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Soft tissue and crestal bone level assessment in implants with platform-switched Morse Taper connections with implant-abutment interface placed subcrestally – a clinical trial

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Abstract

Context:

The location of the implant abutment interface is of major importance for constructing esthetic dental implant restorations with a proper emergence profile. Subcrestally placed implants may also partially compensate for thin mucosal phenotypes.

Aims

To determine proximal crestal bone levels in subcrestally placed platform-switched implants with 160 Morse Taper connections at least 6 months after implantation.

Settings and Design:

This prospective follow-up clinical study is performed at XYZ Institute of Dental Sciences & Research, affiliated with a Health University, after taking Institutional Ethical Committee approval.

Methods and Materials:

19 subjects requiring single- or multiple-tooth rehabilitation were included who were > 18 years old, ASA Grade I or II, with no bone metabolic diseases and adequate bone volume for placement of a standard implant. Subjects with uncontrolled diabetes, poor oral hygiene, unstable periodontitis, and not willing to give consent were excluded. Tapered implants with a platform-switch and a deep 16^0 Morse taper, including an internal indexation, were subcrestally placed 1–4 mm in a flapped approach using a conventional two-stage protocol. Three to four months later, after uncovering, they were restored. Clinical and radiographic parameters were assessed preoperatively, immediately after implant placement (T0), at the second stage, at the time of prosthesis delivery (T1) and 6 months to 2 years after loading (T2).

Statistical analysis used:

Windows-based software Stata version 13.1 (StataCorp, College Station, TX, USA). Descriptive statistics summarised the demographic and clinical characteristics. The changes in mesial and distal bone levels over time points (T0, T1, T2), a paired t-test was used. The relationship between implant placement depth and marginal bone levels was analysed using Pearson's correlation coefficient (r).

Results

A total of 26 implants were placed and evaluated over 6 months to 2 years. The average radiographic depth of the implant at T0, T1 and T2 was 1.91 ± 0.83, 1.78 ± 0.86 and − 0.03 ± 1.60 mm, respectively. The values between T0 to T2 were statistically highly significant ($p < 0.0001$). Pearson's correlation between clinical depth of implant placement and radiographic bone levels at T2 showed strong linear positive correlation ($r = 0.662$, $p < 0.001$).

Conclusions

Within the limitations of the study, we can conclude that, there is linear positive correlation between subcrestal depth of implant placement and presence of marginal bone around implants 6 months to 2 years after implantation in platform-switched implants with 16 degree morse tapers.

Key Message

1. The correlation between subcrestal implant placement and marginal bone loss has not been thoroughly evaluated until now.
2. Negative bone remodelling of up to 2 mm after implantation is considered physiologic and acceptable.
3. The supra-crestalization of implant shoulders after subcrestal placement is prevented to a substantial frequency.
4. We propose that the two-piece implants should be placed ≥2 mm subcrestal.

Introduction

PI Branemark's accidental discovery of osseointegration of titanium plates has become one of the most significant advancements in modern dentistry. Additionally, the introduction of the "platform-switching" concept by Lazzara and Porter[1] has been a major benefit for preserving the crestal bone around implants. Platform switching is defined as the practice of using an abutment with a smaller diameter than the implant, allowing the implant-abutment interface to shift medially from the edge of the implant platform.[1] This creates a horizontal step between the implant platform and the abutment, moving the implant-abutment junction inward toward the central axis of the implant. It has now become a standard feature in the design of conventional dental implants.

Numerous studies[2, 3, 4] have demonstrated that platform-switched implants result in less bone resorption compared to platform-matched implants. For instance, Cappiello and colleagues[2] found a significant protective effect on bone levels associated with platform switching, measuring an average difference of 0.72 mm in a controlled clinical trial involving 131 implants in 45 patients. Similarly, Prosper et al.[3] and Canullo et al.[4] have substantiated the advantages of platform-switched implants in promoting crestal bone stability. Subsequent studies[5] have utilised implants with varying horizontal

relationships between implant and abutment diameters, such as platform switching combined with Morse taper connections featuring micro-structured surfaces extended onto the implant shoulder, like Koutouzis et al.[5], who found noticeable differences in marginal bone resorption based on the level of the implant-abutment interface. They placed implants equicrestal and 1mm and 2mm subcrestal to the buccal bone (10 each) and reported that, after 1 year of follow-up, 90% of the subcrestal implants exhibited bone on the implant platform, compared to only 35% of the equicrestal implants.

In a systematic review, Valles et al.[6] concluded that platform-switched implants positioned apical to the crest exhibited less marginal bone level change compared to those placed at the same level as the crest. They also noted that the location of the microgap and subcrestal placement appear to increase the dimensions of the peri-implant soft tissues, including significantly greater barrier membranes. They included a total of 14 studies, including 7 animal studies, and found that the crestal bone level (CBL) was located at a more coronal position in subcrestal implants with respect to the implant shoulder (WMD = − 1.09 mm; 95% CI = − 1.43 to − 0.75; P < 0.001).

The stability of both hard and soft tissues around dental implants is recognised as a crucial factor for the long-term success of the implant.[7] Traditionally, studies have reported a vertical marginal bone loss of 1 to 1.5 mm during the first year of function, followed by an annual radiographic marginal bone loss of less than or equal to 0.2 mm for two-piece implants.[8]

As stated in 2017 Classification for Periodontal Diseases and Conditions[9], alveolar bone remodelling following the first year of implant in function may depend on the type and position of the implant, but changes or losses of alveolar bone that occur after the implant was placed in function should not exceed 2 mm. Changes ≥ 2 mm at any time point during or after the first year should be considered pathological.

