The Science Journal of the Lander College of Arts and Sciences

Volume 15
Number 1 *Fall 2021*

49-57

2021

What Common Factors may Influence the Success of Dental Implant?

Yehuda Taavar

What Common Factors may Influence the Success of Dental Implant?

Yehuda Taavar

Yehuda Taavar will graduate in January 2022 with a Bachelor of Science degree in Biology

Abstract

The aim of this study is to investigate the common factors that may influence the success of dental implants. Addressing these factors may potentially aid experts in the field in delivering dental implants without approaching or decreasing the number of failures. Smoking, diabetes, implant maintenance, age, and implant size have significantly influenced implant success. It is suggested that patients are advised to quit smoking at least one week before surgery to minimize risk factors. Inadequate glycemic control also contributes to periodontal destruction and is associated with the severity of peri-implant complications. However, if patients maintain good glycemic control, dental implants will still have a high success rate. As a result, treating diabetic patients primarily with proper glycemic control is a safe and successful treatment option. Peri-implant maintenance treatment (PIMT) is another important component for dental implant success. Furthermore, physical, metabolic, and endocrine changes frequently occur as people become older. These changes may lead to an increased risk of osteoporosis that may cause the development of dental implant failure. Lastly, the use of inadequate implant for a certain area of the maxilla or mandible may lead to dental implant failure. This research also shows that short implants should only be utilized in exceptional circumstances, but conventional size implants should be the primary mechanism of implant delivery. As a result, the longer the implant, the better the chance of survival. Furthermore, if the buccolingual width of edentulous crest is sufficient, the use of wide implants is shown to be the best strategy for implant delivery. Having long and wide implants is established to improve the implants strength and resistance to fracture.

Introduction

There are several different methods for replacing missing teeth such as dental implants or dentures. However, dental implants have emerged as the new treatment modality for many patients and are expected to play a significant role in oral rehabilitation in the future. Conventional dentures have restricted indications and outcomes, but implant dentures have advantages in function, stability, comfort, and can replace one to all missing teeth if they are supported by healthy oral (bone quality and quantity) and overall health (Sidjaja, et. al. 2006). Dental implants are defined as surgical components that interact with the jaw or skull bone to support a dental prosthesis, such as a crown, bridge, denture, or facial prosthesis, or to function as an orthodontic anchor (Raikar, et. al. 2017). Dental implants can improve a person's look, confidence, self-esteem, improve their ability to talk and chew properly, and remove the need for complete and partial dentures (Krishnan, et. al. 2020). Over the past 10 years, 90%–95% of dental implants were reported to be successful (Raikar, et. al. 2017). Even though dental implants have a very good survival rate, a rising number of patients are developing peri-implant illnesses. Given the potential systemic consequences of chronic inflammation, it is critical to have a better understanding of peri-implant disease occurrence and risk factors to prevent or manage peri-implant inflammation. These peri-implant illnesses can cause pain, need surgical or non-surgical therapy, have significant consequences on systemic health, or result in implant failure. The future burden of peri implant illnesses must be determined for patient consent, physician decision-making, and resource allocation. Peri-implant illnesses are divided into two categories: peri-implant mucositis and peri-implantitis, both of which are infectious diseases. Soft tissue inflammation around a functional dental implant with bleeding on probing (BOP) has been classified as peri-implant mucositis, and peri-implantitis is differentiated by associated loss of supporting marginal bone past normal bone remodeling. Peri-implant mucositis is reversible, whereas peri-implantitis is more difficult to reverse (Daubert, et. al. 2015).

Prosthetic implants can fail for a variety of reasons, both mechanical and biological. Incomplete osseointegration, infection, and poor healing are the most common reasons of implant failure (Sakka, Coulthard, 2011). Osseointegration is a biological tissue healing process in which a direct functional and structural connection between organized live bone and the surface of a loadbearing implant. The direct anchorage of the implant fixture to surrounding host bone is a very important feature to affirm the reported long term clinical success of dental implants. Several factors with insufficient control can jeopardize the implant's solid anchoring to the bone tissue. These factors can be categorized as surgical (primary stability and surgical technique), tissular (quality and quantity of bone, healing, remodeling), and implantological (macrostructure, microstructure, and dimensions) (Georgiopoulos, et. al. 2007). In addition, a dentist should assess several factors to ensure that a patient is a good candidate for a dental implant treatment and that the surgery will not lead to implant disease. Smoking, diabetes, implant maintenance, age, and implant size are all possible factors that may influence the success rate for dental implant.

Methods

The literature in this research helped provide a thorough examination of the subject and enabled a conclusion to be established on the research topic. Databases including EBSCO, ProQuest, PubMed, and Google Scholar that were primarily accessed through Touro College's Online library, were extremely useful for locating essential and appropriate articles.

