Does Implant Placement Below the Ridge Reduce Crestal Bone Loss? A Split-Mouth Randomized Controlled Clinical Trial

Federica Altieri, DDS, PhD[1]/Michele Cassetta, DDS, PhD[1]

Purpose: To evaluate the extent of crestal bone loss (CBL) at 2, 12, 36, and 60 months in implants placed with the shoulder at the equicrestal level and 2 mm below the alveolar ridge. ***Materials and Methods:*** A split-mouth randomized controlled clinical trial was conducted by selecting subjects with a Kennedy Class IV partially edentulous mandible. Two implants of equal length and diameter were inserted, one equicrestal and the other subcrestal, in the lateral incisor sites. Using Rinn centering devices, intraoral periapical radiographs were taken at implant insertion (T0) and at 2 (T1), 12 (T2), 36 (T3), and 60 months (T4). Descriptive statistics and *t* test were used, with $P \leq .05$ considered statistically significant. Twenty-five patients were recruited, with a mean age of 65 ± 9.88 years (range: 42 to 82 years), and none dropped out. A total of 50 implants were inserted, 25 at the crestal level and 25 at the subcrestal level. ***Results:*** At the 60-month follow-up, no implant or prosthetic failure was recorded. An average CBL of 0.81 ± 0.40 mm (range: 0.1 to 1.6 mm) was recorded in the crestal implant group, while the subcrestal implants had an average CBL of 0.87 ± 0.41 mm (range: 0.2 to 2 mm); however, the higher CBL in the subcrestal group was not statistically significant ($P = .65$). Comparing the mean CBL of both groups at the various follow-ups, greater crestal bone resorption was recorded in subcrestal implants between T0 and T1 (0.25 vs 0.1 mm) and between T1 and T2 (0.39 vs 0.23 mm), while in subsequent follow-ups, a greater and statistically significant ($P = .01$) CBL was recorded in equicrestal implants between T3 and T4 (0.05 vs 0.18 mm). ***Conclusions:*** Thus, over time, the extent of CBL seems to be reduced in subcrestal implants, with bone retention above the implant shoulder. Although the position of the implant shoulder relative to the crestal ridge does not affect the CBL, subcrestal placement is recommended in order to reduce the risk of exposing the rough implant surface. *Int J Oral Maxillofac Implants 2025;40:41–50. doi: 10.11607/jomi.10947*

Keywords: crestal bone loss, dental implant-abutment design, dental implant platform switching, dental radiography, microthreads, Morse taper connection, sub-bone level

A main goal of implant therapy today is not simply implant survival, as in previous years, but also minimizing crestal bone loss (CBL) around implants for soft tissue stability and long-term success.[1–3]

Even today, the literature indicates bone resorption during the first year of loading as relevant, citing about 1.2 mm of CBL in the coronoapical direction.[4] Compared to the levels recorded radiographically at implant placement, the literature also considers CBL < 2 mm as a fundamental criterion of success.[5] In addition, it has been hypothesized that greater initial CBL increases the possibility of progressive CBL in the long-term[6] and that minimal or no marginal bone loss following implant-abutment connection may be considered an indicator of success in long-term follow-ups.[7]

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The literature indicates both mechanical and biologic factors as possible causes of CBL, namely: surgical trauma of the bone and periosteum at the time of implant insertion, the size of the microgap between the implant and abutment, bacterial colonization of the implant sulcus, formation of a biologic width, and biomechanical factors related to load.[8–12] Considering the methods that can be used to determine possible CBL, intraoral periapical radiography is the method of choice, but it has limitations. In fact, this method only monitors the mesial or distal aspect of bone loss around the implant body and is affected by its intrinsic two-dimensional (2D) nature, with anatomical overlap and geometric distortion.[13–15] Considering all the limits of periapical radiography, CBCT has been proposed as an alternative in the evaluation of marginal bone level, but according to De Bruyne al,[16] periapical radiographs remain the most reliable method for measuring peri-implant marginal bone level.

If the accuracy of intraoral periapical radiography in determining crestal bone levels is evaluated, the literature shows that the radiographic examination statistically significantly overestimates bone levels, but accuracy is not influenced by variables such as arch (maxilla/

mandible), implant position (anterior/posterior), timing of implant insertion (early delayed/prolonged delayed), or crestal levels (vestibular/palatolingual).[17] On the other hand, regarding the reliability of intraoral periapical radiography in determining changes in peri-implant crestal bone levels, radiographic measurements enable the changes in marginal bone levels to be determined and represent the only method that can be used to determine peri-implant crestal bone loss.[18]

Recently, several modifications of the implant components have been proposed to reduce crestal bone resorption, such as implant neck microthreads and implant-abutment connections such as platform switching and Morse cone connections.

