Double Crown-Retained Maxillary Overdentures: 5-Year Follow-Up

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ABSTRACT

Background: There is a lack of data concerning implant-supported overdentures (IODs) retained by double crowns in the edentulous maxilla.

Purpose: To perform a retrospective evaluation of clinical outcomes (survival/success rates) of maxillary overdentures retained on four implants via double crowns.

Material and Methods: Between 1993 and 2011, 28 patients with edentulous maxillae were restored with overdentures supported by four implants with a Morse taper connection (Ankylos, Dentsply Friadent, Mannheim, Germany) and double crowns according to the Marburg Double Crown (MDC) technique in a private practice. For retrospective evaluation of implant and prosthetic survival (in situ criterion) and success (event-free observational period), only patients attending a professional maintenance program were included ($n = 20$).

Results: Twenty patients (13 female/ seven male, mean age: 63.45 ± 7.18 years) with 80 implants met the inclusion criteria. The mean follow-up period was 5.64 ± 3.50 years. One implant was lost (cumulative survival rate: 98.75%). Eight implants (10.1%) in two patients (10%) showed peri-implantitis; both patients were active smokers (cumulative success rate: 88.75%). All dentures were still functional (prosthetic survival rate 100%) at the time of investigation. Technical maintenance procedures (e.g., abutment loosening, screw loosening, acrylic fracture or relining) were required at a rate of 0.222/patient-year.

Conclusions: Within the limitations of this study, we conclude that MDC-IODs are a promising treatment alternative for edentulous maxillae offering high implant and prosthesis survival rates > 98% and a limited incidence of biological and technical complications after a mean observational period of >5 years.

KEY WORDS: dental implant, double crown, maxilla, overdenture, peri-implantitis, technical complication

INTRODUCTION

Today, implant-supported overdentures (IODs) are an accepted and reliable treatment for edentulous jaws. Clinical studies have revealed high implant and prosthesis survival rates over observational periods of up to 10 years and a high level of patient satisfaction, as well as an improvement in quality of life compared to conventional dentures.[1–3] A wide variety of IOD designs with various numbers of implants and different attachment types for the connection of implants and removable dentures have been described. Commonly used abutment types included round or milled bars, ball attachments, magnet attachments, and double crowns.[4–6] Although numerous clinical studies have investigated IODs in the mandible, there are only a limited number of prospective and retrospective studies of implant overdenture treatment of the edentulous maxilla.[7,8]

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Therefore, established criteria for the design of maxillary IODs regarding the number and distribution of implants and the type of prosthetic anchorage systems (i.e., splinted or unsplinted) are inadequate.[4,6–8] Commonly, bars have been used as prosthetic attachments for maxillary IODs;[6–8] however, double crowns have been suggested as an alternative attachment type because they may provide better accessibility for peri-implant hygiene measures compared to bar constructions.[9,10] For the prevention of peri-implantitis and in addition to professional maintenance therapy, implant accessibility is important for oral hygiene measures.[11–14] This requirement is, to a large degree, ensured by implant-supported double crown-retained dentures.[10,15,16] Furthermore, double crowns can be used as attachments on natural teeth and on implants. This is of high interest for combined tooth-implant supported overdentures.[10,15]

The following two types of double crowns are most frequently described for the anchorage of removable dentures:[16] the parallel-walled telescopic crown, and the conical crown with a tapered design. Both designs were primarily developed and clinically evaluated with highly precious alloys and possess retentive characteristics as a result of the friction of the opposing surfaces of the inner and outer crowns. Despite the possible advantages of the double-crown attachment system, consideration must be given to the fact that this approach is technique-sensitive and costly, due to the use of noble dental alloys. Another double-crown system, the Marburg double crown (MDC)[17] incorporates a clearance fit. Double-crowns with clearance fit exhibit no friction or wedging during removal and insertion. An additional attachment is used to achieve retention. In this technique, all metal components are produced with a single cobalt-chromium-molybdenum alloy, and the framework (including the outer crowns) is cast in one piece. This technique offers the advantage of producing double crown-retained overdentures from base metal alloys instead of using the noble alloys typically used for individually milled telescopic and conical crowns.