Smoking

Cigarette smoking has been linked to an increase of plaque formation, a higher prevalence of gingivitis and periodontitis, a higher rate of tooth loss, and increased alveolar ridge resorption in the oral cavity (Scabbia, et. al. 2001). When it comes to dental implant rejection and implant-related complications, nonsmokers have a huge advantage. About the time of implant insertion and second-stage surgery, smoking has been linked to implant failure, with smokers having a failure rate double that of nonsmokers (Gorman, et.al. 1994). Smoking may lead to problems with oral connective tissue repair, dignity, and interference with wound healing by inhibiting cellular protein synthesis and reducing the ability of gingival fibroblasts to adhere as a product of nicotine (Hoffman, 1997). The elevated amounts of fibrinogen, hemoglobin, and blood viscosity, abnormal levels of carboxyhemoglobin in blood, impaired polymorphonuclear neutrophil (PMN) leukocyte activity, and increased platelet adhesiveness have all been proposed as mechanisms through which smoking impairs wound healing (Lawrence, et. al. 1984). In a study to evaluate the influence of smoking, 2,194 implants were placed in 540 patients over a 6-year period. The overall failure rate was 5.92% which is consistent with other studies; however, when patients were subdivided into smokers and nonsmokers, it was found that a significantly greater percentage of failures occurred in smokers (11.28%) than in nonsmokers (4.76%) (Bain, Moy, 1993). Although, the authors demonstrated that implants malfunction because of smoking, there are some reports that have shown no significant differences between smokers and nonsmokers in the success of implants. A meta-analysis study monitored the performance of machined surface implants and Osseotite implants in which he was able to isolate the effect of smoking. The study showed that there was no difference observed between the smoking groups and the non-smoking group, however, there was a clinically relevant difference observed between the two types of implants (Bain, et. al. 2002). The results of this meta-analysis revealed that the risks of smoking are not represented in this group of patients who smoke around 12 cigarettes a day on average. The author does, however, emphasize that there may be a significant difference regarding implant failure between heavier smokers and nonsmokers than there are in the current sample.

Even though smoking seems to be harmful to implants, quitting smoking can significantly reduce the rate of implant failure. A smoking cessation plan was developed, and it was discovered that there was a statistically important gap in the failure rates between those who tended to smoke and those who followed the non-smoking protocol (Bain, 1996). Other studies show there was no statistically significant difference between complications and past smoking, this suggests that quitting smoking may even reduce the likelihood of complications to the level of a nonsmoker's (Levin, et. al. 2004). Since smoking has such a negative impact on implants, Bain and Moy's initial guidelines say that long periods of abstinence are needed. They recommended that the patient quit smoking at least one week before surgery to allow for the reversing of increased platelet adhesion and blood viscosity, as well as the nicotine's short-term effects. The patient can refrain from smoking for at least two months after the implant has been placed, by which time bone healing will have advanced to the osteoblastic process and early osseointegration will have occurred (Bain, Moy, 1993). Furthermore, according to certain research, the volume of cigarettes consumed is linked to a higher rate of implant failure. In a prospective study on mandibular implant overdentures found that heavy smokers (30-40 cigarettes per day) with type IV bone had a higher rate of implant failure (Fartash et. al. 1996). Furthermore, other research found that heavy smokers (>14 cigarettes a day) had slightly more marginal bone damage across implants than people who smoked less (14 cigarettes per day) (Lindquist et. al. 1996). This indicates that the higher the rate of cigarette consumption, the more likely it will lead to implant failure.

In general, smoking tends to have a greater effect on maxillary implants than it does on mandibular implants. In a retrospective analysis of over 200 implants, a gap of the success rates in smokers was observed between maxillary and mandibular implants prior to loading. The performance rates in the maxilla were impaired, but not in the mandible (Bruyn, Collaert, 1994). In addition, other research discovered peri-implantitis was slightly worse in smokers than in nonsmokers in the maxilla, but not in the mandible (Hass, et. al. 1996). Posterior maxillary bone is likely to be of poor consistency, making it more vulnerable to the negative effects of smoke. Others observed that bone loss around anterior sites was almost twice as large as bone loss around posterior (Lindquist et. al. 1997). However, it seems logical to say that since it is the region most insulated from the local influence of tobacco smoke and is, moreover, covered by the tongue, there should be lower failure rates in the posterior mandible among smokers than the anterior region. However, this is an area that needs to be looked at more thoroughly.

Diabetes

Diabetes mellitus is a chronic carbohydrate metabolism disease characterized by hyperglycemia, which reflects a disruption of metabolic balance in glucose consumption by tissues, glucose release by the liver, pancreatic, anterior pituitary, and adrenocortical hormone output liberation.

Recent studies have shown that diabetes mellitus affects any tissue of the body in some way, either directly or indirectly (Chauhan, et. al. 2019). This metabolic disease affects an estimated 15.7 million people in the United States, or 5.9% of the population (national institute of health, 1995). Diabetes occurs when the pancreas doesn't contain enough insulin (type 1) or when the body can't use the insulin it produces efficiently (type 2) (Chauhan, et. al. 2019). In the oral environment alone, diabetes has been associated with periodontitis, xerostomia, increased levels of salivary glucose, swelling of the parotid gland, an increased incidence of caries, and slower healing after surgeries leading to tissue necrosis (Rothwell, Richard, 1984). If diabetes is not managed properly, elevated levels of extracellular glucose may also form covalent bonds with macromolecules in the body (Salvatierra, et. al. 2016).

Diabetes is a crucial modifying factor in periodontitis, but its connection to peri-implant diseases has yet to be thoroughly investigated. however, diabetes may be considered one of the most encountered contraindications to dental implant therapy. Animal studies have proven that poor bone-implant healing and delayed osseointegration are linked to inadequate glycemic control (Eskow, Oates, 2017).