The factors contributing to peri-implant marginal bone loss[6] include the establishment of a biologic width, vertical soft tissue thickness, surgical trauma, inter-implant distance, the presence of a microgap at the implant-abutment interface, implant positioning relative to the alveolar crest, the macro design of the cervical area of the implant (i.e., platform-switching versus platform-matching), the type of implant-abutment connection, surface topography of the implant neck, micro-movements of the abutment, frequent connection and disconnection of abutments, smoking status, and peri-implantitis, among others.

Maintaining the crestal bone level is critical for preserving soft tissue.[10] In this context, it has been suggested that platform-switched implants provide greater space for establishing an adequate peri-implant biologic width. This is associated with reduced apical extension of the junctional epithelium and, consequently, less change in crestal bone levels.[11] Canullo L et al.[12] indicated that bone resorption may primarily be influenced by biological factors rather than biomechanical factors such as implant diameter. Furthermore, a study by Vandeweghe and DeBruyn[13] showed that platform switching is effective only when the mucosal thickness allows for the establishment of a proper biological width.

There are various studies indicating the depth of the implant during placement, but those specifically relating it to short- and long-term marginal bone stability are somewhat lacking. Recently, Quispe-López N et al.[14] considered 2mm subcrestal implantations as deep placements and compared them with equicrestal and 1mm subcrestal (shallow) placements. They restored the implants with multi-unit abutments of different heights 3 months after placement and concluded that the lowest level of marginal bone loss (MBL) occurs in subcrestal ≈ 2 mm implants with long abutments, and that the gain in supracrestal tissue height (STH) was significantly greater around these implants only. Another similar study by the same authors[15] reported findings equivalent to the above observations but reiterated the need for more such studies.

All such studies can be considered heterogeneous due to differences in implant systems, varied implant-abutment complexes, restoration philosophies, implant sites, soft-tissue and hard-tissue parameters, etc. We didn't find any literature on the depth of implant placement and MBL for implant systems incorporating tapered implants with platform-switch and deep 16^0 Morse taper connections, including internal indexation.

Therefore, our study aimed to evaluate the proximal bone level and soft-tissue stability in functioning implants at least 6 months after restorations around tapered platform-switched subcrestally placed implants with deep 16^0 Morse taper connections, including internal indexation at the implant-abutment interface, kept at a subcrestal location.

Subjects and Methods

This is a single-arm, human, unicentric clinical trial conducted in accordance with the latest versions of the Declaration of Helsinki and the World Medical Association's ethical guidelines for medical research involving human participants.

Study design and participants

In this prospective interventional study, 19 patients (mean age: 35.2 years, range: 18 to 74 years) who were partially edentulous and required prosthetic treatment at XYZ Institute of Dental Sciences & Research from December 2019 to February 2022 participated. Each patient was given a detailed description of the study design and clinical procedures, and was required to sign an informed consent before participation. The protocol for this study was approved by the Institutional Ethical Committee.

Subjects for the present study were selected from partially edentulous patients who required implant-supported prostheses. Participants were recruited consecutively during the stated study period, and observations and follow-ups continued until December 2024.

Inclusion criteria for the present study were (a) ≥ 18 years old subjects; (b) in general good health condition (ASA- I, II); (c) absence of systemic diseases which affect bone metabolism and wound healing; (d) capable of willingly participating in the study;(e) willing to give written informed consent to

participate in the study; (f) enough bone volume to place a standard implant and (g) good mesiodistal spaces for enough inter-implant and tooth-implant distances.

The subjects were not included in the present study if they present with (a) uncontrolled systemic conditions (ex. Diabetic patients with HbA1c > 7.5%); (b) smoking and tobacco habits; (c) pregnancy or lactation at any time during the study; and (d) regular intake of medication related to bone metabolism or autoimmunity; (e) psychiatric or mental disorders along with sky-high expectations.

Sample size estimation:

We have determined the sample size by considering effect sizes and a two-sided level of significance of 5% and adjusted the sample size for t-distribution for prospective study with before and after measurements. 11 (number of pairs) to achieve a power of 80% and a level of significance of 5% (two-sided), for detecting an effect size of 1 mm of marginal bone loss between pairs. In other words, if one selects a random sample of 11 pairs and determines that the effect size is 1 mm, you would have 80% power to declare that the mean of the paired differences is significantly different from zero, i.e. a two-sided p-value is less than 0.05. Thirteen pairs would be the appropriate sample size given a 20% dropout rate. So, a minimum of 13 subjects should be selected for the study.

Clinical procedure

Following clinical and radiographic examinations, tapered implants with a platform-switch design and a deep 16^0 Morse taper, including an internal indexation (Neodent Helix GM, Bone Level Tapered Implant®, Straumann Inc.), were placed using a two-staged conventional protocol by experienced periodontists. The implants were placed 1–4 mm subcrestally. The implant depth varied at all four aspects: mesial, buccal, distal and oral, as no crestetomy/ crestoplasty was done to achieve a flat architecture before beginning implant osteotomy. The implant size was selected according to ridge morphology and site. Guided bone regeneration (GBR) procedures, if required, were performed only for contour augmentation. After 3–6 months of healing, the second surgery was performed. After healing, porcelain-fused-to-metal crowns were delivered.

Radiographic measurement of hard tissue

Crestal bone level on mesial and distal aspects of the implant was measured on intraoral digital radiographs taken immediately after placement of the implant (T0), at the second stage uncovering, at the time of prosthesis delivery (T1), and 6 months to 2 years after loading of the implant (T2). Preoperative digital radiographs were also taken, using an acrylic stent with metal bars attached for standardisation. Measurements were taken on the mesial and distal aspects of the implant, from the bone crest to the implant shoulder, using ImageJ software (National Institutes of Health, USA), with the

implant length and diameter standardised to their actual sizes. The measurements recorded at T0, T1, and T2 by an independent examiner were taken to avoid operator bias.

