

Effects of Impacted Lower third Molar Removal on Alveolar Bone Height and Periodontal Parameters on Adjacent Second Molar

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Abstract

The effect of surgical third molar removal on the periodontal parameters at distal sites of second molar revealed inconsistent results. Clinical parameters and radiographic parameter; alveolar bone height (ABH) were studied between six to 24 months post-surgery.

Thirty-three subjects who had mesio-angular or horizontal impaction of third molar with available previous records of digital orthopantomogram (OPG) were recruited into the study. ABH of adjacent second molar on the previous OPG were compared with the current OPG. Probing pocket depth (PPD), bleeding on probing (BOP), recession (REC) were also recorded.

ABH distal to second molar showed significant improvement as shown in reduced cemento-enamel junction to alveolar bone crest (CEJ-ABC) distance from $4.3\text{mm} \pm 1.9$ pre-operative to $2.80\text{mm} \pm 2.05$ post-operative ($p < 0.001$). No significant difference was found in ABH between 47 and 37 at baseline; ($4.09 \pm 1.09\text{mm}$ vs $4.30 \pm 2.55\text{mm}$) and post-surgery ($3.00 \pm 2.20\text{mm}$ vs $2.70 \pm 2.35\text{mm}$) where $p < 0.423$. Distal sites of second molars consistently showed significantly higher mean PPD ($3.76 \pm 1.32\text{mm}$) when compared with mesial, mid buccal and mid lingual sites ($p < 0.001$). Higher frequency of BOP (90.9%) were also recorded for distal sites.

Surgical removal of impacted third molars demonstrated significant gain in ABH of second molar post surgically. Significantly deeper PPD were also recorded at distal sites as compared to other sites.

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Introduction

Surgical removal of impacted third molar is the most frequent procedures conducted in oral cavity¹ and was regarded as common problem affecting large proportion of population². The frequency of occurrence was reported to be between 16.7 to 73.82%² with higher prevalence of mandibular third molar impaction was reported for Asian and African population³. Among the reported contributing factors for the impaction are inadequate dental arch space⁴ and erratic eruption paths⁵.

The presence of impacted third molar can predispose a tooth or its adjacent tooth to variety of complications. Common reasons for surgical

removal are caries, pericoronitis and orofacial infection, cystic or neoplastic changes, orthodontic or prosthetic problems, root resorption of the adjacent tooth, temporomandibular joint symptoms⁶ and prevention or improvement of periodontal defect of adjacent second molar^{7,8}.

The latter reason for surgical removal of third molar, have sparked controversial outcome in the literatures. As early as 1980's, studies have been focusing at the relationship between impacted third molars and periodontal health as well as the effect of third molar removal on periodontium of adjacent molar^{9,10}. While some early studies showed persistent or worsening of periodontal defect at the distal second molar^{9,11} more recent studies showed improvement of periodontal health at the sites^{12,13} after the surgery.

Perhaps, this inconsistency is attributed by the different parameters used; i.e clinical measurement such as clinical attachment level

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and or radiographic measurement of alveolar bone height (ABH). Hence, our study was aimed to determine the radiographic changes of alveolar bone height distal to second molar between 6-24 months after the surgery and compare the outcome with the baseline ABH. We also recorded clinical periodontal parameters which include probing pocket depth (PPD), recession (REC) and bleeding on probing (BOP) on all sites of second molar.

Materials and methods

Study design

This is a retrospective study looking at the radiographic changes of alveolar bone height (ABH) as well as clinical changes distal to second molar following surgical third molar extraction. Ethical clearance for dental records access and patients' recruitment was granted by USIM Ethics committee for USIM-PPP-USG-13215. Forty-two patients who had undergone surgical removal of third molar at Dental Polyclinic USIM, with a minimum period of 6 months post-operative and with available pre-surgical orthopantomogram (OPG) records were selected from the USIM's Polyclinic dental records database. Thirty-three patients aged 20 to 50 years (mean age 30.32 ± 6.31) consented to participate in the study. All patients were recruited and subjected for post-operative clinical and OPG examination.