A study contained 200 diabetic patients and 200 non-diabetic control patients. Success occurred in 192 cases in diabetic group, while it occurred in 196 cases in the control group. The results obtained were not significantly different comparing the prognosis of dental implants in diabetic and non-diabetic patients (Chauhan, et. al. 2019). Although a study observed an association between diabetic patients and peri-implantitis, it reported peri-implantitis diagnosed in 24% of diabetic patients and 7% of non-diabetic patients (Ferreira, et. al. 2006). However, these results refer to patients with diabetes regardless of their glycemic management. Furthermore, another study reported a high risk in diabetic patients for peri-implantitis (Daubert, et. al. 2015). However, it seems logical to say that since their study only had five diabetic patients that may have influenced their statistical analysis. Therefore, high success rate is achievable when dental implants are placed in diabetic patients whose disease is under control, but patients that do not have the proper control may be susceptible to implant failure.

Studies were conducted to observe the relationship between the level of metabolic control of diabetes and peri-implantitis. When comparing poorly controlled diabetic patients to well-controlled diabetic patients, certain clinical parameters, such as periodontal disease and radiographic bone degradation, were slightly higher. Authors concluded that inadequate glycemic regulation could play a role in the modulation of periodontal destruction and may be linked to the seriousness of peri-implant complications (Venza, et. al. 2010). Other studies conclude that regardless of the level of glycemic control, type 2 diabetic patients have a significantly higher risk of peri-implantitis and marginal bone loss (Lagunov, et. al. 2019).

A systematic review investigated whether hyperglycemia/diabetes mellitus is associated with peri-implant diseases. According to the meta-analyses, the chance of peri-implantitis is around 50% higher in diabetics than in non-diabetics. Importantly, nonsmokers with hyperglycemia have a 3.39-fold increased chance of peri-implantitis relative to those of normoglycemia. In contrast, the connection between diabetes and peri-implant mucosa was not significant. Therefore, the study concluded that the risk of peri-implantitis is greater in people with hyperglycemia compared to those with normal blood glucose levels. In addition, nonsmokers with hyperglycemia have an increased risk of peri-implantitis, demonstrating that smoking is not needed to intensify the effects of hyperglycemia (Monje, et. al. 2017a). However, only 11 percent of their studies included subjects with satisfactory plaque control, the remaining 89 percent did not report any oral hygiene criteria and thus likely included subjects with low plaque control, which may have influenced their findings. In addition, only three of the experiments used in their comparative analysis omitted smokers, so smoking may have confounded the effects of hyperglycemia for implant success in the other studies.

Although this study suggests that diabetic patients with strong glycemic control may have a high success rate for dental implants, precautionary measures may increase the likelihood of a successful outcome. Before implant therapy, a comprehensive health history should be obtained by the doctor, adequately screening the candidate to ensure that they are taking their diabetic drug, and if their metabolic control seems to be inadequate, delaying implant treatment until improved control is reached is the safest option (Balshi, et. al. 1999).

Future research is required to look at the connection between peri-implant tissue health and long-term changes in glycemia and HbA1c levels. The major glycemic control parameters should be monitored not only for scientific purposes, but also for physicians since inadequate metabolic control can lead to problems such as an increased risk of infection. Under the limitations of this research, the findings suggest that implant therapy in diabetic patients with strong glycemic control is a safe and effective treatment choice.

Implant Maintenance

With the use of dental implants for teeth replacement and denture stabilization, the need for maintenance and repair is becoming more relevant in daily clinical practice. Periodontium is the tissue that surrounds and supports the teeth. If those in the field can understand the biological mechanisms of the gingiva and periodontium in normal teeth versus implants, it will demonstrate how much more critical implant tooth oral hygiene is compared to normal tooth oral hygiene. The peri implant mucosal seal is a region established to apply a tight seal to isolate the implant and the bone from bacterial plaque in the oral environment. However, unlike the periodontium surrounding a normal tooth, the peri-implant mucosal seal still lacks an effective barrier against bacterial invasion from plaque (Weyant, 1994). In addition, the vasculature in the gingival tissue that surrounds dental implants, is not as efficient as the vasculature in normal teeth, thereby, preventing the destruction of biofilms. Furthermore, the oriented collagen fibers around the implant are parallel as supposed to being perpendicular, which makes it more susceptible to bacterial invasions (Nevins, Langer, 1995). Therefore, the lack of proper oral hygiene may not only cause bacteria invasion from plaque accumulation which may lead to periodontitis or gingivitis, it can also induce the development of peri-implantitis (Kurtzman, Silverstein, 2014).

