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Five years prospective study on implant failure and marginal bone remodeling expected using bone level implants with sandblasted/acid-etched surface and conical connection

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Abstract

Aim: the purpose of the present prospective, case series study were to report implant survival rate and marginal bone remodeling expected five years after loading using dental implants placed in in the daily practice. Material and Methods: this research was designed as an open-cohort, prospective case series study. Any completely or partially edentulous patients scheduled to receive at least one bone leve were considered eligible for this study. Primary outcomes were: cumulative implant (ISR) and prosthetic (PSR) survival rates, and any complications experienced up the five years follow-up. Secondary outcomes were: marginal bone remodeling, implant insertion torque, implant stability quotient (ISQ), and thickness of gingival biotype. Results: ninety consecutive patients (34 males and 56 females; mean age 53.2±15.4 years; range of 24–81 years), 243 implants were placed and followed for at least five years after loading (mean of 65.4±3.1 months; range of 60–72 months). The mean implant insertion torque was 42.9±4.8 Ncm (range from 15 to 45 Ncm). Overall, 83.5% of the implants (n=203) were placed with an insertion torque between 35 and 45 Ncm. At the one year follow-up, no drop-outs were recorded, but 17 patients (18.9%) with 18 restorations (12.6%) delivered on 34 implants (14%) were lost at the five years examination. At the five-year examination, six implants failed in six patients, resulting in a cumulative ISR of 97.5%. At the five-year follow-up, four prostheses failed (2.8%) resulting in a cumulative PSR of 97.2%. At the five-year examination, five complications were reported by five different patients, resulting in a prosthetic success rate of 96.5%, measured at patient level. Five years after loading, mean MBL was 0.41 ± 0.30 mm (95% CI: 0.26–0.34). Difference from the one year data was 0.04 ± 0.19 mm (95% CI: 0.01–0.07). The mean ISQ value at implant placement was 71.6 ± 5.5 (range of 45–88). Six months later, the mean ISQ was 76.7 ± 4.4 (range of 66–89). The difference was statistically significant (P=0.0001). Statistically significant higher MBL was found for smokers, and patient with thin gingival biotype. Conclusions: High implant survival and success rates could be expected with stable marginal bone remodeling up to five years after loading. Smoking and thin tissue biotype were the most important variabilities associated with higher MBL. Further research are needed to confirm these results.

Key words: sandblasted implants, acid-etched implants, taper connection, marginal bone remodeling, marginal bone loss.

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Introduction

Bone remodeling around dental implants at early stages is one of the most critical factors in evaluating implant success. In the past, it was believed that a physiological marginal bone loss (MBL) of 1.5–2.0 mm was expected around a dental implant, during the first year of function.(1) After that, a minimal bone loss would be observed.(2–4) Several factors may increase the physiological MBL including but not limiting to the biological width establishment, surgical trauma, implant–abutment connection type, soft tissue thickness and quality, and implant features.(5–8) To make the situation even more complex, several pathological co-factors, including genetic predisposition, history of periodontitis, smoking, diabetes, poor plaque control, as well as, some iatrogenic factors may contribute to increased periimplant bone loss.(9–13)

Modern implantology change the way to define implant success. Papaspyridakos and co-workers,(4) proposed some parameters related to the soft- and hard-tissue stability around implants. Later, Pablo Galindo Moreno and co-workers,(8) demonstrated that implants with increased physiological MBL may compromise their final outcome. Therefore, subsequent MBL of more than 0.44 mm/year is a strong indication of peri-implant bone loss progression. However, there is still confusion whether the physiological and pathological bone remodeling are host-related, prosthesis- and implant-related, and/or load-dependent.(4) Into 2013, the American Academy of Periodontology defined the "periimplantitis" as an "*inflammatory reaction associated with the loss of supporting bone beyond the initial biological bone remodeling around an implant in function*".(14) Finally, Tallarico and co-workers proposed, as a part of a consensus conference on peri-implantitis, an etiology-driven classification to assist the clinician in detecting and classifying the etiology-based peri-implantitis.(15)

In order to maintain the physiological marginal bone remodeling as lower as possible, clinicians should be well aware the biological and mechanical process occurring at the implant abutment connection, as well as the features of the used implant-abutment complex. This is mandatory to understand the expected physiological marginal bone remodeling and any relationships between explanatory variables and pathological MBL, preventing early and further implant failure.

The purpose of the present prospective, case series study is to analyzed survival and success rates of implant-supported restoration placed in in the daily practice, as well as , the marginal bone remodeling expected five years after loading. The intent was to understand possible variabilities associated to implant failure and peri-implantitis. This study is reported according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement for improving the quality of observational studies.

Materials and Methods

This research represents the five-year follow-up of a previous preliminary report.(16) Originally, this study was designed as an open-cohort, prospective case series study. All the surgical and prosthetic procedures were performed by a certified clinician (MT) from September 2014 to December 2016. Participants were enrolled and treated in consecutive order as a part of routine treatments once their written consent had been obtained. Patients were informed about the nature of the study, including clinical procedures, materials, benefits, potential risks, and complications of the proposed treatments. This study was conducted according to the principles embodied in the Helsinki Declaration of 1975, as revised in 2008. The publication of the presente research was approved by the Ethical Committee of Aldent University, Tirana, Albania (2/2021).