Clinical measurements

Demographic data for subjects were collected, including age, gender, history of diabetes, tobacco use, depth of implant placement, implant site, and grafting requirements. Soft tissue margins to bone at prosthesis delivery were recorded at mesial, distal, buccal, and lingual aspects in mm and repeated at T2. The subcrestal depth of the implant on the mesial, distal, buccal, and lingual aspects, in mm, was also recorded immediately after implantation.

Statistical analysis

Statistical analyses were made at both the patient and implant level. Continuous variables were summarised with mean and standard deviation. Counts and percentages were used to describe categorical variables. Data analyses were performed using the Windows-based statistical program Stata version 13.1 (StataCorp, USA).

Descriptive statistics were used to summarise participants' demographic and clinical characteristics. Continuous variables, such as linear measurements of implant depth and soft tissue levels, were expressed as Mean ± Standard Deviation (SD). Categorical variables, such as age group, gender, diabetes, tobacco/betelnut habit, grafting, and Stage II Bone Removal, were presented as frequencies and percentages.

To compare differences between mesial and distal bone levels between time points, a paired t-test was performed for each parameter. The mean difference, along with the 95% confidence interval (CI), was calculated to assess the range within which the true difference lies. A p-value < 0.05 was considered statistically significant.

The relationship between implant placement depth and marginal bone levels at T0, T1, and T2 was investigated using Pearson’s correlation. Additionally, the association between soft tissue parameters and radiographic bone levels at T1 was also investigated using Pearson’s correlation.

Results

We conducted a prospective interventional follow-up clinical trial in patients requiring 1 or 2 implants for prosthetic rehabilitation, evaluating implant depth placement with marginal bone loss up to 2 years of follow-up. A total of 19 patients were finally included based on the inclusion criteria, in whom 26 implants were placed. No patient dropped out during the observation period of the present study, and 26 implants were included in the final analyses. Postoperative healing in all was uneventful, and no

complications were reported during follow-up, except for screw loosening. All 26 implants survived and remained functional at up to 2 years of follow-up.

The implant site distribution between the maxilla (46.15%) and the mandible (53.85%) was nearly homogeneous. In both arches, the majority of implants placed were in molar areas, at 23.1% in each arch.

The majority of the implants placed were ≥ 4 mm in diameter (61.54%), compared with < 4 mm (38.46%). Also, the majority were 10 mm in length (76.9%), and the rest were of other lengths. 27% implants were 5x10 mm, followed by 3.75x10 mm at 15.4% and then the rest diameter x length combinations.

Clinical evaluation and demographic data

The gender distribution was homogeneous: 10 males (52.63%) and 9 females (47.37%). The mean age of all patients was 35.42 ± 11.73 years, with a range of 18–64 years. No patient had diabetes; only 1 had tobacco use; and 9 sites required some form of ridge expansion, an indirect sinus lift, or bone augmentation. Despite subcrestal placement, there was no requirement for surgical bone removal coronal to the implant at stage-II implant surgery, a sharp instrument was enough to remove any such bone formation.

The intrasurgical mean implant placement depth was 1.99 ± 0.67 mm, considering variable depths at mesial, buccal, distal and oral sites. As this is to be analyzed with proximal radiographic depths, the mean intrasurgical implant depth considering only proximal (mesial + distal) sites was 2.29 ± 0.82 mm.

The mean peri-implant soft tissue height, from the crest of the peri-implant mucosa to the top of the fixture at prosthesis delivery, was 3.57 ± 0.47 mm. The mean proximal soft-tissue height can be considered papillary at 3.86 ± 0.64 mm.

Radiographic evaluation

Intraoral periapical digital radiographs (IOPA) at T0, T1 and T2, although not taken with holding devices and paralleling technique, all the measurements were standardised to 5 mm and/ or 10 mm metal wire embedded in acrylic stents, length of the implant placed and diameter of the implant placed, using Image-J software. Figures 1–3 illustrate three representative cases.

The mean distribution of radiographic bone level (MBL) recorded at T0, T1, T2, and soft tissue levels at T1 is shown in Table 2. The MBL was recorded from the bone crest immediately in line with the implant periphery on the proximal sides and the top of the fixture. If the bone crest was noted coronal to the implant, it was denoted as a positive value; if it was apical to the implant shoulder, it was denoted as a negative value (indicating bone loss).

Table 1
Demographic characteristics of participants

Age Group		***No.***	**%**
	< 30Yrs	**7**	**36.84**
	> 30 Yrs.	12	63.16
	Total	19	100.0%
Gender	Male	10	52.63
	Female	9	47.37
	Total	19	100.0%
Diabetes	No	19	100.0%
	Yes	0	0.0%
	Total	19	100.0%
Tobacco/Betelnut Habit	No	18	94.74
	Yes	1	5.26
	Total	19	100.0%
Grafting	No	17	65.4%
	Yes	9	34.6%
	Total	26	100.0%
Stage II Bone Removal	No	26	100.0%
	Yes	0	0.0%
	Total	26	100.0%

No.: Count of number [number of subjects in some (19) and number of implants in others 26)]; %: percentage.

