

The Influence of Prosthesis Design on the Outcomes of Tooth Implants Immediately Placed and Loaded by Means of One-Piece Titanium Machined Restoration

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Our purpose was to evaluate the occurrence of complications and the degree of bone loss in a cohort of patients treated with fixed prostheses supported by immediately loaded dental implants. The primary aim was to compare partial versus full-arch fixed dental prostheses. We then tested the effect of sinus lifting. In the present retrospective cohort study, the patients had their implants restored with fixed dental prostheses supported by dental implants positioned in the posterior maxilla and mandible. When necessary, the maxillary sinuses were grafted with particulate autogenous bone. Patients were then ranked according to the following predictors: length of prosthesis, crown-to-implant ratio, number of crowns to number of implants ratio, and presence of sinus lifting. Outcomes were evaluated for up to 2 years regarding the peri-implant marginal bone loss and implant/prosthesis survival rates. Fifty-eight subjects (209 implants) were rehabilitated with 25 fixed full-arch prostheses and 33 partial fixed dental implant bridges (16 supported by implants placed in grafted sinus). The mean marginal bone loss for implants supporting partial fixed dental prostheses amounted to 0.81 mm, whereas that for implants within the group of full-arch fixed dental prostheses was 1.21 mm; the comparison of the levels in the 2 groups showed a significant difference ($P = .0055$). A statistically significant difference ($P = .0006$) was found between the bone loss around maxillary implants (1.53 mm) and the bone loss around mandibular implants (1.10 mm). Two implants and 4 prostheses failed; 2-year survival rates of partial and of full-arch fixed dental prostheses, respectively, were 94.1% and 96%. Bone loss in full-arch prostheses appeared to be higher than in that of partial prosthesis. Implant-supported prostheses in the maxillae exhibited a bone loss higher than that registered in mandibles.

Key Words: immediate loading, peri-implant bone loss, partial fixed prosthesis, full-arch fixed prosthesis

INTRODUCTION

Endosteal titanium implants supporting prostheses is one of the most significant achievements of modern dentistry, which enables clinicians to rehabilitate edentulous patients with fixed implant-supported restorations. Very high survival rates are attested to by data from the last 25 years for conventional, well-documented, and predictable treatment modality, that is, 2-stage (delayed) dental implants with delayed loading (DL). However, this protocol requires very long treatment periods due to the 2-stage surgical approach.

A biologic soft tissue seal around the implant-abutment complex had to be achieved physiologically; however, certain confounding factors may affect both early and late healing phenomenon. Among several mechanical factors that certainly affect peri-implant marginal bone loss, the presence of augmented bone, the gap between the implant and the abutment, the marginal implant design, and the biologic factors affecting long-term bone remodeling and occlusal overload have been described in detail.¹⁻⁵ Some authors have hypothesized that other mechanical factors, such as crown-implant ratio (CIR), length of the prosthetic cantilever, extension of the prosthesis in the anterior or posterior direction, number of implants or crowns, angulated placement of implants, and presence of different grafting materials may affect marginal bone remodeling.⁶⁻⁹

Under the pressure of patients' high expectations, clinicians developed a nontraditional treatment protocol. Immediate or early functional loadings (IL and EL, respectively) are particularly appreciated by patients because of the drastic reduction of the treatment time frame and the discomforts due to edentulism

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and multiple surgical interventions. The final course is a flapless surgery in which there is dental implant placement in the shortest time possible and using minimally invasive procedures. The dental implant prosthesis could include single crowns, splinted crowns, and fixed partial and full dentures. A different matter is hybrid solutions, such as removable restorations, including implant-supported overdentures retained by splinted anchoring attachment modalities such as bars. IL and EL implant treatments require well-defined planning and a quick insertion of the fixed provisional prosthesis; therefore, digital planning and computer-guided implant surgery could widen the clinician's possibilities for proper placement of dental implants. Sometimes, the fitting between prosthesis and implants can be clinically inadequate; however, those type of bad fits are not a consequence of the loading protocol chosen (IL or DL).⁶ Computerized procedures can be used to produce prosthesis frameworks with a higher degree of precision than conventional laboratory procedures, which are characterized by a multistep manufacturing process.^{10,11}

