Prosthetic Complications in Mandibular Metal-Resin Implant-Fixed Complete Dental Prostheses: A 5- to 9-Year Analysis

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Purpose: *The purpose of this study was to investigate the prosthetic complications of patients with a maxillary complete removable dental prosthesis opposing a mandibular metal-resin implant fixed complete dental prosthesis.* ***Materials and Methods:*** *This study is a retrospective analysis of an ongoing prospective study. Dental records from 46 patients treated with a maxillary complete removable dental prosthesis and a mandibular metal-resin implant-fixed complete dental prosthesis were reviewed for 15 different prosthetic complications. The average recall time was 7.9 years. The percentage of patients exhibiting each complication and corresponding 95% confidence intervals was calculated. Logistic regression analysis determined the effect of recall period, age, and gender on each of the following major complications: tooth fracture, complete denture relines, screw complications, and tooth replacement. The recall period was divided into 3 parts: ≤ 2 years, 2 to 5 years, and more than 5 years.* ***Results and Conclusion:*** *Statistical significance was exhibited for complete denture relines, posterior tooth replacement, and screw complications. No abutment or framework fractures were recorded for any of the time intervals. The most common complications were prosthetic tooth fracture, tooth wear, maxillary hard relines, and screw complications. Patients were 1.06 times more likely to require a heat-processed hard reline with each year increase of age. After 2 to 5 years and > 5 years, patients were 3.7 times and 8.5 times more likely to require a hard reline than at ≤ 2 years. Patients were 52.5 times more likely to need posterior tooth replacement at > 5 years than at ≤ 2 years, and 7.7 times more likely to encounter a screw complication at > 5 years than at ≤ 2 years.* Int J Oral Maxillofac Implants 2008;23:847–857

Key words: *dental implants, metal-resin, prosthetic complications, retrospective study*

Treatment of the edentulous mandible with a metal-resin implant-fixed complete dental prosthesis has become a common treatment modality over the past 25 years as an alternative to conventional complete denture therapy.[1] Numerous studies have reported high success rates of implant integration with low incidence of soft tissue or bony complications with respect to fixed implant-supported prostheses in both edentate and partially dentate patients.[2–13] The vast majority of well-controlled studies pertaining to the metal-resin implant-fixed complete dental prosthesis focus on implant integration success and soft tissue complications. However, many questions still remain about the long-term prosthetic stability of the restorations.

Thus, the focus has turned to complications of the restoration superstructure. Although several studies have reported complications to the superstructure of metal-resin implant-fixed complete dental prostheses,[14–21] these studies have wide variance in how they report complications. They often report different types of complications and have varying amounts of recall time. The studies analyze different types of prostheses, with varying types of opposing occlusions.[14–21] Additionally, they are often poorly controlled and rarely report meaningful statistics. Hence, useful clinical conclusions are difficult to obtain.

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Fig 1 Example of excessive occlusal wear.

Therefore, the purpose of this study was to investigate the complications encountered in patients restored with a maxillary complete denture and a mandibular metal-resin implant-fixed complete dental prosthesis and the relationship they had with recall period, age, and gender.

MATERIALS AND METHODS

Dental records of 46 patients (14 men and 32 women) were reviewed for prosthetic complications. The mean age of the patients was 59 years at the date the prostheses were first placed. These patients are a subset of patients from an ongoing prospective clinical trial evaluating implant and soft tissue complications,[13] but they represent the entire number treated with a mandibular metal-resin implant-fixed complete dental prosthesis opposed by a maxillary complete removable dental prosthesis. All of the patients in this subset of the prospective study were edentulous prior to entering the study. All patients were treated with a maxillary complete denture fabricated with acrylic resin bases and acrylic resin denture teeth. They had either 5 or 6 standard external hexagon Steri-Oss Implants (Nobel Biocare, Yorba Linda, CA) placed in the anterior mandible between the mental foramina. The implant types included: hydroxyapatite (HA) -coated threaded, HA-coated cylindric, and titanium alloy machined-surface threaded endosseous implants.[13] Each patient then received a mandibular metal-resin implant-fixed complete dental prosthesis with the following components: Steri-Oss PME (Precision Margin Esthetics) transmucosal abutments, cast-to copings (60% gold, 20% palladium, 19% platinum, and 1% iridium) with a hexed coping screw (titanium alloy), a cast metal alloy frame, acrylic resin denture teeth, and heat-processed acrylic resin.

