdenture therapy.

1. INTRODUCTION

1.1 Background

Social engagement is defined as the continuation of social relations and involvement in social activities,¹ including the partaking of meaningful social tasks for productive activity, such as paid employment, volunteer work, or gardening.² Research has suggested that social engagement may play an important role in reduced mortality risks,^{3,4} higher levels of cognitive function,^{1,5-9} reduced disability,^{2,10} and decreased depressive symptoms in elderly individuals.^{11,12} Furthermore, depression is a known risk factor for mortality,¹³⁻¹⁵ diminished immune function,¹⁶⁻¹⁸ and poor health recovery in ill individuals.¹⁹⁻²¹ Social engagement has further been proposed to minimize depressive symptoms by positively stimulating various body systems.²²

With an increasing life expectancy, there is a projected increase in edentulism in the adult population older than 55 years of age over the next decade.²³ This will be accompanied by an increased need for functional prostheses for the edentulous population. Advanced age is not a contraindication to long-term implant survival,²⁴ and high survival rates with mandibular implant overdentures are well documented in this population.²⁵⁻²⁹ Furthermore, sufficient evidence does not exist to preclude implant therapy for elderly patients with systemic diseases.³⁰

Edentulous patients wearing conventional complete dentures will undergo a continuous process of resorption of the residual ridges overtime, with a mean

reduction in mandibular anterior ridge height being roughly four times greater compared to that of the maxillary ridge.³¹ This will eventually lead to increased prosthetic treatment complications for patients, particularly problems associated with retention, stability, and support of mandibular complete dentures.

It has additionally been suggested that there may be an association between edentulism and nutritional state, with edentulous individuals not acquiring specific nutrients that may play an important role in preventing various health complications.³²⁻³⁵ Mandibular implant-supported overdentures may overcome many of these obstacles³⁶ and have been declared by some^{37,38} to be the first choice treatment option for edentulous patients.

1.2 **Significance**

Mandibular implant overdenture therapy has a positive physiological and psychosocial impact on edentulous patients compared to patients with conventional complete dentures.³⁹⁻⁴² However, limited studies^{39,43} have evaluated the treatment effect on social engagement with mandibular implant overdenture therapy; and there is a lack of homogeneity among these studies. Furthermore, gender differences related to treatment effect on social engagement with mandibular implant overdenture therapy have not yet been investigated.

Research suggests that social engagement is associated with reduced mortality risks,^{3,4} higher levels of cognitive function,^{1,5-9} reduced disability,^{2,10} and decreased depression in elderly edentulous.^{11,12} Studies have also found gender

differences in social engagement and health.⁴⁴⁻⁴⁸ In spite of this, a review of the literature revealed no studies comparing gender differences in social engagement following overdenture treatment. This study was a first step to explore the treatment effect on social engagement resulting from mandibular two-implant overdenture therapy with resilient attachments, specifically comparing genders.

1.3 **Specific Aims**

The specific aims of this research study were: 1) to investigate if patients with functional conventional mandibular dentures at the UIC COD became more socially engaged following placement of two interforaminal mandibular implants and prosthesis conversion to a mandibular implant-retained overdenture; 2) to determine if gender differences existed regarding treatment effect on social engagement following mandibular two-implant overdenture therapy; 3) to explore patient satisfaction post-treatment.

1.4 **Hypotheses**

The hypotheses for this research study were: 1) for patients at the UIC COD, there will be no differences regarding treatment effect on social engagement with mandibular two-implant overdenture therapy; 2) there will be no gender differences regarding treatment effect on social engagement with

mandibular two-implant overdenture therapy; 3) patients will have a high level of satisfaction with their treatment.

2. REVIEW OF LITERATURE

2.1 **Social Engagement and Health**

Social engagement is described as the continuation of social relations and involvement in social activities.¹ Social engagement has been further defined to include the partaking of meaningful social tasks for productive activity, such as paid employment, volunteer work, or gardening.² Participation in such activities has been linked to reduced mortality risks.^{3,4} One study³ found protective effects of volunteering on the rate of mortality among individuals 65 years of age and older, discussing the possibility of self-identity, role strain, and meaningfulness playing an important role. Another study⁴ examined a sample of 3,968 adults, 64-101 years of age, over 6.3 years in a community in the Piedmont of North Carolina, as part of the Established Population for the Epidemiologic Studies of the Elderly program of the National Institutes of Health. They concluded that elderly adults who attended religious services at least once a week appeared to have had increased survival compared to those who attended services less frequently.⁴

Numerous investigations additionally suggest there is an association between a higher level of social engagement and higher level of cognitive function in elderly individuals, compared to elderly individuals who are less socially engaged.^{1,5-9} Seeman and colleagues⁵ evaluated 3,525 adults, 35-85 years of age, using data from the national Midlife in the U.S. (MIDUS) study. Level of social engagement was determined from longitudinal data on social

contacts, support, and strain/conflict. Cognition evaluated was executive function and episodic memory. The authors found significant positive associations between histories of greater social engagement and cognition, and negative associations between decreases in social engagement and cognition.⁵

Another study⁶ evaluated 6,102 non-Hispanic African Americans and Caucasians, all of whom were 65 years or older from the Chicago Health and Aging Project, an epidemiologic study of risk factors for Alzheimer disease. Each individual was evaluated cognitively up to three times over five years. Social engagement evaluation, measured with four items related to social and productive activity, was based on the number of interactions with their children, relatives, and friends on a monthly basis.

Bassuk and colleagues¹ interviewed 2,812 noninstitutionalized individuals, 65 years of age or older, in their homes over the course of 12 years. A social disengagement scale was designed based on the presence of a spouse, visual contact on a monthly basis with three or more friends or relatives, nonvisual contact with 10 or more relatives or friends on a yearly basis, attendance at religious functions, memberships with groups, and social activities. Decline in cognitive function was classified as a transition to a lower category in the Short Portable Mental Status Questionnaire.

Yeh and Lui⁸ similarly assessed a random sample of 4,993 city residents in Taiwan, 65 years and older, and investigated the influence of social support on cognitive function using multiple regression analysis and Short Portable Mental Status Questionnaire scores. A separate group⁷ studied a community of 354

adults, 50 years of age and older, and examined the relationship between social networks and global cognitive status with Mini-Mental State Examinations over a 12-year period.

Krueger and others⁹ studied multidimensional constructs of both social engagement (social network size, frequency of participation in specific social activities, and perceived level of social support) and cognition (episodic memory, semantic memory, working memory, processing speed, and visuospatial ability). All of these studies^{1,5-9} concluded that there appears to be an association between a higher level of social engagement and higher level of cognitive function in elderly individuals, compared to elderly individuals who are less socially engaged.

Research has also shown an association between higher levels of social engagement and decreased depressive symptoms in elderly individuals.¹¹ This conclusion resulted from an evaluation of three waves of data from a community of 2,812 adults, 65 years and older, from the New Haven Established Populations for the Epidemiologic Study of the Elderly. Furthermore, Bruce and Hoff¹² found that social isolation and inactivity was associated with an increased risk of developing first-onset of major depressive disorder. Understanding this association is imperative, as depression has been linked to mortality,¹³⁻¹⁵ diminished immune function,¹⁶⁻¹⁸ and poor health recovery in ill individuals.¹⁹⁻²¹ Social engagement may also minimize depressive symptoms by positively stimulating various body systems.²² McNeil and colleagues²² found amongst a group of 30 moderately depressed elderly individuals that exercise and social

engagement both resulted in significant reductions in the Beck Depression Inventory scale, a 21-question multiple-choice self-reported scale.

In the elderly population, higher social engagement has also been associated with decreased disability.² This was concluded through measuring the ability of elderly individuals to perform the essential self-care tasks of daily living, tasks that required a certain degree of strength and basic mobility, and basic physical upper and lower extremity functions as they related to disability. For each of these three measures, there was an association between socially engaged elderly individuals and a lesser amount of disability being reported.² Supporting this association, another study¹⁰ surveyed 1,244 non-institutionalized individuals in Spain, age range 70-74 years, and found a strong association between an active social life, emotional support, and disability, suggesting a protective effect of social networks on disability.

However, the findings from these studies^{1-12,22,49} linking social engagement and health must be carefully interpreted, as the relationships may be casual instead of causal. Individuals may actually become less socially engaged due to decreasing cognitive function, increased depression, and increased disability. There may be common risk factors between lower levels of social engagement and decreased mental health and physical ability. Nevertheless, it is still important to research whether or not specific dental treatments may positively impact social engagement, in turn potentially reducing mortality, decreasing depression and disability, and sustaining higher levels of cognitive function in elderly edentulous individuals.

2.2 **Gender Differences Related to Social Engagement and Health**

There has been a substantial amount of research examining the positive association between social engagement and health.^{1-12,22,49} However, a lesser amount of studies have focused on gender differences related to social engagement and health.⁴⁴⁻⁴⁸

Patricia Thomas evaluated gender differences in relation to social engagement and limitations in late life.⁴⁴ Data were obtained from the Americans' Changing Lives survey of 1,642 elderly individuals (1103 women and 539 men), 60 years of age and older, from 1986, 1989, and 1994. A social engagement questionnaire asking about the frequency of involvement with different social activities, the Short Portable Mental Status Questionnaire, and the Rosow-Breslau Disability index, were used to assess social engagement, cognitive limitations, and physical limitations, respectively. Thomas found that for women, greater involvement with social activity led to a reduction in levels of physical and cognitive limitations.⁴⁴ However, for men, it was found that physical and cognitive limitations led to a reduction in levels of subsequent social engagement.⁴⁴ These findings importantly suggest that social engagement may result in health benefits for women, while health limitations for men may have a negative impact on their level of social engagement.