Any partially or completely edentulous patient that was scheduled to receive at least one bone level implant (Osstem TSIII, Osstem Implant CO. LTD., Seoul, South Korea) featured with a sandblasted and acid-etched surface (rough surface [Ra] of 2.5~3.0 μm) and internal conical connection of 11° were considered eligible for this study. As this study was designed as open-cohort research, any implant and prosthetic location and protocol were considered. Exclusion criteria were reported in table 1.

Table 1. Exclusion criteria.
American society of anesthesiologists class III and IV
Patients under treatment or treated in the last 5 years with intravenous aminobisphosphonates
Radiotherapy of the oral and maxillofacial region (<5 years)
Uncontrolled periodontal desease (Bleeding on probing [BoP] and/or plaque index [PI] ≥ 25%)

Initial screening and case evaluation was performed as shown in the table 2.

Table 2. Steps of the initial screening evaluation.
Medical and dental records
Needs and expectations of patients
Comprehensive Periodontal Evaluation
Periapical radiographs, panoramic radiographs or cone beam computed tomography (CBCT)
Preoperative photographs
Digital or conventional study models

Surgical and prosthetic protocols

Complete surgical and prosthetic procedures were reported in the previous publication.(16) In brief, all of the patients received a single dose of an antibiotic (2 g of amoxicillin or 600 mg of clindamycin if allergic to penicillin) one hour before surgery. Implants (Osstem TSIII, Osstem Implant CO. LTD.) were placed at bone level or slightly below using either computer-guided/template-assisted surgery or conventional freehand approach. In case of immediate post-extractive implants, fixtures were placed 1.5 mm below the buccal bone plate. All the implants were placed following the drilling protocol recommended by the manufacturer. Flapless approach was planned in the case of post-extractive implants or in a healed site, according to the width of the available keratinized mucosa. In cases of ridge atrophy (bone height < 7.0 mm and/or bone width < 4.5 mm) implant placement was performed simultaneously to guided bone regeneration. Nevertheless, in cases of severe ridge atrophy, including damage of the residual alveolar socket, implant placement was performed four to six months after bone regeneration/socket preservation. Sinus lift procedures were performed using the lateral approach in case of residual bone height lower then three mm, or by a less invasive transcrestal sinus floor elevation (Crestal Approach Sinus KIT, CAS-KIT, Osstem Implant CO. LTD.) in the case of a residual alveolar crest of at least 3 mm as measured on a CBCT scan. Loading protocols was initially planned on individual case requirements, but finally performed according to the primary implant stability (at least 35 Ncm). Prefabricated restorations were trimmed and polished chairside. Under occlusion, temporary restorations were delivered in partially edentulous patients, while, complete edentulous patients received splinted, metal-reinforced temporary restorations with centric contact and group function, without any cantilever. All of the patients received oral and written recommendations on medication, oral hygiene maintenance and diet. In case of immediate implants, bone regeneration, and/or sinus procedures, postoperative antibiotic therapy (1 g of amoxicillin or 300 mg of clindamycin) was continued every 12 h for six to eight days. Analgesics were administered as needed.

Overdentures, single and partial crowns were delivered after eight weeks; complete arch restorations were delivered after 20 weeks. Definitive restorations were either cemented or screw-retained, delivered on either stock or customized CAD/CAM abutments. Multi abutments (Osstem Implant CO. LTD.) or OT Equator (Rhein 83, Bologna, Italy) were used as intermediate abutment in case of complete arch restorations. After definitive prosthesis delivery, patients were scheduled for a standard hygiene recall program. Periapical radiographs were taken after definitive prosthesis delivery and then annually. Occlusion was checked and adjusted at each recall appointment. Explanatory cases are illustrated in Figures 1 to 5.

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Fig.1a Case 1 (narrow implant) : periapical radiograph at the definitive prosthesis delivery

Fig.1b: Case 1: periapical radiograph at the 5-year follow-up.

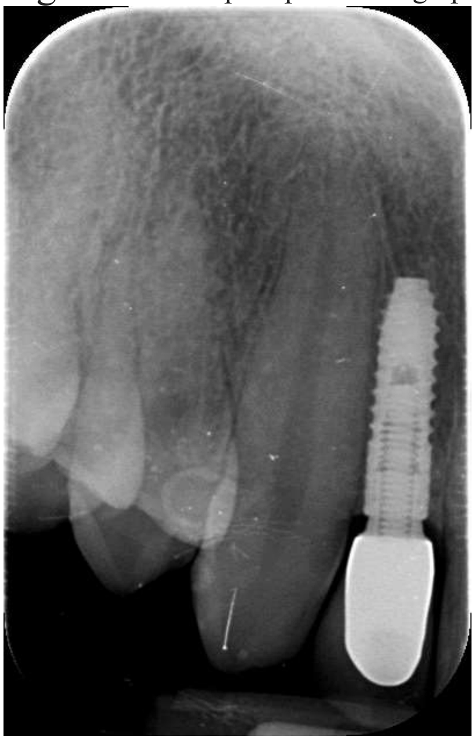

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Fig.1C: Case 1: intra oral picture at the 5-year follow-up.