Microthreads appear to improve the contact area between the implant and the cortical bone, minimizing bone loss and decreasing the shear forces exerted on the crestal bone.[19] The platform-switching concept, on the other hand, has been used to reduce bone loss after abutment placement and consists of using a smaller-diameter abutment connected to a larger-diameter implant neck. This connection moves the perimeter of the implant-abutment joint (IAJ) inwards, towards the central axis, to improve force distribution. Mechanical theory, supported by finite element analysis, suggests that this design reduces stress at the bone–implant interface and in the crestal region of cortical bone by shifting stress to the cancellous bone during loading.[20,21] It is also believed that this displacement of the IAJ from the outer margin of the implant shoulder to the central implant axis results in the removal of inflammatory cells, which are present at the implant-abutment interface (IAI), from the crestal bone. This displacement could also limit crestal bone resorption due to a consequent horizontal shift of the biologic width.[22] In two-component implants, a microgap is always present at the IAI, and the magnitude of this microgap is a key factor contributing to peri-implant bone remodeling, as it allows bacteria, fluids, and small molecules to pass through.[17,23,24] It is likely that this condition results in the crestal bone being positioned 1.5 to 2 mm below the IAI.[18,25]

Nowadays, to reduce the space between the implant and abutment and to improve the distribution of stress, an internal conical connection (a Morse taper) with an internal anti-rotational element is commonly used.[26] Several in vitro studies have shown that this connection reduces bacterial penetration, suggesting a limitation of CBL.[27–29] However, no IAI appears to completely prevent bacterial penetration, which calls into question the clinical relevance of this improved bacterial seal.[30] The internal Morse taper connection may improve the distribution of mechanical stresses compared to the external "flat to flat" connection, and it has been suggested that internal-connection implants have a biomechanical advantage over external connection implants, with less CBL.[31] On the other hand, recent randomized controlled trials concluded that crestal bone remodeling is not affected by the implant-abutment connection and microthreads.[32–35] Bone remodeling is a multifactorial process and might be more dependent on other factors than implant design itself.[32–35] If crestal bone remodeling is not affected by the type of implant-abutment connection nor by microthreads, once can hypothesize that the position of the implant shoulder relative to the crestal ridge may be decisive.[36]

Some authors have proposed a subcrestal position of the implant shoulder to reduce the risk of exposing the upper metal part of the implant or the abutment margin and to have sufficient vertical space to create a harmoniously esthetic emergence profile.[37–39] Considering that in two-component implants, the crestal bone level seems to be related to the microgap position between the implant and abutment, a subcrestal position of the implant-abutment microgap would consequently determine bone resorption.[40–43] Broggini et al[44] determined a significant causal relationship between the extent of peri-implant inflammation and the degree of CBL. The more apical the microgap, the greater the degree of peri-implant inflammation, with a microbial biofilm of greater pathogenic composition, an onset of gingival margin recession, esthetic alterations, and maintenance difficulty.[44] In spite of these considerations, some authors recommend that in esthetic areas, the two-component implant shoulder should be positioned 2 to 3 mm below the cementoenamal junction of the contiguous elements in order to obtain an acceptable emergence profile,[44] while others recommend a more apical position of the implant shoulder compared to that of the natural tooth being replaced.[31] Urdaneta et al state that an intracrestal placement of the IAI can direct occlusal forces more apically, along the implant body, distributing the load over a larger area,[31] while manufacturers of implants with a conometric connection recommend inserting the implant 2 to 3 mm below the ridge.[45]

Reporting the results of a retrospective clinical study comparing the marginal bone resorption of implants inserted at the crestal and subcrestal levels, Romanos et al state that the extent of bone resorption is the same using the two different protocols and is similar, in both cases, to the bone resorption previously reported in the literature.[46] However, the same authors point out that positioning the shoulder on the crestal bone may be associated with a greater risk of implant exposure, even if the extent of marginal resorption is the same when positioning it equicrestally or below the crestal bone. Placing the implant below the crestal bone would minimize