Another study⁴⁵ assessed gender differences concerning social support and health between 3,771 men and 4,954 women in South Korea. All participating individuals were 40 years of age and older, and participated in the 2005 cross-sectional survey of the Seoul Citizens Health and Social Indicators

Survey. Lack of social engagement was associated with poor self-rated health in older adults, particularly older men.⁴⁵

Gender differences on the impacts of social exclusion on mortality among older Japanese were evaluated in another study.⁴⁶ Prospective data analysis from the Aichi Gerontological Evaluation Study of Japanese residents, 65 years of age and older, was conducted. Baseline information was obtained from 13,310 participants (6508 men, 6802 women) in 2003 and they were followed for a period of 4 years, with mortality data being gathered from municipal databases. Social exclusion was evaluated, and Cox's proportional hazard model showed a significantly increased risk of mortality for socially excluded elderly individuals.⁴⁶ Although the prevalence of social isolation was twice as high for men, social exclusion had an overall greater impact on increased mortality for women, compared to men.⁴⁶

Chen and colleagues⁴⁷ investigated gender differences in psychological health and socioeconomic health (social engagement, social support, and financial status) between 384 adults (196 men, 188 women), 65 years of age and older, in Taiwan. Men had better psychological health than women.⁴⁷ However, women reported higher levels of social engagement and social support.⁴⁷ Additionally, married elderly adults and exercisers reported higher levels of psychological and socioeconomic health compared to non-exercisers and single and widowed adults.⁴⁷

A clear gender effect on social engagement and psychological well-being was found in a study⁴⁸ that investigated whether increased social engagement

with residential care members of the same gender enhanced social recognition, well-being, and cognition. Five male groups (12 men) and four female groups (14 women) engaged in social activities fortnightly, and data were collected at the start of the intervention and again 12 weeks later. There was a significant reduction in depression and anxiety and an increased sense of social recognition for men, while for women, there was maintenance of well-being and social identification.⁴⁸

Again, the findings from these studies⁴⁴⁻⁴⁸ must be carefully interpreted as the relationships suggested may be casual instead of causal. Nonetheless, these studies⁴⁴⁻⁴⁸ highlight the importance of evaluating potential gender differences in future research studies involving social engagement and health, and encourage the development of gender-specific approaches to care in relation to social engagement in the elderly population.

2.3 **Edentulism and Mandibular Implant Overdenture Therapy**

Douglass and others²³ answered the important question, “Will there be a need for complete dentures in the United States in 2020?” With edentulism declining by 10% every decade, based on estimates from national epidemiologic survey data, and only 90% of edentulous patients actually wearing complete dentures, one may be led to believe that the need for dentures will decrease. However, the authors calculated that when the number of adults in each age group is multiplied by the percentage in need of a complete denture or dentures,

the need for these prostheses will increase from 33.6 million adults in 1991 to 37.9 million adults in 2020.²³ This is because the 10% decline in edentulism every ten years will be offset by the 79% increase in the adult population older than 55 years of age.²³ Given the tens of millions of Americans that edentulism impacts, more science related to the consequences would be prudent.

A longitudinal study by Tallgren³¹ of edentulous individuals wearing complete dentures over 25 years showed a continuous process of resorption of the residual ridges, with the mean reduction in mandibular anterior ridge height being roughly four times greater compared to that of the maxillary ridge. This significant resorption can lead to increased prosthetic treatment complications, and result in difficulty for patients with conventional mandibular complete dentures. Mandibular implant-supported overdentures may overcome these obstacles, and by some^{37,38} have been declared as the first choice treatment option for edentulous patients.

Contrarily, Brian Fitzpatrick conducted a systematic review on the standard of care for the edentulous mandible.⁵⁰ The available literature suggests that the functional, psychosocial, and physiological demands of edentulous patients are highly variable and individual. Numerous factors, such as educational background, knowledge, dental care experience, financial considerations, adaptive capability, region, culture, age, and gender all play an important role in patient acceptance of a particular treatment modality. From these findings, it was concluded that there is no evidence for a single, unanimously superior treatment modality for the edentulous mandible.⁵⁰

Studies³²⁻³⁵ suggest there may be an association between edentulism and nutritional state, with edentulous individuals not acquiring specific nutrients that may play an important role in preventing various health complications.⁵⁴ Edentulous adults experience more complications with mastication, swallowing, and eating in front of other people, compared to dentate adults, often leading to self-restriction in the amount and type of food they consume.³⁵ The effect of mandibular implant overdenture therapy compared to conventional complete denture therapy on nutrition has been studied.^{36,51-53} Some^{51,52} found no significant differences in dietary intake between the two treatment groups, despite an improvement in chewing ability with implant-supported overdentures, likely due to patients not changing their already established eating patterns. Another study⁵³ emphasized the importance of customized dietary advice and nutrition counseling for patients after receiving implant-supported overdentures. Although patients who received implant-supported overdentures showed improved chewing ability and food selection, 30-50% of these patients still avoided eating more difficult to chew foods, again likely due to an already established habitual eating pattern.⁵³ In another study,³⁶ significant improvements were found in a randomized clinical trial of edentulous patients, 65-75 years of age, in which participants received either two-implant mandibular overdentures (n=30) or conventional complete dentures (n=30). Nutritional state was measured pertaining to percent body fat, skin-fold thickness of various muscles, waist circumference, waist-hip ratio, and serum albumin, hemoglobin,

and B12 levels. Significant improvements in each of these factors were found for the implant overdenture group, but not for the complete denture group.³⁶

A Toronto study²⁴ observed implant osseointegration for elderly patients, concluding that advanced age is not a contraindication to long-term implant survival and that osseointegration can be maintained regardless of the quality of oral hygiene care. With both increasing age and life expectancy, systemic health complications will be more frequently encountered in the elderly edentulous population. However, whether the relationship between edentulism and the development of systemic disorders is coincidental or causal has not yet been determined.⁵⁴ Furthermore, sufficient evidence does not exist to preclude implant therapy for elderly patients with systemic diseases.³⁰ Schmitt and Zarb⁵⁵ strongly support the advantages of implant-supported overdentures as being less invasive, less expensive, less complex, yet equally effective as other treatment options for the edentulous patient.

Despite the strong evidence supporting the benefits that may result from receiving mandibular implant-supported overdentures, many elderly patients dissatisfied with their conventional dentures may still refuse this treatment due to fears of pain, complications, and social embarrassment.⁵⁶

2.4 **Mandibular Implant Overdenture Survival**

High implant survival in the anterior mandible is well documented.²⁵⁻²⁹ Thirty-two mandibular implant-supported overdentures had a cumulative implant

survival rate of 100% after 7 years of loading in one study²⁵ with no difference in implant survival rate between ball versus bar with clip attachments. Goodacre and others²⁶ conducted a literature review assessing clinical implant and prosthesis complications. The authors²⁶ found that of the 5,683 implants evaluated supporting mandibular overdentures across multiple studies, only 242 were lost, resulting in a mean implant loss of 4%. A long-term evaluation of 369 mandibular two-implant overdentures resulted in a Kaplan-Meier analyses showing a overall survival rate of 95.5% after 20 years of loading in another study.²⁷ Endosseous implants for mandibular two-implant overdentures again had a high survival rate of 93% after 10 years of follow-up in a similar study.²⁸ A survival rate of 85.9% over 10-24 years for mandibular implants supporting overdentures was found in an additional long-term clinical observation²⁹ that started with 147 patients and 314 implants. These high survival rates support mandibular implant overdenture therapy as a viable treatment option for edentulous patients.

2.5 **Physiological and Psychosocial Impact from Mandibular Implant Overdenture Therapy**

There are limited studies^{39,43} that have primarily evaluated the treatment effect on social engagement with mandibular implant overdenture therapy. One randomized controlled trial³⁹ evaluated 102 subjects, age 35-65, who were separated into two different treatment groups (conventional complete dentures or

mandibular two-implant overdentures with bar attachments). Both Oral Health Impact Profile and Social Impact Questionnaires were administered at baseline and two-months post-treatment, resulting in a conclusion that mandibular implant overdentures provide greater improvement when eating, speaking, kissing, and yawning.³⁹ Furthermore, implant-overdenture subjects also felt less uneasy kissing and less uneasy during sexual activity than the conventional complete denture subjects.³⁹ Another study⁴³ evaluated the psychosocial effects of implant-retained overdentures through equally dividing 90 patients into three different treatment groups: implant overdenture treatment group, conventional complete denture treatment group, and a preprosthetic surgery treatment group, who underwent surgical interforaminal vestibuloplasty and deepening of the floor of the mouth before insertion of new conventional complete dentures. Based on assessment from psychosocial impact questionnaires, the quality-of-life measures significantly increased in all three treatment groups, with all patients, on average, experiencing less psychosocial limitations one year after treatment.⁴³

Another study⁴⁰ evaluated 83 hospital-based subjects who were divided into three different groups (conventional complete dentures, mandibular two-implant overdentures with ball attachments, or mandibular four-implant overdentures with ball attachments). The Oral Impacts on Daily Performances questionnaire was administered amongst the different cohorts, concluding that mandibular implant overdentures provided greater satisfaction with comfort and eating, and those patients experienced less impact on daily life than patients with conventional complete dentures.⁴⁰

Patient responses to mandibular implant overdenture therapy were also evaluated in a study⁴¹ of a single cohort of 56 subjects who received a mandibular four-implant overdenture with cast bar and distal extracoronal attachments. Each patient originally presented with a conventional mandibular denture and filled out a comparison questionnaire post-treatment. The authors concluded that compared to conventional mandibular dentures, mandibular implant overdentures improved retention and comfort, providing patients with more self-confidence and improving social interaction.⁴¹

A multicenter randomized clinical trial⁴² evaluated 150 patients with severely resorbed mandibles and assigned them to either a treatment group to receive an implant-supported mandibular overdenture and new maxillary denture, or to a control group that was treated with a new set of conventional complete dentures. The treatment group with mandibular implant-supported overdentures provided a higher satisfactory resolution to their previous denture complications, based on analyses of questionnaires focusing on complaints and general satisfaction.⁴²

On the contrary, patient satisfaction with implant-supported mandibular overdentures was evaluated through another study⁵⁷ that compared three different treatment strategies (mandibular two-implant overdentures with ball attachments, two-implant overdentures with bar attachments, or four-implant overdentures with bar attachments). All 110 subjects originally presented with conventional complete dentures and completed Satisfaction and Social Functioning Questionnaires before and 16 months after treatment, resulting in a

conclusion that patients were generally satisfied with their dentures and there was no significant difference found between the three treatment groups.⁵⁷

Assuncao and others⁵⁸ similarly concluded that although there was improved stability with mandibular implant-retained overdentures compared to conventional denture therapy, there were no significant differences between conventional dentures and mandibular implant-supported overdentures in relation to comfort, aesthetics, chewing, ability, overall satisfaction, pain, functional, phonetic, social, and psychological limitations. Thirty-four subjects were distributed into five different treatment groups: conventional denture; mandibular two-implant overdenture with ball attachment; three-implant overdenture with bar-clip attachment; four or five implant overdenture with bar-clip and distal ball attachments. Each patient completed a post-treatment questionnaire based on Oral Health Impact Profile and oral health related quality of life two months after delivery of the prostheses.