The inclusion criteria include presence of horizontal or mesio-angular impaction of third molar based on Winter's classification (1992) and presence of good quality OPG. Patients were excluded if there was absence of adjacent mandibular second molars, pregnant during the extraction or during the examination, had periodontal surgery at the adjacent second molar at the time between extraction of third molar and the re-examination, presence of systemic conditions that might complicate bone growth such as uncontrolled diabetes mellitus and the use of calcium channel blockers and immunosuppressive drugs.

To minimize bias, the radiographic and clinical examination was conducted by different examiner. Radiographic measurement was performed by N.A while clinical measurement was performed by W.N.A.

Clinical periodontal examinations

Clinical measurements of second molar were performed at seven sites which include mesio-buccal, mesio-lingual, mid-buccal, mid-lingual, disto-buccal, disto-lingual and mid-distal. All sites were measured for probing pocket depth (PPD), recession (REC), clinical attachment loss (CAL) and presence or absence of bleeding on probing (BOP). The sum of PPD and REC was calculated to get the clinical attachment loss, CAL. The clinical measurements were compared between the sites as there were no pre-operative record of clinical periodontal data.

Radiographic examinations

To ensure the reliability of the radiographic examination, the OPG radiograph of pre-operative and post-operative image was taken using digital radiograph by Planmeca®. The radiographic measurement of ABH was conducted using digital ruler software based on specified landmark as described by Krausz et al. (2005)¹⁴. The ABH was measured from fixed reference point; the cemento-enamel junction (CEJ) (or the inferior border of existing restoration) to the alveolar bone crest (ABC) (Fig.1). The difference between the pre-operative ABH and post-operative ABH constituted the primary outcome variable of this study.

Results

Thirty-three patients with the mean age of 30.32 ± 6.31 participated in the study. Among the patients, 19 (57.6%) were males and 14 (42.4%) were females. The Malay ethnic group made up the majority of the patients which was, 27 (81.8%). Among the 33 impacted mandibular third molar studied, 18 (54.5%) were horizontal impaction while 15 (45.5%) mesio-angular impaction. A total of 51.5% (17) of the impacted molars were located in the left side of the jaw.

Table 1 shows the ABH at the distal aspect of the second molar pre and post-operative based on second molar grouping. Based on the location of the second molar which were categorised into left and right, there was no inter-group difference in median ABH at pre-operative between 37 ($4.3\text{mm} \pm 2.55$) and 47 ($4.09\text{mm} \pm 1.09$) where $p > 0.05$ when tested using Mann Whitney test. On comparing the ABH between pre and post-operative (intra-group) using Wilcoxon Sign-rank test, both 37 and 47 showed significant gain of ABH in which the

distance from CEJ to alveolar bone crest were reduced to 2.70mm(2.35) and 3.00(2.20) respectively ($p<0.008$, 0.005). When the results of post-operative ABH were compared between the groups, no significant difference were seen ($p>0.05$).

When the second molars were categorised based on types of impaction of the third molar, a more normally distributed data was gained. Using independent t-test, we observed significantly lower mean ABH (4.73mm $\pm$ 1.49) in horizontal impacted group as compared to mesio-angular impacted group (3.43mm $\pm$ 1.24), with $p=0.028$ during the pre-operative visit. However, significant gain of ABH at post-operative was only recorded for horizontally impacted group which was from 4.73mm $\pm$ 1.49 to 3.22mm $\pm$ 1.39; $p=0.03$. When the data of all second molars were pool together, the ABH of second molar showed significant improvement from (4.3mm $\pm$ 1.9) pre-operative to (2.80mm $\pm$ 2.05) post-operative ($p<0.001$).