Fig.2a: Case 2 (fixed partial restoration on regal implants): periapical radiograph at the definitive prosthesis delivery.

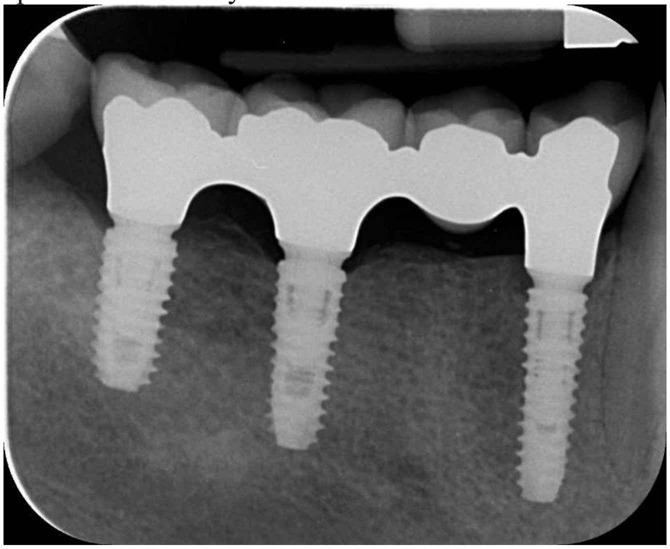

Fig.2b: Case 2: periapical radiograph at the 5-year follow-up.

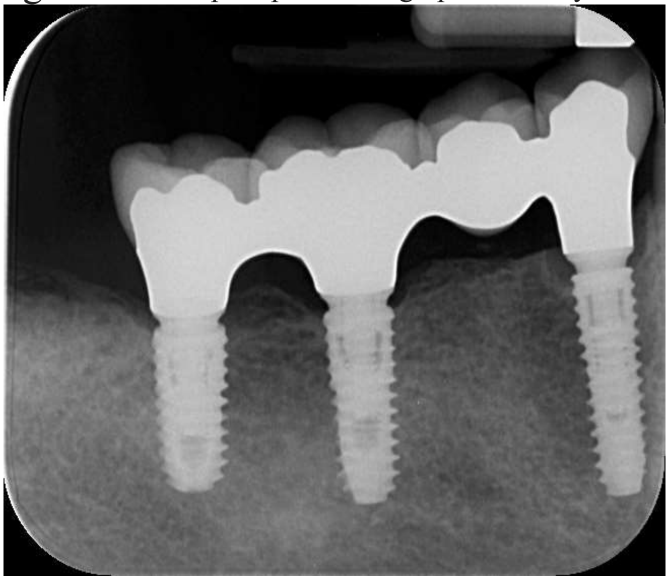

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Fig.2c Case 2: intra oral picture at the 5-year follow-up

Fig. 3a: Case 3 (wide diameter implant): periapical radiograph at the definitive prosthesis delivery.

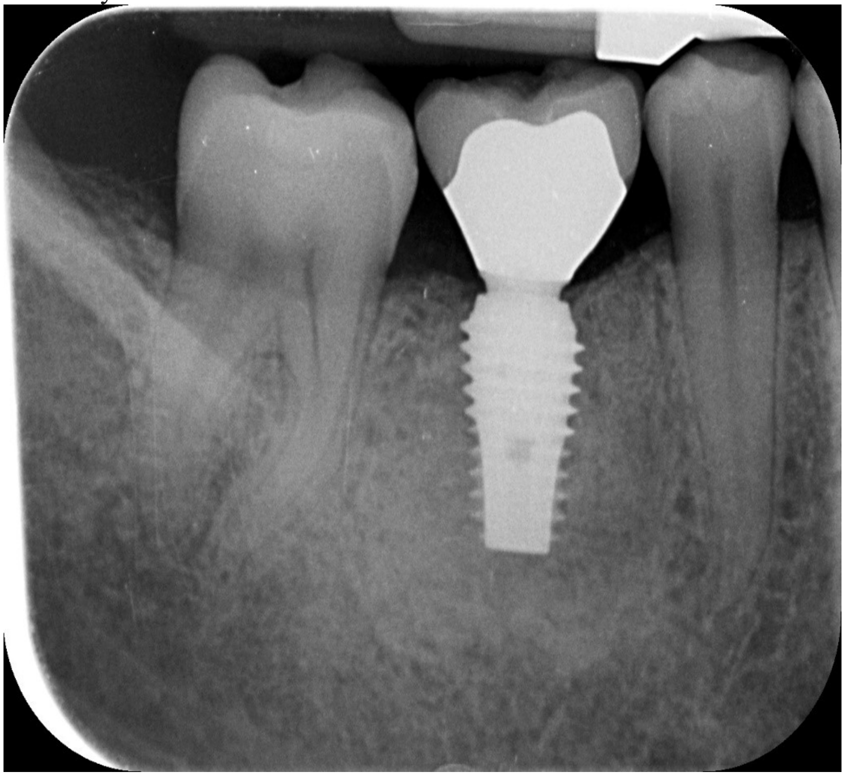

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Fig.3b: Case 3: periapical radiograph at the 5-year follow-up.

