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# COMPARISON OF IMPLANT-RETAINED OVERDENTURE AND CONVENTIONAL COMPLETE DENTURE IN THE EDENTULOUS MANDIBLE: A SURVEY STUDY TO MEASURE PATIENTS' SATISFACTION AND QUALITY OF LIFE IN DENTAL SCHOOL CLINICAL ENVIRONMENT

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DISSERTATION

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A dissertation submitted in partial fulfillment of the  
requirements for the degree of Doctor of Philosophy in the  
College of Medicine  
at the University of Kentucky

By

Dr. Ahmad Kutkut

Lexington, Kentucky

Co-Directors: Dr. Jamie Studts, Professor of Behavioral Science

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Lexington, Kentucky

2021

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## ABSTRACT OF DISSERTATION

### COMPARISON OF IMPLANT-RETAINED OVERDENTURE AND CONVENTIONAL COMPLETE DENTURE IN THE EDENTULOUS MANDIBLE: A SURVEY STUDY TO MEASURE PATIENTS' SATISFACTION AND QUALITY OF LIFE IN THE DENTAL SCHOOL CLINICAL ENVIRONMENT

Patient satisfaction and quality of life are integral parts of assessing the quality of oral health care. Current aging population trends suggest a growing need to understand the effects of edentulism on oral health and quality of life. As the proportion of aged Americans expands, there will be an increased need to understand treatment options and patient communication strategies. In addition, as new treatment options and innovative technologies emerge, it will be essential to understand patients' concerns and identify best practices associated with denture treatments' individual fit and function. Advanced denture treatments can now be fabricated using CAD/CAM digital denture techniques. However, for many Americans still using conventional complete dentures (CD) or Implant Retained-Overdentures (IOD), it remains essential to consider improving their oral health outcomes and quality of life metrics. Dental schools often feel pressured to adopt and teach the most advanced practices. However, they must continue to focus on the needs of edentulous patients and develop communication training and treatment options for an expanding population of CD and IOD patients. New technological innovations will not displace the need for dental school clinics to prepare student clinicians to identify patient concerns and carefully communicate treatment options.

Due to inexperienced student dentists who provide dental care to patients in dental school settings, patient grievances are generally considered a problem. Patients become unhappy and dissatisfied due to several factors such as less caregiving efficiency, discontinuity of care due to the school's curriculum and summer break, and various institutional policies, i.e., competencies. Patient feedback and satisfaction have proven to be valuable resources for monitoring and improving patient safety. Effective management of patient concerns can assist individual patients and provide insight for dental schools and professional prosthodontic practices that aspire to deliver the highest quality of care possible. Until the new CAD/CAM methods are made more available in public practice and reduced in cost, many edentulous patients will choose between CD and IOD based on the recommendations of their dental provider. In some instances, a CD may be required because of anatomic, functional, or economic reasons. However, implant-retained overdentures are increasingly understood as a preferential alternative treatment option for those with remaining natural teeth and financial ability. While these are the two leading treatment options for edentulism, there is a lack of comparative studies in the literature

comparing CD and IOD outcomes. Therefore, there is a need for studies that examine patient satisfaction and quality of life outcomes, particularly as they are associated with student dentists and considered in association with demographic factors. This study assesses patient satisfaction and quality of life among CD wearers and those with IODs. The data collected enable the examination of many essential factors related to oral health and quality of life. Together, these variable considerations allow a deeper understanding of the interpersonal skills and fabrication techniques that should be emphasized in a clinical dental school environment.

The research question that guided the comparative analysis was, "Is patient satisfaction and quality of life affected by the type of prostheses and provider?" A validated questionnaire was mailed to 520 individuals randomly selected from records of patients who had received treatment for edentulous mandible at a student prosthodontic clinic at the University of Kentucky College of Dentistry from 2014 to 2016 with at least one year of follow-up time. A validated questionnaire for edentulous patients based on the Oral Health Impact Profile (OHIP-19) was used. In addition, information on patients' oral health-related quality of life, including questions related to the edentulous patients' satisfaction with their dentures, was collected.

The response rate was 33% (N = 171). Survey results were analyzed using two-sample *t*-tests and chi-square tests to evaluate differences between and within groups. The study's findings confirm previous findings which suggest that IODs may have a greater impact on oral health-related quality of life. Data show that 76% of the IOD group reported improvement in experience when using the implants to retain the mandibular denture. However, there were no statistically significant differences in the OHIP scores between overall CD and IOD patient groups. Males with IOD had lower physical pain, limitations, and disability scores than males with CD. However, females with IOD reported more significant concerns associated with a social disability and handicap domains. Comparing users who had experiences with both treatment options, this study discerned important characteristics that contribute to increased patient satisfaction with IOD and identified significance in outcomes by gender. These findings serve to guide prosthodontic practitioners' patient care practices and identify a continuing need to discuss CD and IOD treatment protocols within dental school curricula.

KEYWORDS: Implant, Overdenture, Denture, Satisfaction, Quality of Life, Edentulous

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Dr. Ahmad Kutkut

12/06/2021

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Date

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## DEDICATION

I would like to thank my God (Allah) for all blessings and achievements I have, especially the faith, the health, the knowledge, and the strength to go forward.  
"O mankind! We created you from a pair of male and female and made you into nations and tribes that you may know each other. Verily the most honored of you in the sight of God is the most pious of you. And God has full knowledge and is well acquainted with all things". Sura 49, Aya 13.

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I would like to express my sincere thanks to my parents, who have been the reason for my existence, and they have always been there when I needed them. Your love, support, and guidance have shaped me into the person I am today. There are no words to express the extent of my gratitude to you. May God reward you with the best of his generosity. I love you both very much.

Lina, my dear wife, I cannot thank you enough for your support, help, and patience. You provide a source of energy that sustains me. I would not have been able to pursue this path without you. May God help me make it up to you. I love you so much. Sons: Amr, Obaida, and Jude, you are the joy of my life and will always be in my heart. I love you all.

I am grateful to my brothers and sisters for your support and the many positive memories that remain a source of pleasure and inspiration. I love you all.

The University of Kentucky's College of Medicine faculty has instilled insights and knowledge that I will use for years to come. I am incredibly grateful for the guidance and support provided by the CTS Ph.D. program faculty. It has been a pleasure working with you and learning from you. Thank you for your time and knowledge. I could not have completed this research without the help of Dr. Studts. In addition to dedicating considerable time to the project, Dr. Studts was an instrumental academic support resource. I owe him special thanks for the countless hours he contributed to help me complete this research. Additional thanks to Dr. Bush, whose time, advice, and words of encouragement have helped me successfully reach my goals throughout the program. I want to take an opportunity to thank Dr. Knudsen for her service as co-chair on the committee and Dr. Mitchell for his contributions as a member of the committee.



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## CHAPTER 1. INTRODUCTION

### 1.1 The Significance of Edentulism

Edentulism, or the complete loss of teeth, represents a loss of the masticatory system's integrity and function (Allen and Locker 2002). Edentulism is a chronic condition associated with continuous progressive alveolar bone resorption, debilitating irreversible circumstances, and several health problems. Millions of people worldwide have been affected by this complication after the complete loss of their teeth. It has negatively impacted patients' oral function, socialization, and normal daily activities (Emami et al. 2013). The impact of edentulism can range from a patient's feeling of inconvenience to severe handicap and even disability (Berg 1993). Edentulism is typically associated with old age (Harford 2009). Without a doubt, tooth loss can adversely affect a person's appearance, increase anxiety in public settings, contribute to loss of self-confidence, and create a need to learn to use new prosthetic implants or get complete dentures fitted (Celebić et al. 2003). Treatment with complete dentures has the potential to improve facial contours, functions, and aesthetics. Treatment may also help improve patients' social relationships and quality of life (Locker 2009). However, despite the advantages of complete dentures, 30% of edentulous patients report complaints with complete dentures (Celebić et al. 2003). For some patients, implant overdenture prosthetics may help reduce the criticisms associated with complete dentures while improving function and aesthetics.

### 1.2 Evolution of the Dental Profession

In the late 19th century, dentistry evolved from a mechanical trade to a medical profession in the United States. During this period, dental education became organized, state regulations were established, and the "American Journal of Dental Science" emerged

as the first peer-reviewed journal of dentistry. The dental profession grew increasingly receptive to scientific theory as new understandings of bacteria and disease were theorized. As early as 1909, William Hunter detailed the idea of focal sepsis and infection. Following the thesis that focal infections of the mouth caused body diseases, Billings (1912) reported a link between ill-fitting crowns on teeth and added bridgework which he speculated harbored septic infection in the mouth and led to systemic disease. As a medical profession, dentistry began to recognize the connection between the mouth and the health of the body. The theory of focal infection or focal sepsis theory helped to explain this mouth-body connection and gained prominence. Focal infection or sepsis theory hypothesized that bacteria spread from chronically infected sites, like the mouth, to critical organs like the heart and liver, increasing the subject's risk for disease. Focal infection theories implied that periodontal diseases were the impetus or progenitor of physical diseases.

As the acceptance of focal infection theory spread among the dentistry profession, the complete therapeutic edentulation of subjects became a standard treatment for individuals with dental infections. Treatment by dental extraction was advocated throughout the early 1900s. Billings (1930) describes the period as "a crusade of tooth extraction" (Billings 1930). Americans did not need to travel far to find a dentist capable of complete dental extraction. At the height of the U.S. dental extraction "crusade" in the 1930s, the dentist to population ratio was 1:1,732, the highest in the nation's history (Burt 1978, Mertz and O'Neil 2002). However, by the 1940s, medical researchers had convincingly demonstrated that heart, liver, kidney, and other organ diseases were not directly attributed to oral infections. During the same era, dentists began reporting that extraction had no impact on diseases previously attributed to oral infection. These new

findings jeopardized the theory of focal infection. The idea fell out of favor as its explanatory power diminished. By the 1950s, the wholesale extraction of teeth was discouraged as a therapeutic treatment (Easlick 1951).

Although the focal infection theory was no longer accepted, the mouth-body connection persisted. As a result, a stronger emphasis on oral health emerged in individual oral hygiene and public health policy changes. The medical community began promoting individual behaviors like regular hygiene as a form of preventative care. Individuals' widespread adoption of regular tooth brushing emerged as a result. Beyond personal changes, whole communities installed water fluoridation programs to improve oral health. As the emphasis on oral health shifted, negative social stigmas emerged around complete tooth loss as an indicator of overall health and social desirability.

In the United States, higher rates of edentulism are associated with geographic location. For example, it was reported that the higher edentulism rate in the Appalachian Mountains and Mississippi Delta because of the rural poverty, which has been endemic to the region since the Great Depression (Gorsuch et al. 2014, Fligstein 1983, Macek et al. 2004, Macek et al. 2004). In addition, the loss of jobs in farming, forestry, and manufacturing affects dental care provision because dental attendance is a strong predictor of tooth retention (Macek et al. 2004).

The projected decline in the number of edentulous people through 2050 is offset by the rising number of individuals who will require conventional complete or implant-retained overdentures (Feine et al. 2002). These considerations will have long-term effects on dental education. One report entitled "Should the Teaching of Full Denture Prosthetics Be Maintained in Schools of Dentistry?" was forthright when answering the question. In

the report, the authors provide a compelling call for the continuation of both CD and IOD educational programs and an expansion of the clinical training opportunities, which enrich the development of the necessary interpersonal skills required to treat edentulous patients (Waldman et al. 2007).

### 1.3 The Research Problem: Tooth Loss in Adults

Dental caries and periodontitis are the most prominent causes of tooth loss (Rozier et al. 2017). Dental caries results in tooth decay that causes the formation of a cavity where bacteria and acids thrive in the presence of sucrose, other sugars, and refined starches. As the bacteria thrive, the tooth decays. Periodontitis is inflammation of the hard and soft tissues around the teeth, often causing recessions of the gingiva and loosening of the teeth. Although problematic, most adults will develop caries or periodontitis at some point throughout their lifetime, usually in several teeth (Rozier et al. 2017). Research has found that the number of dental caries was not strongly associated with levels of complete tooth loss (Davis 1978). More recent research has examined the lifetime risk of tooth loss as it is linked to proximal causes that unfold throughout life. As important moderating factors, these include signs and symptoms of dental disease (e.g., toothache) and phobia from dental care (Pohjola et al. 2008).

In addition to individual behaviors and public health policies, research also demonstrates that tooth loss is affected by various socio-behavioral factors, including:

- (1) Adverse life events (Drake et al. 1995)
- (2) Low prestige (Drake et al. 1995)
- (3) Depression (Drake et al. 1995)
- (4) Needing help from others (Drake et al. 1995)



(5) Psychological stress (Genco et al. 1999) and

(6) Personality attributes, such as anxiety (Ng and Leung 2006).