Categories of second molar based on characteristic	n	Alveolar bone height of second molar(mm) Median (IQR)		Alveolar bone height of second molar(mm) Mean ($\pm$ SD)		P value
		Preoperative	Postoperative	Preoperative	Postoperative	
Location						
Left side	1	4.30 (2.55)	2.70 (2.35)			0.008
37	7	4.09 (1.09)	3.00 (2.20)			0.005
Right side	1					
47	6					
Types of 3rd molar impaction						
Horizontal	1			4.73 (1.49)	3.22 (1.39)	0.003
Mesioangular	8			3.43 (1.24)	2.94 (1.26)	0.142
	1					
	5					
All second molars	3	4.30 (1.90)	2.80 (2.05)			<0.001

Table 1. Alveolar Bone Height at pre and post-operative based on categories of second molar.

Table 2 shows the clinical findings for probing pocket depth (PPD), recession (REC), clinical attachment level (CAL) and bleeding on probing (BOP) in all seven sites of second molar at the post-operative visit. Using One-Way ANOVA, all distal sites (disto-buccal, disto-lingual, distal) significantly showed higher PPD and CAL as compared to other sites (all mesial and all mid sites) ($p<0.001$). The mean PPD for all distal sites was significantly greater ($p<0.001$) which was 3.62mm as compared to 2.29mm for all mid-sites and 2.39 for all mesial sites. The mean CAL for all distal sites (3.78mm) also significantly

higher ($p<0.001$); from all mid-sites (2.33mm) and for all mesial sites (2.39mm). There was no significant difference seen in PPD and CAL between all distal sites ($p>0.05$). Distal sites also presented with higher frequency of BOP as compared to mesial and mid sites. However this observation was not significant.

Site of the tooth	Mean (SD)			Frequency (%)
	PPD	REC	CAL	BOP
37				
Mesial	2.41 (0.66)	0.03 (0.13)	2.44 (0.80)	10 (62.5)
Mesio-buccal	2.63 (0.62)	0.0 (0.0)	2.63 (0.62)	7 (43.8)
Mesio-lingual	2.19 (0.91)	0.06 (0.25)	2.25 (0.93)	9 (56.3)
Mid	2.31 (0.81)	0.05 (0.26)	2.41 (1.07)	10 (62.5)
Mid-buccal	2.50 (0.82)	0.15 (0.50)	2.63 (1.02)	7 (43.8)
Mid-lingual	2.13 (1.09)	0.06 (0.25)	2.19 (1.11)	7 (43.8)
Distal	3.92 (1.25)	0.13 (0.50)	4.00 (2.09)	15 (93.8)
Disto-buccal	4.25 (2.15)	0.19 (0.75)	4.44 (2.66)	14 (87.5)
Disto-lingual	3.63 (2.13)	0.06 (0.25)	3.69 (2.09)	15 (93.8)
Distal	3.88 (1.41)		3.88 (1.41)	
47				
Mesial	2.38 (0.60)	0.0 (0.0)	2.34 (0.83)	14 (82.4)
Mesio-buccal	2.65 (0.93)	0.0 (0.0)	2.63 (0.95)	13 (76.5)
Mesio-lingual	2.12 (0.60)	0.0 (0.0)	2.06 (0.57)	8 (47.1)
Mid	2.26 (0.53)	0.0 (0.0)	2.25 (0.72)	14 (82.4)
Mid-buccal	2.24 (0.56)	0.0 (0.0)	2.19 (0.54)	12 (70.6)
Mid-lingual	2.29 (0.85)	0.0 (0.0)	2.31 (0.87)	9 (52.9)
Distal	3.35 (1.15)	0.0 (0.0)	3.67 (1.63)	16 (94.1)
Disto-buccal	3.35 (1.90)	0.0 (0.0)	4.19 (2.14)	14 (82.4)
Disto-lingual	3.06 (1.20)	0.0 (0.0)	3.13 (1.20)	13 (68.4)
Distal	3.65 (1.27)		3.69 (1.30)	
Overall				
Mesial	2.39 (0.62)	0.02 (0.09)	2.39 (0.68)	24 (72.7)
Mesio-buccal	2.64 (0.78)	0.0 (0.0)	2.63 (0.62)	20 (60.6)
Mesio-lingual	2.15 (0.75)	0.03 (0.17)	2.16 (0.68)	17 (51.5)
Mid	2.29 (0.67)	0.05 (0.26)	2.33 (0.78)	24 (72.7)
Mid-buccal	2.36 (0.69)	0.06 (0.35)	2.41 (0.61)	19 (57.6)
Mid-lingual	2.21 (0.96)	0.03 (0.17)	2.25 (0.93)	16 (48.5)
Distal	3.62 (1.22)	0.06 (0.35)	3.83 (1.52)	30 (90.9)
Disto-buccal	3.79 (2.04)	0.09 (0.52)	4.32 (1.94)	27 (81.8)
Disto-lingual	3.33 (1.71)	0.03 (0.17)	3.41 (1.44)	26 (78.8)
Distal	3.76 (1.32)		3.78 (0.98)	