Two recent systematic reviews[18,19] identified only four clinical studies with survival rates for implants supporting double crown-retained prostheses in the mandible ranging from 97 to 100% after observational periods of 3–10 years.[9,20–22] More recently published studies provide additional evidence for the good clinical performance of double crown-retained IODs over observational periods of 3–5 years[23,24] and 14 years.[16] Nevertheless, the available evidence is limited because most of the studies have been focused on mandibular IODs only, and studies including double crown IODs in the maxillary have relatively short mean observational periods of 2 to 3.4 years.[10,15] Furthermore, it must be taken into account that the majority of the clinical studies were conducted in a university setting; therefore, clinical data for maxillary double crown-retained overdentures generated under the conditions of a private practice with mean observational periods of more than 5 years are particularly lacking.

This study was a retrospective evaluation of the survival and success, including biological and technical complications, of double crown-retained maxillary IODs placed according to the MDC technique in a German private practice.

MATERIAL AND METHODS

This retrospective clinical study was performed in a private practice specializing in implants (Northern Hessia Implant Center, Hofgeismar, Germany). The study is an analysis of primary patient data regarding the clinical outcomes of maxillary IODs retained solely on four implants via MDCs. The study was reviewed and authorized by the Ethics Commission of the Albert-Ludwigs University, Freiburg, Germany (application no. 46/10–120329). The recommendations for strengthening the reporting of observational studies in epidemiology (STROBE) were followed.[25]

Patients who were provided with implant-supported or removable double crown-retained overdentures according to the MDC technique attached to four implants with a Morse taper connection (Ankylos, Dentsply Friadent, Mannheim, Germany) in the edentulous maxilla between January 1991 and December 2011 and who attended a post-implant maintenance program were identified. These patients were approached during their annual maintenance appointments (January 2011–December 2012) and asked to participate in the study after having received written information about the aims and course of the study. Patients who gave written informed consent and met the following inclusion criteria were included:

- Retention of the denture by four maxillary implants with double crown attachments according to the MDC technique

- Regular (at least annual) prophylaxis or supportive therapy at the same dental office where the implants had been inserted surgically
- Complete and continuous documentation of technical and biological complications during the complete functional period
- Periodontal examination including pocket probing depth (PPD) and bleeding on probing (BOP) at four sites per implant within 6 months before data acquisition using a periodontal probe
- Complete medical history including the following potential risk factors: medication (immune suppression and bisphosphonate), diabetes, cardiovascular disease, rheumatoid arthritis, and smoking habits
- Intraoral radiographs at the time of prosthetic delivery
- Functional period of the final prosthetic restoration of at least 12 months

The following exclusion criteria were applied:

- Use of implant designs other than the Ankylos system within a restoration.
- Use of other designs of the telescopic crowns on implants.
- Noncompliance in the post-implant maintenance program (minimum 1x/year).
- Functional time documented <1 year
- Other missing data

COURSE OF TREATMENT

Treatment Planning/Implant Positions

Two implants in each maxillary quadrant were planned, and the implant positions were chosen predominantly in the anterior segment according to the available amount of bone. This substantially reduces the operative complexity (Figure 1a and b).

Surgical Treatment

Surgical treatment was performed under local anesthesia according to the manufacturer's protocol. Antibiotics were given one hour before and for one week after surgery (Amoxicillin 1000 mg 3×1/d). Wound checks occurred after 7 days (suture removal) and at 28 days. Implant uncovering was performed after 3–4 months.