Mandibular Prostheses

Forty-three patients had 5 mandibular implants and 3 had 6 mandibular implants placed and restored for a total of 233 implants in the evaluation. Implant diameters ranged from 3.25 mm to 4.5 mm, and implant lengths varied from 8 mm to 18 mm. The superstructure frameworks of the mandibular prostheses were constructed of various metal alloys: 37 type III gold alloy, 4 type IV gold alloy, 3 gold-palladium alloy, 1 high palladium alloy, and 1 silver-palladium alloy. Each framework was "L" shaped in design, with a metal undersurface. An acrylic wrap-around design was not used in any of the patients. Each patient had acrylic resin denture teeth, which were attached to the framework with heat-processed acrylic resin. The acrylic resin denture teeth varied in brand, and the heat-processed acrylic resin varied in type (Fig 1). The brands of prosthetic teeth and acrylic resin were not noted for the majority of the patients, and therefore brands cannot be addressed.

Maxillary Complete Dentures

All 46 patients received a new maxillary complete denture the day the mandibular prosthesis was inserted. All had the corresponding acrylic resin denture bases and acrylic resin denture teeth that they had in their mandibular prostheses. Additionally, all of the maxillary prostheses were entirely acrylic resin–based; no metal-based complete removable dental prostheses were made.

Prosthesis Fabrication and Occlusion

Once the second-stage surgery was completed, the tissue thickness was measured and an appropriate abutment cuff height was chosen. The abutments were placed and torqued to 30 Ncm. Maxillary and mandibular definitive impressions were made. In the maxillary arch, a border-molded custom tray was used, and an abutment level impression of the mandibular arch was made. At the next appointment, the casts were mounted in centric relation at the proper vertical dimension of occlusion, utilizing maxillary record bases with wax rims and mandibular implant-secured record bases with wax rims. Acrylic resin denture teeth were set. Centric relation, vertical dimension of occlusion, esthetics, and phonetics were verified. The framework was cast in the respective metal alloy for each patient, and then tried in for passive fit. Passivity was verified by a combination of methods: the 1-screw test, radiographically with a panoramic radiograph, and/or visually.[22,23] The frameworks were sectioned and soldered as neces-

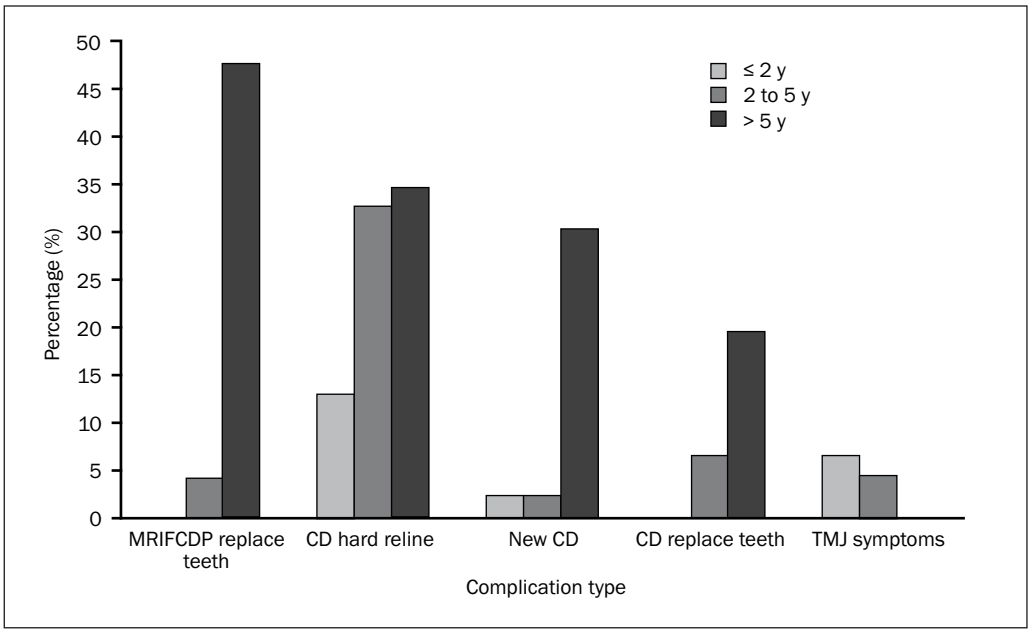

Fig 2 Other complications. MRIFCDP = metal-resin implant-fixed complete dental prostheses.