Table 2. Periodontal parameters recorded at second molar post operatively.

PPD – Periodontal pocket depth

REC – Recession

BOP – Bleeding on probing

CAL – Clinical attachment loss

One-way ANOVA showed:

- Significant difference of overall PPD ($p<0.001$); post hoc of Bonferroni indicate significant difference between: Mesial vs Distal ($p<0.001$), Mid vs distal ($p<0.001$)
- Significant difference of PPD on 37 ($p<0.001$); post hoc of Bonferroni indicate significant difference between: Mesial vs Distal ($p<0.001$), Mid vs distal ($p<0.001$)
- Significant difference of PPD on 47 ($p<0.001$); post hoc of Bonferroni indicate significant difference between: Mesial vs Distal ($p=0.003$), Mid vs distal ($p=0.001$)
- Significant difference of overall PPD ($p<0.001$); post hoc of Bonferroni indicate significant difference between: Mesial vs Distal ($p<0.001$), Mid vs distal ($p<0.001$)
- Significant difference of CAL on 37 ($p<0.001$); post hoc of Bonferroni indicate significant difference between: Mesial vs Distal ($p<0.001$), Mid vs distal ($p<0.001$)
- Significant difference of CAL on 47 ($p<0.001$); post hoc of Bonferroni indicate significant difference between: Mesial vs Distal ($p=0.003$), Mid vs distal ($p=0.001$)

Discussion

Many of the early studies reported on the negative impact of third molar removal on probing pocket depth and attachment loss^{9,15-18}. Ironically, changes in alveolar bone crest level on

distal aspect of second molar influence the probing pocket depth and attachment level of the area. To our concern, very few studies have been conducted to investigate the radiographic alveolar bone height distal to the second molar. Among the studies are early study by Kugelberg et al., (1985)¹⁸ and more recent studies by Peng et al., (2001)¹⁹, Krausz et al., (2005)¹⁴, & Faria et al., (2013)¹³. Nevertheless the outcomes reported were still not conclusive and warrant further investigation.

The current retrospective study was conducted to investigate the radiographic level of alveolar bone height before and after the removal of impacted third molar. Therefore, measurement of baseline ABH is vital for comparative purposes with post-operative ABH. Only patient who had minimum period of six months post-surgery with available pre-operative OPG were re-called and subjected to second OPG. This is in agreement with guidelines by ADA 2012 that any form suitable imaging technique can be taken to assess recall patient's radiographic bone level (ADA, 2012).

We demonstrated significant gain in alveolar bone height (ABH) about 1.5mm at distal second molar following the impacted third molar surgery which can be seen from the reduced CEJ-ABC distance from $4.30 \pm 1.90\text{mm}$ to $2.80 \pm 2.05\text{mm}$. Our result was not consistent with the initial finding by Kugelberg et al., (1985)⁹ and later by Peng et al., (2001)¹⁹ which utilized similar retrospective design. Kugelberg and co-workers demonstrated that 32% of their cases developed intrabony defects of $>4\text{mm}$ at distal second molar 2 years after third molar extraction. However, our radiographic alveolar bone height measurement was different from that Kugelberg in which our alveolar bone height were measured from CEJ to alveolar bone crest whereas in Kugelberg they measured the intrabony defect using periodontal probe as indicator (from gingival margin to the bottom of bony defect) from which they included the PPD reading and not merely ABH.