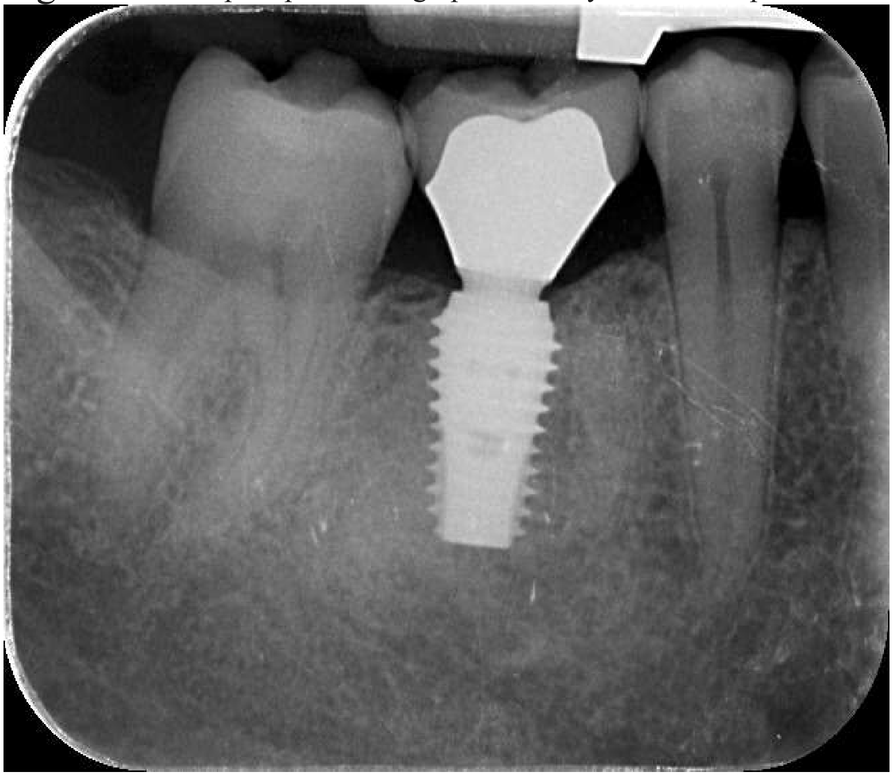

Fig.3c: Case 3: intra oral picture at the 5-year follow-up.

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Fig. 4a: Case 4 (complete-arch restoration): panoramic radiograph at the definitive prosthesis delivery.

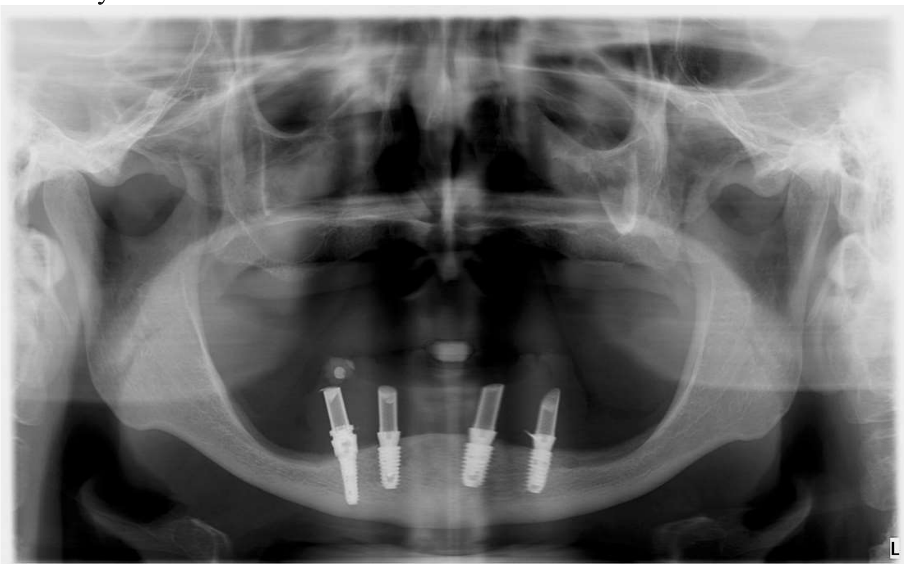

Fig.4b: Case 4: panoramic radiograph at the 5-year follow-up.