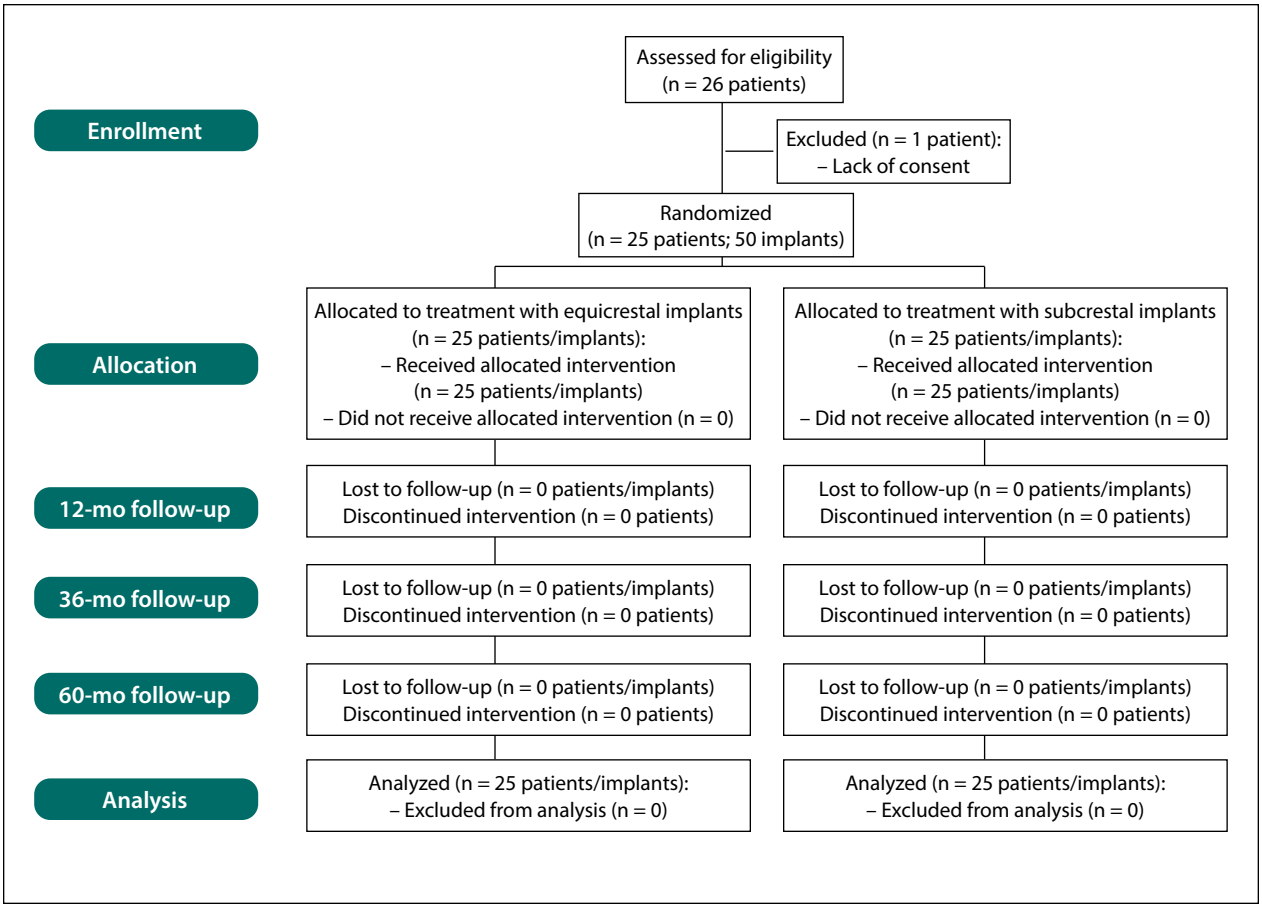


Fig 1 CONSORT flowchart of the study.

this risk, and placing subcrestal platform-switching implants would allow for greater bone stability or bone growth on the implant shoulder.[46]

The present study aimed to evaluate at 2, 12, 36, and 60 months the extent of bone resorption in implants placed with the implant shoulder at the equicrestal level and 2 mm below the crestal bone.

The hypothesis of the study was that placing the implant shoulder 2 mm below the crestal bone may result in less crestal bone resorption.

MATERIALS AND METHODS

Study Design

The present study was designed as a split-mouth randomized controlled clinical trial to evaluate the effect of different implant shoulder positions (equicrestal or subcrestal) on CBL. The study protocol was approved by the Ethics Committee of the Policlinico Umberto I in Rome (#4871).

At the Department of Oral and Maxillo-Facial Sciences of the Sapienza University of Rome, subjects with Kennedy Class IV partially edentulous mandible were selected from January 2017 to December 2017. Two months after extracting the four compromised mandibular incisors, two implants were placed at the lateral incisors, one with the implant shoulder at an equicrestal level and the other with the shoulder placed subcrestally. The study is reported according to the CONSORT statement, and the treatment allocation is summarized in Fig 1. All subjects received written and verbal information about the different techniques used in the study and gave written consent. The study ended in August 2023.

Patient Selection

The inclusion criteria were as follows: *(1)* being partially edentulous for at least 2 months due to the extraction of the mandibular incisors; *(2)* presence of a sufficient amount of alveolar bone for the insertion of two implants (3.8 x 10 mm or 3.8 x 12 mm); and *(3)* providing informed, written consent to the treatment and a willingness to perform check-ups. Patients were excluded from the study if they met any of the following criteria: *(1)* aged < 18 years; *(2)* psychiatric illness; *(3)* periodontal disease or uncontrolled systemic diseases; *(4)* previous radiation therapy of the head or neck; *(5)* use of

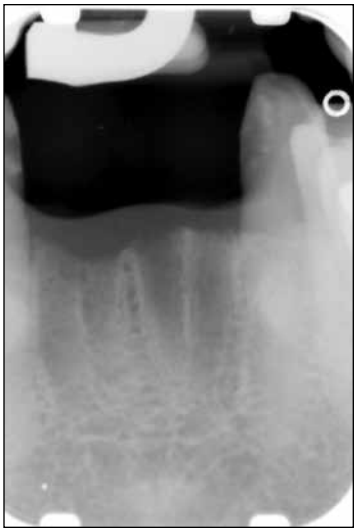


Fig 2 Periapical radiograph 2 months after extractions, prior to implant insertion.