Allen and others⁵⁹ conducted a randomized controlled trial of 118 edentulous patients in a dental hospital comparing mandibular implant-retained (n=62) and conventional dentures (n=56), concluding that there were no significant post-treatment differences in satisfaction found between the two groups at three months. However, the pre- and post-treatment OHIP change-scores were significantly greater for patients who received implant therapy.⁵⁹

These findings suggest that mandibular implant overdenture therapy may have a positive physiological and psychosocial impact on edentulous patients. However, limited studies^{39,43} exist that have focused on evaluating the treatment

effect on social engagement with mandibular implant overdenture therapy. Furthermore, these studies did not evaluate potential gender differences. Although studies⁴⁴⁻⁴⁸ exist that evaluate gender comparison related to social engagement and health, studies that specifically evaluate gender comparison related to social engagement and mandibular implant overdenture therapy seem to be nonexistent. Additional research is needed to evaluate if there is a treatment effect on social engagement with mandibular implant overdenture therapy and to assess whether or not gender differences exist.

2.6 **Oral Health Impact Profile and Differential Semantic Scale**

Slade and Spencer⁶⁰ developed the Oral Health Impact Profile (OHIP) to aid in clinical decision-making and research, and it has become one of the most widely used, reliable, and valid measurements of the social impact of oral disorders. Locker and Slade⁶¹ assessed the oral health and the quality of life among older adults in Toronto, finding that oral conditions have a negative impact on the daily lives of considerable proportions of elderly individuals, particularly for edentulous patients. The OHIP questionnaire has three versions with either 14,⁶² 20,⁶³ or 49⁶⁰ questions that examine patient issues related to physical, psychological, and social handicap in addition to function and pain. OHIP-14, a derived and validated short-form of the Oral Health Impact Profile, was developed by Slade.⁶² This version was drawn from internal reliability

analysis, factor analysis, and regression analysis of 1,217 elderly individuals, 60 years or older, in South Australia.⁶²

The semantic differential scale concept, first described by Osgood and colleagues,⁶⁴ asks participants to select where his or her opinion lies on a scale between two bipolar terms, and such a scale can be used to identify factors that might impact patient satisfaction. Common examples of these bipolar scales used to assess patient satisfaction are related to cost (expensive to inexpensive); time involved for treatment (time-consuming to quick); level of pain during the course of treatment (painful to pain free); aesthetics (poor aesthetics to good aesthetics); chewing ability (poor chewing ability to good chewing ability); experience (unpleasant to pleasant); and overall satisfaction (very dissatisfied to very satisfied). Each of the factors mentioned above were used to develop a semantic differential scale questionnaire that assessed the satisfaction outcomes of endodontic treatment in a study by Dugas and colleagues.⁶⁵

3. METHODOLOGY

3.1 Study Design

A total of 46 completely edentulous patients at the UIC COD with existing complete maxillary and mandibular dentures were initially screened for inclusion in the research study. All patients had their initial treatment for maxillary and mandibular complete dentures completed at the UIC COD. Thereafter, each patient underwent a consultation for mandibular implant supported overdenture therapy, as part of the protocol at the UIC COD. Each patient included in the study independently elected to undergo surgery for the placement of two interforaminal mandibular implants. After a minimum of three months of healing time, the two osseointegrated mandibular implants were uncovered and healing abutments were inserted. A minimum of two weeks later, the mandibular denture was converted chair-side into a two implant-retained mandibular overdenture with resilient Locator™ attachments. All surgical procedures were completed by prosthodontic, periodontic, or oral surgery residents under the supervision of attending faculty at the UIC COD. All restorative procedures were completed, under faculty supervision, by undergraduate dental students or prosthodontic residents within the same institution.

Inclusion criteria were that each patient had to be at least 18 years of age, with a functional set of complete dentures in function for a minimum of four months. A prosthodontic faculty member or a prosthodontic resident determined proper functionality of the dentures through intraoral and extraoral examinations

of both the patients and prostheses. Any patients who had existing denture complications, such as sore spots, inadequate retention, stability, occlusion, or poor phonetics were excluded from participation in the study and assigned to an undergraduate dental student for adjustments, repair, or fabrication of new prostheses. Furthermore, if the patient had complaints of pain or discomfort or disapproval of the dentures that necessitated modification of the existing prostheses or fabrication of new prostheses, the patient was excluded from the research study. As a result, 27 of the 46 patients were included in the study.

Informed consent was obtained under a protocol (#2008-1137) reviewed and approved by the Institutional Review Board of the University of Illinois at Chicago. Demographic information was obtained and treatment effect on social engagement with mandibular overdenture therapy was determined through statistical analyses of pre- and post-treatment questionnaires on social engagement. Post-treatment semantic differential scales and modified OHIP-14 were also completed.

3.2 Materials and Methods

Patients that met the inclusion criteria for the research study completed pre-treatment questionnaires after functioning with their set of complete conventional dentures for a minimum of four months. All questionnaires, pre- and post-treatment, were filled out in person at the UIC COD. The pre-treatment questionnaires were administered at the implant consultation appointment or

prior to resilient attachment insertion and conversion of the complete mandibular denture into an implant overdenture retained by two implants.

The two pre-treatment questionnaires were a demographic questionnaire (Appendix A) and a social engagement questionnaire (Appendix B). The social engagement questionnaire (refer to Appendix B) included questions compiled from previous research studies ^{2,9,11,39-41,44,57} in order to cover a broad array of social interactions that could contribute to social integration. Participants were asked about their frequency of performance, during the previous four months, in 28 activities. Response options were on a five-point Likert scale that included: *never* (coded 0), *rarely* (coded 1), *sometimes* (coded 2), *often* (coded 3), *every day/almost every day* (coded 4), and *not applicable* (N/A) (coded “missing”).

After the mandibular complete denture had been converted to a mandibular implant overdenture attached to two resilient attachments, the patient was contacted four-months later for a recall examination as part of the protocol at the UIC COD. At this appointment, a prosthodontic faculty member or a prosthodontic resident completed intraoral and extraoral examinations of both the patient and prostheses. To be included in the post-treatment assessment, patients had to present with a functional complete maxillary denture opposing a functional mandibular implant overdenture supported by two implants. If a prosthesis was determined to be nonfunctional, as previously defined, the patient was assigned to an undergraduate dental student for adjustments, repair, or fabrication of a new prosthesis. Thereafter, the patient was assigned another recall date for completion of the post-treatment questionnaires four months later.

The post-treatment questionnaires administered to the patients at the recall appointment were the same social engagement questionnaire administered pre-treatment (Appendix B); semantic differential scales questionnaire measuring satisfaction (Appendix C); and a modified version of Oral Health Impact Profile-14 (Appendix D) that specified oral health impact resulting from implant therapy. The seven semantic differential scales used to assess patient treatment satisfaction in the study were previously used by Dugas and colleagues.⁶⁵ Patients selected a number from 1-10 on each of the seven scales, with each numerical increase representing a higher level of satisfaction. Figure 1 shows a flow chart of the study procedures.

