Mandibular Second Molar Periodontal Healing After Surgical Removal of Impacted Third Molar: A Pilot Study

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Abstract

The removal of the mandibular third molar is a routine dental procedure; however, several post-operative complications must be considered, such as nerve injury, trismus, hematoma, ecchymosis and alveolar osteitis. In addition to inferior alveolar nerve injuries, the formation of the periodontal pocket in the adjacent mandibular second molar should also be considered after impacted tooth removal. Factors that may contribute to periodontal pocket formation include buccal and lingual bone discrepancy and the patient's oral hygiene. Evaluation of these factors can help predict periodontal complications following impacted mandibular third molar surgery. This study aims to determine the difference between distobuccal and distolingual alveolar bone height of the adjacent second molar and its relation to the periodontal pocket formation after surgical removal of the impacted third molar. This pilot study included patients aged 18 and above who underwent mandibular third molar removal at College of Dental Medicine, Rangsit University from January to October 2025. Alveolar bone height at the distobuccal and distolingual aspects of the adjacent second molar was measured after removal of the impacted third molar and prior to suturing. Follow-up examinations were conducted at 1, 3, and 6 months postoperatively. Gingival condition, plaque index, and probing depth at the midbuccal, distobuccal, distal, distolingual, and midlingual sites were assessed at each follow-up visit. The study found that probing pocket depth of the mandibular second molar remained within the normal range, with a significant reduction at the mid-distal site between baseline and 6 months. No significant changes were found in plaque index or gingival index. Differences in bone height between the distobuccal and distolingual aspects were not associated with periodontal pocket depth at any time point. A strong positive correlation was found between baseline gingival index and pocket depth at 1, 3, and 6 months, as well as between baseline pocket depth and plaque index at 6 months and gingival index at 1, 3, and 6 months. Overall, this pilot study demonstrated that differences in alveolar bone height between the distobuccal and distolingual aspects after impacted third molar surgery were not significantly associated with periodontal pocket formation. In contrast, gingival inflammatory status was more strongly associated with favorable periodontal pocket outcomes following third molar surgery.

Keywords: *second molar periodontal healing, pocket depth, surgical removal*

1. Introduction

The surgical removal of impacted mandibular third molars is one of the most common oral surgical procedures performed in dental practice. Although the operation is routine, postoperative complications involving the adjacent second molar remain a clinical concern such as nerve injury, trismus, hematoma, ecchymosis, and alveolar osteitis. Among these periodontal defects such as increased probing depth, attachment loss, and bone resorption are frequently reported, particularly on the distal aspect of the mandibular second molar.

The development of postoperative periodontal pockets has been attributed to several factors, including the patient's age, the angulation and depth of impaction, the surgical technique, and the degree of bone removal. Lyons et al. (1980) emphasized that periodontal complications are more common in patients over 35 years of age, suggesting that age-related healing potential plays an important role. In contrast, younger individuals often exhibit faster soft tissue and bone regeneration, resulting in more favorable periodontal outcomes.

Another factor influencing periodontal healing is the difference in alveolar bone height between the distobuccal and distolingual aspects of the second molar following third molar surgical removal. The difference of bone height may lead to an uneven healing surface, impairing gingival attachment and promoting the formation of periodontal pockets. However, evidence regarding the correlation between bone height difference and pocket depth remains limited and inconsistent across studies. Some researchers have reported transient postoperative bone loss that tends to recover within several months, whereas others had observed persistent defects on the distal surface of the second molar.

Given these uncertainties, it is essential to clarify whether variations in bone height after third molar removal contribute to pocket depth formation and to what extent they influence periodontal healing. Therefore, the study aimed to evaluate the relationship between bone height difference and probing depth at the mandibular second molar over different healing periods. Understanding this relationship could help clinicians anticipate postoperative outcomes and refine surgical techniques to preserve periodontal healing.

2. Objective

To determine the relationship between the difference in distobuccal and distolingual alveolar bone height of the adjacent second molar and its probing depth following the surgical removal of impacted third molars.

3. Material and Methods

This pilot study was conducted on patients undergoing third molar surgical removal by dental students at the Department of Oral Surgery, College of Dental Medicine, Rangsit University, from January to October 2025. This study was approved by the Research Ethics Office of Rangsit University, and the research ethics number is RSU-ERB2024/307.1612. The sample size was determined based on the number of eligible patients during the study period. A total of 12 participants were included.