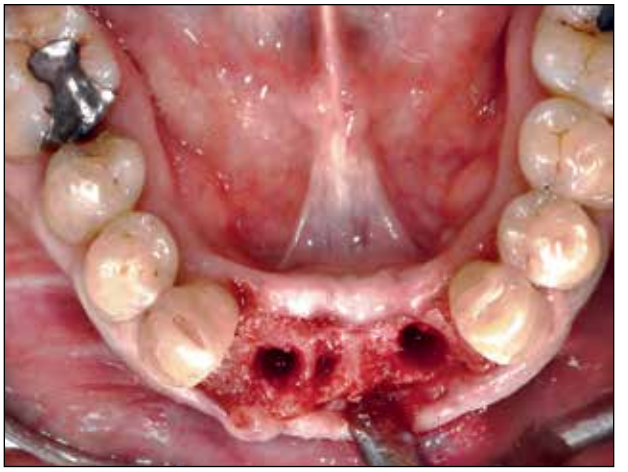


Fig 3 Incision and detachment of the mucoperiosteal flap and preparation of the two implant sites in the lateral incisor sites.

corticosteroids or other drugs that affect bone healing or osseointegration; *(6)* previous or current chemotherapy; *(7)* smoking habit (heavy smoking defined as > 10 cigarettes/day); and *(8)* presence of parafunctional habits. All selected subjects were provisionally rehabilitated with a Maryland bridge attached to the lingual side of the mandibular canines. All selected subjects underwent periodontal treatment, and oral hygiene was optimized before starting implant-prosthetic rehabilitation.

Sample Size Estimation

Referring to a similar previous study,[47] the sample size for the present study was calculated according to the following formula:

$$n = \frac{2(Z_{\alpha}+Z_{1-\beta})^2\sigma^2}{\Delta^2}$$

where α is the level of significance (.05) and 1-β is the power of the study (80%). The σ symbol indicates the estimated standard deviation (0.55 mm), and Δ is the difference in marginal bone level between the two study groups (0.4 mm).

$$n = 24.5\ \frac{2(1.96 + 0.8416)^2 0.55^2}{(0.4)^2}$$

A total of 26 patients were selected for this study, but 1 patient was excluded for not providing valid consent for treatment. The remaining 25 subjects were treated, and the implant placement (subcrestal or equicrestal) was randomly decided by a coin toss and carried out by people unrelated to the research. Both the subject and the two clinicians who took the radiographic measurements were unaware of the initial implant shoulder position. The surgical and prosthetic procedure was performed by a single experienced operator (M.C.) with more than 30 years of experience. Prior to enrollment, subjects underwent clinical and radiographic examinations (orthopanoramic radiography and intraoral periapical radiographs; Fig 2).

Surgical Procedure

Conical implants were used (Titanium alloy Grade 5 ELI; Ti6Al4V), with sandblasted and etched surfaces and a smooth implant bevel of 0.3 mm (Sharp Implant, ImplaDent). The implant neck is characterized by microthreads, while the rest of the implant body has a thread pitch of 0.9 mm. The implant had a Morse cone implant-abutment connection with an internal hexagon. In the crestal-positioned implants, flat cover screws and platform-switched prosthetic abutments were used (straight millable abutments). In the subcrestal implant group, cylindrical cover screws with a height of 2 mm and dedicated platform-switched prosthetic abutments (sub–bone level implant prosthetic components, ImplaDent) were used (straight abutments: 3-mm height and 4-mm diameter). The implant placement surgery was conducted under local anesthetic. A canine-to-canine ridge incision was made, and a mucoperiosteal flap was elevated. After removing any present fibrous tissue, two implant sites were prepared in the lateral incisor areas. Site preparation was carried out while maintaining parallelism of the prepared sites, and drills were used, as recommended by the manufacturer (Fig 3). Each patient received two implants of equal length and diameter, randomly assigning one to be placed with the shoulder at the equicrestal level and the other with the shoulder positioned 2 mm below the crest (Figs 4 to 6). The mucoperiosteal flap was sutured,

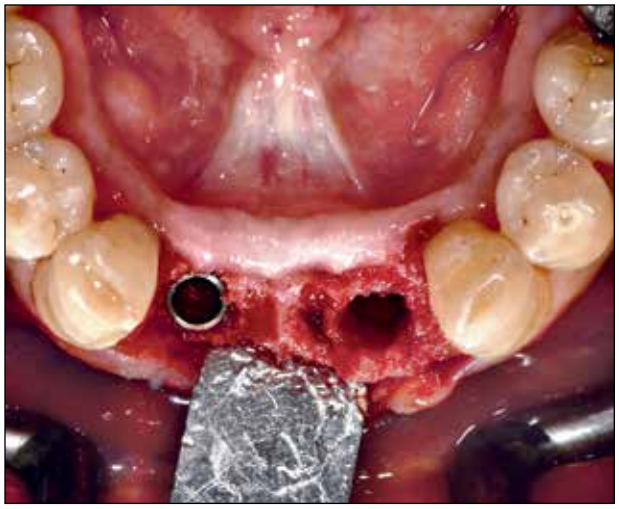


Fig 4 Implants were inserted, with an equicrestal implant shoulder at site 42 and a subcrestal shoulder at site 32 (FDI numbering system).

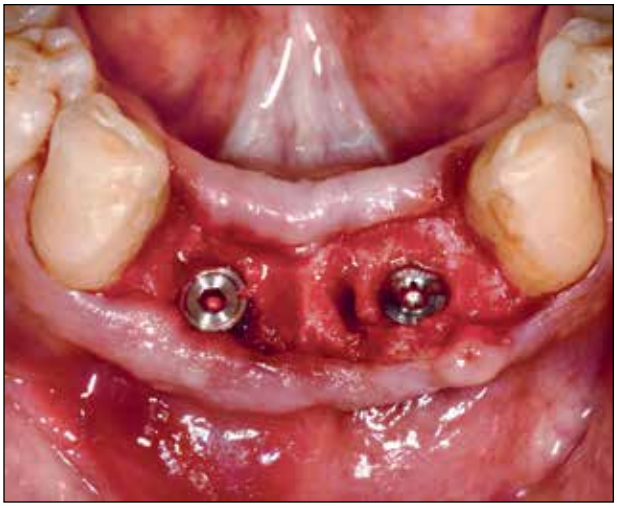


Fig 6 Positioning of the cover screws. A flat cover screw was placed on the equicrestal implant, and a cylindrical cover screw (2-mm height) was placed on the subcrestal implant.