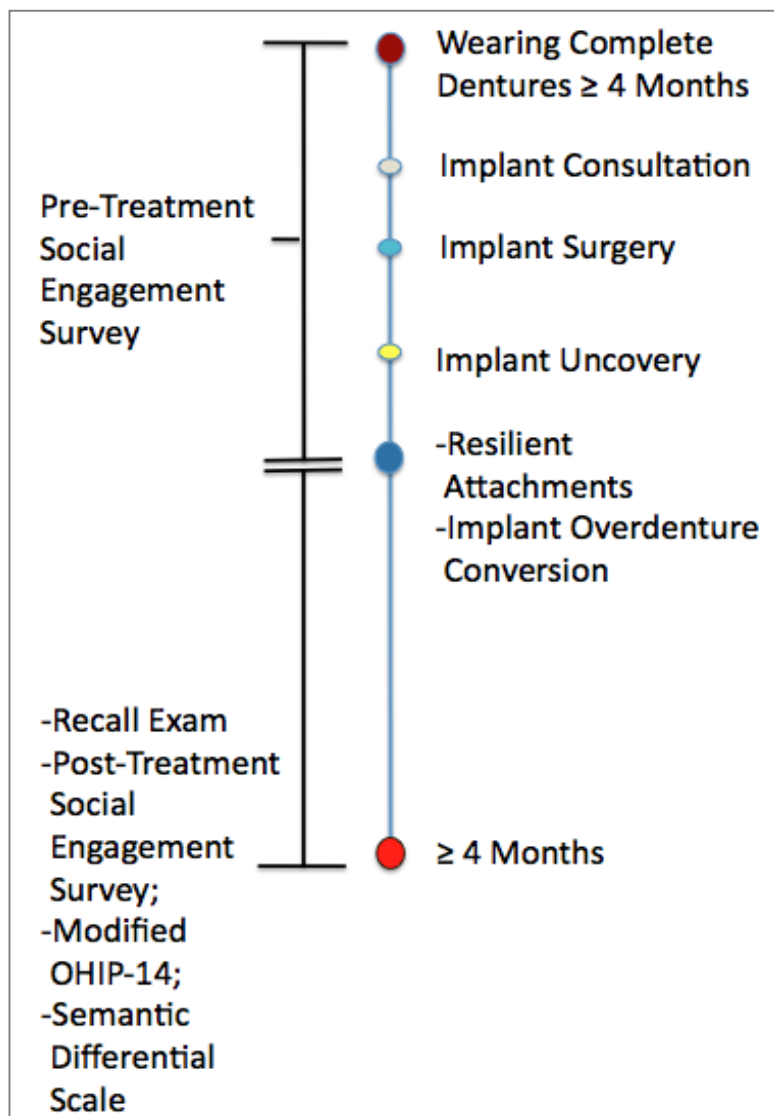


Figure 1. Flowchart of Study Procedures

3.3 Statistical Analysis

Statistical software (SPSS v.20, Armonk, NY, USA) was used for descriptive and statistical analyses. Mean age (SD) and age range were determined for the overall sample, and separately for men and women.

Percentages of the whole were calculated for other demographic variables. Medians were calculated for the pre- and post-treatment social engagement questionnaires, post-treatment semantic differential scales, and post-treatment modified Oral Health Impact Profile-14.

Furthermore, the first eight questions of the social engagement questionnaire that assessed the same social activity, but with different company (family versus friends), were additionally collapsed into four variables that exclusively assessed the social engagement activity, irrespective of the company involved. For each participant, the higher level of social engagement selected between family and friends for pre- and post-treatment assessment of “*went on trips*”, “*visited*”, “*entertained*”, and “*engaged in leisure phone conversations*” were utilized for additional statistical analyses.

Wilcoxon Signed-Rank Tests were performed to compare pre- and post-treatment data of the social engagement questionnaires (original and collapsed versions) for the overall sample, and separately for men and women for gender comparison. The same tests were also performed for two separate age groups (<60 years of age; >60 years of age) to evaluate for potential age-related components. A factor analysis of the 24 variables (4 combined; 20 original) for social engagement was additionally performed. For all statistical analyses in the study, significant levels reported were at $p < 0.05$.

3.4 IRB Approval

Informed consent was obtained under a protocol (#2008-1137) reviewed and approved by the Institutional Review Board of the University of Illinois at Chicago for human participation in this study.

4. RESULTS

4.1 Demographic Results

In total, 27 patients met the inclusion criteria and were able to participate in the study. The study sample comprised 14 men and 13 women, age range 31-83 years. The demographic data for age and gender, race, marital status, education, employment status, income, and living status are listed in Tables I-VII, respectively.

TABLE I
GENDER AND AGE

	Mean Age	Standard Deviation	Age Range	<60 Years of Age	>60 years of Age	Total (n,%)
Men	67	11	44-83	3	11	(14, 52)
Women	57	11	31-74	8	5	(13, 48)
TOTAL	62	12	31-83	11	16	(27, 100)

TABLE II
RACE

	(n, %)
Hispanic	(5, 18)
Black	(4, 15)
White	(18, 67)
TOTAL	(27,100)

TABLE III
MARITAL STATUS

	(n, %)
Non-Married (Single, Divorced, Widowed)	(16, 59)
Married	(11, 41)
TOTAL	(27, 100)

TABLE IV
EDUCATION

	(n, %)
Less than high school	(3, 11)
High school	(13, 48)
College degree or more	(11, 41)
TOTAL	(27, 100)

TABLE V
EMPLOYMENT STATUS

	(n, %)
Unemployed	(17, 62)
Employed	(10, 38)
TOTAL	(27, 100)

TABLE VI
INCOME

	(n, %)
Less than \$5000	(3, 12)
\$5000-\$9,999	(5, 19)
\$10,000-\$14,999	(3, 12)
\$15,000-\$20,000	(6, 23)
Greater than \$20,000	(9, 34)
TOTAL	(26, 100)

TABLE VII
LIVING STATUS

	(n, %)
Live alone	(10, 37)
Cohabitants	(17, 63)
TOTAL	(27,100)

4.2 **Social Engagement Results**

Median values and p-values for the pre- and post-treatment 28-question social engagement questionnaires for the overall sample, men, and women are presented in Table VIII. Response options were on a five-point Likert scale that included: *never* (coded 0), *rarely* (coded 1), *sometimes* (coded 2), *often* (coded 3), *every day/almost every day* (coded 4), and *not applicable* (N/A) (coded missing). Significant differences ($p < 0.05$) were found for women with “*did housework*” ($p = 0.046$; pre-median=3.5; post-median=4.0); “*smiled fully in social situations*” ($p = 0.02$; pre-median=3.0; post-median=4.0); and “*laughed fully in social situations*” ($p = 0.02$; pre-median=3.0; post-median=4.0). A difference approaching significance for women was found with “*did community or volunteer work*” ($p = 0.06$; pre-median=0.0; post-median=2.0). No significant values were found for the overall sample and men. However, differences approaching significance were observed for the overall sample for “*went on trips with family*” ($p = 0.07$; pre-median=1.0; post-median=2.0) and “*phone conversations with family*” ($p = 0.07$; pre-median=3.0; post-median=3.0). For men, differences approaching significance were noted for “*phone conversations with family*”

($p=0.06$; pre-median=2.5; post-median=3.0) and “*went to restaurants*” ($p=0.06$; pre-median=2.0; post-median=1.5).

The results for the four collapsed variables (“*went on trips*”; “*visited*”; “*entertained*”; “*engaged in leisure phone conversations*”) that assessed social engagement activity irrespective of the company involved (family versus friends) are presented in Table IX. Significant differences were found for the overall sample for “*went on trips*” ($p=0.04$; pre-median=2.0; post-median=2.0); “*visited*” ($p=0.03$; pre-median=3.0; post-median=3.0) and “*engaged in leisure phone conversations*” ($p=0.02$; pre-median=3.0; post-median=3.0). For men, significant differences were found for “*went on trips*” ($p=0.03$; pre-median=1.0; post-median=2.0) and differences approaching significance were noted for “*visited*” ($p=0.08$; pre-median=3.0; post-median=3.0) and “*phone conversations*” ($p=0.06$; pre-median=2.5; post-median=3.0). No significant differences were found for women.

Median values and p -values for the pre- and post-treatment 28-question social engagement questionnaires and for the four collapsed variables are presented, by age, in Tables X and XI, respectively. The sample of men in the study was on average 10 years older than the sample of women. Statistics were run for two separate age groups (<60 years of age; >60 years of age) to evaluate potential age-related components. Significant differences were found for the <60 years of age group for “*smiled fully in social situations*” ($p=0.03$; pre-median=3.0; post-median=4.0) and “*laughed fully in social situations*” ($p=0.02$; pre-median=3.0; post-median=4.0). Significant differences were found for the >60

years of age group for “*engaged in leisure phone conversations with family*” ($p=0.05$; pre-median=2.5; post-median=3.0), “*went to restaurants*” ($p=0.02$; pre-median=2.0; post-median=1.0) and for collapsed variable “*engaged in leisure phone conversations*” ($p=0.05$; pre-median=2.5; post-median=3.0).

The factor analysis of the 24 variables (4 combined; 20 original) for social engagement did not result in meaningful reduction of the number of variables, likely due to the small sample size.

TABLE VIII

MEDIAN PRE- AND POST-TREATMENT SOCIAL ENGAGEMENT RATINGS FOR THE OVERALL SAMPLE AND BY GENDER, FOLLOWING MANDIBULAR IMPLANT OVERDENTURE TREATMENT, N=27 (14 MEN,13 WOMEN)