Table 2
Bone Levels and Soft Tissue Measurements Around Implants at T0, T1, and T2 (n = 26)

Immediate Post-op Bone (T0)	**N**	**Mean**	**SD.**	**Min.**	**Max.**
• Mesial	26	1.93	0.95	0.50	3.95
• Distal	26	1.90	0.81	0.50	3.86
Average of Post-op bone (T0)	26	1.91	0.83	0.50	3.68
Prosthesis Delivery Bone (T1)					
• Mesial	26	1.88	0.80	0.50	3.94
• Distal	26	1.69	1.02	0.50	5.32
Average of Prosthesis Bone (T1)	26	1.78	0.86	0.50	4.63
≥ 6 Months Post-op Bone (T2)					
• Mesial	26	0.17	1.67	-3.00	4.20
• Distal	26	-0.22	1.68	-4.11	2.20
Average of ≥ 6 months Bone (T2)	26	-0.03	1.60	-3.55	3.20
Soft Tissue Margin During Prosthesis (T1)					
• Mesial	26	3.88	0.65	3.00	5.00
• Distal	26	3.85	0.61	3.00	5.00
• Buccal	26	3.31	0.55	3.00	5.00
• Lingual	26	3.23	0.51	2.00	4.00
Average soft tissue	26	3.54	0.50	2.60	4.50
Soft Tissue Margin ≥ 6 Months Prosthesis Delivery (T2)					
• Mesial	26	2.23	0.76	1.00	4.00
• Distal	26	2.23	0.76	1.00	4.00
• Buccal	26	1.69	0.62	1.00	3.00
• Lingual	26	1.69	0.62	1.00	3.00
Average ≥ 6 months depth	27	2.00	0.64	1.00	3.50

N: Number of observations; SD: Standard deviation; Min: Minimum; Max.: Maximum.

Mesial bone levels at T0, T1, T2 were 1.92 ± 0.96, 1.87 ± 0.79, 0.16 ± 1.65 mm respectively, while the same for distal sites were 1.90 ± 0.81, 1.69 ± 1.03, -0.22 ± 1.65 mm respectively. The mean radiographic depth (mesial+distal) of implant at T0, T1 and T2 was 1.91 ± 0.82, 1.78 ± 0.86 and − 0.03 ± 1.6 mm, respectively. Table 3 presents changes in mesial and distal bone levels across time points and their significance. The paired t test indicated that the mesial, distal, and mesial+distal means were statistically significantly different ($p < 0.0001$) from T0 to T2.

Table 3
Changes in Mesial and Distal Bone Levels Between Time Points

Parameters	**Mean**	**SEM.**	**95% C. I.**		**Paired t-test**	
			Lower	**Upper**	**'t'**	**'p'**
Mesial						
• Imm Post-op (T0) - Prosthesis delivery (T1)	0.05	0.10	-0.15	0.25	0.51	0.614
• Imm Post-op (T0) - ≥ 6 months (T2)	1.76	0.30	1.15	2.37	5.92	< 0.0001
Distal						
• Imm Post-op (T0) - Prosthesis delivery (T1)	0.22	0.14	-0.08	0.51	1.51	0.144
• Imm Post-op (T0) - ≥ 6 months (T2)	2.12	0.29	1.53	2.72	7.33	< 0.0001
Mesial+Distal Average						
• Avg Imm Post-op (T0) - Avg Prosthesis delive (T1)	0.13	1.20	-0.42	0.59	0.35	0.733
• Avg Imm Post-op (T0) - Avg ≥ 6 months (T2)	1.94	1.80	2.02	4.33	6.44	< 0.0001

Mean: Average difference in bone level measurements; SEM: Standard Error of the Mean; 95% CI: 95% Confidence Interval for the mean difference; t: t-value from the paired t-test; p: p-value indicating the level of statistical significance ($p \leq 0.05$ considered significant); T0: Post-operative baseline bone level immediately after implantation; T1: Bone level at follow-up timepoint 1, 3 months after prosthesis delivery; T2: Bone level at follow-up timepoint 2,≥6 months after prosthesis delivery; Mesial / Distal: Locations around the implant/prosthesis—mesial refers to the side facing the midline of the dental arch; distal refers to the side away from the midline.

Table 4
Pearson's correlation between clinical depth of implants and radiographic marginal bone levels at T2

Correlation between		Mean	Variance	Covariance numerator	Pearson's r	P	Interpretation
Mesial clinical depth versus marginal bone at T2	Clinical Mesial depth	2.3077	19.5385	18.9869	0.515	0.007	Moderate linear positive correlation
	Radio. M MB Level	0.1654	69.5128				
Distal clinical depth versus marginal bone at T2	Clinical Distal depth	2.2692	15.1154	23.5027	0.7189	< 0.001	Strong linear positive correlation
	Radio D MB Level	-0.2204	70.7051				
Mesial + Distal average depth versus marginal bone at T2	Clinical Mesial+ Distal	2.2885	16.5865	21.4362	0.6618	< 0.001	Strong linear positive correlation
	Radio M + D MB Level	-0.0275	63.2445				

Radio M MB: Radiological marginal bone level on mesial side; Radio D MB: Radiological marginal bone level on distal side; Radio M + D MB: Radiological mean marginal bone level at mesial and distal sites together; p-value indicating the level of statistical significance (p ≤ 0.05 considered significant); Clinical depth at T0: Post-operative bone level immediately after implantation during surgery before suturing measured using graduated periodontal probe; T2: Bone level at follow-up timepoint 2,≥6 months after prosthesis delivery; Mesial / Distal: Locations around the implant/prosthesis—mesial refers to the side facing the midline of the dental arch; distal refers to the side away from the midline.

If we compare the depth of implants placed between < 3 mm and ≥ 3 mm (at least at any one of the mesial, buccal, distal, or oral intrasurgical sites), the marginal bone levels at T2 were − 0.63 ± 1.26 and 0.94 ± 1.72 mm, respectively, indicating around 1 mm of bone coronal to the implant collar with deep placements.

Correlation analysis (Table No. 4)

We did a correlation evaluation for intrasurgical depth of implant placement against the radiographic marginal bone levels at T2; for mesial sites, distal sites and average of mesial and distal sites.