Reporting success is different from reporting implant survival. Different criteria have been defined to assign success to implants, and they are based on clinical and radiologic features.^{12,13} Several authors reported some interesting outcomes regarding implant-supported restorations in IL implants used to rehabilitate edentulous maxillae and mandibles^{14–17}; however, those reports referred to short-term outcomes from cohort studies. A very recent systematic review found a lack of evidence when authors aimed at disclosing significant differences regarding the outcomes between the IL and DL approaches.¹⁴ Moreover, the greater part of the studies regarding this issue are designed as cohort studies, and they do not include a control group representing the standard procedure. In any case, they observed similar results (very low failure rates) in the 2 groups.^{15–17}

Studies on implant prognosis among different types of prostheses are limited in number.^{18,19} Clinical studies regarding the effect of prosthetic restorations on implant prognosis are rarely conducted because that would greatly complicate the analysis.

The objective of the present study is to evaluate the impact of two different types of fixed prostheses supported by IL implants (partial vs full-arch prosthesis) on the peri-implant marginal bone loss (MBL) and the clinical outcomes of implants positioned in the posterior maxilla and mandible. The effects of sinus lift on the radiologic and the clinical outcomes of implants were also evaluated.

MATERIALS AND METHODS

Study design and sample

The cohort of the present retrospective study was derived from the population of patients treated between August 2012 and December 2015 at the Clinic of San Martino, Malgrate, Italy. Medical charts of consecutive patients were gathered, and usable information was acquired, included, reviewed, and analyzed.

Patients were included as study subjects if they met the following inclusion criteria: 18 years or older, at least 1 dental

implant placed in the posterior areas supporting partial fixed prostheses, IL, and presence of a complete radiographic survey (periapical/panoramic radiographs just after implant placement and between 1 and 2 years after dental implant insertion).

Exclusion criteria consisted of the following: patients without a signed consent for the retrospective analysis; treated subjects who had undergone adjunctive surgical procedures, except for sinus grafting; following surgery, any treated patient who exhibited signs of a systemic disease that would contraindicate oral surgical treatment; treated subjects who had undergone therapy involving radiation after bone augmentation procedure; patients who had received bone resection as part of an oncologic treatment after surgery; and patients subjected to intravenous and/or oral bisphosphonate therapy after surgery.

Surgery and prosthesis

Sinus Lift Procedure

In case of reduced ridge height below the maxillary sinus for placement of implants of at least 7 mm length, the patient underwent a sinus lift elevation using specific surgery equipment (Simo kit, AMT MEDICAL SRL, Gordona, Italy). The surgical procedure was planned using computerized tomography.

One or 2 blocks, depending on the specific need, had been harvested from the para-symphyseal area, according to the procedure described by Balaji,²⁰ using a horizontal mucosal incision 5 mm apical to the mucogingival junction. The block was reduced to particulate chips with a bone mill (Biocomp Minimill, Walter Lorenz Surgical, Jacksonville, Fla). The recipient site was approached by Tatum technique.²¹

Dental Implant Placement

Titanium dental implants—root-form, titanium calcium phosphate (Ti-CaP) coating (Simo Daisy DLT and NT, AMT MEDICAL SRL)—were inserted, with all implants being placed by a single surgeon. If possible, dental implants were positioned with the implant platform at the level of the alveolar crestal bone. Implants were immediately loaded with a fixed temporary prosthesis.

Functional Rehabilitation

Implant fixture positions were registered at the time of fixture placement surgery, and definitive prostheses with computer-aided design/computer-aided manufacturing (CAD/CAM) technology were fabricated. The following restorations were used: partial and complete implant-supported fixed prostheses cemented over custom metal abutments or screw-retained. Prosthetic rehabilitation was designed and performed by a single prosthodontist. Platform-switching was never performed. Patients were enrolled in an oral hygiene program with a recall visit every 12 months; the patients' compliance was not monitored after the first year.