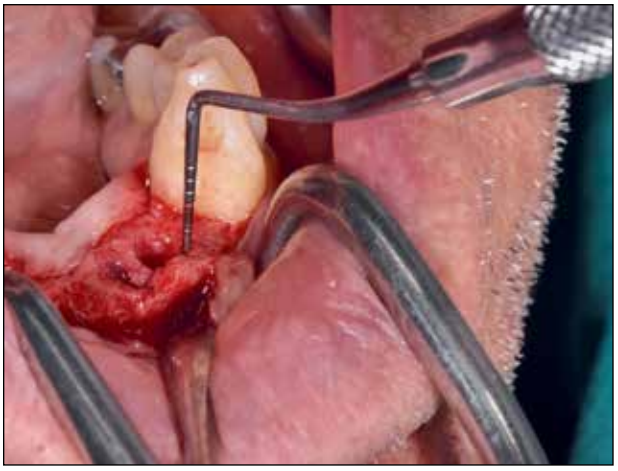
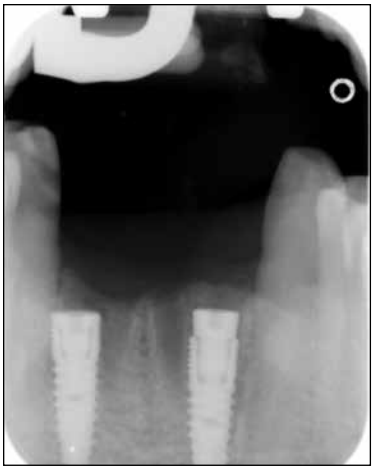


Fig 5 Bone levels were measured intraoperatively on the mesial and distal aspects, and the mean value was calculated.

Fig 7 Periapical radiograph at T0.



and a Maryland bridge was cemented, avoiding any contact between the pontic elements and the underlying tissues. At the end of the surgery (T0), an intraoral periapical radiograph was obtained (Fig 7). Two months after implant insertion (T1), surgery was performed to position the healing abutments, with a different design based on the equi- or subcrestal implant position, and periapical radiographic examinations were performed again (Figs 8 to 10). After 20 days, the prosthetic abutments were positioned with different designs based on the initial equi- or subcrestal implant shoulder position, and the temporary fixed prosthesis was delivered. After 6 months, impressions were taken, and the final prosthetic was delivered (a cemented metal-ceramic fixed prosthesis; Fig 11). Subsequent clinical and radiographic follow-ups took place at 12 (T2), 36 (T3), and 60 months (T4) (Figs 12 to 14, respectively).

Radiographic Examinations

All radiographs were analyzed independently by two examiners who did not participate in the clinical phase of the trial and were unaware of the insertion technique used for the individual implants. To standardize the radiographic images, periapical radiographs were obtained using the long-cone parallel technique and the Super-Bite film-holding system (Kerr). The radiographs were placed parallel to the implant long axis. An intraoral radiograph machine (Oralix AC, Gendex) with a collimator and a focal point distance of 200 mm was employed, using the following exposure settings: 70 kV and 1.12 mA. Digital radiographs were taken (DenOptix QST, Gendex). Linear measurements were obtained using dental imaging software (VixWin PRO, Gendex). The contrast and brightness of the digital images were freely adjusted by the examiners. Examiners evaluated no

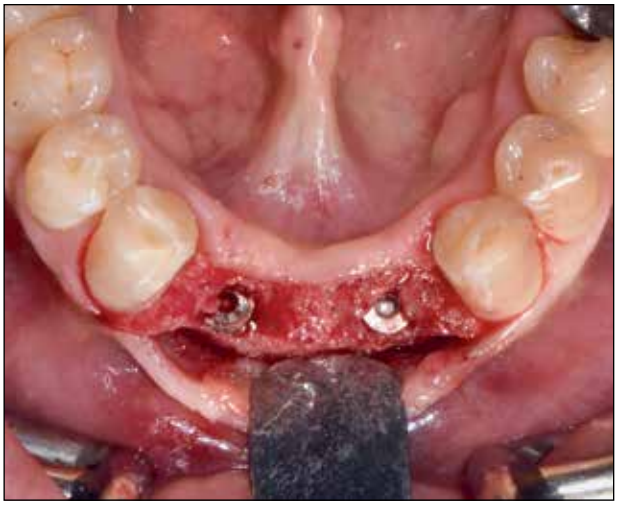


Fig 8 The second surgical phase was performed 2 months after implant insertion.