Prosthodontic Treatment

After impression-taking with screw-retained impression copings and a customized tray with a polyether material

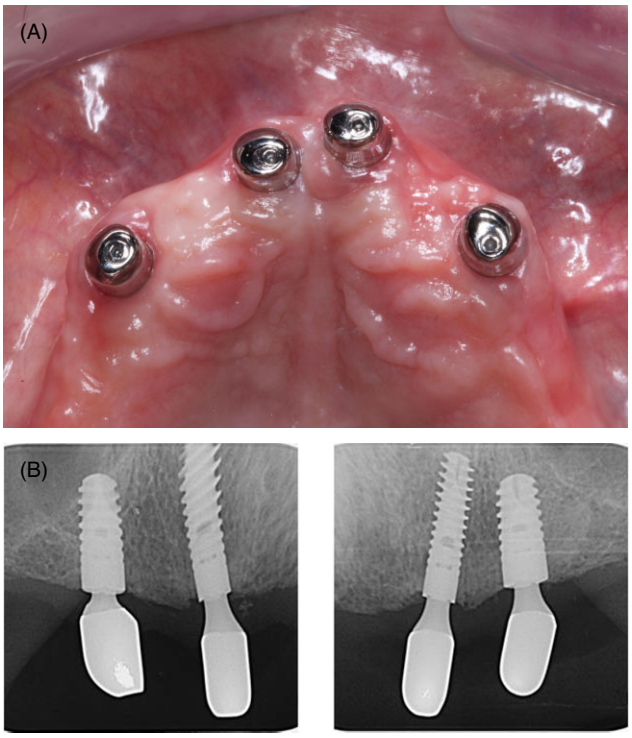

Figure 1 (A) Intraoral view: anterior implant placement. (B) Control-X-ray after the insertion of the prosthetic restoration.

(Impregum 3 M Espe, Seefeld), master models were fabricated with implant analogues and a flexible gingival mask. The telescopes themselves were designed as MDCs with clearance fit[17,26] and an additional retention element (TK Snap, Si-tec GmbH, Herdecke, Germany) (Figure 2). All primary telescopes were affixed with screws to the implants.[16] All IODs were designed to be palatal-free without transversal connectors (Figure 3).

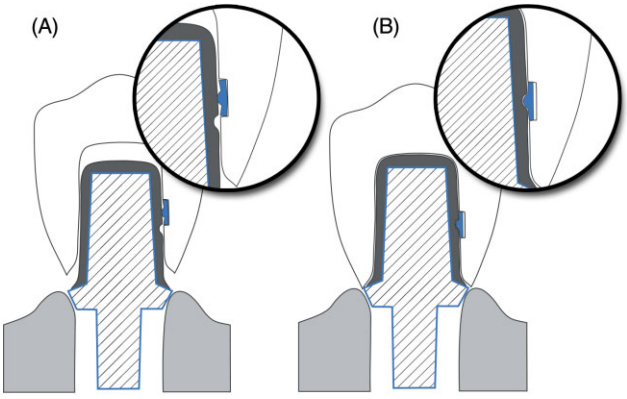

Figure 2 Schematic drawing of the Marburg Double Crown system: (A) During insertion of the prosthesis, the resin body of the snap attachment undergoes elastic deformation. (B) In the final position, the titanium ball of the attachment snaps into the corresponding hollow of the inner crown to provide retention.

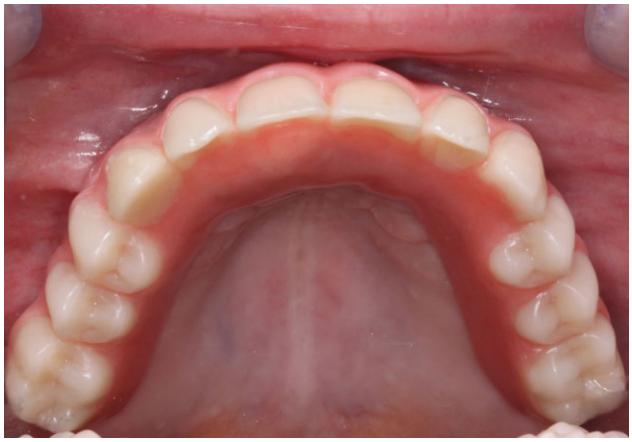

Figure 3 Intraoral view of the inserted maxillary double crown-retained implant-supported overdentures.