Variables

Variables were divided into the following subcategories: physical measurements, variables for sample description, predictors, and outcome variables.

Physical Measurements

The following measurements were made on 2-dimensional radiographs (Figure 1):

- Supraosteal crown height (SCH): along the implant distance between the most incisal or occlusal point of the crown and the most apical point of the marginal bone level at mesial and distal aspects
- Endosteal implant height (EIH): along the implant distance between the apex of the implant and the most apical point of the marginal bone level at mesial and distal aspects
- Peri-implant MBL: along the implant distance between the reference point and the most apical point of the marginal bone level at mesial and distal aspects (mMBLx and dMBLx, respectively, where $x=0$, just after dental implant placement and loading, and $x=1, 2$ further annual surveys within 2 years after implantation surgery). The reference point was the fixture-abutment interface.

Calibration was performed using the known lengths or diameters of the inserted implants. Measurements were taken to the nearest 1/10 mm using computer downloadable (free) software for image analysis (Osiris medical imaging software 4.19, University Hospital of Geneva, Geneva, Switzerland).

Variables for Sample Description

Variables for sample description were age (year), sex (male or female), smoking habits (smoker or nonsmoker), implant position (anterior or posterior), tooth type (incisor, canine, premolar, molar), number of crowns (nC) in a fixed prosthetic restoration, and number of dental implants (nI) supporting a single prosthesis.

Predictors

The following were predictors:

- Type of prosthesis: partial fixed dental prostheses (FDPs) vs full-arch FDPs
- Arch (AR): maxilla or mandible
- Length of the prosthesis (PL): coincides with nC if the patient had a single FDP; otherwise several nCs were averaged in each patient (PL was sorted into 2 groups: <4 and ≥ 4)
- Grafting procedure: grafted and ungrafted maxillary sinus
- Time: time from dental implant placement and loading to radiological survey

Outcome Variables

The outcome variables were as follows:

- Change at MBL (Δ MBL): the outcome variable, obtained by a subtraction (Δ) could be negative or positive, with a reduction being represented by a negative value. It was evaluated for the mesial and distal aspects (respectively, m Δ MBL and d Δ MBL) by subtracting the MBL measured at a 1- to 2-year survey from the respective baseline value obtained at implant insertion ($n\Delta$ MBLx = nMBL0 - nMBLx, with n as mesial or distal, and $x=1,2$). Then, an average mesio-distal change at marginal bone levels was obtained for each implant.

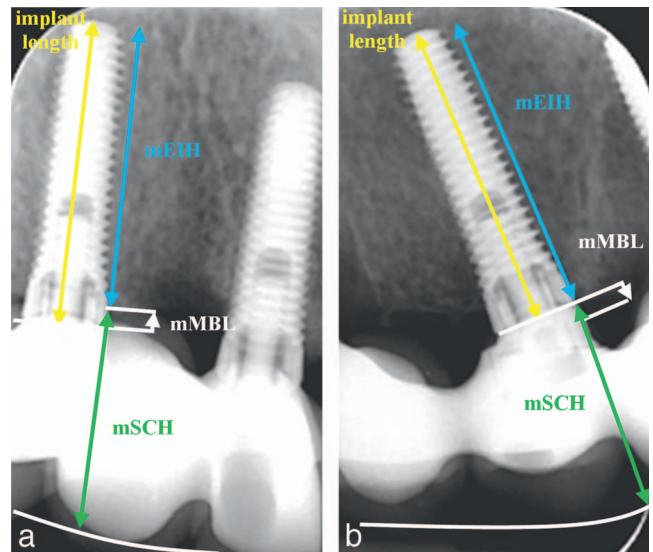


FIGURE 1. Peri-implant marginal bone levels (MBLs) and formula for calculation of crown-to-implant = supraosteal crown height/endosteal implant height (CIR = SCH/EIH) at immediate loading and 12 months after placement. An average mesiodistal CIR was obtained per implant restoration.