Taking up a new consideration of the mouth-body connection, Tyrovolas et al. (2016) reported a significant association between edentulism, depression, and poor self-evaluations of health in younger patients. Among behavioral factors, smoking has been recognized as a predictor of tooth loss (Ahlqwist et al. 1989). Similarly, the consumption of carbonated soft drinks (Sohn et al. 2006) and poor oral hygiene (Amarasena et al. 2002) have been associated with higher dental caries and periodontitis rates. Researchers have even found significant correlations between early life influences like birth weight, duration of breastfeeding, and pacifier use with tooth loss (Pearce et al. 2004). Despite these many factors, the frequency and quality of dental care and individual oral hygiene are crucial factors that contribute to the prevalence of compromised teeth (Gilbert et al. 2006). In direct correlation with socioeconomic status, studies suggest that people with lower income or educational attainment are at greater risk of edentulism (Burt 1990, Davis 1987, Drake 1995, Genco 1999, Ng 2006, Pohjola 2008, Thomson et al. 2000).

#### 1.4 Prevalence of Edentulism Among Adults:

Complete tooth loss (edentulism) affects about 5% of U.S. adults (Slade et al. 2014). Several national surveys have analyzed the prevalence of edentulism associated with; age groups, household income, gender, and race associations (Slade et al. 2014). A longitudinal analysis with a long time series revealed that most of the differences among age groups could be controlled for by accounting for the past experiences of different populations and not the effects of aging itself (Slade et al. 2014). As Americans' oral health

has improved over time, complete tooth loss has declined, even when controlling for the effects of age.

The overall prevalence of edentulism is projected to decline slowly to reach 2.6% in 2050 (Slade et al. 2014). However, this decline will be offset by an expansion in the aging population (Slade et al. 2014). One aspect of edentulism that extends its prevalence in future models is its concentration in low-income groups (Slade et al. 2014). Edentulism has declined significantly among people living in high-income households compared to low-income groups (Slade et al. 2014).

In summary, improvements in oral health have reduced the need to advocate for edentulism as a therapeutic solution. However, despite declining rates of tooth loss among individuals with high socioeconomic status, edentulism remains a common treatment among low-income groups. Therefore, if public health policies and the dental profession aspire to reduce the mean number of missing teeth, the gains will need to be made with interventions in the middle- and low-income groups.

### 1.5 Tooth Loss and Systemic Conditions

The correlation between tooth loss and other systemic conditions is multifactorial. Complete edentulism may exist with one or more diseases (or disorders) for a given patient (Felton 2016, Stein et al. 2007). While this research extends theories of the mouth-body connection, these studies directly negate the original treatment recommendations of focal infection theory. Although the previous solution was complete edentulism, research now recognizes many health risks associated with tooth loss. For dentists, the goal is more often to enable patients to keep their teeth. However, doing so requires understanding the many factors that influence a patient's likelihood of losing teeth or needing dental implants. At

least ten significant associations between the mouth and body have been reported in the literature. It is worth briefly reviewing each.

#### 1.5.1 Nutrition and Malnutrition

It has been reported that nutritional intake is negatively influenced by tooth loss. Malnutrition has a direct correlation with poor oral health and edentulism because of decreased intake of vital nutrients with insufficient amount of fruits and vegetable consumption (De Marchi et al. 2008, De Marchi et al. 2011, Han and Kim 2016, Lancker et al. 2012, Ioannidou et al. 2014, Nowjack-Ramer and Sheiham 2007, Saarela et al. 2014, Sahyoun et al. 2003, and Slade et al. 1996).

#### 1.5.2 Obesity

Obesity is positively associated with many chronic diseases or conditions in patients, including edentulism, especially when not wearing dentures. The overwhelming body of research supports the need for some prosthetics for edentulous patients. The patient's inability to consume fresh fruits and vegetables may lead to reduced nutritional intake and malnutrition. Their dependence on soft processed food, canned food, and other forms of less healthy foods may increase the risk of obesity (De Marchi et al. 2012, Do Nascimento et al. 2013, Felton 2016, Hamdan et al. 2013, Sheiham et al. 2002).

#### 1.5.3 Cardiovascular Disease

In addition to high blood pressure, high LDL cholesterol levels, and smoking, tooth loss has been correlated with the development of heart disease. In increased risk in the formation of carotid artery plaque and higher inflammatory markers in the bloodstream due to periodontal disease has also been demonstrated (Desvarieux et al. 2003, Felton,

2016, Medina-Solis et al. 2014, Polzer et al. 2012, Schwahn et al. 2004, Taguchi et al. 2004).

#### 1.5.4 Diabetes

It was suggested that edentulous patients had a higher risk of developing diabetes. They were more than twice as likely to wear removable prostheses than nondiabetics (Azogui-Levy and Dray-Spira 2012, Cleary and Hutton 1995, Felton 2016, Medina-Solis et al. 2006, Patel et al. 2013).

#### 1.5.5 Rheumatoid Arthritis (R.A.)

It was found that patients with R.A. were more than twice as likely to be edentulous than those with none R.A. dentate patients (Culshaw et al. 2011, de Pablo et al. 2008). Moreover, R.A. risk is higher in edentulous patients than those with fewer than five teeth missing (Demmer et al. 2011).

#### 1.5.6 Chronic Obstructive Pulmonary Disease (COPD)

The primary risk factors for COPD are smoking, poor air quality, and environmental preconditions. Completely edentulous patients had a higher risk for COPD hospitalization and death than the dentate or partially dentate patients (Barros et al. 2013, Corbridge et al. 2012, Offenbacher et al. 2012, Przybyłowska et al. 2015, Wouters 2003, Xie et al. 1997, 1999).

#### 1.5.7 Respiratory Infections

It has been reported that nocturnal denture wear is significantly associated with a higher risk of pneumonia (Sjogren et al. 2008). In addition, elderly patients with

oropharyngeal dysphagia reported an increased risk of developing aspiration pneumonia (Iinuma et al. 2015, Ortega et al. 2014).

#### 1.5.8 Cancer

Cancers of the head and neck, larynx, pharynx, and oral cavity are important to dentists. Complete edentulism has been associated with various cancers, including lung, esophageal, and bladder cancer. In addition, a significant association was reported between tooth loss and cancer death with lower survival rates among completely edentulous patients (Felton 2016, Hiraki 2008 and Felton 2009, Shakeri et al. 2013, Takata et al. 2014, Zeng et al. 2013).

#### 1.5.9 Cognitive Impairment "Dementia"

The most common form of dementia is Alzheimer's Disease. Although a relationship between tooth loss and cognitive disorders was reported, the completely edentulous patients experienced a more significant decline in cognitive function when compared to dentate patients (Eshkoor et al. 2014, Felton 2016, Kisely et al. 2011, Naorungroj et al. 2015, Okamoto et al. 2015, Paganini-Hill et al. 2012, Stein et al. 2007, Tsakos et al. 2015, Zenthofer et al. 2014).

#### 1.6 Complete Edentulism and Mortality

Felton (2009) reported no relationship between edentulism and mortality in literature. However, the risk of death was higher for the edentulous patient than for the partially and fully dentate patients. Unfortunately, no studies have shown whether the replacement of missing teeth improves patient mortality outcomes or not (Ansai et al. 2013, Brown 2009, Holm-Pedersen et al. 2008, Janket et al. 2013, Liljestrand et al. 2015,

Osterberg et al. 2008, Polzer 2012, Schwahn et al. 2013, Sjogren 2008, Barros 2013, Takata 2014, Watt et al. 2012).

### 1.7 Summary

Most edentulous patients have dentures that significantly enhance their quality of life and help mitigate the adverse health effects of complete edentulism. However, even for those with dentures or implant-retained mandibular overdentures, there is a need to study comorbidity factors and better understand how health conditions reveal a connection between the mouth and body. In addition, research needs to continue exploring the relationship between patients' dental devices, complete dentures, implant-retained mandibular overdenture, and their distinct health outcomes, mortality risks, and overall quality of life.

## CHAPTER 2. REVIEW OF LITERATURE

### 2.1 Edentulism: Education and Treatments

Some dental professionals believe that rates of edentulism will continue to decline exponentially, and some educators have even advocated for the removal of denture training from the curriculum (Douglass et al. 2002, Marcus 1996). However, even though edentulism is declining nationally, there is a growing need for dental education in prosthodontics. First, practicing dentists do engage the edentulous patient population needing complete denture services. Second, eliminating complete denture training from the dental education curriculum will force millions of patients to seek denture services from only prosthodontics specialists (Douglass et al. 2002).

To better understand the need for dental education related to edentulism and consider the reasons for training with dentures and implant-retained overdentures, it is necessary to evaluate and compare these treatments' patient factors and technical features individually.

#### 2.1.1 Complete Denture Treatment

Conventional complete denture treatment is the most common method for edentulous patients (Ye and Sun 2017, Carlsson 2010). Dentures will remain necessary for decades as the aging population and socioeconomic trends continue to increase (Salinas 2009). General practitioners do not use the traditional academic complicated method to fabricate dentures. However, "Simplified Treatment of Edentulous Patients" and "One-Step Complete Dentures" have been described in the literature as alternative simplified complete denture techniques (Drago 2003, Duncan 2004, Heydecke et al. 2008, Preti 2011, 2012, Wallace 2012).

In comparison to previous patient cohorts, denture patients of today are characterized as having a higher mean age, living independently, affording care, and retaining more teeth (Ivanhoe 2002, Weintraub 1985). On the other hand, missing teeth are often replaced by fixed partial prostheses, removable partial dentures, and implant-supported restorations (Ivanhoe 2002). However, despite advances in technology, a sizeable complete denture population exists. Furthermore, Douglass et al. (2002) suggested that the edentulous population will increase by 2050.

In clinical settings, patients often detail pain in response to the prosthodontic challenge to adapt dentures to severely resorbed residual ridges, prominent anatomic landmarks, or bony abnormalities (Ivanhoe 2002). Over time, dentures become ill-fitting due to a lack of support, as Kelly (1972) described. In addition, some patients expect the denture teeth to mimic their natural teeth. Sometimes, as a home remedy, patients use over-the-counter soft liners or tissue paper to reline their prostheses, resulting in significant debilitation of the residual ridges (Ivanhoe 2002, Murrell 1972).

### 2.1.2 Patient Education

The aged population is characterized by decreased neuromuscular control, less oral awareness, and impaired oral dexterity, making complete denture treatment more complicated (Wright 1949, Muller 1993). The patient's expectations regarding function and esthetics need to be discussed and realistic. Thorough patient education and preparation for replacement dentures have been critically important and are associated with improved patient health outcomes and more positive patient satisfaction (Devan 1963, Koper 1964, Kotkin 1985, Mojon 1992, Yemm 1991). Beyond the initial consultation and fitting, other prolonged maintenance and hygiene concerns can complicate the treatment of denture



patients. Burnett et al. (1993) pointed out the importance of motivating denture wearers to improve denture hygiene (habits) with verbal and written instructions. Therefore, it is necessary to survey denture patients about their hygiene practices and consider dissatisfaction so that dental professionals can address these concerns and improve patient self-efficacy.

## 2.2 Pre-prosthetic Care

After prolonged use of ill-fitted dentures, correction for gingival hyperplasia from tissue trauma is mandatory and can be done using tissue resting, tissue conditioners, or pre-prosthetic surgery (Lytle 1957, 1959, Schweiger 1959). Removing the dentures for days to provide enough tissue resting is a standard correction method (Lytle 1962, Dukes 1965). Tissue conditioner application can help the gingival tissue return to a healthy condition as the last step to avoid surgical intervention (Chase 1961, Klein 1966). In addition, it can enhance the use of an existing complete denture during the treatment phase. However, pre-prosthetic surgery may be perceived as a burdensome treatment recommendation by experienced denture wearers who have grown accustomed to the developed unhealthy tissue response.

One of the most common treatments is the surgical reduction of enlarged maxillary tuberosities (Ivanhoe 2002). Soft tissue removal from the superior and lingual surfaces of the retromolar pad area is another essential pre-prosthetic surgery (Ivanhoe 2002). Unfortunately, removing redundant tissues covering a knife-edge alveolar ridge is also crucial. Sometimes, the augmentation of a defected ridge with artificial graft materials can be considered pre-prosthetic surgery procedures (Curtis 1986). A better understanding of the steps involved in fabrication and an appreciation for new production techniques may

help educate denture fabricators about the potential for complications in fabrication and improve patient outcomes.