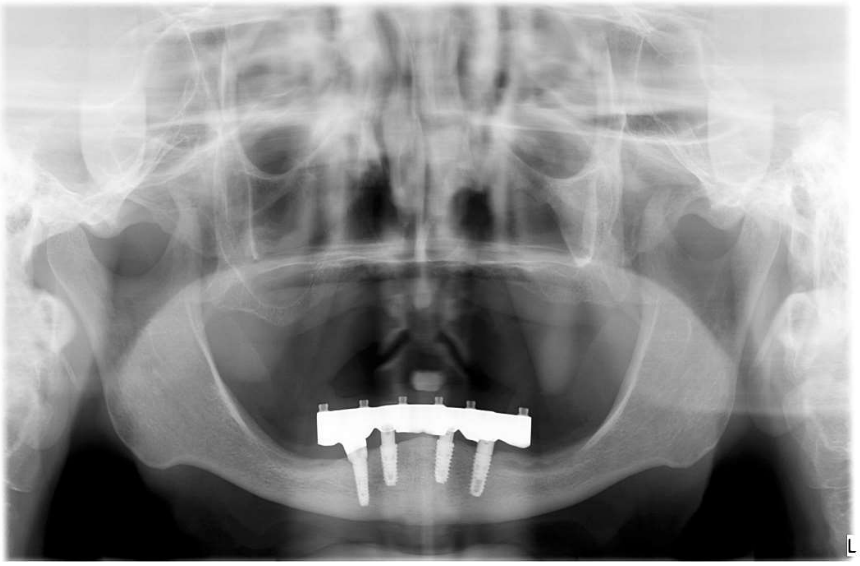

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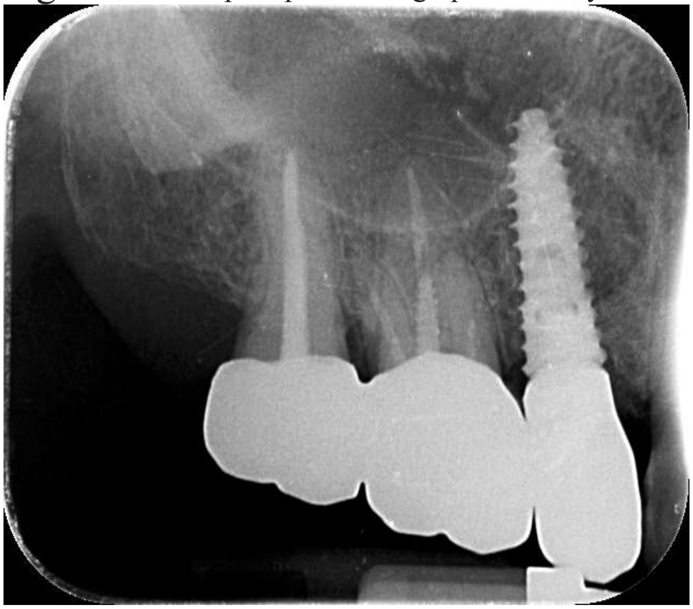
Fig. 5a: Case 5 (biological complication): periapical radiograph one month after implant placement.

Fig.5b: Case 5: periapical radiograph at the 5-year follow-up.



Outcome measures

Primary outcomes were: success rates of implants and prostheses, any complications assessed by two operators (E.X and I.I) not previously involved in this research, at one and five years follow-up, respectively. Implant failure: mobility, assessed by tapping or rocking the implant head with the metallic handles of two instruments, progressive MBL or infection, and any complications rendering the implant unusable, although still mechanically stable in the bone (for example implant fracture). Prosthesis failure: it needed to be replaced with another prosthesis. Any biological (pain, swelling, suppuration, etc.) and/or mechanical (screw loosening, fracture of the framework and/or the veneering material, etc.) complications were considered.

Secondary outcomes were as follows:
– Marginal bone levels were assessed using intraoral digital periapical radiographs at implant placement (baseline), second-stage surgery, definitive crown delivery, one and five years after loading. Intraoral radiographs were taken with paralleling technique using a conventional film holder (Rinn XCP, Dentsply Rinn, Elgin, Ill., U.S.). The radiographs were accepted or rejected for evaluation based on the clarity of the implant threads. All accepted radiographs were evaluated using an image analysis software package (DfW 2.8, SOREDEX) that was calibrated using the known length or diameter of the dental implants. The marginal bone levels were evaluated by an independent calibrated examiner at the mesial and distal margin of the implant neck at the most coronal bone to implant contact. The mean value was used in the statistical analyses.
– Insertion torque was recorded at implant placement by the same surgeon using the surgical unit.
– Implant stability quotient (ISQ) were measured at implant placement and at the six months follow-up by the surgeon using resonance frequency analysis (Osstell Mentor device, Osstell, Gothenburg, Sweden).
– Residual alveolar bone quality was assessed during surgery by the same surgeon and classified according to the Lekholm and Zarb classification.
– Thickness of the gingival biotype was assessed at the time of surgery by the surgeon (MT) using a periodontal probe (PCPUNC156, Hu-Friedy Italy, Milan, Italy) or a tension-free caliper. The gingival biotype was considered thin if the measurement was 1 mm and thick if > 1 mm.

Statistical analysis

All the collected data were recorded in a MS Excel spreadsheet. An independent statistician analyzed the data and performed all of the statistical analysis using SPSS for Macintosh (V. 26; IBM, Chicago, Ill., U.S.). The distributions of continuous variables was given as mean±standard deviation (SD), median and 95% confidence interval (CI), whereas ordinal and dichotomous variables were presented as percentages. The implant/restoration were the statistical units of analysis. Differences in the proportion of patients with implant failures, prosthesis failures and any complications (dichotomous outcomes) were compared between the groups using the Fisher exact test. Differences in mean for marginal bone levels and ISQ (continuous outcomes) were compared by independent samples t-tests and one-way analysis of variance, respectively. Comparisons between each time point and the baseline measurements were made by unpaired t-tests. All statistical comparisons were conducted at the 0.05 level of significance.