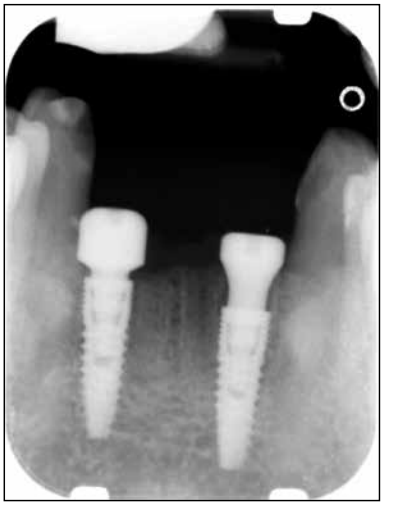


Fig 10 Periapical radiograph at T1.

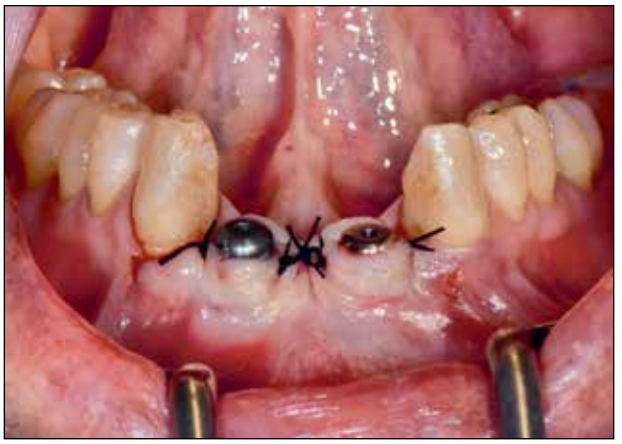


Fig 9 Insertion of healing caps at 2 months. A dedicated healing cap was screwed onto the subcrestal implant at site 32.

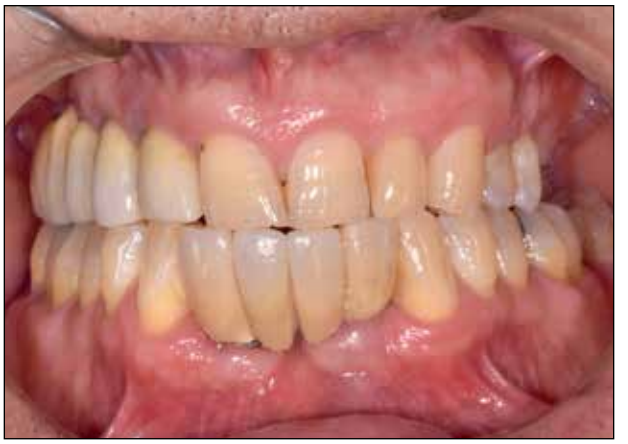


Fig 11 The fixed metal-ceramic prosthesis was delivered.

more than 20 radiographs per day to avoid eye strain. As suggested by de Siqueira et al,[47] measurements of the equicrestal implants were performed from the most crestal bone-to-implant contact and the upper margin of the implant shoulder, whereas measurements on subcrestal implants were performed from the most coronal radiolucent image of crestal bone to the implant shoulder. At each follow-up, distal and mesial values were determined and averaged. Bone loss was determined by calculating the difference between bone levels of two time points. The numerical values of the measurements could be a positive or negative number or zero, with a bone margin higher than the implant shoulder, corresponding to the implant shoulder, or inferior to the implant shoulder. To reduce the symmetric imaging error in the vertical plane, calibration was performed. To obtain calibrated measurements, an object of known size, such as the known implant length, was used.

Statistical Analysis

SPSS (version 17.0, IBM) was used for the statistical analysis. Results were reported using descriptive statistics (means, median standard deviation, and range). To assess the presence of a statistically significant increase in CBL in one of the two groups, *t* test was used, setting the significance to $P \leq .05$. Statistical analysis was performed at the implant level. The intraclass correlation coefficient (ICC) was used to assess the intraobserver and interobserver variability. An estimated ICC close to 1 indicates a strong correlation. For the reliability of radiographic measurements, the interobserver agreement was 0.840, and the intraobserver variability was 0.880 and 0.873. Considering the excellent interobserver and intraobserver agreement, the radiographic measurements were considered reliable.

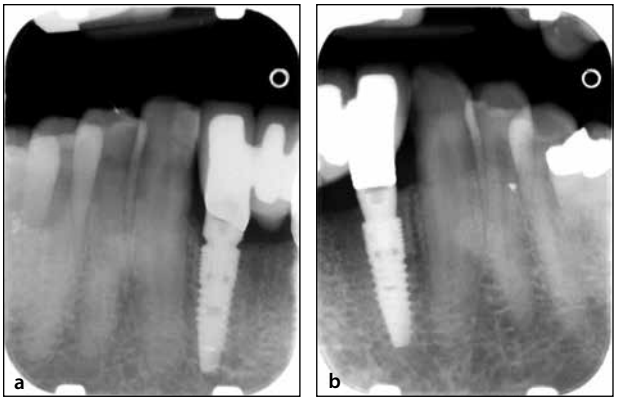


Fig 12 *(a and b)* Periapical radiographs at T2.