sary until a passive fit was determined using a combination of the methods. One laboratory technician fabricated all the metal frameworks. Cantilever lengths were determined so that at least first molar occlusion was achieved. Therefore, cantilever lengths varied from patient to patient and within patients depending on jaw relationship, mandibular arch shape, and implant position. Anterior-posterior spread ratio was not used as a main determinant of the distal cantilever lengths. The teeth were then reset onto the framework, and centric occlusion, vertical dimension of occlusion, esthetics, and phonetics were again verified. The maxillary and mandibular prostheses were processed with heat-cured acrylic resin. The frameworks were not treated to increase the resin-to-metal bond. Retentive features were not added to the prosthetic denture teeth, nor was wax solvent used during processing. The occlusal scheme for all of the prostheses was set to bilateral simultaneous posterior contacts in centric relation with bilateral balanced occlusion in excursive movements. At the final appointment the maxillary and mandibular prostheses were placed, including a clinical remount if deemed necessary. Retaining screws were tightened to 20 Ncm, and the access hole was filled with cotton pellets and a polyester urethane dimethacrylate composite resin (Fermit; Ivoclar Vivadent, Amherst, New York). The patients were then seen for 24-hour recall. One clinician supervised all stages of the prosthesis fabrication and recall appointments for each patient in the Implant Clinic at The Ohio State University. Recall appointments were performed at 3, 6, 9, and 12 months and then annually, unless additional appointments were needed as a result of complications. At each scheduled recall appointment, the mandibular prosthesis was removed and replaced with the existing retaining screws at 20 Ncm torque. Subsequently, the access holes were filled with cotton pellets and a polyester urethane dimethacrylate composite resin.

Complications/Definitions

All patient records were retrospectively reviewed for complications (Fig 2). Dates of each complication were noted with respect to the dates the prostheses were inserted. Each complication that was noted is listed with an associated definition when necessary (Table 1).

Fifteen types of complications were analyzed over 3 recall periods for 46 patients. The recall periods were divided as follows: ≤ 2 years, 2 to 5 years, and > 5 years. Percentage of patients exhibiting each complication and corresponding 95% confidence intervals were tabulated. The most common complications were then grouped together based on etiology. There were 4 separate groups. Logistic regression analysis was used to determine the effect of time period, age, and gender on each of the following groups:

Table 1 Complications and Definitions

Prosthetic parts	Definition (if applicable)
Implant	Any implant failure or fracture resulting in prosthetic disuse of the implant
Screws	
Abutment screw loosening	When the abutment screw can be further tightened with the use of a driver and finger torque.
Abutment screw fracture	
Retaining screw fracture	
Retaining screw loosening	When the retaining screw can be further tightened with the use of a driver and finger torque.
Stripped screws	The inability of the driver to engage screw head in order to tighten or untighten the screw, resulting in an inability to remove the screw.
Components	
Abutment fracture	
Framework fracture	
MRIFCDP occlusion	
Fractured teeth	Debonding of a tooth along with or independent of the acrylic resin from the denture base.
Replacement teeth	Replacement of teeth or the recommendation to replace the teeth due to excessive occlusal wear noted from significant loss of cuspal and occlusal anatomy of the acrylic teeth.
Fractured acrylic resin	Any debonding of the acrylic resin from itself or from the bar (either cohesive or adhesive fracture).
Complete denture	
Heat-processed hard relines	The act of relining or the recommendation of a reline (whichever comes first) as a result of poor fit or retention. The recommendation was made when there was a clinical loss of stability, retention or there was irritation of the underlying soft tissue.
Fractured teeth	Debonding of a tooth along with or independent of acrylic resin from the denture base.
New CRDP	Fabrication of a new CRDP or the recommendation of fabrication of a new CRDP (whichever comes first) as a result of a combination of excessive occlusal wear and poor stability and/or retention.
Replace Teeth	Replacing of teeth or the recommendation of replacing the teeth (whichever comes first) due to excessive occlusal wear noted from significant loss of cuspal and occlusal anatomy of the acrylic teeth (Fig 1).
TMJ symptoms	Any symptom noted relating to the temporomandibular joint or associated masticatory muscles.

MRIFCDP = metal-resin implant-fixed complete dental prostheses; CRDP = complete removable dental prostheses; TMJ = temporomandibular joint.

Table 2 Total Complications

Complication	≤ 2 years	2 to 5 years	> 5 years	Total
Implant failure or fracture	0	0	1	1
Abutment screw loosening	0	5	0	5
Abutment screw fracture	0	1	1	2
Retaining screw loosening	3	1	9	13
Retaining screw fracture	2	2	4	8
Stripped screws	0	0	8	8
Abutment fracture	0	0	0	0
Framework fracture	0	0	0	0
MRIFCDP fracture teeth	9	7	12	28
MRIFCDP replace teeth	0	2	22	24
MRIFCDP fractured acrylic	2	1	2	5
Lab-processed hard reline	6	15	16	37
CRDP fractured teeth	7	7	8	22
New CRDP	0	2	14	16
CRDP replace teeth	0	3	9	12
TMJ symptoms	3	3	0	6

MRIFCDP = metal-resin implant-fixed complete dental prostheses; CRDP = complete removable dental prostheses; TMJ = temporomandibular joint.