Pearson's correlation analysis for mesial sites demonstrated a statistically significant moderate positive correlation ($r = 0.515$, $p = 0.007$), indicating that increases in depth of the implant were associated with increases in the marginal bone levels, in other words less marginal bone loss as we have used negative signs for MB loss. The coefficient of determination ($r^2 = 0.265$) suggested that approximately 26.5% of the variance was shared between the variables.

The same for distal sites reflected a **strong positive statistically significant linear relationship, indicating** higher values in implant depth are quite reliably associated with higher, more positive values in marginal bone level ($r = 0.719$, $p < 0.000$).

A Pearson product-moment correlation coefficient for the average of mesial and distal sites was computed to assess the linear relationship (N = 26). The analysis revealed a highly statistically significant, strong positive correlation between the two variables, $r(24) = 0.66$, $p < .001$ (two-tailed). The likelihood that this relationship occurred purely by chance is less than 0.03%. Higher values in implant depth were systematically associated with an increase in the values of marginal bone. The coefficient of determination ($R^2 = 0.438$) indicates that variations in implant depth account for approximately 43.8% of the total variance observed in MB level.

Discussion

This prospective study, lasting up to 2 years, evaluated radiographically the levels of peri-implant proximal hard tissue. Because of the subcrestal placements, we considered bone present coronal to the implant shoulder as positive and bone apical to it as negative for the purposes of the study.

Galindo-Moreno et al.[16], in their retrospective radiographic study on marginal bone loss (MBL), concluded that implants with increased MBL rates at early stages, such as the healing and immediate post-loading periods, were likely to reach MBL values that compromised their final outcomes. They found insignificant changes in MBL rates during the submerged healing phase and found more MBL during the interval between abutment connection and crown placement, and attributed the bone loss to the prosthetic phase. As depicted in Table 3, the present study found that the proximal bone level change during the period from immediate implant placement (T0) to prosthesis placement (T1) was 0.13 ± 1.20 mm, but the same between T0 to T2 was 1.94 ± 1.80 mm. In a recent publication, Esposito et al.[17], evaluated subcrestal implant placements ten years post-loading. Patients in the 0.5 mm group exhibited an average marginal bone loss of 0.38 ± 0.84 mm, while those in the 1.5 mm group showed 0.17 ± 0.45 mm, a difference that was not statistically significant (difference = -0.21 mm; 95% CI -0.47 to 0.04; p = 0.097). They concluded that, subcrestal implant placement at either 0.5 or 1.5 mm, when at least 1 mm of surrounding bone is present, seems not to affect the long-term outcomes. Another study by Dong et al.[18], analysed subcrestal placements after 1–8 years of follow-up, and noted that most of the platform-switched (Ankylos) implants showed a vertical marginal bone loss of ≤ 0.5 mm after prosthetic restorations. They also concluded that, bone volume fraction, bone surface fraction and trabecular thickness might be critical predictors of long-term MBL progression. Both these studies show MBL of ≤ 0.5 mm in subcrestally placed implants, while our study values are higher at 1.94 ± 1.80 mm, which may be because we considered both bone remodeling and bone loss together.

The study by Quispe-Lopez et al.[15], considered measurements for marginal bone remodelling (MBR) and marginal bone loss (MBL), in implants placed equicrestally, 1 mm subcrestally or > 1 mm subcrestally. Interestingly, they observed the highest MBR levels with > 1 mm implants, while equicrestal

implants showed the highest MBL. **We may consider it very appropriate to lose supra-fixture bone to remodelling, rather than losing marginal bone apical to the implant shoulder.** We wanted to find a correlation, so we placed implants at depths of 1 to 4 mm. We also observed similarly, more the depth of placement, more the remaining marginal bone, a positive linear relationship. We may have to evaluate further to determine a critical depth beyond which the benefits won't supersede. A good perspective of MBR and MBL is discussed by Spinato et al.[19]

The major indices of implant treatment success are peri-implant bone resorption around the implant neck and regression of the surrounding mucosa over time. Retraction of the surrounding mucous membrane with the progression of bone resorption in the neck of the implant body exposes the metallic colour of the implant body surface to the oral cavity, causing esthetic complications, and creating a compromised environment that readily allows bacterial contamination of the implant surface. One of the critical criteria for successful implant treatment is that cervical bone resorption should be suppressed to less than 1.5 mm in the first year of function and to less than 0.2 mm/year thereafter.[20.21]

The benefits of platform switching on bone and soft tissue preservation are evident from both clinical studies and theoretical mechanisms. However, certain factors, such as implant design, abutment selection, and patient-specific variables, must be carefully considered to optimise outcomes. For instance, the use of appropriately designed abutments that fit the implant platform is crucial to the success of platform switching. If the abutment is improperly sized or poorly fitted, the expected benefits of platform switching may not be realised.[22] Elemek et al.[23], also reiterated the benefits of platform-switching in their study on 321 implants. Mean bone loss in platform switch group (Ankylos) was significantly lower (0.81 ± 1.60 mm) as compared to platform match (Dentsply Xive) (1.58 ± 1.59 mm) and platform match (MIS Implant) (1.18 ± 1.36) ($p < 0.005$). They concluded that among different types of dental implants, platform switch seems to preserve marginal bone levels and increase the long-term success of dental implants.

Implant positioning, particularly in relation to the bone crest and surrounding soft tissues, is critical for determining soft-tissue levels. The implant should be placed at an optimal depth, neither too subcrestal nor overly supracrestal, to allow for the development of a healthy peri-implant mucosal seal. Poor implant positioning can lead to soft-tissue complications, such as mucosal recession or inadequate keratinised tissue around the implant.[24] We observed that, if the crestal soft tissue is thin to start with, subcrestal placement of implants and submerged initial healing seems to help formation of an adequately sculpted supracrestal peri-implant soft tissue, if you take proper precautions while doing second stage surgery.