SOCIAL ENGAGEMENT QUESTIONS	PRE-TOTAL Median	POST-TOTAL Median	P-Value TOTAL	PRE-MEN Median	POST-MEN Median	P-Value MEN	PRE-WOMEN Median	POST-WOMEN Median	P-Value WOMEN
1) Went on trips with family	1.0	2.0	0.07	1.0	1.0	NS	2.0	2.0	NS
2) Went on trips with friends	1.0	1.0	NS	1.0	0.5	NS	1.0	1.0	NS
3) Visited family	3.0	3.0	NS	2.5	2.5	NS	3.0	3.0	NS
4) Visited friends	3.0	2.0	NS	3.0	2.0	NS	3.0	2.0	NS
5) Entertained family	2.0	2.0	NS	2.0	2.0	NS	2.0	2.0	NS
6) Entertained friends	2.0	2.0	NS	2.0	1.0	NS	3.0	2.0	NS
7) Phone conversations with family	3.0	3.0	0.07	2.5	3.0	0.06	2.0	3.0	NS
8) Phone conversations with friends	2.0	3.0	NS	2.0	2.0	NS	2.0	3.0	NS
9) Played cards, bingo, or other games	1.0	1.0	NS	1.0	1.0	NS	2.0	1.0	NS
10) Went shopping	2.0	3.0	NS	2.0	3.0	NS	1.0	3.0	NS
11) Went to the movies	1.0	1.0	NS	1.0	1.0	NS	2.0	2.0	NS
12) Went to restaurants	2.0	2.0	NS	2.0	1.5	0.06	2.0	2.0	NS
13) Attended religious services	2.0	2.0	NS	2.0	2.0	NS	0.5	2.0	NS
14) Did community or volunteer work	1.0	1.0	NS	1.0	1.0	NS	0.0	2.0	0.06
15) Went to work	0.0	1.0	NS	0.0	0.5	NS	0.0	1.0	NS
16) Community clubs or organizations	0.0	1.0	NS	0.5	0.5	NS	2.0	1.0	NS
17) Participated in social events/celebrations	2.0	1.0	NS	1.5	1.0	NS	1.0	2.0	NS
18) Went to sporting events	1.0	1.0	NS	2.0	1.0	NS	1.0	1.0	NS
19) Participated in active sports	1.0	1.0	NS	1.0	1.0	NS	1.0	0.0	NS
20) Went for a walk	3.0	3.0	NS	3.0	3.0	NS	2.0	2.0	NS
21) Exercised	2.0	2.0	NS	3.0	3.0	NS	2.0	2.0	NS
22) Worked in the yard or garden	2.0	2.0	NS	2.0	1.5	NS	1.0	2.0	NS
23) Prepared meals	3.5	4.0	NS	3.0	3.0	NS	4.0	4.0	NS
24) Did housework	3.0	3.0	NS	3.0	3.0	NS	3.5	4.0	0.046
25) Smiled fully in social situations	3.0	3.0	NS	3.0	3.0	NS	3.0	4.0	0.02
26) Laughed fully in social situations	3.0	3.0	NS	3.0	3.0	NS	3.0	4.0	0.02
27) Avoided conversation	0.0	0.0	NS	0.0	1.0	NS	0.0	0.0	NS
28) Refused invitations	1.0	1.0	NS	1.0	1.5	NS	1.0	1.0	NS

0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Every Day/Almost Every Day

TABLE IX

RATINGS OF SOCIAL ENGAGEMENT VARIABLES AFTER THE VARIABLES WERE COLLAPSED, PRE AND POST TREATMENT FOR MANDIBULAR IMPLANT OVERDENTURES, OVERALL SAMPLE AND COMPARING MEN AND WOMEN, N=27 (14 MEN,13 WOMEN)

COLLAPSED SOCIAL ENGAGEMENT VARIABLES	PRE-TOTAL Median	POST-TOTAL Median	P-Value TOTAL	PRE-MEN Median	POST-MEN Median	P-Value MEN	PRE-WOMEN Median	POST-WOMEN Median	P-Value WOMEN
1) Went on trips	2.0	2.0	0.04	1.0	2.0	0.03	2.0	2.0	NS
2) Visited	3.0	3.0	0.03	3.0	3.0	0.08	3.0	3.0	NS
3) Entertained	2.0	2.0	NS	2.0	2.0	NS	2.0	2.0	NS
4) Phone conversations	3.0	3.0	0.02	2.5	3.0	0.06	3.0	3.0	NS

0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Every Day/Almost Every Day

TABLE X
MEDIAN PRE- AND POST-TREATMENT SOCIAL ENGAGEMENT RATINGS
BY AGE, FOLLOWING MANDIBULAR IMPLANT OVERDENTURE
TREATMENT, N=27 (11=<60 yo,16=>60 yo)

SOCIAL ENGAGEMENT QUESTIONS	PRE-Median <60 yo	POST-Median <60yo	P-Value <60yo	PRE-Median >60yo	POST-Median >60yo	P-Value >60yo
1) Went on trips with family	2.0	2.0	NS	1.0	1.0	NS
2) Went on trips with friends	2.0	1.0	NS	0.5	0.5	NS
3) Visited family	3.0	3.0	NS	3.0	2.0	NS
4) Visited friends	2.0	3.0	NS	3.0	2.0	NS
5) Entertained family	2.0	2.0	NS	2.0	2.0	NS
6) Entertained friends	2.0	2.0	NS	2.0	1.0	NS
7) Phone conversations with family	3.0	3.0	NS	2.5	3.0	0.05
8) Phone conversations with friends	3.0	3.0	NS	1.5	2.0	NS
9) Played cards, bingo, or other games	2.0	1.5	NS	1.0	1.0	NS
10) Went shopping	2.0	3.0	NS	2.0	3.0	NS
11) Went to the movies	1.0	1.0	NS	1.0	1.5	NS
12) Went to restaurants	2.0	2.0	NS	2.0	1.0	0.02
13) Attended religious services	3.0	2.0	NS	2.0	2.0	NS
14) Did community or volunteer work	2.0	2.0	NS	0.5	0.5	NS
15) Went to work	0.5	2.0	NS	0.0	0.5	NS
16) Community clubs or organizations	1.0	1.0	NS	0.0	0.0	NS
17) Participated in social events/celebrations	2.0	2.0	NS	1.0	1.0	NS
18) Went to sporting events	2.0	1.0	NS	1.0	1.0	NS
19) Participated in active sports	1.0	1.0	NS	0.0	0.0	NS
20) Went for a walk	3.0	3.0	NS	2.5	2.5	NS
21) Exercised	2.0	2.0	NS	3.0	3.0	NS
22) Worked in the yard or garden	1.5	1.0	NS	2.0	2.0	NS
23) Prepared meals	4.0	4.0	NS	3.0	3.5	NS
24) Did housework	4.0	4.0	NS	3.0	3.0	NS
25) Smiled fully in social situations	3.0	4.0	0.03	3.0	3.0	NS
26) Laughed fully in social situations	3.0	4.0	0.02	3.0	3.0	NS
27) Avoided conversation	0.0	0.0	NS	0.0	0.5	NS
28) Refused invitations	1.0	1.0	NS	0.5	1.5	NS

0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Every Day/Almost Every Day

TABLE XI

RATINGS OF SOCIAL ENGAGEMENT VARIABLES AFTER THE VARIABLES WERE COLLAPSED, PRE AND POST TREATMENT FOR MANDIBULAR IMPLANT OVERDENTURES, BY AGE, N=27 (11=<60 yo, 16=>60 yo)

COLLAPSED SOCIAL ENGAGEMENT VARIABLES	PRE-Median <60 yo	POST-Median <60yo	P-Value <60 yo	PRE-Median >60 yo	POST-Median >60 yo	P-Value >60 yo
1) Went on trips	2.0	2.0	NS	1.0	1.5	NS
2) Visited	3.0	3.0	NS	3.0	3.0	NS
3) Entertained	2.0	3.0	NS	2.0	2.0	NS
4) Phone conversations	3.0	3.0	NS	2.5	3.0	0.05

0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Every Day/Almost Every Day

4.3 **Patient Satisfaction Results: Semantic Differential Scale and Modified Oral Health Impact Profile-14**

Median values for the seven semantic differential scales measuring patient satisfaction with mandibular implant overdenture treatment are presented in Table X (overall median=9). Patients were least satisfied with *time involved for treatment* (median=6) and were most satisfied with *aesthetics* (median=9), *chewing ability* (median=9), *experience* (median=9), and *overall satisfaction* (median=10).

TABLE XII
MEDIAN RESPONSES TO THE PATIENT SATISFACTION QUESTIONNAIRE:
DIFFERENTIAL SEMANTIC SCALES, N=27

My treatment was...(1-10)	Median
1) Expensive----Inexpensive	8
2) Time-consuming---Quick	6
3) Painful---Pain Free	8
4) Poor Aesthetics---Good Aesthetics	9
5) Poor Chewing Ability---Good Chewing Ability	9
6) Unpleasant---Pleasant	9
7) Very Dissatisfied---Very Satisfied	10
Overall Median	9

10 indicated the most favorable direction on the semantic scale.

Median values for the modified Oral Health Impact Profile-14 are presented in Table XI (overall median=0.0). Responses were completed on a 5-point Likert scale. Patients, as a whole, reported *hardly ever* having “*trouble pronouncing words*”, having “*painful aching*”, or finding it “*uncomfortable to eat*”

any foods because of their implant restorations". The other eleven measures of satisfaction in the modified OHIP-14 questionnaire were reported as *never*, for the sample as a whole.

TABLE XIII
MEDIAN RESPONSES TO THE MODIFIED OHIP-14, N=27

Question	Median
1) Have you had trouble pronouncing any words because of your implant restorations(s)?	1
2) Have you felt that your sense of taste has worsened because of your implant restoration(s)?	0
3) Have you had painful aching in your mouth?	1
4) Have you found it uncomfortable to eat any foods because of your implant restoration(s)?	1
5) Have you been self-conscious because of your implant restoration(s)?	0
6) Have you felt tense because of problems with your implant restoration(s)?	0
7) Has your diet been unsatisfactory because of your implant restoration(s)?	0
8) Have you had to interrupt meals because of your implant restoration(s)?	0
9) Have you found it difficult to relax because of your implant restoration(s)?	0
10) Have you been embarrassed because of your implant restoration(s)?	0
11) Have you been a bit irritable with other people because of your implant restoration(s)?	0
12) Have you had difficulty doing your usual jobs because of your implant restoration(s)?	0
13) Have you felt that life in general was less satisfying because of your implant restoration(s)?	0
14) Have you been totally unable to function because of your implant restoration(s)?	0
Overall Median	0

0=Never, 1=Hardly Ever, 2=Occasionally, 3=Fairly Often, 4=Very Often

5. DISCUSSION

5.1 Discussion

Within the limitations of the study, the null hypothesis that there would be no differences regarding treatment effect on social engagement with mandibular two-implant overdenture therapy for patients at the UIC COD was tentatively rejected. Significant differences ($p < 0.05$) were found for the overall sample for combined variables “*went on trips*” ($p = 0.035$), “*visited*” ($p = 0.026$), and “*engaged in leisure phone conversations*” ($p = 0.017$). Differences approaching significance were observed for the overall sample for “*went on trips with family*” ($p = 0.071$) and “*engaged in leisure phone conversations with family*” ($p = 0.067$). However, since a multitude of significant tests were performed with a sample size of only 27, these significant findings may be due to Type 1 error. Thus, although significant differences were found for treatment effect on social engagement with mandibular implant overdenture therapy for the overall sample, there is not yet a compelling reason to clinically apply the results to the patient in question.