During the complete study period, prosthesis design, material selection, and technical procedures remained unchanged. The horseshoe-shaped frameworks (including outer crowns) of all IODs were cast in one piece from a nonprecious-metal and included no solder or welded joints. The frameworks were extended to the position of the most distal denture teeth to prevent fracture and fully wrapped by denture resin. As the MDC system is a clearance fit system, corrections of slight misfits during insertion of the IOD occurred very rarely. In case of slight misfits between inner and outer crowns resulting in a too high friction, the inner crown was marked with a permanent color pen. During the insertion of the denture, imperfections were displayed in the outer crown. They were selectively removed with rotary instruments (tungsten carbide) and subsequently polished with silicon polishing instruments until a friction of the IODs was achieved that allowed a simple removal and insertion by the patient.

All clinical procedures were performed by the same experienced clinician (E.F.), and all laboratory work was performed in the same dental laboratory. After the insertion of the prosthetic restoration, intraoral radiographs using the parallel technique were taken to document the peri-implant bone level (baseline) (Figure 1b).

Post-Implant Maintenance Treatment

Following delivery of the IODs, all patients received oral hygiene instructions and were scheduled for a post-operative implant maintenance program with 3- to 12-month follow-ups. Compliance was defined as participation in at least one prophylactic appointment/year. These sessions included an evaluation of the peri-implant tissue status using the Quigley-Hein plaque index (QHI),[27] measuring the pocket probing depths (PPD) with a millimeter-scaled periodontal probe (PCP 15, Hu-Friedy, Chicago, IL, USA) at four locations per implant (mesiobuccal, distobuccal, mesio-oral, and disto-oral), noting any BOP (30 seconds following probing). Furthermore, gingival recessions (REC) with exposure of the implant abutment interface were recorded with a millimeter-scaled periodontal probe (PCP 15, Hu-Friedy, Chicago, IL, USA). Intraoral radiographs were taken for implants with positive BOP and PPD + REC ≥ 5 mm.[16]

Following this evaluation, motivation was reinforced, and the patients were reinstructed in home-based plaque-control techniques. Finally, at each follow-up visit, the implants and teeth involved were professionally cleaned with polishing paste and a rubber cup (FSI Slimline, DeTrey GmbH, Konstanz, Germany).

DATA COLLECTION

The patients included in the study were evaluated according to the following parameters obtained from patient records: age (at the time of implant insertion), gender, medical history, smoking habits, anatomical position of the implants (according to the Fédération Dentaire International [FDI] scheme), number of implants, loss of implants up to the time of data acquisition, time of placement of the denture, opposing dentition, and the period of observation. Moreover, during the last maintenance appointment, the patients were clinically examined by an experienced dentist (E.F.) to evaluate the following biological and technical complications of teeth/implants and removable dentures: screw loosening, material fractures, loss of retention, changing retention elements, relinings, secondary caries (teeth), or peri-implantitis (implants). A periodontal examination including PPD and BOP was performed for all implants. Moreover, REC with exposure of the implant abutment interface were recorded. To confirm the diagnosis of peri-implant disease for implants with positive BOP and PPD + REC ≥ 5 mm, intraoral radiographs using the parallel technique were taken to measure the extent of peri-implant bone loss referenced to the baseline radiograph (prosthetic delivery). All radiographs were measured by the same investigator (D.Z.) in order to increase the reproducibility. Bone loss was documented on the radiograph viewer with the aid of a fourfold magnification by direct measurement with a millimeter-scaled periodontal probe. Measurements