### 2.3 Steps of Traditional Complete Denture Fabrication in Student Clinic

#### 2.3.1 Impressions

A custom acrylic resin tray should be fabricated for functional border molding of the denture bearing area for accurate impressions. In addition, a dual tray procedure that captures redundant mobile tissue in a relaxed state may be required (Felton 1996).

#### 2.3.2 Interocclusal Records

Elderly patients cannot accurately and repeatably reposition the mandibular jaw in retruded position during jaw relation records due to denture base instability or inability to cooperate. Therefore, fast setting interocclusal registration materials should be used to record jaw relations because it is a challenge for the elderly to posture the mandible still for a long time (Ivanhoe 2002).

#### 2.3.3 Aesthetics and Tooth Set-up

Esthetic expectations must be discussed and understood by the patient before the start of the treatment and reinforced throughout the treatment visits. Fortunately, most elderly patients do not demand a younger esthetic appearance (Marxkors 1993, Ivanhoe 2002).

#### 2.3.4 Occlusion

The functional relationship between maxillary and mandibular anterior teeth is set for proper lip support and aesthetics. When the patient understands the need to prioritize

functionality over esthetic, the chances of well-fitting dentures with better mechanics control increase. Consequently, success and satisfaction rates rise with appropriate patient education (Ivanhoe 2002, Lang 1992, Clough 1983). Monoplane posterior occlusal schemes, such as neutrocentric occlusion, may increase the patient's freedom in centric relation and use of various jaw closure positions (Kapur 1965 A-B-C, Garrett 1996). These techniques help to reduce complications in fabrication and promote greater patient education and satisfaction.

### 2.3.5 Soft Liners

The severely resorbed residual ridge may require processed soft liners as a cushion or stress distribution and protection. However, no ideal liner materials fulfill these criteria (Wright 1994, Duncan 1985). Moreover, absent considerable product innovation and especially when combined with little dental education and/or effective hygiene, dental liners may result in patients' added health concerns.

### 2.3.6 Insertion and Post-insertion

The day of denture delivery is the last opportunity to reinforce patient educational behaviors and instruct them of relevant health factors that may cause complications. Giving verbal and written home-care instructions with realistic expectations is the dentist's responsibility (Samant 1984, Ruffino 1983). Getting used to the new dentures to maintain denture retention during function will take time, practice, and patience. The adaptation process starts by getting comfortable with the dentures in the mouth, followed by eating soft food on both sides simultaneously, then gradually eating harder foods. Denture adhesive may be helpful during this adaptation period to keep denture retentive during

function. However, dentists should instruct that denture adhesive be used carefully and encourage instruction and monitoring when utilizing adhesive supplements. Patients increasingly seek denture adhesives to remedy the pain induced by dentures (Kapur 1967). The adaptation time varies between patients from weeks to months (Vinton 1955). However, the adhesive should not compensate for inadequate prosthodontics and should be reduced with time to the minimum (Ghani 1995).

## 2.4 Review of Studies Comparing Traditional (T) and Simplified (S) Complete Denture Fabrication Techniques

### 2.4.1 General satisfaction

Patient satisfaction with dentures fabricated using traditional technique (T) or simplified technique (S) has been compared using a visual analog scale (VAS). It combines the patient's perception with overall satisfaction and comfort, stability, ability to chew, talk, and esthetics (Heydecke et al. 2008, Kawai et al. 2005, Regis et al. 2013, Nunez et al. 2015). There was no statistically significant difference between the S and T groups in patient ratings for general satisfaction in these reported RCTs.

### 2.4.2 OHIP-Edentulous Scale

In the other two studies comparing the T and S fabrication methods, the quality of life (QoL) related to oral conditions was measured using the Brazilian version of the OHIP-Edentulous scale (Nunez et al. 2015, Regis et al. 2013). Also, it was reported no significant differences between the S and T groups for any evaluation periods. Thus the treatment methods did not influence the patients' quality of life or satisfaction.

### 2.4.3 Denture Quality

In two studies of denture quality (Kawai et al. 2005 and Regis et al. 2013), there was no significant difference in denture quality scores between the T and S based on the Prosthodontist's evaluation; however, it was noted that slightly better speech was identified in the traditional technique group. The prosthodontists confirmed that both methods provided similar results with no statistically significant differences (Kawai et al. 2005 and Regis et al. 2013).

### 2.4.4 Masticatory Ability

Research has also compared masticatory ability between T and S groups. A colorimetric assay was used to evaluate masticatory performance based on chewing a test food for 20 and 40 cycles. Moreover, a questionnaire with a 0 to 10 scale was used to assess masticatory ability. Both groups presented similar masticatory performances and skills (Cunha et al. 2013).

### 2.4.5 Time and Cost

Treatment with the simplified method was less expensive, both directly and indirectly. Moreover, a dentist requires less time fabricating dentures using the simplified process and fewer adjustments time and visits (Vecchia et al. 2014, Takanashi et al. 2002, 2004, Ye 2017).

## 2.5 Digital Complete Denture, Current Trends in Denture Fabrications

In 2011, Kanazawa et al. evaluated the concept of fabricating a complete denture using a computer-aided design/computer-aided manufacturing (CAD/CAM) system. They demonstrated that creating a CAD/CAM digital denture is feasible and found that the

resulting denture was accurate. Goodacre et al. (2012) published the first report of clinical patient treatment using a CAD/CAM denture. The prostheses were milled from a prepolymerized resin block in which the denture teeth were bonded into recesses created in the denture base. These two proof-of-concept techniques have since been transformed into a state-of-the-art, fully digital process. The current literature has shown the benefits that CAD/CAM dentures offer. These include fewer patient visits, digitally saved files for more straightforward remakes, improved denture base adaptation, and improved retention. (Goodacre et al. 2012; Baba 2016, Bidra 2013 & 2016).

A retrospective study evaluated student experiences with digital complete dentures fabricated in two visits (Saponaro 2016). The authors concluded that both undergraduate and postgraduate students needed more than two appointments to fabricate digital dentures along with three common complications: lack of denture retention, the inaccurate vertical dimension of occlusion (VDO), and incorrect centric relation (C.R.).

Currently, many systems are available for the fabrication of CAD/CAM dentures, such as AvaDent (Global Dental Science), Baltic Denture System (Merz Dental GmbH), Ceramill Full Denture System (Amann Girrbach AG), DENTCA/Whole You (DENTCA, Inc; Whole You, Inc), and Wieland Digital Denture (Ivoclar Vivadent, Inc) (Baba et al., 2016). Integrating CAD/CAM technology (3D printed or milled dentures) into complete denture design and fabrication improves complete dentures' consistency (Baba et al. 2016). In addition, it enhances the fit when the base is milled from prepolymerized resin. The CAD/CAM process also provides a digital record for future replacement needs. In addition, it reduces or eliminates time-consuming laboratory procedures, provides reproducible, efficient, and accurate prostheses (Baba et al. 2016). These systems are currently available,

and others are in the last stages of the development process, with clinical and laboratory research being conducted on several new denture innovations. Nevertheless, the existing research indicates that this promising digital workflow benefits the dental technician, the clinician, and patients (Saponaro et al. 2016 A&B, Kattadiyil et al. 2015).

## 2.6 Challenges with Complete Dentures

The edentulous patient faces many challenges due to the tendency of complete dentures to move during function, especially with the lower prosthesis (Celebić et al. 2003). It is often a crucial concern that patients might lose control of a denture, particularly in public. In addition to social distress, loose dentures can also cause mucosal trauma and inhibit speech and mastication (Locker 2009). Ideally, a denture should maintain a stable relationship with the underlying structure. However, this is the main obstacle with conventional techniques in which stability is optimized by maximizing retention via adhesion and cohesion (Celebić et al. 2003).

### 2.6.1 Residual Ridge Resorption

Residual alveolar ridges continue to resorb for many years following the extraction of teeth. However, when older adults report problems, it is usually related to difficulty chewing associated with uncomfortably loose dentures on resorbed residual ridges (MacEntee et al. 1991). The most common oral mucosal lesion encountered in older edentulous mouths is denture stomatitis (MacEntee et al. 2004). Cheek biting and traumatic ulcers are also common complications due to pressure areas or overextensions of the flanges and incorrect position of posterior teeth. Patients who wear ill-fitting dentures may develop denture irritation hyperplasia (Jainkittivong et al. 2010). These complications can often be corrected by selective recontouring of the prosthesis.

### 2.6.2 Role of Saliva

The role of saliva as a lubricant is essential for the comfort and function of the mouth. It is unknown whether the quantity or quality of saliva is altered by aging. However, it is known that elders take many potentially xerostomic medications to treat illnesses and conditions like depression, sleep disorders, hypertension, allergies, heart problems, and other conditions associated with aging. In addition, stress, depression, tobacco use, and alcohol consumption can reduce salivary flow and disturb denture retention (Eliasson et al. 2006).

### 2.6.3 Malnutrition

The elderly population is at risk of malnutrition because of edentulism and loss of function. National survey data in the United States revealed that older people frequently had low calories, fibers, or calcium in their diet. In addition, many of them did not consume adequate vitamins (Hung et al. 2003, Nowjack-Ramer and Sheiham 2007, Sahyoun et al. 2003).

### 2.6.4 Attitude and Aging

The attitude of elders to the edentulous state and the aging process is related to their expectations regarding treatment outcomes and an understanding of the procedures and follow-up practices involved (MacEntee 2010). Their attitudes toward complete dentures and their ability to control their prostheses play a crucial role in their quality of life. Understanding a patient's social environment can help the dentist better address their expectations and current dental status background. Different treatment approaches can be offered accordingly (MacEntee 2010). Patients' perception of the cause of the loss of their



teeth can provide insights into their appreciation of dentistry and contribute to the prognosis for prosthodontic success when treatment is completed (MacEntee 2010). Patient expectations are also strongly influenced by previous denture experiences, whether positive or negative, which will affect satisfaction with the new treatment (MacEntee 2010). The patient's satisfaction with the performance of a new set of dentures will reflect their subjective assessment as judged against their *a priori* criteria and expectations, the skills of the dental team, and the patient's ability to adapt psychologically and functionally to the edentulous state and to use their prostheses efficiently (MacEntee 2010).

#### 2.6.5 Anxiety

It is worth remembering that, in general, dentists are excellent communicators in the area of physical and anatomical problems. Still, they tend to be reticent when emotional and psychological issues are involved due to insufficient psychosocial or behavioral science coursework in the dental curriculum (Cooper 2009). Therefore, psychological inventories have been proposed and used to assess the personality characteristics of patients who have difficulty using dentures (Peterson and Yamamoto 2005). It was suggested that many of the so-called maladaptive patients have high scores on indices of neuroticism. Neuroticism is regarded as a chronic anxiety state and affects the performance of tasks requiring neuromuscular coordination (Peterson and Yamamoto 2005). Anxiety levels are either too high or too low and appear to be limiting function, depending on the performed task. Although this suggests that only the most anxious patients should have trouble with their dentures due to difficulty adjusting or adapting to denture use, clinical experience confirms that such a conclusion is narrow and restrictive (Peterson and Yamamoto 2005).

On the other hand, cheerful extroverts are rarely found in the ranks of patients who have difficulty with dentures or who complain substantially. However, no associations have been identified for the absence or presence of problems associated with introversion or extroversion (Peterson and Yamamoto 2005). So, neuroticism may manifest itself as a tendency to complain about everything rather than a unique response to dental care, consistent with the current psychological conceptualization of neuroticism.

#### 2.6.6 Patient Satisfaction

Statistically significant relationships have been reported between patient satisfactory adaptation with complete dentures and age, gender, oral variables, personality, and aesthetics (Walton et al. 2009). The quality of life of such individuals may be profoundly affected by their predicament since their management usually entails considerable efforts of both the clinical-technical and the emotional-supportive variety, although with unpredictable results (Walton et al. 2009). These clinical, interpersonal situations can be very frustrating, especially when it becomes clear that conventional complete denture therapy is not the optimal solution for the patient's edentulism (Cooper 2009, Walton et al. 2009). Diverse reasons are presented in the dental literature to explain the etiology and frequency of chronic inability to wear dentures.

Patients who cannot wear dentures or have difficulty functioning with them usually have one or more of the following signs and symptoms (Jacob 1998):

- Compromised denture supporting areas that significantly reduce the retention of dentures.
- Insufficient oral neuromuscular activity.
- Thin mucosal tissue.

- Parafunctional habits (e.g., bruxism) are creating chronic soreness and denture instability.
- Unrealistic expectations for esthetics and functions.
- Gag reflex induced by a removable prosthesis.
- Inability to accept wearing a well-fitted denture.