Results

A total of 92 patients were considered for this study. Only two patients were excluded (refused to partecipate). Finally 90 consecutive patients (34 males and 56 females; mean age 53.2±15.4 years; range of 24–81 years) were recruited and treated between September 2014 and December 2015. Overall, 243 implants were placed and followed for at least five years after loading (mean of 65.4±3.1 months; range of 60–72 months). Two-hundred-eight implants were placed in non-smoking patients; 20 implants in patients who smoked ≤ 10 cigarettes/day; and 15 implants in patients who smoked > 10 cigarettes/day. The main implant characteristics and distribution are shown in Tables 3-5.

Table 3. Main implant characteristics (length and diameter).

Implant length (mm) and diameter (mm)	7.0	8.5	10.0	11.5	13.0	Total
3.0	-	-	-	-	4	4
3.5		2	6	27	10	45
4.0	3	2	17	31	14	67
4.5	3	8	18	8	20	57
5.0	-	1	20	9	-	30
6.0	-	2	11	3	-	16
7.0	-	4	15	5	-	24
Total	6	19	87	83	48	243

Table 3. Main implant characteristics (length and diameter).

Implant length (mm) and diameter (mm)	7.0	8.5	10.0	11.5	13.0	Total

Table 4. Implant distribution part I.

	Central incisors	Lateral incisors	Canines	Premolars	Molars	Total
Maxilla	26	7	4	45	41	123
Mandible	-	15	5	42	58	120
Total	6	19	87	83	48	243

Table 5. Implant distribution part II.

Implant placement	Immediate implants	43	
	12-16 weeks after tooth extraction and socket preservation	75	
	>4 months after tooth extraction	125	
	Total		243
Loading time	Immediate loading	49	
Guided	Guided implant placement	76	
Guided bone reconstruction procedures	Guided bone regeneration	19	
	Crestal sinus floor elevation	10	
	GBR + Crestal sinus floor elevation	3	
	Socket preservation	39	
	Total		61

Overall insertion torque ranged between 15 and 45 Ncm (mean of 42.9±4.8 Ncm). Two hundred and three implants (83.5%) were placed at an insertion torque ranging from ≥35 to 45 Ncm. One-hundred-forty-three definitive restorations were delivered 8 to 20 weeks after second-stage surgery.

Definitive prostheses were screwed on to 168 implants and cemented on to the remaining 61 implants Moreover, five patients received two-implants-retained overdentures (overall 10 implants) and two patients received an overdentures fully supported by a titanium CAD/CAM bar on four implants (overall eights implants). Data are summarized in table 6.

Table 6. Definitive restorations distribution.

Implant length (mm) and diameter (mm)	Single	FPD	Overdenture*	Hybrid overdenture°	Toronto§	Total
Maxilla	46	9	1	-	7	63
Mandible	58	11	2	2	7	80
Total	104	20	3	2	14	143
Supported implants	1	2 to 3	2	4	4 to 8	243

Table 6. Definitive restorations distribution.						
Implant length (mm) and diameter (mm)	**Single**	**FPD**	**Overdenture***	**Hybrid overdenture°**	**Toronto§**	**Total**
Screw-retained	71	11	-	-	13	
Cemented-retained	33	9	-	-	1	

FPD=Fixed partial denture; *Mucosal-supported; °Implant-supported; §Fixed full-arch restoration.

At the 1 year follow-up, no drop-outs were recorded, but 17 patients (18.9%) with 18 restorations (12.6%) delivered on 34 implants (14%) were lost at the 5 years examination. Two patients died; four patients move to another country/city and refused to return for routine check-up and maintenance, preferring a closer dental clinic; eight patients not allowing the visit due to covid-19 pandemic; and for three patients the reasons was unknown due to they did not answer the phone.

Overall, at the five-year examination, six implants failed in six patients, resulting in a cumulative implant survival rate of 97.5%. Five implants failed before definitive loading. One implant failed at the two-year follow-up. Kaplan-Meier estimation is reported in table 7 and figure 6.

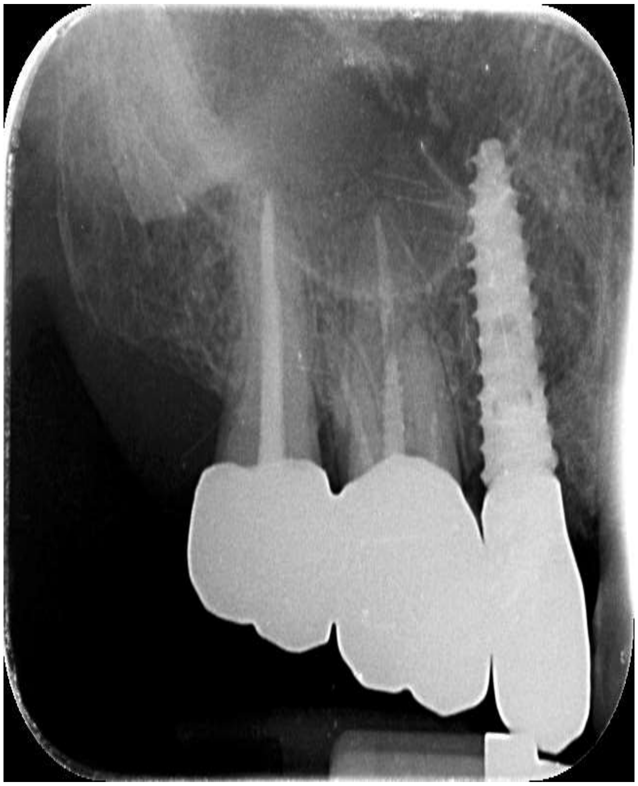


Fig.6: Kaplan-Meier estimation for implant survival.