The inclusion criteria were: patients with impacted third molars that require buccal bone removal, aged over 18 years, and with ASA classification I or II. The exclusion criteria were: patients with a history of pericoronitis before surgery, patients taking medications that affect wound healing, patients with systemic diseases that affect bone healing, pregnant or breastfeeding women, patients currently undergoing periodontal treatment, and patients who experienced post-operative complications following impacted third molar surgical removal.

All participants underwent mandibular third molar surgery performed by sixth-year dental students under the supervision of an oral surgery instructor. Prior to the surgical procedure, participants were provided with information regarding the risks and benefits of the study and signed informed consent forms. Data collection included general information, medication history, and the type of impaction assessed from panoramic radiographs. All mandibular third molars were surgically removed under local anesthesia. A mucoperiosteal flap was reflected, with an incision extending from the external oblique ridge to the distal of the second molar, and another along the cervical line to the distobuccal line angle of the second molar, followed by bone removal and tooth sectioning when necessary. After tooth removal was completed, alveolar bone height was measured by the examiner using a Williams periodontal probe, with reference points from the cemento-enamel junction (CEJ) of the adjacent second molar to the crestal bone at the distobuccal and distolingual line angles. Finally, the wound was closed with 3-0 black silk sutures. All measurements at baseline and follow-up visits were performed by the same examiner to ensure consistency.

The evaluations were conducted at 1 month, 3 months, and 6 months post-surgery, respectively. Each appointment included three examination steps in the evaluation process. The first step involved assessing the gingival index, which measured gingival bleeding caused by inserting a Williams periodontal probe into the pocket on the mesial, distal, buccal, and lingual surfaces of all teeth. The gingival index was assessed according to the guidelines of the Löe and Silness (1963). Gingival bleeding was recorded after probing, and the gingival index was calculated as the percentage of bleeding sites relative to the total number of examined sites, using the following formula:

Gingival Index (%) = (Number of bleeding sites / Total number of examined sites) × 100

Gingival status was classified as follows: a gingival index value of less than 10% indicated clinical gingival health; values between 10% and 30% indicated localized dental plaque–induced gingivitis; and values greater than 30% indicated generalized dental plaque–induced gingivitis.

The second step involved recording the plaque index to evaluate the patient's oral hygiene compared to the baseline plaque index measured after surgical removal. The plaque index was assessed according to the method described by O'Leary (1972). The presence of dental plaque was evaluated after disclosing, and the plaque index was calculated as the percentage of tooth surfaces with plaque relative to the total number of examined surfaces, using the following formula:

Plaque Index (%) = (Number of stained surfaces / Total number of surfaces) × 100

Oral hygiene status was classified as good when the plaque index value was less than 30%.

The final step involved measuring probing depth (in millimeters) at five sites of the second molar—mid-buccal, distobuccal, distal, distolingual, and mid-lingual — using a Williams probe.

Data Analysis

All patient data were recorded and statistically analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows, Version 25.0 (Chicago, IL, USA). The Shapiro-Wilk test was applied to assess normality of the data. As the data were not normally distributed, non-parametric tests, including Friedman's test, Wilcoxon Signed-Rank, Kendall's Tau-b correlation coefficient, were used. Statistical significance was set at $P < 0.05$.

4. Results and Discussion

4.1 Results

A total of twelve participants were included in this study, consisting of 6 males (50.0%) and 6 females (50.0%). Seven participants (58.33%) were aged 20 years or younger, while five participants (41.67%) were older than 20 years. According to Winter's classification, most of the impacted mandibular third molars were of the mesioangular type (8 cases, 66.67%), followed by horizontal angulation (3 cases, 25.00%) and vertical angulation (1 case, 8.33%). Based on the Pell and Gregory classification, Class II impaction was the most common (8 cases, 66.67%), followed by Class I (3 cases, 25.00%) and Class III (1 case, 8.33%). In terms of position, Position B was observed most frequently (6 cases, 50.00%), followed by Position A (4 cases, 33.33%) and Position C (2 cases, 16.67%). The mean difference in bone height between the distobuccal and distolingual aspects was −1.33 ± 4.68 mm (Table 1).