Based on some combination of these signs and symptoms, some patients reject the removable prostheses option and ask for fixed restorations and dental implants. For patients who oppose removable prostheses, there are alternatives to traditional prosthodontic treatment. In addition, research has shown relatively short-term favorable outcomes associated with using natural teeth to support overdenture. As a result, many practitioners endorse routine prescription of this technique (Budtz-Jørgensen 1995). However, this technique has inherent risks as the longevity of overdenture teeth abutments is quite likely to be compromised by caries and periodontal disease over time, jeopardizing the foundation of denture implants (Frentzen 1990).

## 2.7 Introducing Dental Implant for Edentulism

In 1982, the Toronto Conference on "Tissue Integrated Prosthesis" introduced the concept of inducing controlled interfacial osteogenesis between dental implants and host bone to the dental academic community (Zarb 1983). The first human trials were conducted in Sweden, beginning in 1965 (Brånemark et al. 1985). This was followed by an international research endorsement that analyzed the merit of the technique for treating maladaptive edentulous patients with implant-retained removable overdenture prostheses (Brånemark et al. 1985). The McGill consensus statement on overdentures concluded that "Mandibular Implant Overdentures should be considered as the minimum first-choice

standard of care for edentulous patients" (Feine et al. 2002. Page # 4). The available evidence suggests that "...restoring the edentulous mandible with a conventional denture is no longer the most appropriate first-choice prosthodontic treatment" (Feine et al. 2002. Page # 4).

The technique of dental implant and osseointegration has virtually solved the predicament of maladaptive denture behavior. One way to achieve relatively immobile denture is an overdenture retained with 2-implants and supported by soft tissue (Zarb and Schmitt 1996). (See Table 1 Advantages and Disadvantages of Implant Overdenture)

While many prosthodontists have favored these, there remain essential considerations to discuss with patients before choosing implant-retained overdentures (IOD) as the treatment protocol. The literature reveals at least five points of reference that patients and providers should discuss, including:

- (1) financial consequences,
- (2) anatomical problems that limit the number of implants,
- (3) need for more stability and retention of a denture,
- (4) when soft tissue and/or hard tissue defects are presented, and
- (5) unfavorable maxillomandibular ridge relations were reported.

(Brånemark et al. 1985, Feine et al. 2002, Zarb and Schmitt 1996)

Beyond these patient education and discussion points, there are also essential contradictions in the research that necessitate a closer consideration of fabrication techniques and patient anatomy. Among the contradictions reported in the literature, three factors may require providers to discourage IOD as the treatment protocol:

- (1) The residual ridge is not adequate for the standard or narrow implant placements

(2) The patient's general health conditions do not allow a minor surgical intervention

(3) If the patient is satisfied with a complete denture with no complaints.

The increasing availability of dental implants has changed the prosthetic rehabilitation of edentulous patients. The preponderance of recent evidence suggests that using dental implants to retain mandibular overdenture significantly improves clinical outcomes and quality of life for edentulism. The evidence currently available suggests better efficacy of IODs when compared to conventional CDs in the management of edentulous patients (Kutkut et al. 2018). Higher patient satisfaction ratings demonstrate the positive impact of the implant-retained prosthesis in the perceived ability to chew and speak and higher satisfaction ratings associated with stability and comfort (Kutkut et al. 2018). Locker (2009) argues that any health care intervention's ultimate and overriding aim should be to reduce pain and discomfort, improve function, and enhance psychosocial well-being. Compared to conventional complete dentures, implant-retained prostheses are often a more practical option for patients seeking to overcome their functional deficiencies.

When comparing self-reports of satisfaction associated with IOD and conventional mandibular treatment, there is evidence in the literature that patients with IOD report a significantly better oral health-related quality of life than those who received conventional dentures (Kutkut et al. 2018). In addition, although more expensive, the provision of low-cost mandibular two-implant prostheses may improve edentulous patients' dietary intake and nutritional state in ways that have added benefits to quality of life and overall health (Kutkut et al. 2018).

Overall, patients with conventional complete dentures experienced a more negative impact on daily life related to the wearing of their dentures than patients with implant-retained overdentures. The effect of edentulism on everyday life was strongly affected in this patient population by the treatment received. Patients with IOD were less likely than wearers of conventional complete dentures to report a negative impact related to difficulty eating, smiling, speaking, social contact with other people, "going out" or maintaining emotional stability (Kutkut et al. 2018).

It was reported in the literature that dietary interventions are effective in patients who have received IOD treatment (Kutkut et al. 2018). This is supported not only by the reported dietary data but also by biological indices of antioxidant status. This is of considerable significance as the intake of fruits and vegetables has been associated with reduced risk for several chronic conditions, including obesity, diabetes, cardiovascular disease, and cancer. This suggests that improved functionality resulting from IOD facilitates the patient's compliance with eating healthier food like vegetables and fruits. Given the strong evidence linking dietary health with the reduced risk of chronic diseases, these positive dietary effects should be perceived as a considerable health benefit of this combined form of prosthetic rehabilitation and diet intervention (Kutkut et al. 2018).

A recent systematic review of studies comparing conventional complete denture (CCD) and implant-retained overdenture (IOD) was conducted to answer a fundamental question: How do CCD compare to unsplinted IOD regarding efficacy satisfaction and quality of life? (Kutkut et al. 2018). In general, mandibular IOD was associated with less physical pain and discomfort. As a result, patients' self-reported data would be expected to

show a significantly lower rating of psychological disability, psychological discomfort, and psychological limitations (Kutkut et al. 2018).

Overall, prostheses were rated as having significantly less dysfunction after IOD treatment during all activities: eating, speaking, yawning, and kissing. Additionally, subjects wearing mandibular IODs were found to have higher bite forces than those of patients with CCDs. Masticatory efficiency was increased significantly with IODs, and masticatory performance in patients with IODs was significantly higher than those with CCDs. In addition to the quality-of-life benefits from IODs addressed previously, patients with IODs were shown to be significantly more likely to take in their nutrients through fresh, whole fruits, and vegetables suggesting additional health advantages. Although patients who received IODs had significant improvement when chewing and making food choices, an evaluation of clinically essential differences in blood nutrients and health parameters was not observed between groups (Kutkut et al. 2018).

Table 1: Advantages and Disadvantages of Implant Overdenture

Advantages of Implant Overdenture IOD	Disadvantages of Implant Overdenture IOD
<ul style="list-style-type: none"> <li>• Enhanced denture stability and retention (particularly in the mandible)</li> </ul>	<ul style="list-style-type: none"> <li>• Being removable option</li> </ul>
<ul style="list-style-type: none"> <li>• Superior esthetics with flange support</li> </ul>	<ul style="list-style-type: none"> <li>• Overall bulk prosthesis</li> </ul>
<ul style="list-style-type: none"> <li>• Simple protocol</li> </ul>	<ul style="list-style-type: none"> <li>• Potential of soft tissue irritation</li> </ul>
<ul style="list-style-type: none"> <li>• Predictable treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Potential of gingival hyperplasia</li> </ul>
<ul style="list-style-type: none"> <li>• Affordable by the larger patient pool</li> </ul>	
<ul style="list-style-type: none"> <li>• Reduced number of implants</li> </ul>	
<ul style="list-style-type: none"> <li>• Ease of hygiene</li> </ul>	



### CHAPTER 3. TREATING EDENTULISM IN DENTAL SCHOOL CLINICS

Prosthetic therapy focuses on the technical and clinical expertise required to fabricate complete dentures (Cooper 2009). Therefore, the approaches using new or enhanced materials and providing necessary research related to patient expectations, aesthetics, and functionality are recommended. However, clinical experience suggests that patient satisfaction and comorbidities are dependent on the technical skills and individual abilities of prosthodontists who carefully customize the form and fit of complete dentures to meet the individual needs of edentulous patients (Cooper 2009). For this reason, treatment with complete dentures or overdentures became, and remains, an integral and essential part of dental education and practice.

Some trends in current undergraduate dental education signal a reduction of time allocated to prosthetic instruction in dental curricula. The average prosthetics requirement for graduation was the fabrication of three sets of dentures. Due to inexperienced student dentists who provide dental care to patients in dental school settings, patient grievances are generally considered a significant problem. In this case, patients may become unhappy and dissatisfied because of many factors, such as; less efficient caregiving, discontinuity of treatment due to the school's breaks, and institutional policies. It has been suggested in the literature that all dental schools should incorporate interpersonal skills development in their curricula since solid interpersonal skills play a vital role in patient satisfaction, retention, treatment acceptance, and referral (Petropoulos and Rashedi 2005).

Previously, edentulous patients that sought treatment from a dental school in the United States were often treated using CCD by students attending a predoctoral denture

program that required patient fabrication before graduation. Traditionally, the fabrication of IODs was performed by specialists, denturists, or general dentists who had completed individual education courses and added training. However, with the growing popularity of this treatment option, predoctoral dental education programs are increasingly training students on this procedure and performing IOD treatments within dental school clinics. As IOD use has increased and quickly become the standard of care for the edentulous mandible, its incorporation into the predoctoral curricula provides students with much-needed clinical practice. In addition, there is a growing effort within dental schools to teach techniques related to complete dentures and implant-retained overdentures through lectures, laboratory work, and clinics. In the United States, there has been a "call to go back to basics" (Hawkinson 2005) and an emphasis on the importance of teaching complete dentures with dental implants. Indeed, all restorative dentistry requires thorough knowledge and understanding of traditional complete denture fabrication (Hawkinson 2005, Faigenblum and Sharma 2007).

Despite the reduction in the trend to edentulism, there will be an increase in the population's life span that will outweigh this reduction (Carlsson and Omar 2010). Therefore, there will continue to be a need to fabricate complete dentures for the foreseeable future (Youngson et al. 2007). Furthermore, although student dentists graduate with competency in treating edentulous patients, there is a gap in the literature about the consequence of CCD and IOD replacement on patient satisfaction and quality of life as the dental providers' education and experience moderate it. Therefore, it is necessary to consider the differences in patient satisfaction associated with CCD and IOD treatments in professional prosthodontic clinics and dental school settings. Toward that end, this study

aimed to compare outcomes of implant-retained overdenture and conventional complete denture patients treated by dental students at the University of Kentucky College of Dentistry (UKCD) using a validated survey of patients satisfaction and quality of life.

### 3.1 Assessment of Oral Health Quality of Life

Several Patient-Reported Outcomes (PROs) assessing oral health quality of life (OHRQoL) have been developed due to the increased concern about the impact of oral health status on a person's QoL. Today, OHRQoL assessments are widely used in clinical trials and studies evaluating dental care outcomes, and many studies highlight the psychosocial impact of oral conditions. For example, OHRQoL has been used to investigate the effects of losing all-natural teeth and describe the strengths and weaknesses of available treatment options. In addition, as a helpful metric, OHRQoL includes some factors that may be affected by patients' oral health, such as personal ability to function, psychological state, social factors, and pain/discomfort.

Usually, OHRQoL is measured by the Oral Health Impact Profile (OHIP) questionnaire, consisting of 49 questions. However, several versions of this questionnaire have been shortened. One of them is OHIPEDENT as a specific questionnaire for edentulous patients and considered instruments of choice to assess OHRQoL in the elderly (Hebling and Pereira 2007). In addition, the current literature contains several reports using the OHIP-19 survey to assess OHRQoL among complete denture or implant-retained overdenture wearers depending on prosthetic and patient-related factors (Chen et al. 2012, Perea et al. 2013).

In addition to comparing OHRQoL outcomes for CCD and IOD patients in dental school settings, this study contributes to methodological considerations of patient

satisfaction and quality of life. Toward that end, one of the objectives of this study is to assess possible trends and analyze differences using the OHIP-19 scale over one year. The study also explores variability in OHIP-19 results by gender, QoL metrics, and self-reports of overall satisfaction among patients wearing complete dentures and implant overdenture.

It is necessary to evaluate the patient with a variable focus on gender (Abramo and Ciriaco 2018, Holdcroft 2007). Study design in the 1970s, in response to sex discrimination legislation and resulting social changes, made efforts to mix genders within study groups since this was considered the most equitable study approach (Holdcroft 2007). In 1994, the U.S. National Institutes of Health (NIH) issued a guideline to ensure the safety and efficacy of medical practice for the study and evaluation of gender differences in clinical trials (Rochon et al. 1998).

### 3.2 Research Hypothesis:

It is hypothesized that patients using Implant-retained mandibular overdentures (IOD) will report significantly higher patient satisfaction and better quality of life than those with conventional dentures (CD). Patients in the IOD group will benefit from retaining the mandibular denture during function using implants. Consequentially, it is believed that so they will experience significantly less functional difficulty. This study predicts a significant difference between two patient groups representing CD and IOD patients responding to the OHIP-19. Additionally, this study hypothesized that there would be no association of gender between and within groups of the OHIP-19 scale.