The presence of adequate keratinised tissue around dental implants is essential for maintaining soft tissue health, particularly in functional implants. The amount of keratinised tissue around an implant helps to stabilise the mucosal margin and provides better protection against mechanical forces during mastication. Studies have shown that implants placed in areas with insufficient keratinised tissue are more prone to soft tissue recession and inflammation.[25] A thicker peri-implant mucosa is also

associated with improved soft tissue stability, and it helps resist recession over time. In contrast, thin mucosa can lead to faster soft tissue breakdown under functional loads. Surgical techniques, such as connective tissue grafts or soft tissue augmentation procedures, can be used to enhance the thickness of peri-implant soft tissues when insufficient keratinised tissue is present.

The goal of this study was to determine proximal bone levels around the implant at different time points and to correlate them with the depth of implant placement and the soft tissue present around the implant. As per the 2017 World Workshop Classification of Periodontal and Peri-implant diseases and conditions,[26] that, up to 2 mm of remodelling of bone crest, i.e., bone loss, is acceptable during the first year after installation and prosthetic restoration of an implant. In this study, we found that implant depth influences crestal bone loss to some extent. It is helpful to assess crestal bone stability when placing implants subcrestally, as this also helps ensure implant longevity. Despite this, this study is not without limitations. The drawbacks of the study include a limited sample and the inability to determine the three-dimensional positioning of the implants using CBCT, as it does not eliminate magnification errors seen in RVGs. Future studies can consider these for proposing prevention strategies and treatment planning methodologies.

Our additional objective was to evaluate the strength and direction of the linear dependence between the initial implant depth and marginal bone level at final follow-up appointment, a bivariate Pearson correlation analysis was executed. The data met the distributional assumptions requisite for parametric testing, with a sample size of N = 26 pairs.

The correlation matrix yielded a Pearson coefficient of r = 0.662, with an associated t-statistic of 4.325 at 24 degrees of freedom. The resulting two-tailed probability value (p = 0.0002) falls well below the standard statistical alpha threshold (alpha = 0.05), thereby permitting the rejection of the null hypothesis (H_0: \rho = 0). This robust positive association demonstrates that increments in implant depth correspond to predictable, proportional shifts in marginal bone level. Given that the effect size is substantial, these findings suggest a meaningful biological or physical interplay between the underlying mechanisms of both data series, warranting further causal investigation.

Conclusion

Within the limitations of the study, after upto a 2-year follow-up, the present study concluded that subcrestal implant placement results in less proximal bone loss and is a key factor in preserving crestal bone. Even after a good amount of bone remodelling, the remaining bone around implant shoulders is significantly more as you go deeper with implant placement.

References

1. Lazzara RJ, Porter SS (2006) Platform switching: a new concept in implant dentistry for controlling postrestorative crestal bone levels. Int J Periodontics Restor Dent 26:9–17

2. Cappiello M, Luongo R, Di Iorio D, Bugea C, Cocchetto R, Celletti R (2008) Evaluation of periimplant bone loss around platform-switched implants. Int J Periodontics Restor Dent 28:347–355
3. Prosper L, Redaelli S, Pasi M, Zarone F, Radaelli G, Gherlone E et al (2009) A randomised prospective multicenter trial evaluating the platform-switching technique for the prevention of postrestorative crestal bone loss. Int J Oral Maxillofac Implants 24:299–308
4. Canullo L, Rasperini G (2007) Preservation of peri-implant soft and hard tissues using platform-switching of implants placed in immediate extraction sockets: a proof-of-concept study with 12- to 36-month follow-up. Int J Oral Maxillofac Implants 22:995–1000
5. Koutouzis T, Neiva R, Nonhoff J, Lundgren T (2013) Placement of implants with platform-switched Morse taper connections with the implant-abutment interface at different levels in relation to the alveolar crest: a short-term (1-year) randomised prospective controlled clinical trial. Int J Oral Maxillofac Implants 28:1553–1563
6. Vallés C, Rodríguez-Ciurana X, Clementini M, Baglivo M, Paniagua B, Nart J (2018) Influence of subcrestal implant placement compared with equicrestal position on the peri-implant hard and soft tissues around platform-switched implants: a systematic review and meta-analysis. Clin Oral Investig 22:555–570
7. Palaska I, Tsaousoglou P, Vouros I, Konstantinidis A, Menexes G (2016) Influence of placement depth and abutment connection pattern on bone remodelling around 1-stage implants: a prospective randomised controlled clinical trial. Clin Oral Implants Res 27:e47–e56
8. Albrektsson T, Zarb G, Worthington P, Eriksson AR (1986) The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants 1:11–25
9. Renvert S, Persson GR, Pirih FQ, Camargo PM (2018) Peri-implant health, peri-implant mucositis, and peri-implantitis: Case definitions and diagnostic considerations. J Clin Periodontol 45:S278–S285
10. Novaes AB Jr, Barros RR, Muglia VA, Borges GJ (2009) Influence of interimplant distances and placement depth on papilla formation and crestal resorption: a clinical and radiographic study in dogs. J Oral Implantol 35:18–27
11. Rodriguez X, Navajas A, Vela X, Fortuno A, Jimenez J, Nevins M (2016) Arrangement of peri-implant connective tissue fibres around platform-switching implants with conical abutments and its relationship to the underlying bone: a human histologic study. Int J Periodontics Restor Dent 36:533–540
12. Canullo L, Iannello G, Penarocha M, Garcia B (2012) Impact of implant diameter on bone level changes around platform-switched implants: preliminary results of 18 months follow-up—a prospective randomised matched-pairs controlled trial. Clin Oral Implants Res 23:1142–1146
13. Vandeweghe S, De Bruyn H (2012) A within-implant comparison to evaluate the concept of platform switching: a randomised controlled trial. Eur J Oral Implantol 5:253–262
14. Quispe-López N, Gómez-Polo C, Flores-Fraile J, Figueras-Álvarez O, Muñoz-Bruguier M, López-Valverde N, Montero J (2025) The influence of peri-implant mucosal phenotype on marginal bone

changes in single-tooth implants with direct restorations: a 36-month clinical trial. J Dent 163:106100