were performed in a darkened room on shielded radiographs. The radiographic linear distance from the implant shoulder to the first bone-to-implant contact was used to calculate the marginal bone levels. The location of the marginal bone level in relation to the implant shoulder was assessed at the mesial and the distal aspects at the post-operative and last follow-up radiograph. To take into account the anatomic magnification and distortion in the films, the linear dimensions of the images were calibrated. This was achieved by setting the scale in the image to the known distance between the implant shoulder at the most apical point of the implant.[14,16] The radiographic bone loss was calculated by subtracting the marginal bone level at baseline from the marginal bone level at the follow-up examination. The values were rounded to the 1/10 mm.

DIAGNOSTIC CRITERIA AND STATISTICAL ANALYSIS

Survival was defined as the implant or prosthetic reconstruction remaining present in the mouth, independent of biological and/or technical complications.[14,16] The survival time of a restoration was defined as the period between the day of placement and the last follow-up appointment or, in case of a failure, the appointment scheduled to address the failure as documented in the patient's file.

Any technical complication related to the overdenture or the implant abutment (e.g., abutment screw loosening, fracture of abutment, fracture of denture base or denture teeth, loss of retention, or defects of the attachments) was recorded. Incidence rates for technical complications were calculated on the basis of treatments occurring per patient and year (T/P/Y).

Every recorded incident of BOP was defined as peri-implant mucositis.[28] No true endpoints have been identified to diagnose peri-implantitis[29–31] Therefore, the following surrogate endpoints were used: positive BOP, PPD + REC ≥ 5 mm, and a maximum bone loss of ≥ 3.5 mm.[14,16] Due to the small sample size, no meaningful statistical analysis of potential factors influencing the outcome of the treatment was possible. Therefore, only descriptive statistics were applied.

RESULTS

Patients

In total, 28 patients with edentulous maxillae underwent restoration with implant-supported double crown-retained IODs between 1991 and 2011. Three patients moved out of the area, three patients changed their dental care provider, and two patients died. Therefore, 20 edentulous patients fulfilled the inclusion criteria and could participate in the study.

Of the 20 patients, 13 were female (65%) and 7 were male (35%). The average age of the patients at the time of implant placement was 63.45 ± 7.18 years.

Three patients were active smokers (15%), two suffered from diabetes (10%), and seven (35%) from heart disease. The average observational period was 5.64 ± 3.50 (range: 1.33 to 15.08) years (Table 1).

Implants

In total, 80 implants were provided with telescopic crowns according to the MDC technique. In all cases, four implants were included in the IODs. The implants had an average length of 11.78 ± 1.71 mm (range: 9.5 to 17 mm). Table 2 provides an overview of the distribution of the implants according to the FDI scheme. One implant was lost after 5 years resulting in a cumulative survival rate of 98.75%. Although the patient refused reimplantation, the IOD has remained fully functional for another >10 years (Table 3).

Dentures

The opposing dentition was restored with a fixed reconstruction in seven (35%) cases; 13 patients (65%) wore a

TABLE 1 Characteristics of Investigated Patients (*n* = 20)

Characteristics	Values
Age in years (mv ± SD)	63.45 ± 7.18
Gender	
Female	13 (65%)
Male	7 (35%)
General illnesses	
Diabetes mellitus	2 (10%)
Coronary heart disease	7 (35%)
Active smoker	3 (15%)
Observation period in years (mv ± SD; median)	5.64 ± 3.50; 4.58
Number of implants / patient	4
Opposing dentition	
Fixed [n, (%)]	7 (35%)
Complete denture [n, %)]	13 (65%)
Implant length in mm (mv ± SD, range)	11.78 ± 1.71; (9.5–17)

mm = millimeter; mv = mean value; SD = standard deviation.