1. Anterior tooth fracture: Maxillary and mandibular fractured teeth were included in this group. The fractures were not specified in the progress notes as to whether they were cohesive or adhesive in nature.
2. Maxillary complete denture heat-processed hard relines.
3. Screw complications: All retaining screw and abutment screw complications were included in this group.
4. Posterior tooth replacement: Either maxillary or mandibular teeth were replaced or recommended to be replaced.

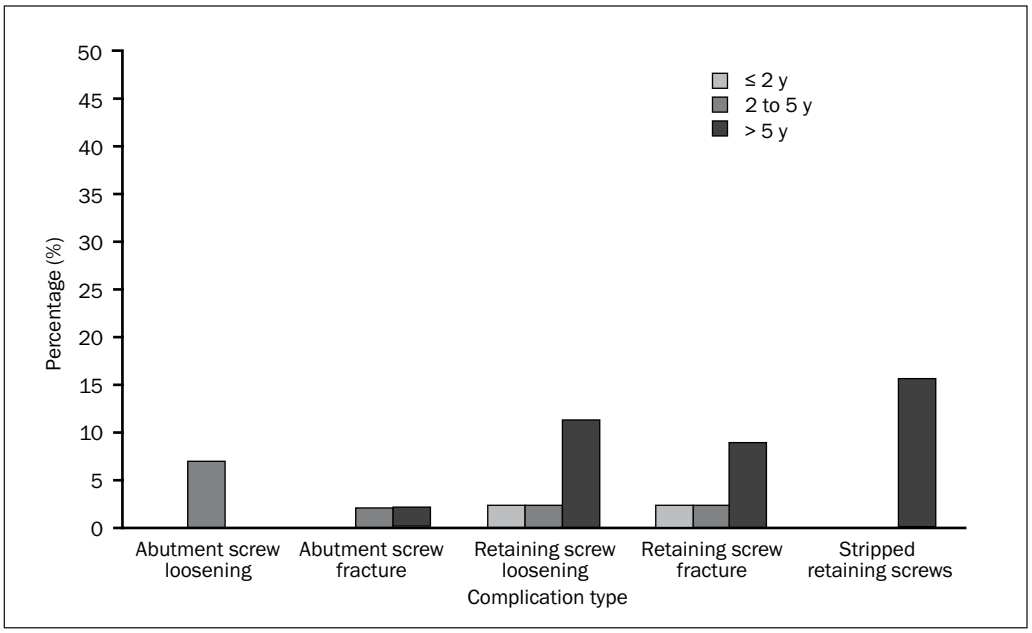

Fig 3 Complications.

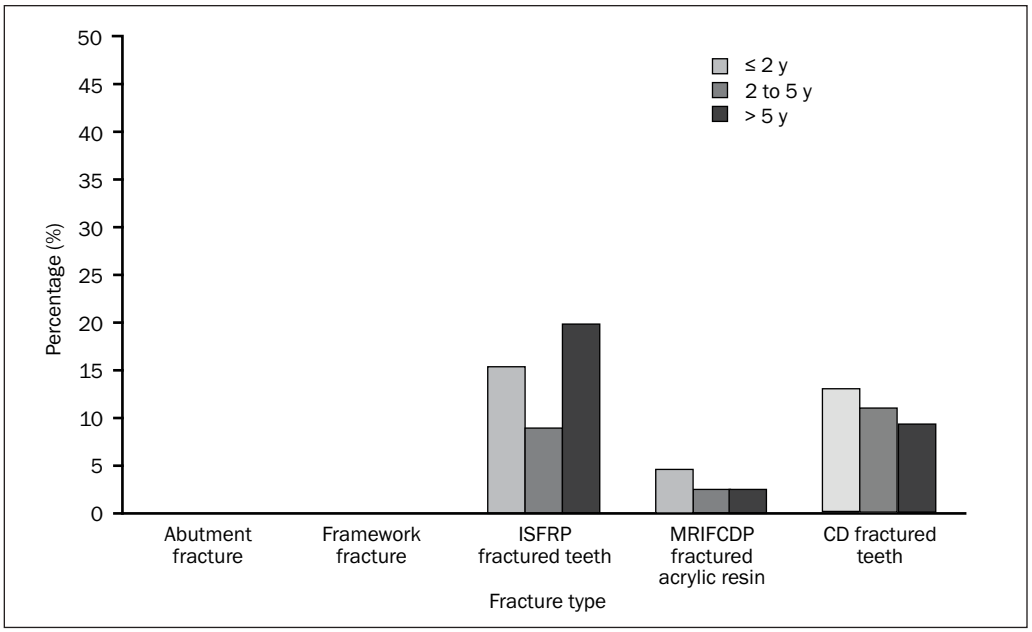

Fig 4 Fractures. MRIFCDP = metal-resin implant-fixed complete dental prostheses.