The null hypothesis that there would be no gender differences regarding treatment effect on social engagement with mandibular two-implant overdenture therapy was tentatively rejected. Significant differences were found for women with “*did housework*” ($p = 0.046$), “*smiled fully in social situations*” ($p = 0.019$), and “*laughed fully in social situations*” ($p = 0.024$). For men, a significant difference was found only for the combined variable “*went on trips*” ($p = 0.025$). However, due to the small sample size and numerous statistical comparisons that

increased the likelihood of Type 1 error, potentially leading to spurious results, there is not yet a compelling reason to clinically apply the results suggestive of gender differences in treatment effect on social engagement with mandibular implant overdenture therapy.

The results of this pilot study tentatively suggest that there may be a treatment effect on social engagement with mandibular implant overdenture therapy and gender differences may exist, with a potentially more prominent effect on the female gender, however, future research is needed. Similar studies by Heydecke and colleagues³⁹ and Bouma and colleagues⁴³ reported mandibular implant overdentures provided greater social engagement and less psychosocial limitations after treatment, respectively.

The hypothesis that patients would have a high level of satisfaction with their treatment was accepted. High post-treatment satisfaction scores with mandibular implant overdenture therapy, based on results from seven semantic differential scales and a modified version of OHIP-14, support similar findings in other studies^{39-43,59} that have assessed patient satisfaction with mandibular implant overdenture therapy. Satisfaction scores for the semantic differential scales were relatively high (≥ 8 on a 1-10 scale), for six of the seven semantic differential scales, with an overall median of 9.

The semantic differential scale with the lowest median value (6) was for “*time involved for treatment*”. This is likely attributed to treatment taking place in a dental school environment, where appointment times run longer to meet the educational needs of the dental students. Each patient also had to undergo

numerous appointments to arrive at the completion of his/her implant-retained mandibular implant overdenture prosthesis. These appointments included, but were not limited to, initial screening exams, comprehensive exams, appointments required for the fabrication of conventional dentures, separate implant consultation appointments with restorative and surgical departments, and surgical and restorative appointments. Furthermore, undergraduate dental students were required to coordinate appointments with their schedules and the schedules of the patients, and faculty they were working with, adding to an increased time frame for treatment. Nonetheless, patients were very satisfied with *aesthetics* (median=9), *chewing ability* (median=9), and *experience* (median=9). More importantly, the median value for the semantic differential scale assessing overall satisfaction scored the highest (10.0 on a 1-10 scale), showing that despite lengthy treatment time, patients were “*very satisfied*” with their overall treatment. High satisfaction scores for the semantic differential scales measuring *level of pain* (median=8) and *treatment experience* (median=9) suggest that patients should not avoid implant overdenture treatment due to fear of pain or unpleasant treatment experience. Based on the results of the study, patients have a relatively pain free and pleasant experience with implant overdenture therapy.

The modified Oral Health Impact Profile-14 additionally showed a high level of patient treatment satisfaction with mandibular implant overdenture therapy. Heydecke and colleagues³⁹ and Allen and colleagues,⁵⁹ who both used Oral Health Impact Profile-49 to measure patient treatment satisfaction with

mandibular implant overdenture therapy, found similar results. With lower values representing higher patient satisfaction related to lesser frequency of complications, the median values for 11 of the 14 questions were zero (representing “*never*”) with an overall median of zero. The other three questions had median values of 1 (representing “*hardly ever*”). Patients hardly ever had “*trouble pronouncing words*”, “*any painful aching in the mouth*”, or “*found it uncomfortable to eat any foods because of their implant restorations*”. Patients never “*felt self-conscious*” or “*embarrassed because of their implant restorations*”. This is an interesting finding when considering two of the three significant differences found from the social engagement questionnaire for women were “*smiled fully in social situations*” and “*laughed fully in social situations*”. Together these findings may suggest the important role that mandibular implant overdenture therapy may serve in positively impacting patient self-esteem and confidence for women, in turn positively impacting their level of social engagement.

The remaining significant difference found for women regarding treatment effect on social engagement with mandibular implant overdenture therapy was “*did housework*.” This may also be related to a proposed increased level of self-esteem, confidence, and self-satisfaction for women. Altschuler⁶⁶ evaluated the meaning of housework and its centrality to personal identity among 53 older women, 55-84 years of age, through taped in-person interviews with open-ended questions. Some women reported that doing housework gave them satisfaction and pleasure, once completed.

Due to research suggesting social engagement has a positive impact on patient health,^{1-12,22,49} it is important to research whether or not specific dental therapy may positively impact social engagement. The number of completely edentulous patients needing prostheses is estimated to increase to 37.9 million by 2020.²³ Mandibular implant-retained overdenture therapy is a treatment option for these patients, and by some is considered to be the first choice treatment option for edentulous patients.^{37,38} With high success and survival,²⁵⁻²⁹ even for elderly patients with or without systemic complications,^{24,30,54} mandibular implant overdenture therapy remains a predictable treatment option that can provide patients with increased satisfaction, function, and quality of life.^{36,39,40-43,59} More interestingly, studies specifically evaluating gender differences related to treatment effect on social engagement with mandibular implant overdenture therapy have not yet been investigated.

The study at hand suggests that there may be a treatment effect on social engagement with mandibular implant overdenture therapy for both men and women. Different improvement levels and levels of significance were found for men and women, with more significant differences found for women. Therefore, it is suggestive that although there may be a treatment effect on social engagement with mandibular implant overdenture therapy for both men and women, the mode and level of impact may be different by gender. Gender differences in mode of effect was similarly suggested by Patricia Thomas,⁴⁴ who found that for women, greater involvement with social activity led to a reduction in levels of physical and cognitive limitations. On the contrary, for men, it was

found that physical and cognitive limitations led to a reduction in levels of subsequent social engagement.⁴⁴ Siato and colleagues⁴⁶ found that social exclusion had an overall greater impact on increased mortality for women, compared to men, despite the prevalence of social isolation being twice as high for men. The development of gender-specific approaches to care in relation to social engagement is strongly encouraged and additional research on this topic is of utmost importance.

5.2 **Limitations of the Study and Future Research**

The greatest limitation of the study was the small sample size (n=27, men=14, women=13). Due to strict inclusion criteria to increase the homogeneity of the study, a single cohort was used for completion of pre- and post-treatment social engagement questionnaires. This resulted in the exclusion of 19 patients from participation in the study. Additionally, excluding patients that had denture complications may have altered the outcomes of the study, resulting in a group of patients with an initial high level of satisfaction with their conventional complete dentures. Administration of pre-treatment semantic differential scales and modified OHIP-14 would have been ideal for pre- and post-treatment satisfaction comparison between conventional dentures and mandibular implant overdentures. The small sample size and myriad of statistical comparisons (3 times 32 statistical analyses) considerably increased the chances of Type 1 errors, likely resulting in spurious significant results. Since the chance of making

an error on any one of the statistical comparisons was 5%, the chance of at least one error occurring after doing 96 tests was over 100%. The strong likelihood of Type 1 error is further supported by the resulting significant p-values falling between 1% and 5%. Of course, small sample size might also lead to Type 2 errors, where important differences cannot be detected. In addition, the small sample size precluded the meaningfulness of a factor analysis. A larger sample size is desirable to further evaluate the treatment effect on social engagement with mandibular implant overdenture therapy.

As the principle goal of the study was to assess treatment effect on social engagement with mandibular implant overdenture therapy, a questionnaire covering a broad array of social engagement activities was desired. Such a questionnaire was created through compilation of 28 specific social engagement questions extracted from previous studies^{2,9,11,39-41,44,57} evaluating social engagement. Although the 28 questions had been previously used in other research studies, the 28-question social engagement questionnaire as a whole had not yet been evaluated. This study may indicate which social engagement measures will be useful in measuring the impact of overdentures on social engagement.

For example, to make the social engagement questionnaire more defined, four original questions (*“went on trips”*; *“visited”*; *“entertained”*; *“engaged in leisure phone conversations”*) were separated into eight questions comparing company involved in the social engagement activity (family versus friends). Since no significant differences were found when the company was divided, but

the questions did reveal differences when the company was collapsed, this indicates that future measures should use the original wording.

Seasonal changes in weather may have potentially had an impact on the way patients completed pre- and post- social engagement questionnaires, since frequency of involvement in outdoor activities, such as going for a walk or working in the yard or garden, may be weather-related.

Moreover, demographic variables such as age, race, income, education, employment status, marital status, and living status are all factors that may have had an effect on the gender comparisons. For example, the mean age of the sample of men was ten years older (67) than the sample of women (57). Thus, Wilcoxon Signed-Rank Tests were performed to compare pre- and post-treatment data of the social engagement questionnaires (original and collapsed versions) for two separate age groups (<60 years of age; >60 years of age) to evaluate for potential age-related components. Significant differences were found for the <60 years of age group for “*smiled fully in social situations*” ($p=0.03$) and “*laughed fully in social situations*” ($p=0.02$). Interestingly, significant differences were found for women for the same social engagement variables, “*smiled fully in social situations*” and “*laughed fully in social situations*” (both $p=0.02$). Likewise, significant differences were found for the >60 years of age group for “*engaged in leisure phone conversations with family*” ($p=0.05$), “*went to restaurants*” ($p=0.02$) and for collapsed variable “*engaged in leisure phone conversations*” ($p=0.05$). For “*engaged in leisure phone conversations with family*”, close to significant differences were found for men ($p=0.06$) and the overall sample ($p=0.07$). For

“went to restaurants”, a close to significant difference was found for men ($p=0.06$). For collapsed variable *“engaged in leisure phone conversations”*, significant differences were found for the overall sample ($p=0.02$) and a close to significant difference was found for men ($p=0.06$). Thus, there may be age-related components that affected the results of the study that were disguised as gender and/or social engagement differences.