- Implant survival: an implant was classified as failing on the day of its removal. A survived implant was defined as being immobile, and free from peri-implant radiolucency, infection, or neurologic disorder¹² and without associated pain, either spontaneous or induced by a torque ranging from 10 to 20 Ncm in case of screw retained prosthesis or of vertical/lateral compression applied to the prosthesis edge.^{22,23}

In addition, the implant had to allow for placement of a functional fixed prosthesis²⁴:

- Number of crowns to number of implants ratio (nCIR): in a single prosthesis, it was the ratio between the number of overall crowns and the number of overall dental implants supporting them. If patients had more than 1 FDP, nCIR were averaged. nCIR was sorted into 2 groups.
- Prosthesis survival: a prosthesis was classified as failing when it could not remain in function as a consequence of implant loss or fixed-prosthetic-device detachment, loosening of abutment screw/healing cap, or fracture (screw, framework or esthetic material). Otherwise the prosthesis was considered as survived.
- CIR: to obtain the mesial CIR, the mesial SCH was divided by the mesial EIH. The distal CIR was also determined, and then an average mesio-distal CIR was calculated (Figure 1).

Data management and statistics

An independent statistician, not involved in patients' treatment and acquisition of clinical data, performed all analysis.

All patient-related data were entered into a database, allowing for calculations to be done automatically. Descriptive statistics were computed for all the variables. Patients were the unit of analysis: data regarding the posterior maxilla or mandible in each patient were averaged. Normal distribution

TABLE 1
Descriptive statistics for sample*

Variable Describing Sample	Procedures							
	Conventional		Full-Arch		Reconstruction		Overall	
	Median (No.)	IQR (%)	Median (No.)	IQR (%)	Median (No.)	IQR (%)	Median (No.)	IQR (%)
Age at implant placement, y (n = 58)	60.0	15.3	68.0	11.0	67.1	11.5	66.9	16.9
Sex (n = 58)								
Male	5	8.6	10	17.3	8	13.8	23	39.7
Female	12	20.7	15	25.8	8	13.8	35	60.3
Smoking habit (n = 58)								
Yes	3	5.2	9	15.5	4	6.9	16	27.6
No	14	24.1	16	27.6	12	20.7	42	72.4
Location (n = 209)								
Anterior	4	1.9	76	36.4	1	0.5	81	38.8
Posterior	33	15.8	64	30.6	31	14.8	128	61.2
Maxilla (n = 109)								
Incisor	1	0.9	24	22.0	0	0.0	25	22.9
Canines	0	0.0	16	14.7	1	0.9	17	15.6
Premolars	7	6.4	17	15.6	13	11.9	37	33.9
Molar	3	2.8	9	8.3	18	16.5	30	27.6
Mandible (n = 100)								
Incisor	2	2.0	27	27.0	0	0.0	29	29
Canines	1	1.0	9	9.0	0	1.0	10	10
Premolars	11	11.0	27	27.0	0	0.0	38	38
Molar	12	12.0	11	11.0	0	0.0	23	23
Implant length, mm (n = 209)								
7	3	1.4	0	0.0	0	0.0	3	1.4
8.5	3	1.4	2	1.0	0	0.0	5	2.4
10	5	2.4	6	3.0	0	0.0	11	5.4
11.5	5	2.4	7	3.3	0	0.0	12	5.7
13	13	6.2	25	12.0	17	8.1	55	26.3
15	8	3.8	100	47.8	15	7.2	123	58.8
Graft in sinus (n = 209)								
Yes	0	0.0	0	0.0	31	14.8	31	14.8
No	37	17.7	140	67.0	1	0.5	178	85.2

*IQR indicates interquartile range.

for each outcome was checked, but not confirmed, by Shapiro-Wilk test. The patients were grouped according to primary predictors. P values were obtained for each significant pairwise comparison by the Wilcoxon sign rank test for paired data and by the Wilcoxon rank sum test for unmatched data. Spearman correlation (r_s) was used to assess the strength of the bivariate association between the Δ MBLs and the other continuous variables.