Table 1 Descriptive statistics of demographic characteristics

Characteristics	Total (n=12)
	n (%)
Gender	
Male	6 (50.00)
Female	6 (50.00)
Age (years)	
18-24	12 (100)
Winter's classification	
Mesioangulation	8 (66.67)
Horizontal angulation	3 (25.00)
Vertical impaction	1 (8.33)
Pell & Gregory classification	
Class	
I	3 (25.00)
II	8 (66.67)
III	1 (8.33)
Position	
A	4 (33.33)
B	6 (50.00)
C	2 (16.67)
Different of bone (Mean ± SD.)	-1.33 ± 4.68

SD. = Standard Deviation.

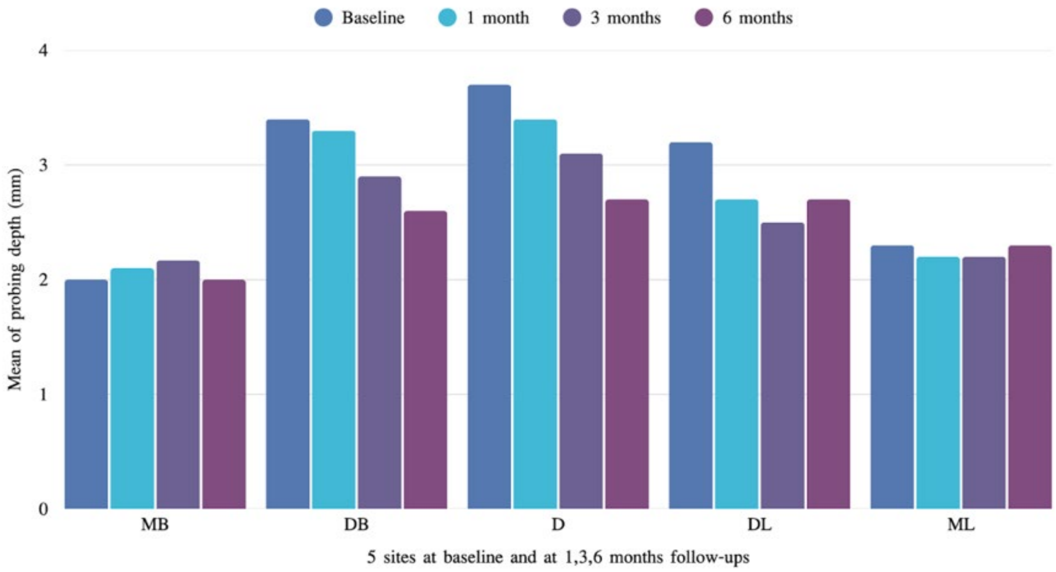

Figure 1 The mean score of probing depth in 5 sites at baseline and at 1, 3, and 6-months follow-ups

Table 2 Comparison of factors affecting the mandibular second molar at baseline and at 1, 3, and 6 months after surgical removal

Factors		Time	Median	IQR (Q3-Q1)	Mean Rank	df	Chi-Square	p-value
Plaque index		Baseline	32.31	42.20-18.70	1.79	3	5.85	0.119
		1 month	32.05	46.52-20.67	2.46			
		3 months	31.46	45.68-22.70	2.79			
		6 months	34.95	44.95-22.55	2.96			
Gingival index		Baseline	0.00	1.00-0.00	2.33	3	0.93	0.820
		1 month	1.00	1.00-0.00	2.67			
		3 months	0.50	1.00-0.00	2.50			
		6 months	1.00	1.00-0.00	2.50			
Probing depth								
	Mid-Buccal	Baseline	2.00	2.00-2.00	2.33	3	0.818	0.845
		1 month	2.00	2.75-2.00	2.58			
		3 months	2.00	2.75-2.00	2.63			
		6 months	2.00	2.00-2.00	2.46			
	Distobuccal	Baseline	3.00	4.75-2.25	2.88	3	7.73	0.052
		1 month	3.00	4.00-3.00	2.92			
		3 months	3.00	3.75-2.00	2.29			
		6 months	3.00	3.00-2.00	1.92			
	Mid-distal	Baseline	3.00	4.25-3.00	3.10	3	9.86	0.020*
		1 month	3.00	4.25-3.00	2.85			
		3 months	3.00	3.25-2.75	2.30			
		6 months	3.00	3.00-2.00	1.75			
	Distolingual	Baseline	3.00	3.75-3.00	2.96	3	3.86	0.277
		1 month	3.00	3.00-2.00	2.42			
		3 months	2.50	3.00-2.00	2.13			
		6 months	3.00	3.00-2.00	2.50			
	Mid-lingual	Baseline	2.00	3.00-2.00	2.54	3	0.31	0.959
		1 month	2.00	3.00-2.00	2.46			
		3 months	2.00	3.00-2.00	2.42			
		6 months	2.00	3.00-2.00	2.58			