### 3.3 Materials, Methods, and Measures

This study included survey data generated using the validated OHIP questionnaire, which has acceptability, consistent reliability, and demonstrated use value as a valid

assessment of OHRQoL (Slade and Spencer 1994). Even shorter versions of this instrument have proven to provide effective estimates with tested reliability and validity, such as OHIP-14, OHIP-19, and the OHIP-EDENT. Each is considered a valuable instrument and presents a more concise inventory of questions to evaluate the perceived impact of oral health on subjects' well-being in edentulous patients (He and Wang 2015, Montero et al. 2012, Slade 1997). The OHIP questionnaire consisted of 19 items divided into seven domains:

- (1) Functional limitation refers to difficulty chewing, food catching, and dentures not fitting correctly.
- (2) Physical pain includes; painful aching, uncomfortable to eat, sore spots, and uncomfortable dentures.
- (3) Psychological discomfort includes worry and self-consciousness.
- (4) Physical disability includes avoiding eating, interrupting meals, and being unable to eat.
- (5) Psychological disability includes upset and embarrassment.
- (6) Social disability includes social tolerance, irritability, social isolation, and sexual function.
- (7) Handicap includes the inability to enjoy daily activities and finding life unsatisfying.

The responses were coded as 0, 1, 2 for Never, Sometimes, and Almost Always for each item. Domains were created by summing the responses for items within each domain.

Summary statistics were presented overall by denture type and gender; percentages were shown for categorical variables, and the mean  $\pm$  standard deviation was presented for

continuous variables. OHIP items were considered as categorical variables, and domains were analyzed as continuous variables. Bivariate comparisons were made using chi-square tests and two-sample t-tests for categorical and continuous variables, respectively. Comparisons between denture types were additionally stratified by gender. All tests and statistics are calculated using IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. All tests used a two-sided significance level of 0.05. Due to the exploratory nature of this study, no correction for multiple comparisons was made.

### 3.3.1 Procedure

Before implementing study methods, IRB approval was obtained. Subjects who received treatment for edentulism at the University of Kentucky, College of Dentistry (UKCD) student's clinics, and those who meet the study criteria were identified using medical record review. Candidate addresses were retrieved from the most current records. Candidates received an IRB-stamped cover letter inviting patients to participate in this research survey, a brief overview of the proposed research, and a validated survey consisting of questionnaires that took approximately five minutes to answer. Study candidates who were willing to participate were asked to complete the two-page survey independently and return it to the investigator using a self-addressed stamped envelope provided in the mailed materials. A five-dollar gift card was sent to participants who completed and returned the survey. Research activities were internally funded by UKCD and the Department of Oral Health Practice.

### 3.3.2 Participants

Participation in the study was voluntary, and refusal to participate did not influence future treatment in any way. To be considered an eligible study candidate, individuals were required to be 21 years of age or older. Patients were required to meet three additional criteria related to the hypotheses. First, patients selected for the study were completely edentulous. Second, chosen patients wore an implant-retained mandibular overdenture (IOD) or conventional mandibular complete dentures (CD) fabricated and delivered by a DMD student dentist at the UKCD. Third, patients selected must have been using their IOD or CD for at least one year. Individuals were not eligible to participate if they had complete dentures over natural teeth. Beyond self-reports of gender, no other personal identification demographic information was documented or used for this study's analysis.

A total of 520 edentulous patients on both arches who received treatment with a complete denture or implant overdenture at UKCD student prosthodontics clinic were selected. Their median age was 65 years, and their median time of denture wearing was 1.5 years (ranged 1-5 years). All participants were seen and treated by student dentists under faculty supervision in the Prosthodontics Clinic at the UKCD.

The survey instrument used to collect data from study participants is available in the Appendix. The survey included two sets of questions. The first set included demographic and treatment information, and the second set included patient satisfaction questions using a standardized questionnaire. In terms of treatment information, four questions were included to address the number of sets of dentures patients had previously had, the type of dentures they currently used, and how likely they would be to recommend

the UKCD student clinic to friends and family, a final question sought to determine how confident patients felt with the dental care provided by the UKCD student dentists.



## CHAPTER 4. RESULTS

### 4.1 Study Population

Of the 171 patients, a representative portion of responses was female, 87 (50.9%). Among patients' treatment options, 96 patients were implant-retained overdenture wearers (56.1%). However, with 75 patients treated with complete dentures, this lesser proportion is still effectively represented in this study (43.9%). In the complete denture group, 39 were females (52%), while the gender distribution was more even in the implant-retained overdenture group (Table 2).

Table 2: Study Population and Treatment Option by Gender and Response Rate

Gender	CD: N=75 (43.9%)	IOD: N=96 (56.1%)	Total: N=171	# Surveys Sent	Response rate
M	36 (48%)	48 (50%)	84 (49.1%)	520	33%
F	39 (52%)	48 (50%)	87 (50.9%)		

## 4.2 Demographic Data

Table 3 also shows demographic information and patient satisfaction data comparing the groups and by gender. Nearly 60% of the patients in both groups had only one previous denture experience and reported results on this first experience. Within the IOD group, 76% reported improvement in experience when using the implants to retain the mandibular denture. This indicated functional improvement and enhanced satisfaction with the denture treatment after implant placement transitioned from conventional complete denture to implant-retained overdenture. Results show that most patients were willing to recommend the student clinic for both treatment modalities (90% CD & 84% IOD). However, when the results were stratified by gender, a significantly larger number of female participants in the IOD group would not recommend the student clinic compared to the CD (5% vs. 21%,  $p=0.05$ ). Essential differences in confidence for CD and IOD were found in both female and male participants, but the association of type and confidence differed by gender. Females in the CD group were more confident in the student clinic (87% vs. 71%,  $p=0.04$ ), while males in the IOD group were more confident (77% vs. 94%,  $p=0.03$ ). (Table 3).

Table 3: Demographic Data Analysis Comparing Overall Groups Based on Gender

Category		All n= 171			Female n= 87			Male n= 84		
		CD n= 75	IOD n= 96	p <sup>1</sup>	CD n= 39	IOD n= 48	p <sup>1</sup>	CD n= 36	IOD n= 48	p <sup>1</sup>
1 <sup>st</sup> set of Dentures		43 (57.3%)	60 (62.5%)	.49	21 (53.8%)	28 (58.3%)	.68	22 (61.1%)	32 (66.7%)	.60
Experience with implant	Better	-	73 (76.1%)	-	-	36 (75%)	-	-	37 (77.1%)	-
	Same	-	9 (9.4%)	-	-	4 (8.3%)	-	-	5 (10.4%)	-
	Worse	-	13 (13.5%)	-	-	8 (16.7%)	-	-	5 (10.4%)	-
Recommend student clinic	Highly recommend	52 (69.3%)	70 (72.9%)	.10	27 (69.2%)	33 (68.8%)	* .05	25 (69.4%)	37 (77.1%)	.67
	Recommend	16 (21.3%)	11 (11.5%)		9 (23.1%)	5 (10.4%)		7 (19.4%)	6 (12.5%)	
	Don't Recommend	6 (8.0%)	15 (15.6%)		2 (5.1%)	10 (20.8%)		4 (11.1%)	5 (10.4%)	
Confident in the student clinic	Confident	62 (82.7%)	79 (82.3%)	.80	34 (87.2%)	34 (70.8%)	* .04	28 (77.8%)	45 (93.8%)	* .03
	Not Confident	12 (16%)	17 (17.7%)		4 (10.3%)	14 (29.2%)		8 (22.2%)	3 (6.2%)	

\* <sup>1</sup>P-values were calculated using a chi-square test of independence to compare CD vs. IOD.

#### 4.3 Survey Analysis Comparing Overall Groups Based on Gender

No significant differences were noted between responses overall when stratified by gender or when comparing OHIP items on CD versus IOD (See Table 4). However, it was possible to observe a reverse trend in the scores between male and female groups in responses related to the quality of life associated with food getting caught in dentures, patients likelihood to avoid eating some foods because of problems with dentures, and an expressed inability to eat with dentures because of issues with them. This provides initial support to suggest that males and females have different experiences in CD and IOD groups. In addition to this finding between groups, the results were consistent with the answers between CD and IOD among overall groups. Comparing mean domain scores by CD and IOD overall also showed no significant differences; comparisons stratified by gender were significant for physical limitations, physical pain, physiological disability (males), and social disability and handicap (females). When compared to CD, males with IOD had lower scores of physical pain (2.3 vs. 2.7,  $p=0.04$ ), limitations (2.3 vs. 3.0,  $p=0.05$ ), and psychological disability (0.7 vs 1.0,  $p=0.03$ ). For females, social disability (0.9 vs 0.5,  $p=0.001$ ) and handicap (0.9 vs 0.6,  $p=0.04$ ) were significantly higher in IOD when compared to CD. (Table 4).

Table 4.1 Functional Limitation Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171			Female n= 87			Male n= 84		
		CD n= 75	IOD n= 96	P <sup>1</sup>	CD n= 39	IOD n= 48	P <sup>1</sup>	CD n= 36	IOD n= 48	P <sup>1</sup>
Q1: Difficulty Chewing	Never	21 (28.0%)	30 (31.3%)	.90	12 (30.8%)	13 (27.1%)	.53	9 (25.0%)	17 (35.4%)	.17
	Sometimes	38 (50.7%)	47 (49.0%)		19 (48.7%)	20 (41.7%)		19 (52.8%)	27 (56.3%)	
	Almost Always	16 (21.3%)	19 (19.8%)		8 (20.5%)	15 (31.3%)		8 (22.2%)	4 (8.3%)	
Q2: Food Catching	Never	14 (18.7%)	22 (22.9%)	.53	11 (28.2%)	10 (20.8%)	.60	3 (8.3%)	12 (25.0%)	.11
	Sometimes	35 (46.7%)	48 (50.0%)		14 (35.9%)	22 (45.8%)		21 (58.3%)	26 (54.2%)	
	Almost Always	26 (34.7%)	26 (27.1%)		14 (35.9%)	16 (33.3%)		12 (33.3%)	10 (20.8%)	
Q3: Fitting Properly	Never	32 (42.7%)	38 (39.6%)	.92	15 (38.5%)	16 (33.3%)	.14	17 (47.2%)	22 (45.8%)	.07
	Sometimes	26 (34.7%)	35 (36.5%)		16 (41.0%)	13 (27.1%)		10 (27.8%)	22 (45.8%)	
	Almost Always	17 (22.7%)	23 (24.0%)		8 (20.5%)	19 (39.6%)		9 (25.0%)	4 (8.3%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD

Table 4.2 Physical Pain Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171		P <sup>1</sup>	Female n= 87		P <sup>1</sup>	Male n= 84		P <sup>1</sup>
		CD n= 75	IOD n= 96		CD n= 39	IOD n= 48		CD n= 36	IOD n= 48	
Q4: Painful Aching	Never	51 (68.0%)	56 (58.3%)	.09	27 (69.2%)	25 52.1%	.26	24 (66.7%)	31 (64.6%)	.08
	Sometimes	15 (20.0%)	33 (34.4%)		9 (23.1%)	18 (37.5%)		6 (16.7%)	15 (31.3%)	
	Almost Always	9 (12.0%)	7 (7.3%)		3 (7.7%)	5 (10.4%)		6 (16.7%)	2 (4.2%)	
Q5: Uncomfortable Eating	Never	20 (26.7%)	40 (41.7%)	.12	10 (25.6%)	16 (33.3%)	.39	10 (27.8%)	24 (50.0%)	.08
	Sometimes	42 (56.0%)	41 (42.7%)		22 (56.4%)	20 (41.7%)		20 (55.6%)	21 (43.8%)	
	Almost Always	13 (17.3%)	15 (15.6%)		7 (17.9%)	12 (25.0%)		6 (16.7%)	3 (6.3%)	
Q6: Sore Spots	Never	35 (46.7%)	30 (31.3%)	.12	17 (43.6%)	13 (27.1%)	.15	18 (50.0%)	17 (35.4%)	.20
	Sometimes	34 (45.3%)	56 (58.3%)		20 (51.3%)	28 (58.3%)		14 (38.9%)	28 (58.3%)	
	Almost Always	6 (8.0%)	10 (10.4%)		2 (5.1%)	7 (14.6%)		4 (11.1%)	3 (6.3%)	
Q7: Uncomfortable Denture	Never	35 (46.7%)	42 (43.8%)	.91	16 (41.0%)	20 (41.7%)	.40	19 (52.8%)	22 (45.8%)	.14
	Sometimes	28 (37.3%)	39 (40.6%)		18 (46.2%)	17 (35.4%)		10 (27.8%)	22 (45.8%)	
	Almost Always	12 (16.0%)	15 (15.6%)		5 (12.8%)	11 (22.9%)		7 (19.4%)	4 (8.3%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD

Table 4.3 Psychological Discomfort Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171		p <sup>1</sup>	Female n= 87		p <sup>1</sup>	Male n= 84		p <sup>1</sup>
		CD n= 75	IOD n= 96		CD n= 39	IOD n= 48		CD n= 36	IOD n= 48	
Q8: Worried	Never	41 (54.7%)	53 (55.2%)	.95	22 (56.4%)	24 (50.0%)	.81	19 (52.8%)	29 (60.4%)	.45
	Sometimes	25 (33.3%)	33 (34.4%)		12 (30.8%)	16 (33.3%)		13 (36.1%)	17 (35.4%)	
	Almost Always	9 (12.0%)	10 (10.4%)		5 (12.8%)	8 (16.7%)		4 (11.1%)	2 (4.2%)	
Q9: Self-conscious	Never	48 (64.0%)	60 (62.5%)	.43	24 (61.5%)	29 (60.4%)	.99	24 (66.7%)	31 (64.6%)	.18
	Sometimes	17 (22.7%)	28 (29.2%)		10 (25.6%)	13 (27.1%)		7 (19.4%)	15 (31.3%)	
	Almost Always	10 (13.3%)	8 (8.3%)		5 (12.8%)	6 (12.5%)		5 (13.9%)	2 (4.2%)	
	Sometimes	29 (38.7%)	38 (39.6%)		13 (33.3%)	20 (41.7%)		16 (44.4%)	18 (37.5%)	
	Almost Always	12 (16.0%)	6 (6.3%)		8 (20.5%)	5 (10.4%)		4 (11.1%)	1 (2.1%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD

Table 4.4 Physical Disability Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171		p <sup>1</sup>	Female n= 87		p <sup>1</sup>	Male n= 84		p <sup>1</sup>
		CD n= 75	IOD n= 96		CD n= 39	IOD n= 48		CD n= 36	IOD n= 48	
Q10: Avoid Eating	Never	23 (30.7%)	36 (37.5%)	.63	13 (33.3%)	13 (27.1%)	.79	10 (27.8%)	23 (47.9%)	.17
	Sometimes	37 (49.3%)	44 (45.8%)		17 (43.6%)	24 (50.0%)		20 (55.6%)	20 (41.7%)	
	Almost Always	15 (20.0%)	16 (16.7%)		9 (23.1%)	11 (22.9%)		6 (16.7%)	5 (10.4%)	
Q11: Unable to Eat	Never	34 (45.3%)	52 (54.2%)	.11	18 (46.2%)	23 (47.9%)	.39	16 (44.4%)	29 (60.4%)	.13
	Sometimes	29 (38.7%)	38 (39.6%)		13 (33.3%)	20 (41.7%)		16 (44.4%)	18 (37.5%)	
	Almost Always	12 (16.0%)	6 (6.3%)		8 (20.5%)	5 (10.4%)		4 (11.1%)	1 (2.1%)	
Q12: Interrupt Meals	Never	35 (46.7%)	45 (47.4%)	.57	18 (46.2%)	20 (41.7%)	.90	17 (47.2%)	25 (53.2%)	.29
	Sometimes	30 (40.0%)	42 (44.2%)		16 (41.0%)	22 (45.8%)		14 (38.9%)	20 (42.6%)	
	Almost Always	10 (13.3%)	8 (8.4%)		5 (12.8%)	6 (12.5%)		5 (13.9%)	2 (4.3%)	
	Almost Always	6 (8.0%)	7 (7.3%)		4 (10.3%)	6 (12.5%)		2 (5.6%)	1 (2.1%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD



Table 4.5 Psychological Disability Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171		p <sup>1</sup>	Female n= 87		p <sup>1</sup>	Male n= 84		p <sup>1</sup>
		CD n= 75	IOD n= 96		CD n= 39	IOD n= 48		CD n= 36	IOD n= 48	
Q13: Upset	Never	42 (56.8%)	53 (55.2%)	.91	20 (52.6%)	22 (45.8%)	.51	22 (61.1%)	31 64.6%	.13
	Sometimes	21 (28.4%)	30 (31.3%)		13 (34.2%)	15 (31.3%)		8 (22.2%)	15 (31.3%)	
	Almost Always	11 (14.9%)	13 (13.5%)		5 (13.2%)	11 (22.9%)		6 (16.7%)	2 (4.2%)	
Q14: Embarrassed	Never	43 (57.3%)	65 (67.7%)	.35	21 (53.8%)	30 (62.5%)	.54	22 (61.1%)	35 (72.9%)	.45
	Sometimes	26 (34.7%)	24 (25.0%)		14 (35.9%)	12 (25.0%)		12 (33.3%)	12 (25.0%)	
	Almost Always	6 (8.0%)	7 (7.3%)		4 (10.3%)	6 (12.5%)		2 (5.6%)	1 (2.1%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD

Table 4.6 Social Disability Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171			Female n= 87			Male n= 84		
		CD n= 75	IOD n= 96	P <sup>1</sup>	CD n= 39	IOD n= 48	P <sup>1</sup>	CD n= 36	IOD n= 48	P <sup>1</sup>
Q15: Avoided Going Out	Never	61 (81.3%)	75 (78.1%)	.71	30 (76.9%)	34 (70.8%)	.46	31 (86.1%)	41 (85.4%)	.94
	Sometimes	10 (13.3%)	17 (17.7%)		6 (15.4%)	12 (25.0%)		4 (11.1%)	5 (10.4%)	
	Almost Always	4 (5.3%)	4 (4.2%)		3 (7.7%)	2 (4.2%)		1 (2.8%)	2 (4.2%)	
Q16: Less Tolerant	Never	63 (85.1%)	76 (79.2%)	.44	34 (89.5%)	34 (70.8%)	.09	29 (80.6%)	42 87.5%	.40
	Sometimes	8 (10.8%)	17 (17.7%)		4 (10.5%)	12 (25.0%)		4 (11.1%)	5 (10.4%)	
	Almost Always	3 (4.1%)	3 (3.1%)		0 (0.0%)	2 (4.2%)		3 (8.3%)	1 (2.1%)	
Q17: Irritable	Never	60 (80.0%)	76 (80.0%)	.95	33 (84.6%)	35 (74.5%)	.31	27 (75.0%)	41 (85.4%)	.33
	Sometimes	12 (16.0%)	16 (16.8%)		6 (15.4%)	10 (21.3%)		6 (16.7%)	6 (12.5%)	
	Almost Always	3 (4.0%)	3 (3.2%)		0 (0.0%)	2 (4.3%)		3 (8.3%)	1 (2.1%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD

Table 4.7 Handicap Domain Survey Question Analysis Comparing Overall Groups Based on Gender

Category		All n= 171			Female n= 87			Male n= 84		
		CD n= 75	IOD n= 96	P <sup>1</sup>	CD n= 39	IOD n= 48	P <sup>1</sup>	CD n= 36	IOD n= 48	P <sup>1</sup>
Q18: Unable to Enjoy	Never	54 (72.0%)	73 (76.0%)	.30	28 (71.8%)	33 (68.8%)	.72	26 72.2%	40 (83.3%)	.18
	Sometimes	19 (25.3%)	17 (17.7%)		10 (25.6%)	12 (25.0%)		9 (25.0%)	5 (10.4%)	
	Almost Always	2 (2.7%)	6 (6.3%)		1 (2.6%)	3 (6.3%)		1 (2.8%)	3 (6.3%)	
Q19: Less Satisfying	Never	57 (76.0%)	70 72.9%	.19	30 (76.9%)	32 (66.7%)	.16	27 (75.0%)	38 (79.2%)	.78
	Sometimes	16 (21.3%)	17 (17.7%)		8 (20.5%)	9 (18.8%)		8 (22.2%)	8 (16.7%)	
	Almost Always	2 (2.7%)	9 (9.4%)		1 (2.6%)	7 (14.6%)		1 (2.8%)	2 (4.2%)	

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD

#### 4.4 7- Domain Analysis Comparing Overall Groups Based on Gender

A comparison was made between the OHIP scores for all subjects in both treatment groups. The results indicated a statistically significant difference in feeling uncomfortable to eat any foods because of problems with dentures and feeling that life, in general, was less satisfying because of problems with dentures with  $p=.03$  and  $p=.02$ , consequently (See Table 5). CD group was less comfortable and less satisfied with their dentures than the IOD group. When comparing the scores based on gender, in the female group, there was a significant difference between treatment groups in the tolerance of spouses or family because of problems with dentures ( $p<.001$ ), irritability with other people because of problems with dentures ( $p<.001$ ), and feeling that life, in general, was less satisfying because of problems with dentures ( $p<.001$ ). Additionally, the females in the CD group were less tolerant, more irritable, and less satisfied with their dentures than the IOD.

There was a significant difference in the feeling that dentures did not fit correctly ( $p=.02$ ). Subsequently, different responses were associated with having pain or ache in the mouth when using dentures ( $p=.03$ ). Males in the patient groups were more likely to express displeasure and problems with dentures ( $p=.01$ ). They were also more likely to be embarrassed because of problems with dentures ( $p=.04$ ). The men in the patient group surveys also reported being less tolerant of spouse or family because of problems with dentures ( $p=.02$ ) and being irritable with other people because of dentures ( $p=.01$ ). The males in the CD group reported more improper denture fitting indicators and, consequently, more pain and ache in the mouth when using the dentures. They also noted more embarrassment because of dentures problems, less tolerance with their spouse or family, and more irritability with other people associated with problems and dentures. The CD

group data suggest that these patients were more upset with their denture treatment than those who had received IOD denture treatment.

Table 5 Domain Analysis Comparing Overall Groups Based on Gender

Domain	All n= 171			Female n= 87			Male n= 84		
	CD n= 75	IOD n= 96	p <sup>1</sup>	CD n= 39	IOD n= 48	p <sup>1</sup>	CD n= 36	IOD n= 48	P <sup>1</sup>
Physical Limitations Mean ± SD	2.9 ± 1.86	2.8 ± 1.88	.99	2.8 ± 1.84	3.2 ± 2.10	.13	3.0 ± 1.91	2.3 ± 1.52	.05*
Physical Pain Mean ± SD	2.7 ± 2.28	2.7 ± 2.23	.84	2.6 ± 2.05	3.2 ± 2.44	.18	2.7 ± 2.54	2.3 ± 1.93	.04*
Physical Discomfort Mean ± SD	1.1 ± 1.28	1.0 ± 1.19	.22	1.1 ± 1.31	1.2 ±1.36	.99	1.1 ± 1.26	0.8 ± .97	.18
Physical Disability Mean ± SD	2.3 ± 1.94	1.9 ± 1.68	.28	2.3 ± 2.08	2.3 ± 1.79	.28	2.2 ± 1.80	1.5 ± 1.49	.54
Psychological Disability Mean ± SD	1.1 ± 1.33	1.0 ± 1.26	.18	1.2 ± 1.39	1.3 ± 1.44	.91	1.0 ± 1.29	0.7 ± .99	.03*
Social Disability Mean ± SD	0.7 ± 1.28	0.7 ± 1.40	.31	0.5 ± .92	0.9 ± 1.55	.00 1*	0.8 ± 1.57	0.5 ± 1.22	.20
Handicap Mean ± SD	0.6 ± .96	0.7 ± 1.18	.17	0.6 ± .94	0.9 ± 1.29	.04 *	0.6 ± .99	0.5 ± 1.03	.62

Note: Results are presented as MEAN ± SD.

<sup>1</sup> P-value was calculated using a two-sample t-test to compare CD vs. IOD.

## CHAPTER 5. DISCUSSION

This survey study aimed to compare patient-reported outcomes among patients treated by student dentists with CDs versus IODs, across clinically relevant variables: patient satisfaction and quality of life. Locker (2009) expressed that any health care intervention's ultimate and overriding aim should be to reduce pain and discomfort, improve function, and enhance psychosocial well-being. Additionally, it has been reported that satisfaction is the most crucial goal for edentulous patients, making it a critical outcome to consider. The present study's findings encourage the rejection of the hypothesis that patients' satisfaction and quality of life using Implant-retained mandibular overdentures (IOD) will be higher and better than those with conventional dentures (CD).

Although the literature supports the superiority of IODs compared to CDs regarding efficacy, satisfaction, and quality of life in different clinical settings (Kutkut et al, 2018), the results of this study reflect a student clinic setting patients' self-reporting feedback based on the removable prosthodontic curriculum applied at dental schools. Therefore, the overall findings of outcome similarity between the groups could be generalized for student clinics but may not be generalized for different settings such as private practices or faculty practice clinics at schools.