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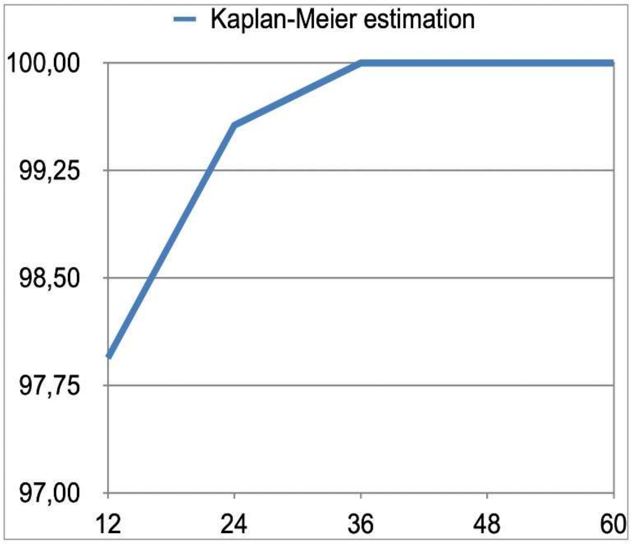

Fig.7: Association between MBL and variabilities

Not statistically significant differences were found were comparing implant failures within sub-groups, except for insertion torque value. In fact, two failed implants were placed in combination with bone augmentation procedures (P=0.6310); one implant was immediately loaded (P=1.000); two implants were placed immediately after tooth extraction (P=0.2108). The last failed implant fractured two years after definitive prosthesis delivery (0.4%). On the contrary, two failed implants were placed with an insertion torque of < 35 Ncm (failures 2/7 versus 4/236; P=0.010).

Table 7. Kaplan-Meier estimation.

Follow-up (months)	Sample at risk (implants)	Drop-outs	Failures	Actual Sample	Kaplan-Meier estimation
12	243	0	5	238	97,94
24	230	8	1	229	99,57
36	223	6	0	223	100,00
48	217	6	0	217	100,00
60	203	14	0	203	100,00

At the five-year follow-up, four prostheses failed (2.8%) resulting in a cumulative prosthetic survival rate of 97.2%. One zirconia-based, full-arch framework, delivered on six implants, presented a misfit between the framework and the most distal implant at the try-in appointment. The framework was remade with no further complications. One zirconia-based, full-arch, screw-retained restoration, delivered on four implants, fractured five years after loading. The fractured prosthesis was remade with a new one. Two cemented-retained single crowns delivered of mandibular molar region failed at the 5-year examination due to abutment damage. Both prostheses were remade with new screw-retained restorations.

At the five-year examination, five patients experienced one complication each, resulting in a cumulative prosthetic success rate of 96.5% at patient level. Three patients with a single screw-retained restoration experienced screw loosening at the one year follow-up. The screws were tightened chairside after prosthesis cleaning, with no further complications except for one patient. For the latter, the patient experienced a new screw loosening at the two-year follow-up. Occlusion was adjusted, the screw was replaced, with no further complications. Two patients experienced pain and swelling up to three weeks and four years after implant placement, respectively, resulting in a MBL greater than two millimeters comparing with previous control. Both patients are enrolled in a strictly maintenance program, and no further pathological MBL was experienced.

All the implants were placed at the bone crest level or slightly below. At the definitive prosthesis delivery (n=243), the mean MBL was 0.26 ± 0.25 mm (95% CI: 0.23–0.29). The mean MBL between implant placement and the one year after loading (n=243) follow-up was 0.37 ± 0.25 mm (95% CI: 0.33–0.41). The difference was 0.11 ± 0.14 mm (95% CI: 0.09–0.13). Five years after loading (n=203), the mean MBL between implant placement was 0.41 ± 0.30 mm (95% CI: 0.26–0.34). Difference from the one year data was 0.04 ± 0.19 mm (95% CI: 0.01–0.07).

Overall, 4.4% of the implants (n=9) showed zero marginal bone loss five years after loading, while 78.8% of the implants (n=160) showed an MBL ≥ 0.1 and ≤ 0.5 mm. Twenty-five implants (12.3%) showed a MBL ≥ 0.5 and ≤ 1.00 mm. Only nine implants (4.4%) showed a MBL greater than 1.0 mm (range 1.1 - 2.3 mm). All of these patients were under strictly hygiene maintenance program. No surgical procedures were performed. Comparison of MBL and the investigated risk factors was conducted at the one year follow-up. It was found a statistically higher MBL for smokers, thin gingival biotype and GBR.