Friedman Test, **p-value* < 0.05

The Shapiro–Wilk test was employed to evaluate the normality of data distribution. Non-parametric tests were selected because the data did not follow a normal distribution. Repeated-measures analysis using the Friedman test revealed that the mid-distal probing depth demonstrated a statistically significant difference among the time intervals of baseline, 1 month, 3 months, and 6 months. In contrast, no significant differences were observed in plaque index, gingival index, or probing depths at the mid-buccal, distobuccal, distolingual, and mid-lingual sites over the same periods (Table 2).

Table 3 Pairwise comparisons distal probing depth of the mandibular second molar at baseline and at 1, 3, and 6 months after surgical removal

Time	Time	Mean Rank	Sum of Ranks	Z-test	p-value
Baseline	1 month	3.00	6.00	-1.00	0.317
	3 months	3.00	3.00	-1.68	0.096
	6 months	3.00	3.00	-2.18	0.031*
1 month	3 months	2.50	2.50	-1.00	0.317
	6 months	3.50	3.50	-1.90	0.058
3 months	6 months	2.50	2.50	-1.41	0.157

Wilcoxon Signed-Rank, **p-value* < 0.05

Pairwise comparison using the Wilcoxon Signed-Rank test indicated that the distal probing depth at baseline was significantly different from that at six months (Z = –2.18, $P = 0.031$). The mid-distal probing depth at 6 months was greater than that at baseline (mean rank = 3.00) (Table 3).

Table 4 Correlations between probing depth and the difference in bone height of the mandibular second molar at baseline and at 1, 3, and 6 months after surgical removal.

Probing Depth	**Difference of Bone Height (mm)**							
	Baseline		**1 Month**		**3 Months**		**6 Months**	
	r	**p**	**r**	**p**	**r**	**p**	**r**	**p**
Mid-Buccal	-0.32	0.209	0.02	0.933	-0.30	0.238	-0.08	0.770
Distobuccal	-0.45	0.060	-0.25	0.300	-0.34	0.165	-0.40	0.104
Mid-distal	0.00	1.000	0.17	0.500	0.04	0.876	-0.27	0.273
Distolingual	0.04	0.876	-0.30	0.226	-0.24	0.350	0.04	0.873
Mid-lingual	0.14	0.607	-0.21	0.406	-0.06	0.811	0.02	0.938

r = Kendall's Tau-b correlation coefficient, $p < 0.05$

The results of the Kendall's Tau-b correlation coefficient analysis between the probing depth measurements at the mid-buccal, distobuccal, mid-distal, distolingual, and mid-lingual sites at different time intervals (baseline, 1 month, 3 months, and 6 months) and bone height were as follows:

At baseline, the mid-lingual and distobuccal sites showed a moderate negative correlation with bone height, while the distolingual and mid-lingual sites demonstrated a weak positive correlation with bone height, which was not statistically significant. No correlation was observed between the distal site and bone height.

At 1 month, the mid-buccal and distal sites showed a weak positive correlation with bone height, whereas the distobuccal and mid-lingual sites exhibited a weak negative correlation. The distolingual site showed a moderate negative correlation with bone height, which was not statistically significant.

At 3 months, the mid-buccal and distobuccal sites demonstrated a moderate negative correlation with bone height, while the distal site showed a weak positive correlation. The distolingual and mid-lingual sites showed a weak negative correlation with bone height, all of which were not statistically significant.

At 6 months, the mid-buccal and distal sites exhibited a weak negative correlation with bone height, whereas the distobuccal sites showed a moderate negative correlation. The distolingual and mid-lingual sites demonstrated a weak positive correlation with bone height, none of which reached statistical significance, as shown in Table 4.