Additionally, each time a new maxillary complete denture was recommended to be made or one was made, 1 complication was added to both the maxillary complete denture reline group and the posterior tooth replacement group. For the logistic regression analyses, $P < .05$ was considered statistically significant.

RESULTS

After all the prostheses were inserted, only 1 implant failed. The failed implant was the distal implant on the right side and was discovered at the 6-year recall. This implant was not replaced. All original prostheses were in service at the time of the most recent recall appointment, for 100% continuous prosthesis success. The average recall was 7.9 years (range, 5.0 to 9.7 years). Total complications experienced in each of the recall periods are listed in Table 2. Percentage of patients exhibiting each complication are shown in Figs 1, 3, and 4. For the < 2 years recall period, the low was 0% for multiple categories of complications and the high was 15.2% (95% CI = 6.3 to 28.9) for mandibular fractured teeth. In the 2-to-5-year recall period, the low was 0% for multiple categories of complications and the high was 32.6% (95% CI = 19.5

to 48) for hard relines of the maxillary complete denture. The > 5-year recall period had a low of 0% for multiple complications and a high of 47.8% (95% CI = 32.9 to 63.1) for mandibular tooth replacement. Logistic regression analysis was used to determine the effect of recall period, age, and gender on each of the following major complications.

Tooth Fracture

The odds of tooth fracture did not increase significantly for time period, age, or gender.

Complete Denture Relines

The odds of requiring a reline were significantly higher in recall periods 2 to 5 years versus < 2 years (odds ratio = 3.71; 95% CI = 1.44 to 9.54; $P = .0066$), and > 5 years versus < 2 years (OR = 8.49; 95% CI = 2.79 to 25.78; $P = .0002$). For each year of increase in age, the odds of requiring a reline were OR = 1.06 (95% CI = 1.0 to 1.12; $P = .0386$).

Tooth Replacement

The odds of requiring the posterior teeth to be replaced was significantly higher in the time period > 5 years versus < 2 years (OR = 52.5; CI 95% = 6.7 to 411.3; $P < .001$).

Screw Complications

The odds of having a screw complication was significantly higher in time > 5 years versus < 2 years (OR = 7.7; CI 95% = 1.5 to 38.9; $P = .0135$).

DISCUSSION

There are many prosthetic complications that can occur in a patient who has a maxillary complete denture and a mandibular metal-resin implant-fixed complete dental prosthesis, and these complications are not isolated from one another and certainly can be interdependent. By today's standards, it is safe to say that none of the complications are negligible. Rather they are often inconvenient and expensive to both the doctor and the patient. This is especially true when many of the same complications occur many times over. This research delineates the complications that are encountered most frequently and their relationship with time. It also demonstrates that some complications previously reported do not seem to occur, possibly due to improved prosthetic materials and methods.

Implant Complications

Today, endosteal dental implants are the primary implant type utilized worldwide with years of proven success.[2–13] The primary implant complications encountered related to the prosthesis are loss of integration and fracture of the implant body.[24,25] Implant fracture has been limited to less than 1% incidence, and implant failure for the anterior mandible has been reported anywhere from 1% to 5%.[2–13,25–29]

In this study there were no implant fractures and only 1 implant failure; the failed implant was not replaced. The implant failed at the 6-year recall appointment and the etiology was unknown. The metal-resin implant-fixed complete dental prostheses have been worn without any further implant complications to date.

Framework Fracture

In this study there were no framework fractures. Earlier studies had a high incidence of framework fracture attributed to a learning curve in restoring the MRIFCDP.[23,28] The most common cited reasons for fracture was poor alloy choice (i.e. Type III gold alloy) and decreased cross-sectional dimension distal to the most posterior implant.[23,28] Once both were corrected then further complications were significantly reduced or eliminated.[23, 28] However, in this study a large percentage of frameworks were composed of Type III gold alloy, despite there being no instances of framework fracture. Special attention was given to framework design, by increasing the cross-sectional area and vertical height of the framework, as recommended by Stewart et al.[30] A "L" beam design was used for each of the frameworks.