TABLE 2 Anatomical Distribution of Maxillary Implants according to the FDI Scheme ($n = 80$)

Number of implants	0	1	2	9	10	10	7	1		1	7	13	7	11	1	0	0
Tooth position (FDI)	18	17	16	15	14	13	12	11		21	22	23	24	25	26	27	28

FDI = Fédération Dentaire Internationale.

removable partial denture (Table 1). No prostheses had to be renewed during the study. The survival probability for the implant-borne telescope prostheses was 100% after a mean observational period of 5 years.

Technical Maintenance Requirements

In the observational period, there were a total of 25 visits that required interventions due to technical complications, of which eight were implant-related (32%) and 17 were prosthetic-related 68%. In eight patients (40%) with a mean loading time of 6.51 years, no technical complications were recorded whatsoever. Table 4 provides an overview of the reasons for maintenance interventions. The distribution of repairs is shown in Table 5. In total, four relinings in three subjects (15%) were necessary. This indicates an overall incidence of 0.035 relinings/patient/year. Acrylic fractures necessitated five prosthesis repairs in five patients (25%), for an incidence of 0.044 acrylic fractures/patient/year. Three changes of TK Snap retention elements were necessary in three subjects (15%; overall incidence: 0.027/patient/year). The total incidence for maintenance requirements was 0.222 treatments/patient/year.

Peri-Implant Mucositis/Peri-Implantitis

Thirty-eight implants (47.5%) in 15 patients (75%) showed positive BOP and were consequently rated as peri-implant mucositis. Hyperplasia of peri-implant soft tissues was not observed. The average pocket probing depth (PPD) was 3.48 ± 0.73 mm (median: 3.25 mm), and the mean maximal pocket depth per implant was 4.06 ± 1.05 mm (median: 4 mm). According to the selected criteria (mean bone loss of ≥ 3.5 mm, PPD > 5 mm and positive BOP), eight implants (10.1%) in two patients (10%) had peri-implantitis at the time of the last dental examination (overview in Table 3). Both were active smokers. No peri-implantitis was diagnosed in the subgroup of the 17 nonsmoking patients, whereas two of three smoking patients fulfilled all diagnostic criteria for peri-implantitis in one or more implants. The cumulative implant success rate was 88.75% after a mean observational period of 5.6 years.

DISCUSSION

In this retrospective practice-based study, clinical data for the survival/success of maxillary implant-borne rigidly double crown-retained dentures in 20 patients with 80 implants after a mean observational period of 5.6 years are presented. The cumulative survival rate (CSR) of the implants was 98.5%, whereas 100% of the prosthetic reconstructions remained functional in the same period of time. The implant-related prevalence of peri-implant mucositis was 47.5% (patient-related: 75%). The implant- and patient-related peri-implantitis rates were 10,1% and 10%, respectively (cumulative success rate: 88.75%). Peri-implantitis was diagnosed only in patients with a smoking habit. Technical complications occurred with a frequency of 0.222 T/P/Y.

The limited number of patients must be considered in the evaluation of the results of the present study.

TABLE 3 Biological Complications, Survival Rates/Success Rates of Implants ($n = 80$) and Dentures ($n = 20$)

Mean Observational Period: 5.64 years	Number of Implants	%	Number of Patients	%
Peri-implant mucositis	38	47.5	15	75
Peri-implantitis	8	10	2	10
Survival rate of implants	79	98.75	19	95
Success rate of implants	71	88.75	17	85
Survival rate of prostheses	20	100	20	100

TABLE 4 Maintenance Requirements of Implant-Borne Telescopic Dentures

Localization	Complication	Number (*n*)	Maintenance Requirement (Treatment/Patient/Year)
Implant abutment related	Loose abutment	2	0.018
	Screw loosening (in telescopic crown)	6	0.053
	Total number	8	0.071
Denture related	Attachment renewal (Si-Tec)	3	0.027
	Denture repairs	14	0.125
	Total number	17	0.151
Overall complication rate		**25**	**0.222**

Another limitation is that all treatments were performed by a single provider. In addition, it should be considered that due to the retrospective nature of the study, the restorations evaluated demonstrated a great variation in the time of clinical service ranging from 1.3 to 15 years. Furthermore, a control group with fixed restorations matching the study group could not be presented.