In summary, there was no significant relationship between probing depth and the difference in bone height at any measured site or time point. Most of the correlations were weak to moderate, indicating that variations in bone height did not have a clear effect on periodontal pocket depth following surgery (Table 4).

Table 5 The correlations between probing depth factors and plaque index (PI) and gingival index (GI)

Factors	**Probing Depth**							
	Baseline		**1 Month**		**3 Months**		**6 Months**	
	r	**p**	**r**	**p**	**r**	**p**	**r**	**p**
PI baseline	0.36	0.167	-0.18	0.496	0.17	0.517	-0.07	0.781
PI 1 month	0.31	0.222	0.00	1.000	0.17	0.517	0.07	0.781
PI 3 months	0.48	0.061	-0.09	0.734	0.17	0.517	0.07	0.781
PI 6 months	0.61	0.018*	-0.04	0.865	0.22	0.405	0.12	0.643
GI baseline	0.08	0.781	0.68	0.020*	0.71	0.015*	0.71	0.015*
GI 1 month	0.63	0.030*	0.14	0.637	0.57	0.051	0.24	0.411
GI 3 months	0.79	0.007*	-0.06	0.850	0.63	0.031*	0.30	0.304
GI l 6 months	0.66	0.029*	-0.12	0.692	0.49	0.106	0.10	0.746

r = Kendall's Tau-b correlation coefficient, $^{*}p < 0.05$

The Kendall's Tau-b correlation analysis was performed to evaluate the relationships between mid-buccal probing depth measured at baseline, 1, 3, and 6 months and plaque index (PI) and gingival index (GI) measured at the same time points.

A strong positive correlation was observed between baseline probing depth and plaque index at 6 months (r = 0.61, p = 0.018), gingival index at 1 month (r = 0.63, p = 0.030), gingival index at 3 months (r = 0.79, p = 0.007), and gingival index at 6 months (r = 0.66, p = 0.029), all of which were statistically significant. In addition, a strong positive correlation was found between baseline gingival index and probing depth at 1 month (r = 0.68, p = 0.020), 3 months (r = 0.71, p = 0.015), and 6 months (r = 0.71, p = 0.015). These correlations were statistically significant (Table 5).

4.2 Discussion

Periodontal defects at the distal aspect of mandibular second molars are recognized as a significant complication following the surgical removal of impacted third molars. In the present study, the difference between distobuccal (DB) and distolingual (DLi) alveolar bone heights was used as an indicator of surgically induced two-wall osseous defects.

According to Montero and Mazzaglia (2011), local risk factors such as the bone removal required during surgery significantly influence post-operative probing depths. In particular, the need for buccal bone removal to facilitate tooth delivery often results in an asymmetrical alveolar bone contour (Montero & Mazzaglia, 2011). This alteration in bone architecture typically leaves only the lingual and proximal walls intact, leading to the formation of a two-wall defect, commonly described as an osseous crater (Kugelberg, 1990). Such concave defect morphology may compromise periodontal healing by limiting soft tissue adaptation and promoting plaque retention, thereby increasing the risk of persistent periodontal pocket formation at the distal aspect of the second molar.

To monitor the resolution of these defects over time, the present study employed a follow-up protocol at 1, 3, and 6 months post-surgery, corresponding to the biological phases of wound healing and bone regeneration. The 1-month evaluation reflects the completion of soft tissue closure and the resolution of early post-operative inflammation. The 3-month interval represents the phase of active osteogenesis, during which initial bone formation occurs within the extraction site. By 6 months, alveolar bone remodeling is largely complete, and the gingival sulcus has stabilized, making this time point suitable for assessing long-term periodontal outcomes.

However, the present study demonstrated generally favorable periodontal healing outcomes. The probing depths around the mandibular second molars remained within a normal range, suggesting stable periodontal attachment and a low risk of postoperative periodontal deterioration. Furthermore, a significant finding was the improvement of periodontal pockets from pathological to normal conditions. Specifically, the mid-distal probing depth of the mandibular second molar showed a statistically significant reduction between baseline and 6 months.

Several previous studies support the findings of the present study. Krausz et al. (2005) also demonstrated a significant gain in alveolar bone height distal to the second molar after third molar removal, suggesting bone regeneration during healing, while Montero and Mazzaglia (2011) observed a gradual recovery in periodontal health over time. Similarly, Faria et al. (2012) found that probing depth and attachment level improved postoperatively, and Pham and Nguyen (2019) reported a significant improvement in the periodontal condition of the mandibular second molar following surgical removal of the impacted third molar.