A potential placebo effect may have impacted the results from the semantic differential scales and modified OHIP-14 that measured post-treatment satisfaction. Patients may have rated high satisfaction scores based on preconceived notions and treatment expectations.

Another limitation was that only short-term data were collected and reported in the study with patients completing questionnaires four months before and after treatment. Long-term assessment of treatment effect on social engagement with mandibular implant overdenture therapy is desired. Lastly, there was no control group (conventional mandibular dentures) in the study. Long-term comparison between a control group and treatment group would help to determine whether or not mandibular implant overdenture therapy demonstrates a treatment effect on social engagement.

Future research should entail a randomized, controlled, crossover study design of a larger sample size. Long-term assessment and follow-up with repeated administration of the questionnaires should be incorporated in the study design to help control for measurement error caused by intra-subject variability. To decrease the likelihood of Type 1 error, a new scale on social engagement

could be developed by selecting the questions that appeared to improve in this pilot study, and then repeat the study with the new social engagement questionnaire. This would lower the number of statistical tests, decrease the chance of Type 1 error, and focus the measures on what might be most likely to change, resulting in more plausible data.

6. CONCLUSION

Within the limitations of the study, the following conclusions were drawn:

1. For the overall sample, two-implant retained mandibular overdenture therapy with resilient attachments may have had a significant treatment effect on some aspects of social engagement. Significant differences ($p < 0.05$) were reported for *“went on trips”*, *“visited”*, and *“engaged in leisure phone conversations”*.
2. Two-implant retained mandibular overdenture therapy with resilient attachments appeared to have a different treatment effect on social engagement for men and women, and for different age groups. Women reported improvements in *“did housework”*, *“smiled fully in social situations”*, and *“laughed fully in social situations”*. Men reported improvements in *“went on trips”*. Significant differences were found for the <60 years of age group for *“smiled fully in social situations”* and *“laughed fully in social situations”*. Significant differences were found for the >60 years of age group for *“engaged in leisure phone conversations with family”*, *“went to restaurants”*, and for collapsed variable *“engaged in leisure phone conversations”*.
3. Patients had a high level of satisfaction with implant-retained overdenture treatment based on post-treatment semantic differential scales (overall median=9.0) and modified OHIP-14 (overall median=0).

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APPENDICES

APPENDIX A. Pre-Treatment Demographic Questionnaire.

PRE-TREATMENT DEMOGRAPHIC QUESTIONNAIRE	
PLEASE CIRCLE OR FILL IN THE APPROPRIATE RESPONSE:	
1.	How long have you been wearing your present lower denture: a. Less than 4 months b. 4 months or greater
2.	Sex: a. Female b. Male
3.	Date of Birth: _____
4.	Race: a. Hispanic b. Black c. Asian d. White e. Other (please print): _____
5.	Marital status: a. Single b. Married c. Divorced d. Widowed e. Unmarried Partners
6.	Living Status: a. Live Alone b. Live with Other People If living with another individual(s) please answer the following: 1. Total number in household (including yourself): _____ 2. Do you live with: a. Family b. Friend(s) c. Both
7.	Education: a. Less than high school b. High school c. College degree or more
8.	Employment Status: a. Non-Employed b. Part-time Employment c. Full-time Employment
9.	Annual Household Income: a. Less than \$5000 b. \$5000-\$9,999 c. \$10,000-\$14,999 d. \$15,000-\$20,000 e. Greater than \$20,000

APPENDICES (continued)

APPENDIX B. Pre- and Post-Treatment Social Engagement Questionnaire.

	Social Engagement Survey: In the last 4 months, how often have you done each of the following:	Never	Rarely	Some-times	Often	Every Day / Almost Every Day	Not Applicable
1	Went on day or overnight trips with family						
2	Went on day or overnight trips with friends						
3	Visited family						
4	Visited friends						
5	Entertained family						
6	Entertained friends						
7	Engaged in leisure phone conversations with family						
8	Engaged in leisure phone conversations with friends						
9	Played cards, bingo, or other games with people						
10	Went shopping						
11	Went to the movies						
12	Went to restaurants						
13	Attended religious services						
14	Did unpaid community or volunteer work						
15	Went to work (part-time or full-time employment)						
16	Participated in community groups, clubs, or organizations						
17	Participated in social events or celebrations						
18	Went to sporting events						
19	Participated in active sports						
20	Went for a walk						
21	Exercised						
22	Worked in the yard or garden						
23	Prepared meals						
24	Did housework						
25	Smiled fully in social situations						
26	Laughed fully in social situations						
27	Avoided conversation						
28	Refused invitations						

APPENDICES (continued)

APPENDIX C. Post-Treatment Semantic Differential Scales.

Patient satisfaction measurement with Implant treatment

My treatment was...

1	2	3	4	5	6	7	8	9	10
expensive					inexpensive				
1	2	3	4	5	6	7	8	9	10
time-consuming					quick				
1	2	3	4	5	6	7	8	9	10
painful					pain free				
1	2	3	4	5	6	7	8	9	10
tooth had poor aesthetics					good aesthetics				
1	2	3	4	5	6	7	8	9	10
poor chewing ability					good chewing ability				
1	2	3	4	5	6	7	8	9	10
unpleasant					pleasant				

I was...

1	2	3	4	5	6	7	8	9	10
very dissatisfied					very satisfied				

APPENDICES (continued)

APPENDIX D. Post-Treatment Modified Oral Health Impact Profile-14.

Please assess the following and circle the best answer:

	0=never	1=hardly ever	2=occasionally	3=fairly often	4=very often
Have you had trouble <i>pronouncing any words</i> because of your implant restoration(s)?	0	1	2	3	4
Have you felt that your <i>sense of taste</i> has worsened because of your implant restoration(s)?	0	1	2	3	4
Have you had <i>painful aching</i> in your mouth?	0	1	2	3	4
Have you found it <i>uncomfortable to eat any foods</i> because of your implant restoration(s)?	0	1	2	3	4
Have you been <i>self-conscious</i> because of your implant restoration(s)?	0	1	2	3	4
Have you <i>felt tense</i> because of problems with your implant restoration(s)?	0	1	2	3	4
Has your <i>diet been unsatisfactory</i> because of your implant restoration(s)?	0	1	2	3	4
Have you had to <i>interrupt meals</i> because of your implant restoration(s)?	0	1	2	3	4
Have you found it <i>difficult to relax</i> because of your implant restoration(s)?	0	1	2	3	4
Have you been a bit <i>embarrassed</i> because of your implant restoration(s)?	0	1	2	3	4
Have you been a bit <i>irritable with other people</i> because of your implant restoration(s)?	0	1	2	3	4
Have you had <i>difficulty doing your usual jobs</i> because of your implant restoration(s)?	0	1	2	3	4
Have you felt that life in general was <i>less satisfying</i> because of your implant restoration(s)?	0	1	2	3	4
Have you been <i>totally unable to function</i> because of your implant restoration(s)?	0	1	2	3	4

APPENDICES (continued)

APPENDIX E. Pre-Treatment Social Engagement Raw Data.

PATIENT ID#	GENDER M/F	AGE	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	
1	F	59	2	2	3	3	3	2	3	2	2	3	2	2	1	N/A	4	1	2	2	1	2	1	1	4	4	3	3	N/A	0	
2	F	47	2	0	3	2	2	2	3	2	2	2	1	1	2	0	0	0	2	2	2	1	1	2	4	4	2	2	2	1	
3	M	61	0	0	3	3	2	2	4	2	4	2	0	2	2	1	0	0	2	0	0	2	2	0	4	4	4	4	0	2	
4	M	58	3	2	3	2	3	2	3	3	1	2	1	3	0	4	4	4	4	2	1	3	1	3	3	3	3	1	1	1	
5	M	64	3	3	3	3	3	2	4	4	0	2	0	2	2	0	4	0	0	2	0	0	4	2	4	4	2	2	2	2	
6	M	58	2	2	2	2	2	2	4	4	3	3	1	3	3	3	N/A	3	3	2	2	4	3	N/A	4	4	4	4	0	0	
7	F	65	2	0	3	2	3	2	3	2	0	2	1	2	2	0	0	0	2	1	0	2	2	2	2	3	3	2	2	2	
8	M	84	1	1	3	3	2	2	3	3	4	3	3	3	1	1	0	1	2	1	3	2	3	0	3	2	3	3	0	1	
9	F	75	0	2	0	3	2	2	1	1	2	3	2	2	2	0	0	2	2	2	0	4	4	2	4	3	2	3	0	0	
10	F	51	2	2	3	3	3	2	4	3	2	3	2	2	2	0	3	0	3	0	0	2	2	2	4	3	4	4	0	1	
11	F	61	2	0	2	0	0	0	3	1	0	4	2	2	0	0	4	0	0	0	0	2	3	0	N/A	N/A	N/A	N/A	0	0	
12	F	58	1	2	3	2	3	2	2	2	2	2	1	2	3	2	0	1	2	1	1	3	1	0	3	3	3	3	0	1	
13	M	82	0	0	2	3	0	2	0	0	0	3	1	1	0	0	0	0	0	2	0	3	3	0	3	4	1	1	0	1	
14	M	65	1	1	2	3	2	2	2	2	1	3	1	2	1	1	4	1	1	1	1	1	1	3	0	3	2	2	2	2	
15	F	31	1	1	4	4	4	4	4	4	2	4	2	3	3	2	1	2	2	1	1	4	3	3	4	4	4	4	0	2	
16	F	68	1	1	3	3	2	2	3	2	1	2	1	2	2	1	1	0	0	3	1	3	2	2	2	2	3	3	0	0	
17	M	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	4	3	3	3	0	0	
18	M	67	1	1	0	1	1	1	2	2	1	2	2	3	2	1	4	1	1	0	0	3	2	2	2	2	3	3	0	0	
19	M	67	1	1	3	3	2	2	1	1	1	2	2	3	3	1	0	0	1	2	1	3	4	3	3	3	4	4	0	0	
20	F	62	1	0	3	3	2	3	3	3	2	3	1	1	3	1	4	3	2	1	1	3	2	1	4	4	3	3	0	0	
21	F	58	0	1	0	3	0	2	0	2	1	2	1	1	1	2	0	1	2	1	0	3	3	1	4	4	3	3	1	0	
22	M	73	2	1	3	3	3	2	3	1	2	3	1	2	3	2	0	2	2	2	2	3	3	4	4	3	3	3	2	2	
23	F	59	3	2	2	1	2	1	1	2	1	2	2	2	3	1	0	0	2	3	1	2	2	2	1	4	4	0	0	2	1
24	M	44	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	2	0	0	
25	F	57	2	0	3	2	2	1	4	4	0	2	1	2	3	0	0	0	1	0	0	1	2	1	3	2	0	0	0	2	
26	M	71	0	0	2	2	2	2	2	1	2	2	0	1	3	0	N/A	0	2	2	1	2	0	4	1	2	2	2	2	0	0
27	M	79	0	0	3	3	2	1	2	1	0	1	1	2	3	0	0	0	0	1	0	3	3	2	2	3	3	3	2	2	2