At implant placement, the mean ISQ value was 71.6 ± 5.5 (range of 45–88); At the six-month follow-up, mean ISQ was 76.7 ± 4.4 (range of 66–89). The difference was statistically significant (P=0.0001).

One hundred and sixty-six implants were placed in bone of Type 1 and 2 quality (n = 18). The remaining 77 implants were placed in Type 3 and 4 bone. No statistically significant correlation was found between insertion torque and MBL (p = 0.4216). A thin gingival biotype was associated with higher MBL compared with a thick biotype. The difference was statistically significant (p = 0.0307).

Discussion

The aim of this prospective open-cohort, case series study was to investigate, over a five years after loading period, the implant and prosthetic survival and success rates of sandblasted and acid-etched bone level implants featuring an 11° Morse taper connection placed in private practice, and to evaluate the expected amount of physiological marginal bone remodeling in the medium term follow-up. The main limitation of the present study was the small sample size, particularly referred to the heterogeneity of the treatments. Unfortunately, COVID-19 pandemic contributes to a relative higher drop-outs. Nevertheless, 203 equal implants were placed and patients were followed for at least five years after loading, enough to evaluate the physiological marginal bone remodeling that could be expected in private practice.

In the present study, six out of 243 implants failed over a period of five years after loading, scoring a cumulative implant survival rate of 97.5%. All of these implants failed before definitive loading. Kaplan-Meier estimation showed that after an initial risky period, cumulative survival rate become higher. A possible explanation was that marginal bone loss remain almost stable during time. At the five years follow-up examination, only nine implants (4.4%) showed a marginal bone loss between 1.1 and 2.3 mm. On the contrary, 91.1% of the implants showed a MBL ≥ 0.5 and ≤ 1.00 mm (of these, 78.8% showed an MBL ≥ 0.1 and ≤ 0.5 mm).

According to the preliminary report,(16) the subgroup analysis demonstrated that previous guided bone regeneration, thin tissue biotype, and smoking were associated with a statistically significantly higher MBL. This results is in agreement with previous researches from other authors. Sgolastra et co-workers concluded that smoking habits is associated to higher MBL, implant failure, as well as risk of biological complications, such us periimplantitis.(17) The results of the present research are also in agreement with a systematic review with meta-analysis that showed that implants placed with an initially thick periimplant soft tissue may expect less radiographic MBL in the short-term follow-up.(18)

In the present research, even if GBR is associated with slightly higher MBL, survival rate of implants placed in combination with or after GBR are successful without differences when compared with implants placed into sites with pristine bone. Data reported in the present study are consistent with other report.(19-21) On the contrary, immediate loading and the placement of a definitive abutment the day of the implant insertion and never removed, have been proven to reduce MBL.(22,23) A possible explanation could be that, in the present research, most of the immediately loaded implants were placed flapless, using guided surgery, and received the definitive abutment on the day of surgery, minimizing MBL.

In the present research, two out of seven implants placed with an insertion torque < 35 N cm failed, reaching a statistically significant difference. It is well known that high primary implant stability is one of the main factors mandatory for achieving a high success rate.(24-29) Nevertheless, there is still no consensus to the ideal insertion torque required to prevent implant failure. In the present study, 83.5% of the implants were placed at an insertion torque between 35 and 45 N cm. The drilling protocol was adapted according to the bone density, and following the manufacturers' recommendations. Conventional preparation was performed in healed sites with a bone density of Type 2 or 3.(29) Under or halfway adapted preparation were performed in the case of post-extractive implants, poor bone quality, and sinus lift with simultaneous implant placement. Moreover, in some maxillary cases, osteotomes were used to perform bone spreading, improving bone density and subsequently, primary implant stability.

The major clinical concern of the present research was the relative higher prosthetic failure and complications. Five years after loading four prosthesis failed and three technical complications were experienced. Complications were resolved chiarisce, but all the failed prostheses have been redone. However, one prosthesis failed during the try-inn examination. This means that some technical problems could be made during laboratory procedures. The second zirconia framework failed 5 years after loading. It is the author opinion that zirconia materials improve during time. Moreover, some years ago, the connection between the prosthesis and the implants were made in zirconia as well. So, today, using improved materials, and titanium connection, it can be expected longer time free of complications. The last two prostheses were two single crowns. In both cases the hexagon of the abutment broken 5 five after loading. Both implants were wide diameter implants placed in mandibular molar region. One of these patients was overt bruxers. The second patients was not scheduled as bruxers, nevertheless, the patient experienced two bereavement (husband and a son) a fews months before the prosthetic complication. It is probably that some parafunctional habits appeared. Nevertheless, this point focused the importance of occlusal maintenance besides the normal hygiene maintenance.

Conclusions

Low implant failure and stable marginal bone remodeling, up to five years after loading, can be expected using Osstem TSIII implants in the daily practice. Smoking and thin tissue biotype were the most important variabilities associated with higher MBL. Prosthetic failure and complications may occur. For the latter, continues occlusal controls should be planned in order to reduce these complications.

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