Screw Complications

In this study, abutment screw loosening and fracture and retaining screw loosening and fracture were relatively low (0% to 6%) in the first 5 years of recall, which is in agreement with several studies.[5,8,14,15,23,31,32] Most reports that have been between 3 and 5 years in recall have reported screw complications in 3% to 8% of patients. Most of the studies involved the Brånemark System Nobel Biocare implants and prosthetic parts, including the gold alloy retaining screw.[8,14,15,23,32]

In the > 5 years recall period, this study found significantly more incidents of screw complications. For retaining screw loosening there was 10.9% incidence; for retaining screw fracture, 8.7%; and for stripped retaining screws, 15.2% (Fig 3). Screw complications were combined into 1 group and analyzed over the 3 different time periods. The logistic regression analysis confirmed this observation with statistical significance in recall period > 5 years versus < 2 years. There was increased chance (7.7 times) of an incidence of any kind of screw complication in recall

period > 5 years versus < 2 years. This increased incidence after 5 years is less than what Zarb and Schmitt found in 1990 and 1996 reports on prosthetic complications more than 4 to 9 years and in a 15-year follow-up study, respectively.[28,33] They cited parafunction resulting in overload, nonpassive fit of the framework, and cyclical stress loading fatigue from occlusal forces as reasons for fracture.[28]

Screw complications can result from many factors: inadequate preload on the screws, over-tightening of the screw leading to stripping and/or screw deformation, occlusal overload either from parafunction, occlusal interferences, or excessively long cantilevers, to name a few.[34,35] Perhaps these complications can be further affected by the material composition of the component parts. The superstructure has been designed as an "ascending stack of descending strength,"[36] with a weak link that is relatively easily retrievable and replaceable with no additional harm to the patient.[28,36]

Early implant components such as the abutment and the implant body were composed of commercially pure titanium, and the retaining screw was gold alloy. Today and in the present study, most of the implants and abutments as well as the retaining screw are composed of titanium alloy, a material with superior mechanical properties.[37–39] Many of the studies as discussed here had similar early results, regardless of the components' composition. After 5 years, however, Zarb and Schmitt reported a higher incidence of screw complications, both abutment and retaining screws, compared to this study.[28,33] Perhaps this can be attributed to factors such as material composition or differences in torque control. Nonetheless, it may be the case that with further study, titanium alloy components suffer the same complications, but to a lesser degree than commercially pure titanium and gold alloy components.

Additionally, stripped screws were a common complication rarely mentioned previously in the literature. This could be from 1 of 2 sources: *(1)* repeated removal and replacement of the prosthesis upon recall appointments, resulting in wear/rounding of the screw head and/or *(2)* incomplete seating of the driver into the screw head. The screws should be placed with proper torque control, ensuring complete seating of the driver into the screw head, and removal of the prosthesis may be limited to when it is necessary due to hygiene or suspicion of implant or abutment complications.

Tooth Fracture and Tooth Wear

In this study, fractured teeth from both the mandibular implant-supported complete denture and the maxillary complete denture occurred substantially in all 3 recall periods. Additionally, of all of the fractured teeth, only 1 was a posterior tooth. Replacement of the posterior teeth due to wear occurred with much greater frequency in the > 5 years recall period than in all other recall periods for both the metal-resin implant-fixed complete dental prosthesis and the complete removable dental prosthesis (47.7% and 19.6%, respectively). Furthermore, new complete dentures were made at an incidence of 30.4%. New complete dentures were made due to a combination of both posterior tooth wear and the need for a laboratory hard reline. This fact puts the incidence of replacing posterior teeth for the mandibular and maxillary prosthesis at virtually equally high levels for the > 5 years period. For the logistic regression analysis, only anterior tooth fractures were included, and the maxillary and mandibular groups were combined. Additionally, the posterior tooth replacement groups for the metal-resin implant-fixed complete dental prostheses and the complete removable dental prostheses were also combined. There were no statistically significant factors for tooth fracture. Tooth fracture seemed to occur in every patient and at all recall periods with relatively equal frequency, whereas posterior tooth replacement was significant for recall period > 5 years versus < 2 years ($P = .001$), with an odds ratio of 52.5.

Most of the existing literature also has found complications involving tooth fracture and tooth wear as the primary complicating factors for the metal-resin implant-fixed complete dental prostheses.[14,15,17,32] Incidences of 20% to 90% of the patients experiencing these types of complications have been reported when acrylic resin prosthetic components were used.[14,15,17,32]

Despite this observation, some reports have stated that fracture and wear are not major complicating factors.[8,10,22,28,31] These complications have been viewed as easily fixable and noncatastrophic. Other studies have noted maxillary complete denture fracture through the midline, either in conjunction with or in spite of tooth wear as a complication.[32] None of the patients in this study had any midline denture fractures.