APPENDICES (continued)

APPENDIX F. Post-Treatment Social Engagement Raw Data.

PATIENT ID#	GENDER M/F	AGE	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28
1	F	59	3	1	3	3	2	2	4	3	2	3	2	2	2	2	4	1	2	2	1	2	2	3	4	4	4	4	1	1
2	F	47	2	2	3	2	2	2	3	3	N/A	3	1	1	1	0	N/A	0	2	1	2	2	1	2	4	4	4	2	1	1
3	M	61	0	0	3	1	2	1	4	3	1	2	0	1	2	0	0	0	0	0	0	0	2	0	3	2	1	0	1	0
4	M	58	3	1	3	1	1	1	3	1	0	2	0	3	0	3	4	4	3	1	1	3	1	3	4	4	3	3	2	2
5	M	64	3	0	2	3	3	0	4	2	0	4	3	3	2	0	4	0	0	0	0	0	0	2	4	4	4	4	3	3
6	M	58	2	2	3	4	3	4	4	4	4	4	1	3	4	4	N/A	4	4	1	1	4	4	0	4	3	4	4	0	0
7	F	65	1	0	2	2	2	1	4	1	0	1	0	1	2	0	0	0	1	0	0	2	2	0	4	4	2	2	0	0
8	M	84	2	2	2	3	2	2	3	3	4	3	3	3	0	1	0	1	2	1	3	3	4	0	4	3	4	4	1	1
9	F	75	2	2	3	3	3	3	3	3	1	3	3	2	0	3	N/A	3	2	1	0	4	4	3	4	3	4	3	0	0
10	F	51	2	2	3	3	2	2	4	4	2	3	2	2	3	1	3	1	2	2	0	2	1	1	3	3	4	4	0	1
11	F	61	2	1	2	2	2	1	2	2	1	3	2	2	0	0	4	1	1	0	0	2	2	2	4	4	3	3	0	2
12	F	58	2	1	3	2	3	1	3	3	1	3	0	3	3	2	0	1	3	1	1	4	1	0	4	4	4	4	0	1
13	M	82	0	0	3	2	1	1	1	1	0	3	2	1	0	0	0	0	2	3	0	3	3	0	3	3	3	3	1	1
14	M	65	0	2	2	2	1	1	3	3	1	3	0	1	0	0	4	0	0	0	3	2	3	0	2	2	2	2	2	1
15	F	31	1	1	3	3	3	3	2	3	2	1	1	2	3	2	1	1	1	1	1	3	2	1	1	4	4	4	1	1
16	F	68	2	1	2	2	2	2	3	1	2	2	1	1	2	1	1	0	0	2	1	2	2	3	3	3	3	3	0	2
17	M	70	1	1	2	1	0	0	3	2	0	0	0	0	3	0	0	0	0	2	1	4	4	2	4	4	3	3	1	2
18	M	67	2	0	2	2	2	2	2	2	1	2	2	2	2	1	4	1	1	1	0	2	2	1	2	2	3	2	0	0
19	M	67	1	1	3	3	2	2	1	1	1	2	2	2	3	1	1	1	1	2	1	3	3	4	2	2	1	1	2	2
20	F	62	2	1	3	3	2	2	3	2	1	3	2	1	3	2	4	3	1	1	0	3	2	2	4	4	4	4	0	0
21	F	58	0	2	0	3	0	3	0	4	1	3	2	2	1	2	0	2	3	1	0	4	4	0	4	4	4	4	0	0
22	M	73	N/A	0	2	3	2	1	3	2	1	3	0	1	3	1	N/A	1	2	2	1	4	4	4	4	3	3	3	0	2
23	F	59	2	1	2	2	2	1	3	3	1	3	2	2	3	2	N/A	0	2	3	1	4	2	3	4	4	4	4	0	1
24	M	44	3	3	3	3	3	3	3	3	3	3	1	3	1	2	3	1	3	3	3	3	3	3	3	3	3	3	4	0
25	F	57	2	1	4	2	4	2	4	3	1	3	1	3	2	0	0	0	0	0	0	1	2	1	3	3	3	3	0	1
26	M	71	0	0	2	2	1	1	2	1	2	3	1	1	3	2	0	0	0	0	0	3	3	4	0	2	3	0	0	2
27	M	79	0	0	3	1	2	2	3	2	0	0	0	1	3	0	0	0	1	0	0	2	4	0	2	3	2	2	1	2

APPENDICES (continued)

APPENDIX G. Post-Treatment Semantic Differential Scales Raw Data.

PATIENT ID#	GENDER M/F	SCALE 1	SCALE 2	SCALE 3	SCALE 4	SCALE 5	SCALE 6	SCALE 7
1	F	5	5	8	9	9	10	10
2	F	10	10	10	10	10	10	10
3	M	9	3	3	10	9	9	9
4	M	5	5	1	10	10	10	10
5	M	10	10	10	10	8	10	10
6	M	8	6	8	6	9	7	10
7	F	6	4	7	10	8	9	10
8	M	9	3	8	8	9	9	9
9	F	8	8	7	9	8	9	9
10	F	10	8	7	10	10	9	10
11	F	10	8	10	8	10	10	10
12	F	6	6	8	10	10	10	10
13	M	10	7	10	10	9	8	9
14	M	8	2	5	6	5	5	8
15	F	1	1	1	9	5	5	10
16	F	10	6	10	10	9	9	10
17	M	7	6	8	8	6	7	8
18	M	9	8	5	8	8	9	9
19	M	4	5	2	7	7	7	7
20	F	10	8	6	7	9	10	8
21	M	8	7	8	9	9	9	10
22	F	7	7	9	9	8	7	10
23	F	6	4	7	10	10	9	10
24	M	7	7	10	10	8	10	10
25	F	10	5	7	10	8	10	10
26	M	4	3	5	8	5	7	8
27	M	9	9	9	10	9	9	10

APPENDICES (continued)

APPENDIX H. Post-Treatment Modified OHIP-14 Raw Data.

PATIENT ID #	GENDER M/F	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
1	F	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	F	1	0	1	2	0	0	0	2	0	0	0	1	0	0
3	M	2	1	1	1	0	0	0	0	0	0	0	0	0	0
4	M	1	2	0	1	1	0	0	0	0	1	0	0	0	0
5	M	1	0	0	2	0	0	0	0	0	0	0	0	0	0
6	M	1	0	0	0	0	0	0	1	0	0	0	0	0	0
7	F	0	0	1	0	1	0	0	0	0	1	0	0	0	0
8	M	0	0	0	0	0	0	0	1	0	0	0	0	0	0
9	F	0	0	1	1	0	0	0	1	0	0	0	0	0	0
10	F	0	0	2	0	0	0	0	0	0	0	0	0	0	0
11	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	F	0	0	1	0	0	0	0	0	0	0	0	0	0	0
13	M	1	2	0	1	0	0	0	2	0	0	0	0	0	0
14	M	1	3	1	2	1	0	1	0	0	1	0	0	1	0
15	F	1	2	2	0	0	0	0	0	0	0	0	0	0	0
16	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	M	1	0	0	2	0	0	2	0	0	0	0	0	0	0
18	M	1	1	0	2	0	0	0	1	0	0	0	0	0	0
19	M	0	3	1	1	2	2	2	1	2	2	1	1	1	0
20	F	2	0	0	0	0	0	0	1	0	1	0	1	0	0
21	M	0	0	1	1	0	1	0	0	0	0	0	0	0	0
22	F	1	2	1	2	0	1	1	2	0	0	0	0	0	0
23	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	M	0	0	2	2	1	0	0	1	0	0	1	1	0	0
25	F	0	1	2	2	0	0	0	1	0	0	0	0	0	0
26	M	1	0	1	2	0	0	0	0	0	0	0	0	0	0
27	M	4	0	1	2	1	2	2	2	1	0	1	0	0	0

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Professional Membership: American College of Prosthodontists

Abstract Poster Presentations: Master Thesis: "*Treatment Effect on Social Engagement with Mandibular Implant Overdenture Therapy*"

- American College of Prosthodontists, November 2012
- American Prosthodontic Society, February 2013
- University of Illinois at Chicago College of Dentistry, March 2013