Despite these limitations, this study is one of the first investigations focused on maxillary double crown-retained overdentures with only one implant design. This study can contribute to the evaluation of the long-term performance of IODs in edentulous maxillae, as the data were generated under the typical conditions of a private practice, and the mean observational period exceeds 5 years. This is of great importance because the majority of the existing trials with double crown-retained IODs were generated in university settings and cover mean observational periods of less than 5 years.[10,15,20–24]

Two systematic literature reviews assessed the CSR of double crown-retained removable prostheses.[18,19] Only four studies with implant CSR of 97–100% and overdenture CSR 95–100% after 3 to 10.4 years were found.[20–23] Two comparative studies showed no significant differences between the survival of IODs with bar attachments or double crowns, although the double crown-retained overdentures resulted in more favorable gingival conditions with less plaque accumulation.[9,24] All of these studies concerned mandibular treatments; data on maxillary double crown-retained overdentures could not be found. Two more recently published retrospective studies[10,15] reported the survival and success rates of implant- and tooth implant-supported IODs, including maxillary IODs retained by double crowns. Bernhart et al.[10] reported results for 12 maxillary and seven mandibular IODs. During the 2-year observational period, 2 of 84 implants failed, and for two implants, a peri-implantitis was diagnosed. Schwartz et al.[15] reported a superstructure survival of 93% for solely implant-supported IODs after a mean observational period of 3.4 ± 1.9 years. Despite the promising implant and prosthesis survival rates, it must be considered that the mean observational periods of these studies are relatively short (mean observational period 2–3.4 years). Therefore, clinical studies with prolonged observational periods are necessary. The present study included 20 dentures with 80 implants in edentulous maxillae assessed over an average observational period of 5.6 years. The implant CSR in the present study (98.75%) and the CSR of the superstructures (100%) agree with the results of the previously cited studies with double crown-retained IODs in the mandible.[18,19] Furthermore, the results of the present study are in agreement with the CSR for implants and prostheses for maxillary IODs retained by milled bars, demonstrating cumulative implant survival rates of 94.4–98.2% and superstructure survival rates of 94.7% after 5 years.[1,6–8]

The sparse available data on the requirements for prosthetic maintenance of IODs mostly cover

TABLE 5 Distribution of Prosthetic Repairs

Type of Repair	Number (*n* = 14)	%
Fracture of denture teeth or base	5	35.71
Relining	4	28.57
Veneer repair	2	14.29
Replacement of posterior teeth	1	7.14
Other	2	14.29