The statistical significance (set at $P = .05$) and power analysis were performed by a statistical tool from Matrix Laboratory (Statistics Toolbox, MatLab 7.11, The MathWorks, Natick, Mass).

All measurements in the text and tables are described as count or as median and interquartile range, m(IQR). In the figures, distributions have been depicted by whiskers plot.

RESULTS

Sixty-five subjects had their implants restored with fixed prostheses. Fifty-eight patients had subsequent follow-up visits and were included in the present study. Two hundred nine Simo Daisy dental implants were placed and immediately restored with 25 fixed full-arch prostheses and 33 partial fixed

dental implant bridges (16 FDPs supported by implants placed in grafted sinus). The mean age of the patients was 66.9 years (range, 39.7–77.7 years). Thirty-five (60.3%) patients were women, and 16 were smokers (27.6%). All the prostheses were completed by a single prosthodontist.

Table 1 presents the descriptive statistics for all the study variables: 37 implants were ranked in the conventional group in which patients were treated by partial FDPs, 140 in the full-arch group, and 31 were positioned in patients in which the maxillary sinus was lifted. Of 209 dental implants, 109 were positioned in the maxilla (37 bicuspid and 30 molars) and 100 in the mandible (38 bicuspid and 23 molars).

At mean follow-up of 12.3 ± 8.3 months, the registered marginal bone loss was of 1.20 (0.78) mm with a measured CIR of 0.90 (0.27).

Partial FDPs versus full-arch FDPs

As shown in Table 1, because only 5 dental implants were placed in the anterior regions of the jaw, the comparative analysis was performed only for posterior implants. As described in the section regarding predictors, the patients were ranked according to the type of prosthesis (partial FDPs vs full-arch FDPs). The median bone loss at 2-year survey for

TABLE 2

Statistical analysis of peri-implant marginal bone loss (MBL) and the crown-to-implant ratio (CIR) for data regarding posterior implants within a 2-year follow-up*

Variables	MBL (mm)	CIR	nCIR
Primary aim			
Type of treatment			
Group conv	-0.81 (0.85)	0.91 (0.29)	1.08 (0.24)
Group full	-1.21 (0.72)	0.95 (0.17)	2.10 (0.51)
<i>P</i> values conv vs full	0.00557†	0.2370‡	< 0.0001§
Post hoc power analysis	0.8928§	0.2300§	1§
Arch			
Group U	-1.53 (0.58)	0.75 (0.20)	1.0 (0.5)
Group L	-1.10 (0.38)	0.93 (0.27)	2.0 (2.0)
<i>P</i> values U vs L	0.0006†	<0.0001†	0.0032†
Post hoc power analysis	0.9984§	0.9940§	0.9428§
Length of prosthesis (l_p)			
Group 1 ($l_p \leq 4$)	-1.00 (0.42)	0.93 (0.35)	1.0 (0.0)
Group 2 ($l_p > 4$)	-1.22 (0.38)	0.88 (0.24)	2.0 (1.13)
<i>P</i> values 1 vs 2	0.1286†	0.4626†	<0.0001‡
Post hoc power analysis	0.7339§	0.2044§	0.9999§
Secondary aim			
Type of treatment			
Group UG	-1.55 (0.38)	0.76 (0.24)	1.0 (0.1)
Group G	-1.53 (0.55)	0.71 (0.42)	1.0 (0.0)
<i>P</i> values A vs B	0.8614†	0.2949†	0.1060†
Post hoc power analysis	0.0568§	0.1504§	0.0500§