Tooth fracture can be caused by a variety of factors, including inadequate bonding of the teeth to the acrylic resin, which can originate from insufficient wax removal on processing; trauma or inappropriate incising with the denture; dropping or mishandling the denture; insufficient support either from the mandibular framework or from the denture base; or from premature anterior contacts from decreased vertical dimension of occlusion, which results from excessive posterior tooth wear. Excessive wear of the posterior teeth was observed in this study and in

many other studies mentioned previously. As occlusal forces are increased with the implant prosthesis, the resin teeth wear and this can be at an accelerated rate compared with conventional tissue-supported complete dentures. Additionally, parafunctional activities alone or in combination with continuous prosthesis wear could increase the wear of the teeth as well. Another factor that could play a role is the type of prosthetic tooth used. Certainly different types of resin denture teeth have different wear rates, but there are other options to possibly slow the process of tooth wear. These options include altering the surface with amalgam or gold alloy, or using porcelain denture teeth.

Anterior teeth seem to undergo fracture rather than wear in contrast to posterior teeth. There are several probable reasons for this: *(1)* occlusal loads on anterior teeth are inherently less than those of posterior teeth, *(2)* the difference in direction of force vectors, and *(3)* insufficient acrylic resin and metal framework support. The primary force in the posterior is vertical in direction and compressive in nature, which is favorable for the bond between the tooth and the acrylic resin. The maxillary anterior teeth, when in contact in maximum intercuspation or excursive movements, experience anteriorly directed forces. The bond between the acrylic resin and the teeth is challenged in tension and shear but virtually never in compression. The ability of the maxillary anterior teeth to stay in place is a balance between tooth wear and the strength of the bond between the anterior teeth and the denture base. The mandibular anterior teeth, on the other hand, when they make occlusal contact, exert a shear and tension force on the majority of the denture tooth. If the framework and/or the acrylic resin does not provide for adequate support, then fracture may more easily occur.

To decrease the amount of tooth fracture, several steps might be considered. Regular occlusal analyses should be performed to ensure distribution of the load and elimination of interferences. The anterior teeth on the metal-resin implant-fixed complete dental prostheses should be well supported by the framework and acrylic resin. It is more difficult for maxillary anterior teeth to have increased support, therefore retentive diatorics and/or treatment with dichloromethane should be considered to increase retention of anterior teeth.[40] The balance between complications is a balance between proper occlusion, decreased tooth wear rates with improved materials, support of the teeth, and bond strength of the tooth to the denture base. Finding the perfect balance may result in less tooth wear and tooth fracture, but the next weakest element may inevitably appear, possibly in the form of increased frame fracture, screw fracture, implant fracture, or complete denture midline fracture.[10]

Complete Denture Reline

The next major finding was that the maxillary complete dentures needed heat-processed hard relines in a significant number of the patients in each recall period. Thirteen percent needed relines after up to 2 years, 32.6% needed them after 2 to 5 years, and 34.8% needed them after more than 5 years. In the logistic regression analysis, maxillary relines were significant for age in the 2- to 5-years group compared with the ≤ 2 years group and between the > 5 years group compared with the ≤ 2 years group. A patient was 1.06 times more likely to need a maxillary reline for each year increase in age. Also, the patients were 3.7 times more likely to need a hard reline in recall period 2 to 5 years versus ≤ 2 and 8.5 times more likely to need a hard reline after > 5 years than after ≤ 2 years.

Compared to the existing literature, these results agree with some reports and differ from others. Lindquist et al, in 1987, reported on 49 patients who required 13 relines of the complete dentures.[10] Zarb and Schmitt in 1990 investigated 49 edentulous arches and did not report an increased need for complete denture relines. Rather they commented they did not think that increased bone resorption was taking place.[28]

Patients with a maxillary complete denture opposing a mandibular metal-resin implant-fixed complete dental prostheses experience several differences compared to the conventional complete denture patient. Occlusal forces and contact area are larger and more anterior in patients with a metal-resin implant-fixed complete dental prostheses combined with a complete removable dental prosthesis.[41] Additionally, there is a unilateral or bilateral loss of posterior occlusal contacts when the patient is in the retruded position and an increase in pressure on the anterior maxillary ridge during occlusion.[42] Maxillary complete dentures become more unstable in implant denture wearers, which means that the stability, retention, and occlusion need to be checked and adjusted more frequently in the metal-resin implant-fixed complete dental prostheses patient than in the conventional denture patient.[41]

"Combination Syndrome" -like signs have been reported,[42–44] but very few studies have been performed to analyze the consequences suffered in the maxilla restored with a complete denture when opposed by a metal-resin implant-fixed complete dental prostheses. Gupta et al[42] found that the average loss of alveolar ridge height in the anterior max-

illa was 0.17 mm when there was a maxillary conventional removable denture and a mandibular metal-resin implant-fixed complete dental prosthesis, which was not statistically significant compared to patients with a maxillary and mandibular complete removable denture.