A cross-sectional study was performed on patients who were healthy and partly edentulous. 206 implants were fulfilled on 115 patients that were divided into three categories; 1) usual compliers which experienced peri-implant maintenance therapy (PIMT) at least twice a year; 2) erratic compliers which experienced PIMT less than twice a year; 3) non-compliers which didn't experience any PIMT. The study discovered that association between compliance and peri-implant condition were statistically significant. Compliance was associated with 86% fewer conditions of peri-implantitis. The probability of PIMT compliance was substantially associated with frequency of peri-implantitis (Monje, et. al. 2017b). As a result, PIMT enforcement could be the path to maintaining an inflammation-free condition that allows hard and soft tissue integrity to coexist. For instance, it was demonstrated that the failure rate of dental implants was decreased by 90 percent of patients who received routine maintenance compared to those who did not. In fact, patients who received at least one maintenance appointment on a yearly basis had a 60 percent lower failure rate than those who did not have any maintenance (Gay, et. al. 2016). In this regard, it has been stated that patients who receive regular PIMT have a lower risk of peri-implant bone loss development. To stress the importance of PIMT, in a systematic review, the long-term results of patients with periodontitis who underwent periodontal therapy and implant placement were evaluated. According to the findings, patients of periodontitis had good implant outcomes, within trials with a 10-year follow-up, implant survival was high (92.1 percent) (Zangrando, et. al. 2015). The high success rate of implant therapy in patients with periodontitis who received adequate treatment and routine periodontal care, demonstrates the significance for implant maintenance.

Regarding this, many patients remain unaware of the critical steps that must be taken to ensure proper implant maintenance. A study was performed out to assess the knowledge of oral hygiene measures in patients with dental implants. A questionnaire that involved 50 patients on a basis of assessing the awareness about hygiene maintenance for their implants. Patients who had dental implants rehabilitated were asked approximately ten questions. Patients were questioned about their brushing method, the kinds of brushes they used for implants, if they used mouthwash and floss to keep their implants clean, and if they used any other implants aids. Around 80% of patients said they are aware of the oral hygiene measures required for implants, and that they learned about them from their dentist; however, 10% of patients were unaware of the importance of hygiene measures in preserving dental implants. The findings of this survey shows that the patients in the study had a poor understanding of dental implant hygiene and its effects, and the experience of dental implant maintenance in patients is inadequate (Krishnan, et. al. 2020). As a result, dentists should be advised to provide routine dental exams and give oral hygiene tips to all patients who have dental implants. Services aimed at improving oral hygiene and implant management for implant patients are required.

Unfortunately, implant failure is associated with a lack of professional implant maintenance. It has been proposed that a professional mechanical plaque removal procedure should be programmed to avoid the formation of peri-implantitis. Disruption of the assemblage of surface associated microbial cells enclosed in an extracellular polymeric matrix must be routinely removed through self-performed oral hygiene measures. Accordingly, Peri implant maintenance compliance, experiencing at least 2 PIMT yearly has been demonstrated as a crucially essential factor for preventing peri-implantitis in healthy patients.

Age

Patients' conditions vary greatly, particularly among the elderly. Implant failure seems to be a multi-factorial problem, so it's unclear if age is a risk factor for implant placement. However, there are physical, metabolic, and endocrine changes that occur as people age, and clinicians must consider that these changes can impact implant treatment. The human skeleton accumulates bone until around the age of 30 years, at which point it begins to lose bone, causing the bone to weaken (Heersche, et. al. 1998). In addition, since diabetes and osteoporosis are prevalent in the elderly population, these conditions may influence dental implant success.

Age-associated bone loss is related due to an uncoupling of osteoblastic and osteoclastic activity, since the osteoblastic activity that creates new bone can't keep up with the osteoclastic activity that breaks down bone to rebuild it (Freemont, et. al. 2007). Furthermore, as age increases, the rate of bone healing slows down. Possible suggestions for the cause of delayed healing may include, reduction of the osteogenic stem cell numbers, a decrease in the proliferation and differentiation capability, and reduced local blood flow (Strube, et. al. 2008). An analysis was conducted to see how long it took for bone to heal and close a fracture gap for rats. By 4 weeks after fracture, young 6-week-old rats have formed bone to close the fracture gap, adult 26-week-old rats took 10 weeks, and older 52-week-old rats require more than 26 weeks (Meyer, et. al. 2004). The causes for poor bone healing may be because open wounds compress more slowly, and incised wounds develop strength more slowly as age increases. In addition to weak bone regeneration, increased aging may also cause reduced keratinization of the epithelium, a decrease in the synthesis of collagen in periodontal ligaments, and a reduction in the number of cells on the osteogenic layer of the alveolar bone, all leading to implant failure.

A prospective study was carried out with 2 groups of healthy edentulous patients to determine the influence of age on peri-implant tissues in patients treated with implant-supported overdentures in the mandible. The mean age of the younger group was 46 years, and the mean age of the older group was 68 years. After three years, the mean bone loss in the younger group was 1.2 mm, and in the older group it was 0.8 mm, but the difference was not significant. The clinical performance of implant-supported overdentures in the mandible was similarly effective in younger and older patients (Meijer, et. al. 2001). This study indicates that increased age alone is not a contradiction to implants. However, another study looked at a vast number of patients who had been operated on by an experienced surgeon and discovered that elderly age raised the likelihood of implant failure; patients over 60 years old were twice as likely to have negative results (Brocard, et. al. 2000). Furthermore, a 7-year prospective trial was observed in a private practice with the same model of implants, and it was discovered that only a limited minority of implants existed in patients over the age of 60 (Moy, et. al. 2005).