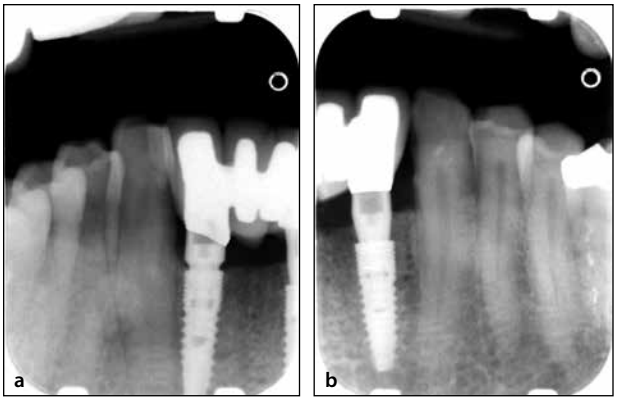


Fig 13 *(a and b)* Periapical radiographs at T3.

RESULTS

Initially, 332 patients requiring implant-supported rehabilitation were examined. Of these subjects, only 26 had Kennedy class IV partial edentulism, and 1 person was excluded due to a lack of written consent for study participation. Of the patients, there were 18 men and 7 women with a mean age of 65 ± 9.88 years (range: 42 to 82). There were no patient dropouts. A total of 50 implants were inserted (25 patients/implants per group), and none failed. Each patient received two implants of equal length and diameter in the lateral incisor areas, one positioned at the crestal level and the other 2 mm below the crest. At the 60-month follow-up, no implants had failed (survival rate: 100%), and were no complications associated with the cemented fixed prosthesis (prosthetic survival rate: 100%).

Regarding CBL, an average loss of 0.81 ± 0.40 mm (range: 0.1 to 1.6 mm) was recorded between T0 and T4 in the equicrestal implant group; Table 1 reports the CBL values at the different follow-up times. Evaluating the subcrestal implant group, the average CBL between T0 and T4 was 0.87 ± 0.41 mm (range: 0.2 to 2 mm); Table 2 reports the CBL values at the different follow-up times.

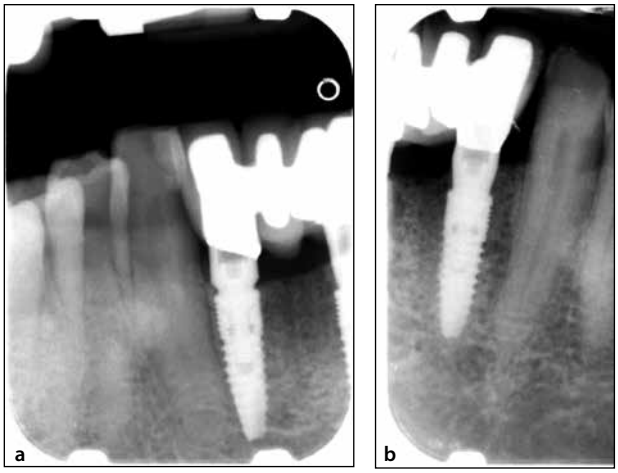


Fig 14 *(a and b)* Periapical radiographs at T4.

Comparing the mean CBL values of the two groups between T0 and T4, higher resorption was recorded in the subcrestal group (0.87 mm vs 0.81 mm), but this greater resorption was not statistically significant ($P = .65$). Comparing the mean CBL values of the two groups at the different follow-ups, greater crestal bone resorption was recorded in subcrestal implants between T0 and T1 (0.25 mm vs 0.1 mm) and between T1 and T2 (0.39 mm vs 0.23 mm), while in subsequent follow-ups, a statistically significant ($P = .01$) greater CBL was recorded between T3 and T4 (0.05 mm vs 0.18 mm) in equicrestal implants. In the other follow-ups, the difference was not statistically significant. In the subcrestal group, crestal bone levels remained more coronal (on average) compared to those at the implant shoulder.

DISCUSSION

The present study aimed to determine the influence of the implant shoulder position (equicrestal vs subcrestal placement) on the extent of CBL. The hypothesis was that a subcrestal shoulder position of a bone-level implant would result in less resorption of the peri-implant bone. The study hypothesis was rejected, as there was no statistically significant difference in mean CBL values between the two groups. Marginal bone resorption was lower in the equicrestal implant group, but this lower mean resorption at 60 months (0.06 mm) was not clinically nor statistically significant. The only statistically significant difference was recorded in the last follow-up (T3 to T4), with less resorption in the subcrestal group.

A limitation of the present study is that only CBL was determined, while soft tissue thickness before implant placement and peri-implant soft tissue condition (such as probing depth [PD]) were not evaluated. This is certainly a limitation, although it must be considered that

Table 1 Changes in CBL Between Different Follow-ups in the Equicrestal Implant Group (mm)

CBL values	ΔT1–T0	ΔT2–T1	ΔT3–T2	ΔT4–T3
Mean	−0.1025	−0.2275	−0.2975	−0.185
SD	0.215501	0.21489	0.211184	0.215272
Minimum	−0.4	−0.9	−0.8	−0.55
25%	−0.2125	−0.3	−0.4	−0.4
50%	−0.1	−0.2	−0.25	−0.2
75%	0	−0.1	−0.1875	0
Maximum	0.25	0.25	0.25	0.25

All data are presented in millimeters from a sample of 25 patients/implants. Negative values indicate a loss of crestal bone.