The OHIP-19 was used because it is a validated questionnaire explicitly used for edentulous patients (Souza et al. 2007, Ellis et al. 2007). The impact of edentulism on daily life was strongly demonstrated in the patient responses in both patient treatment groups showing the necessity to continue both IOD and CD treatment options. Along with previous literature, this study finds additional support suggesting that patients who receive IODs are less likely than wearers of CDs to report a negative impact related to difficulty in

eating, smiling, speaking, social contact with other people, “going out,” or maintaining emotional stability (Melas et al. 2001). These negative impacts limit complete denture wearers' satisfaction, inhibit their quality of life, and have even been associated with comorbidities including malnutrition, obesity, and heart disease, among others (Melas et al. 2001). This research suggests that patients treated with IODs report superior outcomes associated with psychological and physical health domains than those who received CD treatments. In this way, these findings confirm and extend previously published data by Awad et al. (2014). As a contribution to the body of research associated with OHIP and QoL, the differences between groups and gender were considered. The initial findings suggest there may be important reasons to consider why men and women may be more or less predisposed to choose mandibular implant overdentures. Despite their higher cost, the findings of this study suggest that for edentulous patients and women, in particular, mandibular implant overdentures may have significant advantages when considering OHIP and QoL metrics over conventional dentures (Allen et al. 2006, Assuncao et al. 2007, Rashid et al. 2011). Given these findings, dental educators and practitioners are encouraged to discuss gendered concerns associated with issues like food getting caught in the teeth, inhibiting eating habits, and causing increased self-consciousness among women. Among male patients with CD or IOD treatments, educators and practitioners are encouraged to discuss the potential that poor fittings may increase irritability, intolerance and inhibit intimacy. Male patients seem to be under-reporting. In contrast, female patients tend to be more open to reporting symptoms and feedback.

Another significant contribution of this study confirms the previous findings and inspires future research. This study suggests that treating CD wearers with implants to



retain their dentures led to noticeable improvements in patients' satisfaction with their oral status as measured by questionnaires. The majority of previous studies confirm this. (Harris et al. 2013, Diehl et al. 1996, de Albuquerque et al. 2000, Klemetti 2008; Mericske-Stern et al. 2002). In earlier research, IODs have been superior to CDs regarding patient satisfaction and quality of life. A preponderance of the available evidence demonstrates increased satisfaction for patients treated with IODs compared to their prior experience with CDs. Implant-retained overdentures have been reported to be a more valuable option when compared to CD treatments, especially for those patients seeking to overcome functional deficiencies. Overall, this study confirms those findings and reports that patients with CDs experienced a more negative impact on daily life related to the wearing of their dentures than patients with IODs. Along with a large body of previous evidence, this study suggests that a patient's quality of life improves after treatment with mandibular IODs based on one question "If you have implants: How would you compare your experience with dentures after the implants?" (Harris et al. 2013, Diehl et al. 1996, de Albuquerque et al. 2000, Klemetti 2008, Mericske-Stern et al. 2002).

Generally, older patients are less critical than the younger ones, especially with the esthetics of their dentures. Turker et al. (2009) reported that age or gender did not associate with the denture's satisfaction. Muller and Hasse-Sander (1993) noted that the ability to adapt to new dentures is not age correlated. Moreover, aging is a biological process that leads to a substantial personal difference in oral ability and quality of life. Finally, patients' self-reflected survey data requires interpretation of the measures and necessitates their reflection on personal experiences in ways that remain intrinsically individual and

subjective (Ellis and Pelekis 2007). Therefore, a certain level of discomfort or handicap may be acceptable to one patient and intolerable to another (Ellis and Pelekis 2007).

### 5.1 Limitations and Recommendations for Future Research

This study was limited to patients who received treatment at the University of Kentucky, College of Dentistry, Prosthodontics clinics. As a result of the limited population and the reliance on student dentists under faculty supervision, there may be limitations to consider and opportunities to extend future research in light of these limitations. This study identifies three main limitations of the survey measures, population, and resulting data to improve and direct future research. The first regards the main difference between this study's population and those used by previous studies. The subjects studied in this population were from various cultures and socioeconomic characteristics, affecting the quality of life. Previous research on edentulism has often focused on low socio-economic status and rural location as factors associated with edentulism. However, one of the limitations of this study is that it did not consider these demographic factors. Therefore, in addition to considering socioeconomic disparities in OHIP and QoL associated with treatment, future research should also consider how socioeconomic status influences patients' decision to choose a student dental clinic.

Moreover, future research is needed to determine how socioeconomic status and geographic location moderates their experiences of OHIP, QoL, confidence in treatment recommendations, and overall willingness to recommend similar treatments to friends and family. Future studies will be more beneficial to collect more demographic data such as; specific age for each participant, state, county, socioeconomic status, educational level, and ethnicity. The extensive literature review findings also suggest that it will be more valuable

if educators and practitioners review each subject's patient medical and dental history to correlate their satisfaction and quality of life with general health conditions, including tobacco use, dietary habits, and other individual health characteristics.

Although this study identified essential differences in confidence for CD and IOD in both female and male participants, the association of type and confidence differed by gender; at the same time, this may also be a small sample size issue, the results indicated enough of a difference in these that future scholars should be reluctant to combine these patient groups. Scholars should recognize that if you have two groups providing opposite trends or disparate data, combining them risks nullifying significant findings. Future research should continue to consider if reports associated with OHIP and QoL vary by gender.

Another factor limiting this study and the extension of the results is that participants were informed that the dental professionals they interacted with were students in training. Given the nature of the survey design, participants may have sought to avoid negatively impacting students' success and refrained from negatively reflecting on their development. As a result, survey data might not adequately reflect patients' negative feedback. However, despite this limitation, 76% of the subjects in the overdenture group felt improved function and increased satisfaction with the treatment when they compared their experience with dentures after the implant placements. This is an important finding that confirms the general recommendation in literature and supports the McGill consensus regarding the benefits of IOD treatment over CD.

A final limitation of our study is related to survey non-response. Of the 600 participants recruited, 80 were excluded because of wrong addresses, and of the 520

eligible participants, only 171 completed surveys. Given the low response rate (33%), there may be increased potential for a sample bias in the respondents who have chosen to complete the survey for the five-dollar incentive gift card. Moreover, there is a potential for a selection bias associated with the lower cost of treatment, and reduced practitioner experience, associated with a student clinic. Future research should make a more significant effort to increase the number of survey participants. Given practical limitations, this study did not control gender to achieve an equal number of participants in each group based on gendered representation. However, the resulting population sample was nearly equally distributed by gender. Future research, with expanded resources, should aspire to take up a controlling consideration of gender. Additionally, future research should aspire to control for the longevity of treatment quality and record longitudinal data. Including short-term follow-ups, ranging from 1-5 years, would require a substantial survey population to account for the expected mortality and need an extensive survey design with longer surveys to gather patient follow-up feedback.

## 5.2 Recommendations for Educators and Prosthodontic Practitioners

Currently, available evidence suggests restoring the edentulous mandible with a conventional denture is no longer the first-choice prosthodontic treatment. Instead, there is overwhelming evidence that a two-implant overdenture should become the first choice of treatment for the edentulous mandible. Implant-retained overdenture showed a high success rate with fewer surgical interventions, fewer clinical visits, fewer postoperative complications, and improved quality of life (Awad et al. 2014).

The dental appearance of denture wearers is affected by several factors: tooth color, shape, and position; quality of restoration; and the general arrangement of the denture teeth,

especially of the anterior (Qualtrough and Burke 1994). While these concerns are ancillary to function, educators and practitioners must consider the patient's esthetic needs when fabricating CD and IOD prosthodontics (Van der Geld et al. 2007). All esthetic components must act together to meet patients' expressed needs (Qualtrough and Burke 1994, Alkhatib et al. 2005, Vallittu et al. 1996). Similar to these previous findings (Tin-Oo et al. 2011), this study found that women expressed less confidence and greater dissatisfaction with dentures than men. In addition, unhappiness with student clinics was a significant negative influence on patient satisfaction with their dentures. These may be areas for dental educators and practitioners to consider to communicate interpersonally with patients.

Gender should be recognized as an essential determinant of health. It is an essential component of IRB (Tannenbaum et al. 2016). Increased attention to gender should influence educators' and practitioners' treatment options and better inform their interpersonal communication with patients. However, research shows that gender affects the physical and social environments to which individuals are exposed in ways that suggest considerable gendered disparities and imply a lack of equitability in the provision of treatment options (Nieuwenhoven and Klinge 2010, Miller et al. 2017, Su et al. 2009, Thelwall et al. 2019). Future research should continue an examination of these differences.

Disparities related to gender can be modified and structured to influence variables associated with ethnicity, indigenous status, social status, sexuality, geography, socioeconomic status, education, age, disability/ability, migration status, and religion. For this sense, future dental educators and practitioners are encouraged to adopt an intersectional approach to implementing practices, programs, and policies (Tannenbaum et al. 2016, Legato et al. 2016, Rich-Edwards et al. 2018, Johnson et al. 2009). Such an

approach recognizes that each patient must be met at their unique axis of identity and encourages future scholars to consider determining treatment options and communication protocols that improve patients' OHIP and QoL.

### 5.3 Conclusion

Although focal infection theory has fallen from favor, the mouth-body connection remains. An overwhelming body of evidence has demonstrated comorbidities associated with dental health and identified the importance to overall wellbeing. Dentists continue to pursue efforts to reduce patients' pain and discomfort to improve their quality of life. Prosthodontic research has identified significant correlations between patients' aesthetic needs and issues of functional fabrication and individual fit. This research suggests that dental educators and practitioners must emphasize developing interpersonal skills that enable patients to disclose their expectations and needs. Dissatisfaction with the esthetic fit and improper function of CD and IOD treatments have been linked to a wide range of health concerns, including but not limited to; malnutrition, obesity, cardiovascular disease, diabetes, rheumatoid arthritis (RA), respiratory infections, and chronic obstructive pulmonary disease (COPD), cognitive impairments, and several different types of cancer. Given the wide range of health concerns and comorbidities associated with CD and IOD treatments, these patient-provider conversations are critical and require increased practice in dental education programs.

While some have predicted that the declining rate of completely edentulous patients eliminates the need to focus on CD treatment and consultation in dental education, I have provided evidence that suggests that this trend will be offset by population growth and aging trends in the coming thirty years. Moreover, I have indicated that eliminating

attention to CD treatment for completely edentulous patients would be particularly problematic in areas of low socioeconomic status and disproportionately impact patients who cannot access or afford regular dental care. For this reason, and to improve all patients' overall quality of life, prosthodontic researchers must continue to study and compare patient satisfaction outcomes associated with both CD and IOD treatment options. Indeed, the results of this study suggest that both patient groups found improved satisfaction and quality of life, though not statistically significant. It is worth noting that the IOD treatment group did report slightly higher overall mean scores of OHIP and QoL. Given that both patient groups saw increases in satisfaction, CD may remain a more affordable treatment option for many completely edentulous patients

This study has presented several options for researchers who aspire to improve patient quality of life and further explore the communicative dynamics of aesthetic fit and functional fabrication. This research suggests that dental educators must instruct students in clinics about important demographic factors related to patient outcomes. This study's consideration of gender encourages additional attention to how gendered expectations inhibit patient satisfaction and impact health outcomes. While both male and female patient groups noted increased satisfaction and confidence in both CD and IOD treatment groups, this research identified significant gendered differences associated with OHIP and QoL that are worth continuing to explore. Moreover, this study provided self-reported data, which suggests that among those who have had both, IOD are preferable to CD treatments. Going further, the study's attention to gender reveals that there may be gendered factors that differentially account for patient satisfaction and quality of life. This variable focus on the moderating effects of gender should be extended to other demographic considerations

to better understand best practices in patient-provider communications and improve patient health outcomes.

This study was conducted in a student dental clinic and provided recommendations for many vital contributions for prosthodontic educators and practitioners. While the study was limited in terms of resources and constrained by survey response rate, the findings from this study extend the work done previously to compare complete denture and implant overdenture wearers' satisfaction and quality of life. Importantly, this study found that both patient groups reported improvements in OHRQoL, which were statistically significant for some domains of OHIP-19. This research also positively impacted patient satisfaction with implant placement to retain a complete mandibular denture. Therefore, IOD may still be considered a favorable option for the rehabilitation of edentulous patients. Even as new CAD/CAM digital denture technologies are being developed, educators, dentists in student clinics, and professional prosthodontists should continue to discuss CD treatment options with their patients. As the aging population expands and more baby boomers become completely edentulous, the need to discuss the practicality and affordability of CD treatment with patients will persist.