A rat study involved three age groups, 6 weeks (younger group), 12 weeks (older group), and around 2 years (old group), the young group demonstrated that new trabecular bone developed aggressively around the implant and that strong bone interaction was reached more quickly than the adult group. The old group, on the other hand, had less recently developed trabecular bone around the implant and had less bone interaction than the other groups (Shirota, et. al. 1993). The findings showed that as rats get older, the rate and amount of new bone development around implants decreased. This study demonstrates that as patients increase in age the likelihood for developing osteoporosis increases as well.

Diabetes mellitus is a serious disease that affects people all over the world. Diabetic patients get more prevalent as people get older, particularly those over 50 (Harris, et. al. 1998). Diabetic patients have poorer wound healing, greater chance of microvascular disease, a slower response to infection, and are more susceptible to periodontal disease, all of which can make implant placement more difficult (Olson, et. al. 2000). Mineral metabolism is also changed which can potentially disturb the integration process (Fiorellini, et. al. 2000). Furthermore, the time span of diabetes may affect implant performance, as an increase in diabetes duration could induce microvascular disruptions, which could lead to implant complications (Olson, et. al. 2000). As a result, implant failure is more likely to occur in elderly patients who have been diabetics for a longer time.

The reduction of bone mass and density in the body, including the jaws, is known as osteoporosis. Osteoporosis is closely linked to estrogen deficiency, so postmenopausal women are at risk for osteoporosis. The reduction in estrogen during the menopausal transition process causes more bone resorption than development, resulting in osteoporosis. There are two types of postmenopausal women. Type one or 'postmenopausal osteoporosis, in which trabecular bone loss is prevalent, resulting mostly in vertebral and wrist fractures, and Type two or senile osteoporosis, in which both cortical and cancellous bone are missing, resulting in hip fractures.

A study that examines the relationship between premenopausal and postmenopausal women and implant failure found no evidence of a higher failure rate for implants in women over 50 relative to women under 50 or between women and men over 50 (Dao, et. al. 1993). However, according to a survey, women lost about 10 percent of their hip bone mineral density between the ages of 50 and 60, compared to just 2 percent for men. (Looker, et. al. 1998). Just like other bones in the body can decrease bone mass for postmenopausal women, the alveolar ridges have been stated to decreased bone mass in postmenopausal women as well (Humphries, et. al. 1989). Although some evidence indicates that the mandible varies sufficiently from postcranial skeletal sites, and it is therefore unclear if bone mass throughout the skeleton corresponds to bone mass in the mandible and maxilla (Boyde, Kingsmill, 1998). However, mandibular bone mineral content declines with age, and mandibular bone density was shown to be lower in elderly female subjects than in male subjects (Heersche, et. al. 1998), which indicates that postmenopausal women are more likely to develop osteoporosis even in the mandible and maxilla due to estrogen deficiencies.

According to a study that looked at jaw variations in pre- and postmenopausal women, the effect of postmenopausal estrogen status on impaired implant healing was seen in the maxilla but not in the mandible. In addition, hormone replacement therapy decreased the rate of maxillary bone loss by 41 percent. Since osteoporosis affects trabecular bone rather than cortical bone, and the maxilla has more trabecular bone composition than the mandible, the authors reasoned that the maxilla is more vulnerable to systemic osteoporosis (August, et. al. 2001). Therefore, postmenopausal women may be more likely to experience implant failure especially in the maxilla due to hormone deficiency.

Implant Size

Optimizing implant geometry to maintain a healthy stress level at the bone-implant contact is a complex issue. The use of an inadequate implant for a certain area of the maxilla or mandible may lead to dental implant failure. Dental implants come in a variety of lengths, ranging from 5.0 to 20 mm. The most frequent implant length is 8 to 15 mm, which corresponds to the length of a normal root. The diameter of currently available implants ranges from 3.0 to 7.0 mm. The implant diameter requirements are based on both surgical and prosthetic concerns.

It is not always possible to deliver dental implants of sufficient length since many situations lack having more than 8 mm of residual vertical bone height. Therefore, clinicians must choose between augmentation of the bone or the placement of short implants (Renouard, Nisand, 2006). For clinicians to prevent the use of short implants, resorbed bone should be augmented using different bone-grafting procedures. This will allow the clinician to place a longer implant. However, short implants may still be a better option than bone augmentation, since augmentation treatments can lead to extra surgical interventions, serious postoperative morbidity and complications, higher cost, and take longer before patients can chew on their implant-supported prostheses (Esposito, et. al. 2011). A study suggests that 5 mm short implants yield equal, if not better, outcomes than longer implant placed in bone one year after loading. Using the bone levels at implant placement as baseline data, there was a statistically significant difference between short and long implants. Short implants lost an average of 1 mm and long implants lost around 1.2 mm in peri-implant marginal bone levels one year after loading (Esposito, et. al. 2011). However, this study has limitations due to the small sample size, because only a few individuals had enough bone width (at least 8 mm) to tolerate implants with a 6 mm diameter. Short implants with diameters of 4.0 to 5.0 mm should also be assessed since clinicians often compensate for a lack of height by using implants with a larger diameter (Esposito, et. al. 2011). Therefore, it's logical to assume that the larger diameter of 6 mm in this study was responsible for the positive success rate of shorter implants. However, short implants with narrow diameters may lead to implant failure.