15. Quispe-López N, Guadilla Y, Gómez-Polo C, López-Valverde N, Flores-Fraile J, Montero J (2024) The influence of implant depth, abutment height and mucosal phenotype on peri–implant bone levels: A 2-year clinical trial. J Dent 148:105264
16. Galindo-Moreno P, León-Cano A, Ortega-Oller I, Monje A, O'Valle F, Catena A (2015) Marginal bone loss as a success criterion in implant dentistry: beyond 2 mm. Clin Oral Implants Res 26:28–34
17. Esposito M, Visconti RF, Gualini F, Rigotti F, Mazzarini C, Longhin D, Grigoletto M, Giudice A, Greco K, Salina S (2026) Ten-Year Post-Loading Outcomes of Subcrestally Placed Implants With Internal Conical Connections at 0.5 mm Versus 1.5 mm Depth: A Multicentre Within-Person Randomised Controlled Trial. Clin Oral Implants Res 37:905–921
18. Dong W, Lang X, Xia J, Yang Y, Yang F, Wang L (2026) Association Between Bone Microstructure Derived From CBCT and Marginal Bone Loss in a Platform-Switched Implant System: A 1-to-8-Year Retrospective Study. Clin Implant Dent Relat Res 28:e70124
19. Spinato S, Lombardi T, Stacchi C (2023) Bone Remodeling and Bone Loss Around Subcrestal Implants: Two Distinct Entities. Int J Periodontics Restor Dent 43:410–411
20. Adell R, Lekholm U, Rockler B, Brånemark PI (1981) A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg 10:387–416
21. Zarb GA, Albrektsson T (1998) Towards optimised treatment outcomes for dental implants. J Prosthet Dent 80:639–640
22. Esposito M, Grusovin MG, Worthington HV (2010) The effectiveness of platform switching in reducing bone loss around dental implants: a systematic review and meta-analysis. J Clin Periodontol 37:297–306
23. Elemek E, Urgancioglu A, Dincer J, Cilingir A (2019) Does Implant-Abutment Interface affect Marginal Bone Levels around Implants? Eur J Dent 13:47–52
24. Jung RE, Zembic A, Hämmerle CH (2013) A prospective randomised controlled trial to evaluate the effect of platform switching on peri-implant hard and soft tissue levels in the esthetic zone: a 5-year follow-up. Clin Oral Implants Res 21:591–599
25. Lindhe J, Liljenberg B, Svanberg G (1997) The peri-implant mucosa in healthy and diseased tissue around osseointegrated implants. J Clin Periodontol 24:669–674
26. Renvert S, Persson GR, Pirih FQ, Camargo PM (2018) Peri-implant health, peri-implant mucositis, and peri-implantitis: case definitions and diagnostic considerations. J Periodontol 89:S304–S312