*Variables were compared between types of prosthesis (2 ranked groups: conv vs full), arches (U and L), length of the prosthesis, l_p (2 ranked groups: 1 and 2), and nCIR (2 ranked groups: A and B). Additionally, variables were compared for the presence of sinus grafting procedure (2 ranked groups: grafted [G] vs ungrafted [UG]). Variables are described with the respective median and interquartile range. conv indicates conventional; full, full-arch; U, upper posterior; L, lower posterior; UG, upper posterior; G, in sinus. *P* values resulting from †Wilcoxon test for paired, ‡unpaired data, and §power analysis.

implants supporting partial FDPs amounted to 0.81 (0.85) mm, and for implants in the group with full-arch FDPs, the marginal bone loss was 1.21 (0.72) mm; the loss in the 2 groups showed a significant difference ($P = .0055$). The 2 groups did not show any significant difference regarding CIR, whereas the 2 groups did show a significant difference ($P \leq .0001$) when the variable nCIR was compared, 1.08 (0.24) and 2.10 (0.51), respectively, for the partial and full-arch groups (Table 2).

Arch and length of FDPs

Patients were then ranked considering the arch of interest. The loss of peri-implant bone level for implants supporting FDPs in the upper jaw amounted to 1.53 (0.58) mm, whereas for implants in the group of prostheses restoring lower arches, the marginal bone loss was of 1.10 (0.38) mm with a statistically significant difference between arches ($P = 0.0006$). When the treatment effects in the maxilla and mandible were compared, CIR (0.75 [0.20] and 0.93 [0.27] for the upper and lower groups, respectively) and nCIR (1.0 [0.5] and 2.0 [2.0], for the upper and lower groups, respectively) showed significant differences ($P < .0032$). The predictor length-of-prosthesis did not show any significant differences between the groups.

Grafted versus ungrafted sinus

When results of FDPs restoring the posterior maxilla were ranked considering the presence of sinus grafting, the loss of peri-implant bone for implants supporting FDPs with (1.53 [0.55] mm) or without (1.53 [0.38] mm) sinus grafting did not show any significant differences (Table 2). The 2 groups did not

show any significant difference regarding either CIR or number of crowns to number of implants ratio.

Correlation analysis

Changes at peri-implant marginal bone did not show any statistically significant correlations with any of the other continuous variables.

Survival rates and complications

Results at 2-year follow-up showed the following:

- Two dental implants failed within 1 year of survey: 1 in partial FDPs and 1 in full-arch FDPs, with a survival rate of 94.1% for the former and of 96% for the latter. No implant placed in grafted sinus failed within the survey.
- The 2 prostheses partially supported by the failing implants had to be replaced with new fabricated ones; another 2 prostheses were removed and repaired due to technical drawbacks (fractures in the esthetic materials). Prosthetic cumulative survival rates were of 94.1% for the conventional group and 92% for the full-arch group. The prosthesis supported by implants placed in augmented areas registered a survival rate of 93.8%.

Discussion

The present retrospective cohort study investigated peri-implant bone loss and short-term survival and success rates

of dental implants, as well as of fixed prostheses for immediate loading procedures. Patients were ranked into 2 groups: partial vs full-arch FDPs. The analysis suggested that the relative marginal bone loss around implants could be affected by the arch and the type of prosthesis. No immediate partial bridges had cantilever, whereas full-arch had cantilever (with a mean of 1.25 units of fixed prosthesis with cantilever pontics) if the clinician could not plan the surgical position of the implant at the back of the jaw. However, as reported by Halg et al, it seemed that cantilever bridges appeared to affect neither remodeling of hard tissue nor survival rates.²²

The present study showed that peri-implant bone losses of 0.81 and 1.21 mm were found, respectively, for the partial and full-arch groups; this suggested that dental implants supporting full-arch fixed prostheses could have higher bone loss than implants supporting partial fixed prostheses. The present findings regarding the partial FDPs group seem to be similar to those reported by other authors, who described bone loss in posterior areas ranging between 0.3 and 1.1 mm after 2 years.^{25,26} For IL full-mouth dental implants after 12- to 18-month follow-up, these authors stated that a mean bone loss ranging between 0.32 and 0.78 mm was found for implants, irrespective of the implant position.²⁷⁻²⁹ The above-mentioned bone loss appeared lower than that registered in the present study; however, it is worth noting that Δ MBL was calculated only for the posterior areas.