In contrast, other studies have reported less favorable outcomes. Ash (1962) and Ziegler (1975) documented a high incidence of periodontal pocket formation distal to the mandibular second molar both before and after removal of impacted third molars. Likewise, Kugelberg et al. (1986) reported an increased prevalence of pocket depths and infrabony defects postoperatively, while Kan et al. (2002) observed that impacted third molars led to long-term localized periodontal problems even after surgical removal. These studies highlight that age, bone removal, and surgical complexity may adversely affect the healing response.

The difference in bone height between the distobuccal and distolingual aspects was not statistically associated with periodontal pocket formation. This finding suggests that postoperative bone remodeling and periodontal healing processes may compensate for early discrepancies in alveolar bone height, thereby contributing to periodontal stability. In contrast, gingival inflammation demonstrated a strong and consistent association with pocket depth. The gingival index at baseline showed a strong positive correlation with pocket depth at 1 month (r = 0.68, p = 0.020), 3 months (r = 0.71, p = 0.015), and 6 months (r = 0.71, p = 0.015), indicating that initial gingival condition is closely associated with future periodontal pocket depth. Most correlations between plaque index at other time points and pocket depth at 1, 3, and 6 months were not statistically significant. The gingival index demonstrated stronger associations with pocket depth than plaque index. These findings support the concept that gingival inflammation plays a critical role in changes in periodontal pocket depth, particularly during the early healing period following treatment.

These findings are further supported by previous studies evaluating plaque and gingival indices following third molar surgery. Kugelberg et al. (1991) and Krausz et al. (2005) reported that minor bone loss after third molar surgery tended to recover during normal healing when plaque control was adequate, while plaque and gingival index did not vary significantly during follow-up. This suggests that patients maintained good oral hygiene throughout recovery, and consistent plaque control likely minimized inflammation and supported favorable soft-tissue adaptation. Therefore, any change in pocket depth could be attributed mainly to surgical factors rather than plaque accumulation. This observation is consistent with the findings of Stella et al. (2017), who observed a significant postoperative increase in plaque index, suggesting that insufficient oral hygiene may compromise periodontal healing.

In the present study, the participants were young adults, with a mean age ranging from 18 to 24 years. This younger age group demonstrated favorable periodontal healing following surgical removal of impacted mandibular third molars. No significant association was observed between differences in bone height and periodontal pocket formation. These findings suggest that younger patients may possess greater healing potential and more predictable periodontal recovery after third molar surgery. Previous studies have consistently reported that age is an important factor influencing periodontal outcomes following third molar removal. Lyons et al. (1980) reported that periodontal complications associated with mandibular third molar surgery were more prevalent in patients over 35 years of age, which may explain the absence of significant periodontal deterioration observed in the present study. Similarly, Von Wowern and Nielsen (1989) reported a very low incidence of periodontal pocket formation in young adults with good oral hygiene, supporting the favorable outcomes observed in younger patients. Kugelberg (1990) demonstrated that postoperative periodontal defects at the distal aspect of the mandibular second molar were two to three times more common in patients aged 25 years and older compared with younger patients, suggesting that age ≥25 years is a critical risk factor for persistent periodontal breakdown after impacted third molar surgery.

Overall, the findings of this pilot study suggest that periodontal healing of the mandibular second molar following impacted third molar surgery is influenced more by gingival inflammatory status and patient-related factors, such as age, than by differences in alveolar bone height. However, further studies with larger sample sizes and a wider age range are necessary to further clarify these associations.

5. Conclusion

These findings suggest that there is no significant association between the difference in distobuccal and distolingual alveolar bone height and probing depth at any time point following surgical removal of impacted third molars. Gingival index, particularly at baseline, showed strong associations with pocket depth. All participants demonstrated satisfactory periodontal healing of the mandibular second molar following surgical removal of impacted third molars. Additionally, the young age of the participants appeared to contribute to favorable healing outcomes. Overall, these findings suggest that periodontal healing after third molar surgery is influenced more by gingival inflammatory status and patient age than by alveolar bone height discrepancies.

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