According to the findings of a systematic study, the placement of short rough-surface implants is not a less efficacious treatment modality than the placement of conventional rough-surface implants (Kotsovilis, et. al. 2009). Furthermore, a study involving 7-, 8.5-, and 10-mm implants were analyzed, and it was determined that short implants should be explored as an alternative to advanced bone augmentation operations (Neves, et. al. 2006). Another study established that when delivering 6- and 7-mm implants, short implants with a press-fit shape and a sintered porous surface geometry exhibited the highest performance (Hagi, et. al. 2004). However, other research demonstrate that short implants may be linked to decreased survival rate (Lee, et. al. 2005). According to the findings from a systematic review, short (<10 mm) implants can be successfully placed in the partially edentulous patients, though with a tendency of an increasing survival rate per implant length (Telleman, et. al. 2011). As a result, short implants should only be utilized in exceptional circumstances, but conventional implants should be the primary mechanism of implant delivery. Several presumed reasons to explain why short implants are likely to have a worse survival probability in the posterior region may be because there is less bone to implant contact due to the smaller surface area of short implants. Furthermore, due to substantial resorption in the posterior region, a larger crown to implant ratio is created over short dental implants, which may lead to a greater implant failure rate (Telleman, et. al. 2011). In addition, it has been proposed that as the length of the surface area rises, the stress levels for a given applied load decreases on longer implants. The mechanical resistance to masticatory forces is also improved because of this (Hoon, et. al. 2005). Aside from implant length, having an implant in a threaded design rather than a smooth design may increase its surface area. This will aid in the transmission of axial tensile or compressive loads better than smooth implant types (Hoon, et. al. 2005).

Aside from implant length, the usage of implants with a larger diameter may provide numerous advantages. From a biomechanical standpoint, larger diameter implants can help provide engagement of a maximum bone and better stress distribution in the surrounding bone (Arisan, et. al. 2010). The use of wider components also enables for more torque to be applied in the placements of prosthetic component (Lee, et. al. 2005). In addition, wide diameter implants will provide an Increase bone-to-implant contact, bicortical engagement, and rapid insertion at failure locations, as well as a reduction in abutment stresses and strains. As a result, having a larger contact area improves initial stability and minimizes stress. By increasing the diameter of the implant, it is possible to improve its strength and resistance to fracture (Lee, et. al. 2005). However, wide implants are restricted due to the the width of the residual ridge and aesthetic requirements for a natural emergence profile (Lee, et. al. 2005). However, when the buccolingual width of the edentulous crest is insufficient, narrow diameter implants can be used to replace missing teeth. According to an article examining the clinical and radiographic outcome of mini dental implants (MDIs), in comparison to conventional-diameter implants, MDIs are cost-effective, have fewer complications during flapless implant placement, and can be used in edentulous arches with minimal remaining bone in a facial–lingual dimension to avoid bone graft. In addition, MDIs also has a great advantage because of its short healing time, reduced post-operative discomfort and quick restoration of mastication and aesthetics for patients throughout the healing phase (Elsyad, et. al. 2011).

Although increasing the diameter of the implant may decreases the amount of bone in the surrounding area, a recent study examined the success and survival rates of narrow diameter implants over a 10-year period, as well as peri implant characteristics and mechanical and prosthetic post loading complications. They concluded that narrow diameter implants can be utilized safely in situations only when a conventional diameter implant is not appropriate, since most of the bone loss surrounding narrow diameter implants happened within the first two years of loading and was minor afterwards (Arisan, et. al. 2010). As a result, the primary strategy should be the use of wide implants, since increasing implant diameter decreases the maximum value of Von Mises equivalent stress. Therefore, as the surface area transmitting a horizontal component of force applied to a dental implant increased, the stress distribution in the maxilla and mandible have become more effective.

References

Aguilar-Salvatierra, Antonio, et al. "Peri-implant evaluation of immediately loaded implants placed in esthetic zone in patients with diabetes mellitus type 2: a two-year study." Clinical oral implants research 27.2 (2016): 156-161.

Arisan, Volkan, et al. "Evaluation of 316 narrow diameter implants followed for 5–10 years: a clinical and radiographic retrospective study." Clinical Oral Implants Research 21.3 (2010): 296-307.

August M, Chung K, Chang Y, Glowacki J. Influence of estrogen status on endosseous implant osseointegration. J Oral Maxillofac Surg 2001; 59:1285—9. discussion 90-1.

Bain CA, Moy PK. The association between the failure of dental implants and cigarette smoking. Int J Oral Maxillofac Implants 1993; 8:609-15.

Bain CA, Weng D, Meltzer A, Kholes SS, Stach RM. A meta-analysis evaluating the risk for implant failure in patients who smoke. Compend 2002; 23:695-706.

Bain CA. Smoking and implant failure- Benefits of a smoking cessation protocol. Int J Oral Maxillofac Implants 1996; 11:756-9.

Balshi, Thomas J., and Glenn J. Wolfinger. "Dental implants in the diabetic patient: a retrospective study." Implant Dent 8.4 (1999): 355-9.

Boyde A, Kingsmill VJ. Age changes in bone. Gerodontology 1998; 15:25—34.