observational periods of 3–5 years and mainly concern mandibular IODs. In the literature, variability between 0.25 and 4.03 T/P/Y has been reported.[3,32,33] In a comparative prospective 3-year comparison with four interforaminal implants in the lower jaw, a prosthetic-related maintenance requirement of 0.41 T/P/Y for bars and 0.45 T/P/Y for telescopic crowns was reported.[24] The value of 0.222 T/P/Y found in the present study shows that MDC IODs had a comparatively low maintenance requirement, particularly considering that approximately 68% of the appointments were purely prosthesis-related (e.g., relinings, fractures of prosthetic teeth, etc.). This is in accordance with the findings of other clinical trials evaluating the complication rates of double-crowns identifying relining and minor denture repairs as the most frequent maintenance intervention.[21,24] It is interesting that in the present study, abutment screw loosening was a rare event with an incidence of 0.018 T/P/Y. This equals an implant-based incidence of 1.2% within 5 years. A systematic review identified an incidence for abutment screw loosening of 2.4 to 2.7% within 3 years for internal and external implant abutment connections.[34] For implant-supported telescopic crowns on implants with an internal connection, this type of technical complication was reported at rates of 3–10% after observational periods of 3–5 years.[23,24] It was suggested that a Morse taper connection of implant and abutment can decrease the rate of screw loosening. This is supported by the results of the present study, and a prospective study showed a relatively low (0.65%) rate of abutment loosening for implants with a Morse taper connection after 4 years.[35] Whereas most of the clinical trials on the long-term performance of IODs include information on technical complications, information on biological complications, for example, peri-implantitis, is still sparse.[30,31] Based on the published results, it may be stated that the prevalence of peri-implantitis seems to be on the order of 10% of implants and 20% of patients during 5–10 years after implant placement; however, the individually reported figures demonstrated great variation.[31] The variation in the outcomes can be explained by differences in the study populations, variations in observational periods, level of maintenance measures, and the use of different criteria to define peri-implant mucositis and peri-implantitis.[29] In addition to smoking habits and the history of peri-implantitis in particular, inadequate oral hygiene is among the risk factors linked to the occurrence of peri-implantitis.[13,14,30,31] The implant- and patient-based peri-implantitis rates in the present study were 10.1% and 10%, respectively, after 5.6 years. Peri-implant mucositis was diagnosed in 75% of the patients, and 47.5% of implants, respectively.

Because variations in the reported complication prevalence can be explained by the heterogeneity of the diagnostic criteria, the data of the present study should preferably be compared to studies with a similar design.[29]

In a practice-based cross-sectional study including 89 patients with fixed implant restorations and using the same diagnostic criteria as in the present study, an overall peri-implantitis prevalence of 11% (patient-based) at a comparable mean observational period was recorded (present study 10%).[14] In both studies, smokers showed more peri-implantitis than nonsmokers. This supports the already well-documented fact that smoking is a significant risk factor for the development of peri-implant lesions.[30,31]

Another evaluation applying the same diagnostic criteria as the present study revealed a patient-based peri-implantitis rate of 8% after a mean observational period of 14 years for double crown-retained IODs on different implant systems in nonsmoking patients.[16] A fairly low biological complication rate for double crown-retained IODs in nonsmoking patients is confirmed by the results of the present study (0% after a mean observational period of 5.6 years). A possible reason for the low prevalence can be seen in the study design. Both studies included only patients who regularly (i.e., at least annually) attended a professional prophylaxis program. Other clinical studies[13,14] have suggested that compliance to a professional prophylaxis program can significantly reduce the risk for peri-implantitis. Another factor that might reduce the risk for peri-implantitis can be seen in the design of the prosthesis itself. Hyperplasia of peri-implant mucosa has been reported as a frequent complication in patients with bar-retained overdentures.[9,24] Double crown-retained IODs ensure good accessibility for cleaning in the context of oral hygiene homecare procedures which might reduce the risk for hyperplasia and peri-implantitis.[10,15] This was supported by the findings of clinical trials comparing IODs retained by bars or telescopic crowns,[9,24] both determining significantly more plaque accumulation and hyperplasia for bar attachments.

1 The initial clinical performance of maxillary IODs retained by double crowns according to the MDC is promising, with implant and prosthesis survival rates comparable to maxillary IOD retained by alternative attachment.
2 Nonsmoking patients restored with a maxillary double crown-retained IOD who are compliant with a professional maintenance (prophylaxis) program demonstrated a low risk for peri-implantitis.
3 Clinical interventions to maintain function were mostly necessitated by technical failures related to the removable denture (e.g., tooth or denture base fracture, relining). The double-crown attachment according to the MDC technique placed on implants with a Morse taper connection showed no increased risk for technical complications.

Considering the low number of restorations, MDC-IODs might represent a viable therapeutic option for edentulous maxillae opposing a partially dentate mandible restored with fixed reconstructions (implant- or tooth-borne). In nonsmoking patients with post-implant maintenance program compliance, high survival/success rates and low incidences of biological and technical complications can be expected.

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