Table 2 Changes in CBL Between Different Follow-ups in the Subcrestal Implant Group (mm)

CBL values	ΔT1–T0	ΔT2–T1	ΔT3–T2	ΔT4–T3
Mean	−0.25	−0.39	−0.1825	−0.05
SD	0.283772	0.332692	0.174171	0.087359
Minimum	−1.05	−1.05	−0.6	−0.15
25%	−0.3	−0.5	−0.2625	−0.15
50%	−0.25	−0.25	−0.2	−0.05
75%	−0.2	−0.15	0	0
Maximum	0.45	−0.1	0.1	0.15

All data are presented in millimeters from a sample of 25 patients/implants. Negative values indicate a loss of crestal bone.

an increased marginal bone resorption corresponds to an increased PD.[48] Another weakness of the study is the use of implants with specific components for the subcrestal implant shoulder position (cylindrical cover screws with a height of 2 mm and dedicated platform-switched prosthetic abutments). All other studies in the literature have used the same implants with the same prosthetic components ,and this condition does not allow a generalization of the present results.

Considering the strengths of the present study, the relatively extensive follow-up must be highlighted; few studies are present in the literature with a follow-up at 60 months or later. Additionally, the study design minimized the influence of most of the clinical variables that can potentially affect CBL, such as confounding factors related to the implants used and the subject, surgical technique, and prosthetic factors. In the present study, the compared implants were placed in the same subject, in the same anatomical site, and with the same surgical and prosthetic protocol, all performed by a single operator.

Considering comparable studies in the literature, de Siqueira et al[49] conducted a randomized controlled trial with a 5-year follow-up, aiming to evaluate bone crest changes around implants with an internal tapered connection placed interforaminally at different depths (equicrestal and subcrestal) and loaded immediately. In 11 subjects, 28 implants were placed equicrestally and 27 implants were placed subcrestally, with depths ranging from 1 to 3 mm. All subjects attended a 5-year follow-up, and no implants or prostheses failed within the 60-month evaluation period (implant and prosthetic survival rates of 100%). At the 5-year follow-up, equicrestal implants showed a higher bone crest resorption (0.99 mm) than subcrestal implants (0.80), without statistical significance ($P > .05$). However, the study reported a thread exposure in the equicrestal group and no exposure in the subcrestal group.[49] These findings confirm what Romanos[46] reported, namely that despite overlapping crestal bone resorption entities, an equicrestal position presents a greater risk of implant surface exposure than a subcrestal position. The results of that study are similar to those of the present study, but it should be noted that the implants inserted by de Siqueira et al[49] were loaded immediately.

Sun et al[48] conducted a split-mouth randomized controlled clinical trial to evaluate peri-implant soft tissue and marginal bone loss around platform-switched, tapered internal connection implants in crestal and subcrestal positions in posterior regions. The authors treated subjects who lacked at least two adjacent dental elements, uni- or bilaterally, in the posterior maxilla. Of the two implants, one was positioned equicrestally, the other subcrestally. In contrast to the present study,

the subcrestal implants were inserted 1 mm below the crest. Considering the type of prosthetic restoration and the healing time, the authors used a screw-retained prosthesis and a healing time of 4 months, inserting the implants at least 3 months after extraction. Clinical and radiographic measurements were taken at implant insertion, at prosthetic restoration delivery, and at the 1-year follow-up. At the 1-year follow-up, 18 subjects and 38 implants were evaluated, reporting less resorption in the subcrestal group than in the equicrestal group (0.04 ± 0.08 mm vs 0.17 ± 0.17 mm, respectively; $P = .004$). The same authors determined a peri-implant PD of 2.31 ± 0.48 mm in the subcrestal group and 1.92 ± 0.43 mm in the equicrestal group, with a statistically significant difference ($P = .002$). The authors also determined that the two groups showed no statistically significant differences when comparing MBL or PD values between restoration delivery and the 1-year follow-up. Additionally, after 1 year of functional loading, subcrestal implants showed less marginal bone resorption and greater soft tissue height than equicrestal implants. Comparing these results[48] with those of the present study, despite the statistical significance of marginal bone resorption at 1 year determined by Sun et al,[48] the difference in the mean bone resorption was 0.13 mm, which is not clinically significant. Another aspect to consider is the surgical protocol followed by Sun et al,[48] who, prior to implant insertion, performed a "bone ridge flattening" by modifying the characteristics of the alveolar ridge. In addition to assessing marginal bone resorption, Sun et al[48] evaluated bone remodeling using a method similar to that of the present study. Considering the extent of crestal resorption, Sun et al[48] recorded, in the subcrestal group, a bone resorption of 0.60 mm between implant insertion and 1 year of loading, overlapping with the crestal bone resorption recorded in the present study.

When reporting the results of a retrospective clinical study comparing the marginal bone resorption of implants inserted at equicrestal and subcrestal levels, Romanos et al[46] stated that the extent of bone resorption is the same using the two different protocols and is similar to the bone resorption previously reported in the literature.[46] However, those authors point out that even if the extent of marginal resorption is the same, the shoulder position in the ridge may be associated with a greater risk of implant exposure.[46] Placing the implant at a subcrestal level would minimize this risk, and placing subcrestal platform-switched implants would allow for greater bone stability or bone growth on the implant shoulder.[46] In the present study, implants placed with the shoulder 2 mm below the crest had relatively greater CBL while maintaining crestal bone levels above the shoulder, considering the original subcrestal position.

CONCLUSIONS

Although the CBL of implants placed subcrestally is relatively greater than that of implants placed equicrestally, subcrestal placement is recommended in bone-level implants in order to reduce the risk of exposing the rough implant surface.

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