Brocard D, Barthet P, Baysse E, Duffort JF, Eller P, Justumus P, et al. A multicenter report on 1,022 consecutively placed ITI implants: a 7-year longitudinal study. Int J Oral Maxillofac Implants 2000; 15:691—700.

Chauhan AS, Mehta M, Bajaj H, Mahajan A, Bala K, Goyal M Evaluation of prognosis of dental implant in diabetic patient. HECS Int J Comm Health Med Res 2019; 5(3):103-105.

Dao TT, Anderson JD, Zarb GA. Is osteoporosis a risk factor for osseointegration of dental implants? Int J Oral Maxillofac Implants 1993; 8:137—44.

Das Neves FD, Fones D, Bernardes SR, et al. short implants analysis of longitudinal studies. Int J Oral Maxillofac Implants. 2006; 21:86–93.

Daubert, Diane M., et al. "Prevalence and predictive factors for peri-implant disease and implant failure: a cross-sectional analysis." Journal of periodontology 86.3 (2015): 337-347.

De Bruyn H, Collaert B. The effect of smoking on early implant failure. Clin Oral Implants Res 1994;5:260-4.

Elsyad MA, Gebreel AA, Fouad MM, et al. The clinical and radiographic outcome of immediately loaded mini implants supporting a mandibular overdenture. A 3-year prospective study. J Oral Rehabil. 2011; 38:827–834

Eskow, Caroline C., and Thomas W. Oates. "Dental implant survival and complication rate over 2 years for individuals with poorly controlled type 2 diabetes mellitus." Clinical implant dentistry and related research 19.3 (2017): 423-431.

Fartash B, Tangerud T, Silness J, Arvidson K. Rehabilitation of mandibular edentulism by single crystal sapphire implants and overdentures. 3–12-year results in 86 patients. A dual center international study. Clin Oral Implants Res 1996; 7:220-9.

Ferreira, S.D.; Silva, G.L.M.; Cortelli, J.R.; Costa, J.E.; Costa, F.O. Prevalence, and risk variables for peri-implant disease in Brazilian subjects. J. Clin. Periodontal. 2006, 33, 929–935.

Fiorellini JP, Chen PK, Nevins M, Nevins ML. A retrospective study of dental implants in diabetic patients. Int J Periodontics Restorative Dent 2000; 20:366—73.

Freemont AJ, Hoyland JA. Morphology, mechanisms, and pathology of musculoskeletal ageing. J Pathol 2007; 211:252—9.

Gay IC, Tran DT, Weltman R, et al. Role of supportive maintenance therapy on implant survival: A university based 17 years retrospective analysis. Int J Dent Hyg 2016;14:267-271.

Georgiopoulos, Basile, et al. "The effects of implant length and diameter prior to and after osseointegration: a 2-D finite element analysis." Journal of Oral Implantology 33.5 (2007): 243-256.

Gorman LM, Lambert PM, Morris HF, et al. The effect of smoking on implant survival at second stage surgery. Implant Dent. 1994;3:165-168.

Haas R, Haimbock W, Mailath G, Watzek G. The relationship of smoking on peri-implant tissue: a retrospective study. J Prosthet Dent 1996;76:592-6.

Hagi D, Deporter DA, Pilliar RM, et al. A targeted review of study out- comes with short (X7 mm) endosseous dental implants in partially edentulous patients. J Periodontol. 2004;75: 798–804.

Harris MI, Flegal KM, Cowie CC, Eberhardt MS, Goldstein DE, Little RR, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey, 1988—1994. Diabetes Care 1998;21:518—24.

Heersche JN, Bellows CG, Ishida Y. The decrease in bone mass associated with aging and menopause. J Prosthet Dent 1998;79: 14—6.

Hoffmann D, Hoffmann I. The changing cigarette, 1950-1995. J Toxicol Environ Health. 1997;50:307-364.

Hoon LJ, Frias V, Woo LK, Wright RF (2005) Effect of implant size and shape on implant success rates: a literature review. J Prosthet Dent 94:377–381

Humphries S, Devlin H, Worthington H. A radiographic investigation into bone resorption of mandibular alveolar bone in elderly edentulous adults. J Dent 1989;17:94—6.

Kotsovilis S, Fourmousis I, Karoussis IK, et al. A systematic review and meta-analysis on the effect of implant length on the survival of rough-surface dental implants. J Periodontol. 2009;80: 1700–1718.

Krishnan, Preethi, et al. "Knowledge of Oral Hygiene Measures in Patient with Dental Implants." Drug Invention Today, vol. 13, no. 3, Mar. 2020, pp. 451–454.

Kurtzman G, Silverstein L. Dental implants: Oral hygiene and maintenance. Int Dent J 2014;10:56-62.

Lagunov, V.L.; Sun, J.; George, R. Evaluation of biologic implant success parameters in type 2 diabetic glycemic control patients versus healthy patients: A meta-analysis. J. Investig. Clin. Dent. 2019, 10, e12478.

Lawrence WT, Murphy RC, Robson MC, Heggers JP. The detrimental effect of cigarette smoking on flap survival: An experimental study in the rat. Br J Plast Surg 1984;37:216-9.

Lee JH, Frias V, Lee KW, et al. Effect of implant size and shape on implant success rates: A literature review. J Prosthet Dent. 2005;94:377–381.