Some authors ranked their results according to the arch; they registered, after 1 year, marginal bone resorptions ranging from 0.9 to 1.3 mm in the maxilla and from 1.04 to 1.4 mm in the mandible.³⁰⁻³² When the above-mentioned authors focused on immediate loading with maxillary vs mandibular FDPs, marginal bone loss averaged 1.53 mm in the maxilla and 1.1 mm in the mandible after 12-month follow-up.³⁰⁻³² The present results concerning the mandible are similar to those reported in the literature; on the other hand, the bone loss observed around implants placed in the maxilla appeared worse than those observed in other studies.³⁰⁻³²

Crown-to-implant ratio appeared to be dependent on the arch; in fact, a statistically significant difference was detected between maxillary (0.75) and mandibular (0.93) CIR. None of the authors describing CIR compared their data between the upper and the lower arch. They found that the mean clinical CIR increased from the time of delivery of the prosthesis to the 2-year follow-up and ranged between 1.82 and 2.53 for fixed partial prostheses, although these data were collected for only short dental implants.³³⁻³⁵ However, correlation analysis of the present data revealed that CIR did not appear as a major mechanical risk factor; implants probably immediately splinted together by means of a final fixed prosthesis made by CAD/CAM technology, reducing improper proximal and occlusal contacts. Moreover, in the present work, just 8 implants could be defined as short implants, but none of those implants were truly short (=6 mm).

The effect of the sinus grafting procedure was investigated. It seemed that the grafting procedure did not affect the marginal bone loss at implants placed in the maxilla; in fact, values of Δ MBL were very similar for both groups (-1.53 and -1.55 mm, respectively, for the grafted and ungrafted sinus).

For the purpose of the present study, a secondary research

question was whether the survival rate of implants would be comparable to that of other similar studies published. In different studies with a design similar to that of the present one, the authors recorded lower prosthesis survival rates than those reported here: ranging between 95% and 95.8% for fixed partial dental prostheses^{36,37} and ranging between 96.2% and 97.4% for full-arch reconstruction.^{38,39} However, in the above-mentioned studies, patients were not used as the unit of statistical analyses.

The uniformity of the implant brand and merchandizing was one of the strong points of the present paper; furthermore, a single clinician performed all surgical steps, whereas another clinician performed immediate rehabilitation of the edentulous jaw. The lack of randomization was a weak point of the study; however, it is indeed difficult to randomize a sufficient number of patients who required treatment either with partial or with full-arch fixed dental prostheses.

Further long-term analysis is needed to confirm the present speculative findings regarding linear bone loss and survival rates of fixed dental prostheses.

CONCLUSIONS

On the basis of the results of this study, it is possible to conclude that patients rehabilitated with fixed partially or totally definitive prostheses with CAD/CAM technology showed similar outcomes.

Moreover, the analysis of the subgroups suggested that (1) full-arch fixed dental prostheses showed a bone loss higher than that registered in the partial fixed dental prostheses; (2) implant-supported prosthesis that rehabilitates the maxillae showed a bone loss higher than that registered in the mandibles; and (3) CIR seemed not to be correlated to peri-implant bone loss.

ABBREVIATIONS

AR:	arch
CAD/CAM:	computer-aided design/computer-aided manufacturing
CIR:	crown-to-implant ratio
DL:	delayed loading
EIH:	endosteal implant height
EL:	early functional loadings
FDP:	fixed dental prosthesis
IL:	immediate functional loadings
MBL:	peri-implant marginal bone level
nC:	number of crowns
nCIR:	number of crowns to number of implants ratio
nI:	number of dental implants
PL:	length of prosthesis
SCH:	supraosteal crown height
Δ MBL:	change at marginal bone level

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NOTE

The authors state that there are no conflicts of interest.

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