Peng et al. (2001)¹⁹ showed significantly greater alveolar bone loss of 5.51mm as compared to contralateral second molar which was 2.79mm. This was higher than ABH reported in our study which was $2.80 \pm 2.05\text{mm}$. This differences could be related to the study design in which they compared the ABH of second molar with history of surgical removal of third molar with those second molar without surgical removal of

third molar while our study compared the ABH between baselines with 6-24 months post-surgery. Furthermore, Peng used conventional periapical radiograph which might affect the accuracy of measurement. Moreover, their retrospective design was up to 5 years post-operative that could have increase the rate of attachment loss at the distal aspect of second molar.

Nevertheless our result is consistent with later finding by Krausz et al., (2005)¹⁴. Using similar retrospective design and CEJ-ABC measurement technique, they reported on significant improvement in ABH from $4.063 \pm 0.42\text{mm}$ to $3.399 \pm 0.32\text{mm}$. The ABH gain was however greater in our study; 1.5mm as compared to 0.662 ± 0.28 in their study. More recently, Faria et al., (2013)¹³ also reported on similar outcome. They demonstrated significant decreased in radiographic infrabony defect (RID) from $4.54 \pm 1.87\text{mm}$ to $3.14 \pm 1.74\text{mm}$, $2.59 \pm 1.85\text{mm}$ and $1.78 \pm 1.85\text{mm}$ at 3, 6 and 12 months respectively. They recorded greater improvement in defect depth which was 1.4mm in 3 months follow-up and another 1.2 mm in 6 and 12 months follow up consecutively. The amount of ABH gain in their study was more or less similar with our study which demonstrated 1.5mm ABH improvement.

In contrast, third molar removal caused negative impact to clinical parameters. This was reported widely by many previous researchers^{9,19-21}. Tabrizi and co-workers²⁰ reported on increased PPD and AL from $2.71 \pm 0.59\text{mm}$ to $3.60 \pm 0.88\text{mm}$ and $3.62 \pm 0.69\text{mm}$ to $3.48 \pm 0.74\text{mm}$ respectively from baseline to 4 months while Peng et al., (2001)¹⁹ reported on high mean PPD of 5.66mm at distal sites. Similarly, Kan et al., (2002)²¹ concluded deep PPD was prevalent at distal sites of second molar in patient with inadequate plaque control. The mean PPD recorded in their study was $5.4 \pm 1.9\text{mm}$ for a period of 6 to 36 months post-operative. This was in agreement with our study that reported on significantly deeper PPD and CAL ($3.62 \pm 1.22\text{mm}$ and 3.83 ± 1.52) respectively as compared to mesial and mid sites. In addition, Kan and co-workers also reported on high frequency of bleeding on probing; 96% at distal sites as compared to other sites which was also consistent with our study.

Few recent studies, however proved otherwise^{12,22-25}. Petsos et al., (2016)²² reported on significant reduction in PPD from 3.3mm to 2.6mm at 6 months post-operative. Faria et al.,

(2012)¹², stated that periodontal defect was evident at distal second molar 3 months post-operative. The defect however gradually improved from 5.7mm to 3.77mm at 12 months follow up. Similar improvement were also reported by Chaves et al., (2007) and Leung et al., (2005)^{24,25}. Chaves and coworkers studied the effect of different types of flap while Leung et al., (2005) studied the effect of systematic periodontal care to clinical parameters of second molar. Interestingly, it can be noted that the positive outcome gained in the above mentioned studies could be due to the prospective design in which many confounding factors can be controlled and modulated. Hence, it can be concluded that good periodontal parameters at the distal aspect of second molar following impacted third molar surgery can be achieved when there is systematic periodontal care.

Conclusions

Within the limitation of our study, we demonstrated that Impacted third molar removal lead to significant gain in ABH on distal aspect of second molar. However, clinical parameters including PPD and CAL showed significant deterioration particularly at all distal sites.

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