Levin L, Herzberg R, Dolev E, et al. Smoking and complications of onlay bone grafts and sinus lift operations. Int J Oral Maxillofac Implants. 2004;19:369-373.

Lindquist LW, Carlsson GE, Jemt T. A prospective 15-year follow-up study of mandibular fixed prostheses supported by osseointegrated implants. Clin Oral Implants Res 1996;7:329-36.

Lindquist LW, Carlsson GE, Jemt T. Association between marginal bone loss around osseointegrated mandibular implants and smoking habits: A 10 year follow-up study. J Dent Res. 1997;10: 1667-1674.

Looker AC, Wahner HW, Dunn WL, Calvo MS, Harris TB, Heyse SP, et al. Updated data on proximal femur bone mineral levels of US adults. Osteoporos Int 1998;8:468—89.

Meijer, Henny JA, Rutger HK Batenburg, and Gerry M. Raghoebar. "Influence of patient age on the success rate of dental implants supporting an overdenture in an edentulous mandible: a 3-year prospective study." International Journal of Oral & Maxillofacial Implants 16.4 (2001).

Meyer MH, Etienne W, Meyer Jr RA. Altered mRNA expression of genes related to nerve cell activity in the fracture callus of older rats: a randomized, controlled, microarray study. BMC Musculoskelet Disord 2004;5:24.

Monje, Alberto, Andres Catena, and Wenche S. Borgnakke. "Association between diabetes mellitus/hyperglycaemia and peri-implant diseases: systematic review and meta-analysis." Journal of clinical periodontology 44.6 (2017a): 636-648.

Monje, Alberto, Hom-Lay Wang, and José Nart. "Association of preventive maintenance therapy compliance and peri-implant diseases: a cross-sectional study." Journal of periodontology 88.10 (2017b): 1030-1041.

Moy PK, Medina D, Shetty V, Aghaloo TL. Dental implant failure rates and associated risk factors. Int J Oral Maxillofac Implants 2005;20:569—77.

National Diabetes Data Group (US), et al. Diabetes in America. No. 95. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 1995.

Nevins M, Langer B. The successful use of osseointegrated implants for the treatment of the recalcitrant periodontal patient. J Periodontol 1995;66:150-7.

Olson JW, Shernoff AF, Tarlow JL, Colwell JA, Scheetz JP, Bingham SF. Dental endosseous implant assessments in a type 2 diabetic population: a prospective study. Int J Oral Maxillofac Implants 2000;15:811—8.

Raikar S, Talukdar P, Kumari S, Panda SK, Oommen VM, Prasad A. Factors Affecting the Survival Rate of Dental Implants: A Retrospective Study. J Int Soc Prevent Communit Dent 2017;7:351-5.

Renouard F, Nisand D. Impact of implant length and diam- eter on survival rates. Clin Oral Implants Res 2006;17(suppl 2):35-51.

Esposito, Marco, et al. "Rehabilitation of posterior atrophic edentulous jaws: prostheses supported by 5 mm short implants or by longer implants in augmented bone? One-year results from a pilot randomised clinical trial." Eur J Oral Implantol 4.1 (2011): 21-30.

Rothwell, Bruce R., and Eldon L. Richard. "Diabetes mellitus: medical and dental considerations." Special Care in Dentistry 4.2 (1984): 58-65.

S. Sakka and P. Coulthard, "Implant failure: etiology and complications," Medicina Oral, Patolog´ıa Oral y Cirug´ıa Bucal, vol. 16, no. 1, Article ID 16870, pp. e42–e44, 2011.

Scabbia A, Cho KS, Sigurdsson TJ, et al. Cigarette smoking negatively affects healing response following flap debridement surgery. J Periodontol. 2001; 72:43-49.

Shirota T, Ohno K, Suzuki K, Michi K. The effect of aging on the healing of hydroxylapatite implants. J Oral Maxillofac Surg 1993;51:51—6.

Sidjaja, Suhandi, et al. "The influence of hyperthyroidism on implant restoration treatment outcome." Medical Journal of Indonesia 15.3 (2006): 191-5.

Strube P, Sentuerk U, Riha T, Kaspar K, Mueller M, Kasper G, et al. Influence of age and mechanical stability on bone defect healing: age reverses mechanical effects. Bone 2008;42:758—64.

Telleman G, Raghoebar GM, Vissink A, et al. A systematic review of the prognosis of short (,10 mm) dental implants placed in the partially edentulous patient. J Clin Periodontol. 2011; 38:667–676.

Venza, I.; Visalli, M.; Cucinotta, M.; De Grazia, G.; Teti, D.; Venza, M. Proinflammatory Gene Expression at Chronic Periodontitis and Peri-Implantitis Sites in Patients with or Without Type 2 Diabetes. J. Periodontol. 2010, 81, 99–108.

Weyant RJ. Characteristics associated with the loss and periimplant tissue health of endosseous dental implants. Int J Oral Maxillofac Implants 1994;9:95-102.

Zangrando MS, Damante CA, Sant'Ana AC, Rubo de Rezende ML, Greghi SL, Chambrone L. Long-term evaluation of periodontal parameters and implant outcomes in periodontally compromised patients: A systematic review. J Periodontol 2015;86:201-221.