Patients usually need relines of the complete denture as a result of decreased support, retention, and comfort.[45] The reason for the decreased support and/or retention can be multifactorial: soft tissue changes, hard tissue changes such as resorption, pathology, and/or poor impression techniques resulting in improper extension of the complete denture.[45] The increased need for maxillary complete denture relines could have different etiologies: *(1)* a result of having a fixed implant prosthesis on the mandibular arch can be increased resorption and remodeling of the maxilla due to increased bite force, *(2)* the stability and retention of the maxillary complete denture is significantly reduced as the maxilla is now the weaker arch, or *(3)* a combination of both. It is difficult to identify the reason for the increased need without further research. Additionally, occlusion should be checked and adjusted more frequently to reduce the amount of complete denture instability due to interfering contacts.

Other Complications (TMJ Symptoms and Abutment Fracture)

The main complication with abutments is fracture. This study was consistent with the literature in that abutment fracture was a relatively rare complication.[15] Additionally, the PME abutment was used, which is composed of titanium alloy. This particular abutment has been shown to have excellent mechanical properties resulting from its composition and design.[37]

The literature has shown that in most cases, if any signs or symptoms of temporomandibular joint disorder or muscle discomfort developed, it is usually transient in nature.[14,22,28,33] In this particular study, joint symptoms were identified with an incidence of 6.5% at ≤ 2 years, 4.4% at 2 to 5 years, and 0% after 5 years. Most of the symptoms noted were muscle soreness, all of which dissipated over time. Reasons for this type of complication have not been definitively established in the literature, but increased masticatory function and increased parafunctional habits have been suggested.[46–49] Additionally, the literature supports that the many benefits the maxillary complete denture opposing the mandibular metal-resin implant-fixed complete dental prosthesis provides certainly do not preclude its use because of transient muscle discomfort.[14,46,48–54]

There are numerous weaknesses to this type of study. First, it is retrospective in nature, which makes controlling most if not all of the variables very difficult. Additionally, the sample size was relatively small. In this study, several clinicians evaluated the patients at the recall appointments. Despite the fact that they were being trained in the same clinic under the same attending doctor, their differences in clinical judgment could have affected recommendations on maintenance. However, these clinicians did not know that their decisions would be evaluated in a future study, which would free their decisions from bias. Some of the variables that could have been controlled better were the materials, such as the frame alloys and denture tooth types. Other factors which should be considered for future studies are control groups with patients only restored with complete dentures and monitoring of occlusion and the amount/number of occlusal adjustments needed. Hopefully through this study and the knowledge of how it can be improved, more useful research will be performed to improve this and other prosthetic situations.

Clinicians performing restorations should be able to inform their patients that the most common complications that they can expect to encounter are anterior fractured teeth, maxillary complete denture relines, and replacement of the posterior teeth due to excessive wear. Additionally, the doctors will be able to tell the patients when and over what time frame these complications can be expected to occur. With this information, both the doctor and the patient will have a less frustrating and more fulfilling experience with these types of prostheses.

CONCLUSIONS

From this study, patients with a maxillary complete denture and a mandibular metal-resin implant-fixed complete dental prosthesis can be given additional information on what to expect over the next 5 to 9 years. In this study of 46 patients, all restored with a maxillary complete denture and a mandibular metal-resin implant-fixed complete dental prosthesis, the following conclusions were made:

1. There were no framework or abutment fractures.
2. The 3 most common complications were replacement of the acrylic resin prosthetic posterior teeth due to significant wear, the need for maxillary complete denture laboratory heat-processed hard relines, and fractured acrylic resin anterior prosthetic teeth.
3. Patients are 1.06 times more likely ($P = .0386$) to require a heat-processed hard reline with each year increase of age.

4. Patients are 3.7 times (P = 0.0066) more likely to need a hard reline in the 2- to 5-year recall period than they are in the first 2 years of service.
5. Patients are 8.5 times (P = .002) more likely to need a hard reline after 5 years of service than they are in the first 2 years.
6. Patients are 52.5 times (P = .0002) more likely to need posterior tooth replacement after 5 years of service than they are in the first 2 years.
7. Patients are 7.7 times (P = .0135) more likely to encounter a screw complication after 5 years of service than they are in the first 2 years.

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