APPENDICES

**Demographic Data Collected**

Gender  M  F

Date: \_\_\_\_\_

First set of Dentures:  Y  N , if not, how many set of dentures prior

Please select one option:  Lower complete denture/plate OR

Lower 2-implant anchored complete denture/plate

If you have implants: How would you compare your experience with dentures after the implants?

Better

Same

Worse

How likely are you to recommend the UKCD Student Clinic Dental implant/denture program to a friend or family member?

I would recommend the program even without being asked.

I would recommend the program if asked.

I would not recommend this program.

How confident do you feel with the dental care provided by your student dentist at UKCD?

Very confident

Confident

Somewhat confident

Not confident

## Denture Questionnaire

Oral health quality of life OHQoL was measured with the OHIP-19. This consisted of 19 items divided into seven domains.

- **Functional limitation**

1. Have you had difficulty chewing any foods because of problems with your dentures?

Never                       Sometimes                       Almost always

2. Have you had food catching in your dentures?

Never                       Sometimes                       Almost always

3. Have you felt that your dentures have not been fitting properly?

Never                       Sometimes                       Almost always

- **Physical pain**

4. Have you had painful aching in your mouth?

Never                       Sometimes                       Almost always

5. Have you found it uncomfortable to eat any foods because of problems with your dentures?

Never                       Sometimes                       Almost always

6. Have you had sore spots in your mouth?

Never                       Sometimes                       Almost always

7. Have you had uncomfortable dentures?

Never                       Sometimes                       Almost always

- **Psychological discomfort**

8. Have you been worried by dental problems?

Never                       Sometimes                       Almost always

9. Have you been self-conscious because of your dentures?

Never                       Sometimes                       Almost always

• **Physical disability**

10. Have you had to avoid eating some foods because of problems with your dentures?

Never                       Sometimes                       Almost always

11. Have you been unable to eat with your dentures because of problems with them?

Never                       Sometimes                       Almost always

12. Have you had to interrupt meals because of problems with your dentures?

Never                       Sometimes                       Almost always

• **Psychological disability**

13. Have you been upset because of problems with your dentures?

Never                       Sometimes                       Almost always

14. Have you been a bit embarrassed because of problems with dentures?

Never                       Sometimes                       Almost always

• **Social disability**

15. Have you avoided going out because of problems with your dentures?

Never                       Sometimes                       Almost always

16. Have you been less tolerant of your spouse or family because of problems with your dentures?

Never                       Sometimes                       Almost always

17. Have you been a bit irritable with other people because of problems with your dentures?

Never                       Sometimes                       Almost always

- **Handicap**

18. Have you been unable to enjoy other people's company as much because of problems with your dentures?

Never                       Sometimes                       Almost always

19. Have you felt that life, in general, was less satisfying because of problems with your dentures?

Never                       Sometimes                       Almost always

For each OHIP-19 item, participants were asked how frequently they had experienced the impact of that item. Responses were made on a 3-point Likert scale: never, sometimes, and almost always. Higher scores imply poorer OHQoL and, thus, lower satisfaction of the denture wearer.

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Zenthofer A, Rammelsberg P, Cabrera T, et al. Determinants of oral health-related quality of life of the institutionalized elderly. *Psychogeriatrics.* 2014;14:247-254.

## VITA

Ahmad Kutkut, DDS, MS, FICOI, DICOI

### **Educational Institutions Attended:**

- Aug. 2013 – Dec. 2021      **Ph.D.** Clinical and Translational Science  
University of Kentucky, College of Medicine
- Aug. 2007 – Feb. 2011      **M.S.**, Oral Science  
State University of New York at Buffalo, School of Dental  
Medicine
- Aug. 2007 – Aug. 2010      **Certificate**, Advanced Education Program in Prosthodontics  
State University of New York at Buffalo, School of Dental  
Medicine
- Sep. 2005 – July 2007      **Certificate**, Advanced Education Program in Implant Dentistry  
New York University, College of Dentistry
- Sep. 2004 – July 2005      **Certificate**, Advanced Education Program in General Dentistry  
New York University, College of Dentistry
- Sep. 2001 – Feb. 2002      **Certificate**, Internship in General Dentistry and Community  
Dental Health Al Basheer Hospital, Amman, Jordan
- Aug. 1996 – July 2001      **D.D.S.**, Doctor of Dental Surgery  
University of Jordan, Amman-Jordan

### **Board Certification Credentials:**

- 2018      American Board of Prosthodontics, Scenario Section C  
2016      Diplomate International Congress of Oral Implantologist  
2015      Fellow International Congress of Oral Implantologist  
2010      American Board of Prosthodontics, Written Section A  
2009      National Board Dental Examinations, Part I and II

### **Dentistry Profession License:**

- 2016 – Present      UK Hospital Clinical Privileges “Provider # 022547”  
2011 – Present      Kentucky Board of Dentistry “License # 9124”  
2002 - 2023      Jordanian Dental Association, Ministry of Health & Health Care  
The Hashemite Kingdom of Jordan

### **Professional Training:**

- 2020      UK Chairs’ Academy  
2020      Academic Leadership Academy  
2018      Laser Proficiency Certificate

## Curriculum Vitae

Ahmad Kutkut, DDS, MS, FICOI, DICOI

### Professional Positions Held:

- Jan. 2021 – Present **Chief, Division of Prosthodontics**  
Jan. 2020 – Present **Endowed University Professorship in Dentistry**  
July 2017 – Present **Associate Professor with Tenure – Director of Predoctoral Implant Program**  
Division of Prosthodontics  
Department of Oral Health Practice  
University of Kentucky, College of Dentistry
- Sep. 2011 – 2017 **Assistant Professor – Director of Predoctoral Implant Program**  
Division of Prosthodontics  
Department of Oral Health Practice  
University of Kentucky, College of Dentistry
- Sep. 2010 – 2011 **Clinical and Research Instructor**  
Department of Restorative Dentistry  
State University of New York at Buffalo, School of Dental Medicine
- Sep. 2005 - 2007 **Research Director Assistant (Part-Time)**  
New York University, College of Dentistry
- Feb. 2002 – 2004 **General Dentist**  
Al-Masha'al Dental Center, Amman, Jordan. Private office

### Visiting Professor

- Mar. 2018 – Present University of Business and Technology, Department of Stomatology,  
Pristina – Kosovo
- June 2012 – 2014 American University of Tirana, Department of Stomatology,  
Tirana – Albania

### Clinical Research Consultant

- Sep. 2010 – 2016 Taibah University, College of Dentistry  
Al Madinah Al Munawwara, Kingdom of Saudi Arabia

### Administrative Positions:

- Sep. 2019 – Present Director of DMD Implant Clinic  
Sep. 2013 – Present Director of Annual Dental Implant Symposium  
Sep. 2012 – Present Chair UKCD Implant Board  
Sep. 2011 – Present Director of Predoctoral Implant Program

### Invited Academic Positions:

#### Chair, Adult Restorative Dentistry Department

University of Nebraska Medical Center – College of Dentistry  
January 2020, Lincoln, NE

#### Director of Dental Implant Center

University at Buffalo, School of Dental Medicine  
June 2019, Buffalo, NY

**Scholastic and Professional Honors:**

- 2017 UKCD Deans' Research Award.
- 2017 UKCD 5 Year Service Award Recognition.
- 2016 Diplomate International Congress of Oral Implantologist.
- 2016 ITI Official Speaker Status.
- 2015 Fellow International Congress of Oral Implantologist.
- 2013 Faculty Patient Care Award for Outstanding Achievement.  
University of Kentucky, College of Dentistry.
- 2012 Hippocratic Award. Hippocrates Ordine Society, Tirana, Albania.
- 2010 Nobel Biocare Implant Fellowship Award (\$40,000).  
State University of New York at Buffalo, School of Dental Medicine.

**Professional Publications:**

- **Scientific Books:**

1. *Glossary of Oral Implant Terminology*, Journal of Oral Implantology. Ahmad Kutkut is co-author of the Glossary "2016". <http://www.brightcopy.net/allen/orim/Glossary/>
2. *Color Atlas of Common Oral Diseases*, 5th edition, Copyright 2017 Wolters Kluwer, "Dr. Ahmad Kutkut is Contributor"
3. *Digital Dentistry Curriculum* for predoctoral and advanced education in Prosthodontics. Copyright © 2017, the American College of Prosthodontists.
4. *Contemporary and Practical Periodontology and Implant Dentistry*. Chapter: Clinical Considerations for Implant-Restorative Procedures. By: Ahmad Kutkut. "under press 2021".
5. *General Guide to Digital Oral Implantology, Color Atlas of Clinical Cases*. Ahmad Kutkut "under press 2022".

- **Students/Residents Implant Manual:**

"2013 – Present" Implant Treatment Manual from Tooth Extraction to Implant Restoration including Digital Implant Dentistry Workflow.

- **Scientific Articles:**

1. Faraj SA, **Kutkut A**, Taylor RC, et al. Comparison of Dehydrated Human Amnion-Chorion and Type 1 Bovine Collagen Membranes in Alveolar Ridge Preservation: A Clinical and Histological Study. *J Oral Implantol*. 2021;47(5):385-393.
2. Whitt J, Al-Sabbagh M, Dawson D, Shehata E, Housley-Smith M, Tezanos A, **Kutkut A**. Efficacy of stem cell allograft in maxillary sinus bone regeneration: a randomized controlled clinical and blinded histomorphometric study. *Int J Implant Dent*. 2020;6(1):25.
3. **Kutkut A**, Abu-Eid R, Sharab L, Al-Sabbagh M. Full Mouth Rehabilitation with Implant-Prosthesis in Marfan Syndrome Patient: Clinical Report and Literature Review. *J Oral Implantol*. 2020 Apr 1;46(2):115-121. (Featured Article for a Press Release

<https://meridian.allenpress.com/joi/pages/joi/pages/successful-dental-implant-for-marfan-syndrome-patient>)

4. **Kutkut A**, Rezk M, Zephyr D, Dawson D, Frazer R, Al-Sabbagh M. Immediate Loading of Unsplinted Implant Retained Mandibular Overdenture: A Randomized Controlled Clinical Study. *J Oral Implantol*. 2019 Oct;45(5):378-389
5. Almas K, Smith S, **Kutkut A**. What is the Best Micro and Macro Dental Implant Topography? *Dent Clin North Am*. 2019 Jul;63(3):447-460
6. Almeahmadi N, **Kutkut A**, Al-Sabbagh M. What is the Best Available Luting Agent for Implant Prosthesis? *Dent Clin North Am*. 2019 Jul;63(3):531-545
7. Vellis J, **Kutkut A**, Al-Sabbagh M. Comparison of Xenogeneic Collagen Matrix vs. Free Gingival Grafts to Increase the Zone of Keratinized Mucosa Around Functioning Implants. *Implant Dent*. 2019;28:20–27
8. **Kutkut A**, Bertoli E, Frazer R, Pinto-Sinai G, Fuentealba Hidalgo R, Studts J. A systematic review of studies comparing conventional complete denture and implant-retained overdenture. *J Prosthodont Res*. 2018 Jan;62(1):1-9.
9. Al-Thobity A, **Kutkut A**, Almas K. Microthreaded Implants and Crestal Bone Loss: A Systematic Review. *J Oral Implantol*. 2017; 43:157-166. (Featured Article for a Press Release <http://joionline.org/page/Microthreaded-Dental-Implants-Preserve-Crestal-Bone>)
10. Al-Humaidi SF, Dar-Odeh NS, Alnazzawi A, **Kutkut A**, Hudieb M, Abu-Hammad O. Volatile sulphur compounds in exhaled air of dental students smoking the waterpipe: a nested case-control study. *Minerva Stomatol*. 2017; 66:157-162.
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1. Health and Wellness Magazine - Online March 2019
2. Digital Dentistry Offers Accurate, Efficient, Faster Treatment. *Health & Wellness Magazine*, 16 (6), 22.  
[https://issuu.com/rockpointpublishing/docs/hwmarch19\\_36p\\_digital/22](https://issuu.com/rockpointpublishing/docs/hwmarch19_36p_digital/22)
3. **Prosthopedia®**: “<http://prosthopedia.prosthodontics.org>”



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- Atraumatic Extraction and Ridge Preservation Techniques, Two Cases Report.
- Bilateral Ridge Augmentation, A Case Report.
- Block Graft and Sinus Augmentation, Treating Atrophic Maxillary Ridge, a Case Report.
- Distraction Osteogenesis and Osteotome Sinus Lift Techniques, Two Cases Report.
- Free Gingival Graft for Implant Retained Mandibular Overdenture, a Case Report.
- Guided Implant Surgery with Immediate Implant Provisionalization, a Case Report.
- Immediate Implant Placement Protocol, a Case Series Report.
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