Figures

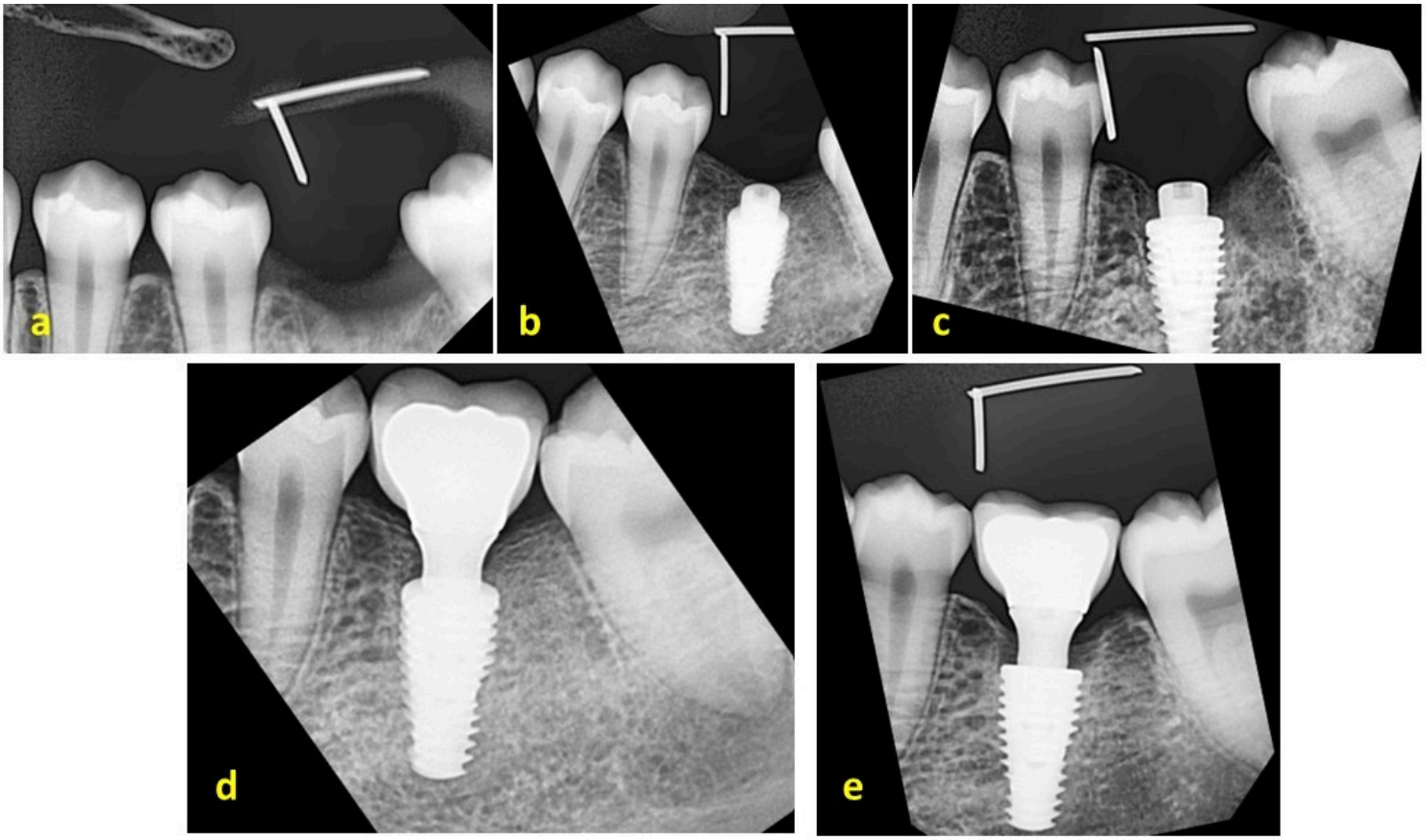


Figure 1

Case no. 1: a) preoperative bone levels, b) immediately after implant placement, c) at 2nd stage surgery, d) 3 months after prosthesis delivery, and e) ≥6 months after prosthesis delivery.

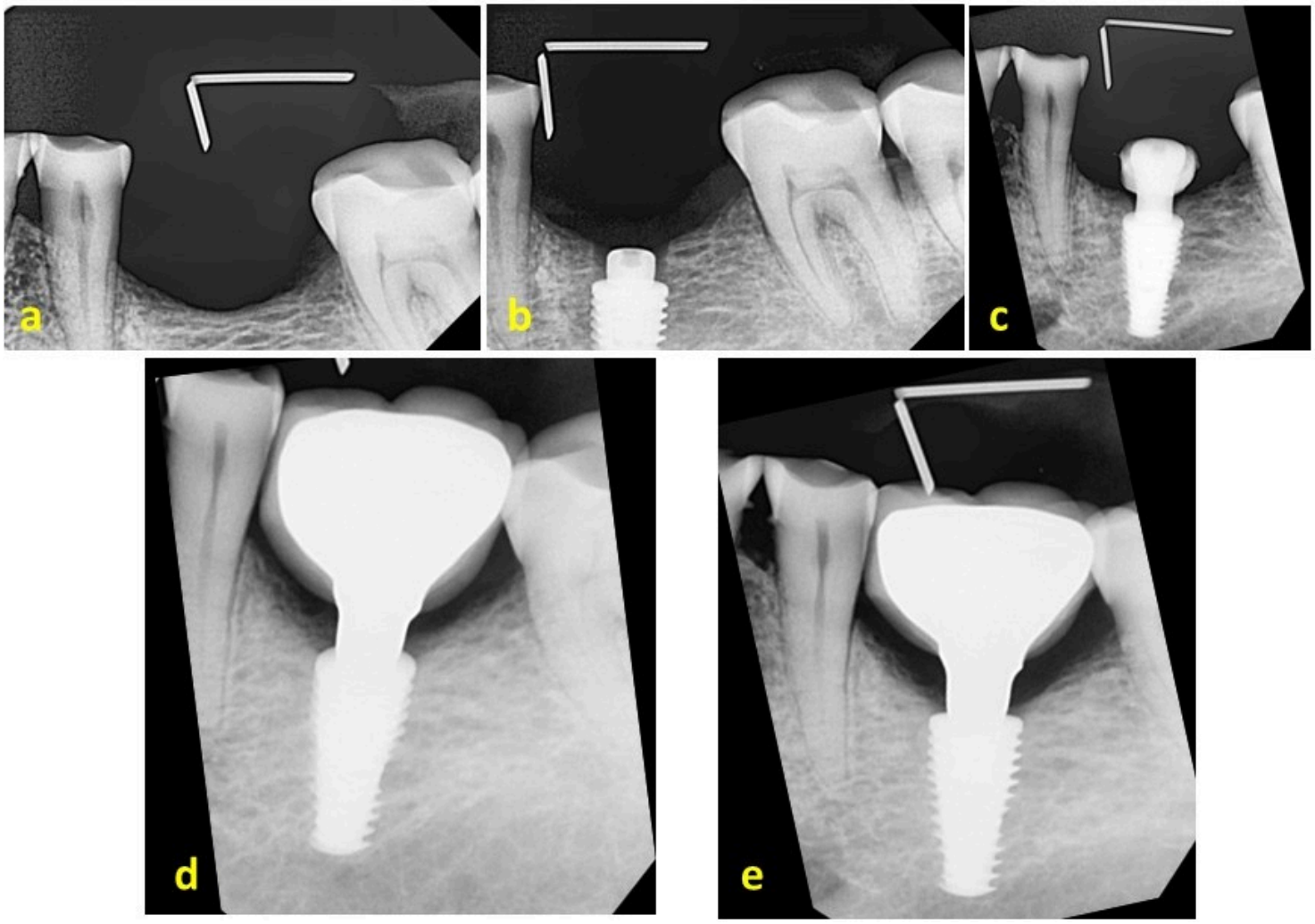


Figure 2

Case no. 2: a) preoperative bone levels, b) immediately after implant placement, c) at 2nd stage surgery, d) 3 months after prosthesis delivery, and e) ≥6 months after prosthesis delivery.



Figure 3

Case no. 3: a) preoperative bone levels, b) immediately after implant placement, c) during impression making, d) 3 months after prosthesis delivery, and e) ≥6 months after prosthesis delivery.