

# Influence of third molars in Le Fort 1 osteotomy

## Access this article online

### Website:

www.amsjournal.com

### DOI:

10.4103/2231-0746.92777

### Quick Response Code:



S. M. Balaji

Director, Balaji Dental and Craniofacial Hospital,  
30, KB Dasan Road, Teynampet, Chennai – 600 018, India

### Address for correspondence:

Prof. S. M. Balaji, Balaji Dental and Craniofacial Hospital,  
30, KB Dasan Road, Teynampet, Chennai – 600 018, India.

E-mail: [smbalaji@gmail.com](mailto:smbalaji@gmail.com)

## ABSTRACT

**Background:** The influence of maxillary third molar (M3) on the outcomes of Le Fort 1 osteotomy is not deeply investigated. **Aim:** To investigate the influence of M3 on Le Fort 1 osteotomies. **Setting:** Tertiary Referral Center, operated by a single surgeon, prospective study. **Period:** January 2005 to December 2010. **Patients:** Consecutive Le Fort 1 osteotomy patients with both M3. **Predictor Variable:** Gender, position, M3 root morphology, and degree of impaction. **Outcome Variable:** Time taken after all osteotomy cuts to point of time when maxilla is placed in predetermined plane. **Result:** A total of 658 M3 in line of cut were studied. Of all M3, 312 were impacted, 28.9% were partially impacted and 23.7% were erupted. Of all the M3, 2.9% had their cuspal tips above the horizontal cut, 13.8% along the line of cut, and in 20.7% below the line but not erupted. Buccoverted tooth took shortest time (7.74 minutes), while palatoversion required more time (8.44 minutes) ( $P = 0.000$ ). When the cuspal tip of M3 was located above the horizontal line of cut, the mean time required to achieve the planned position was 7 minutes, while the completely erupted teeth took a mean of 8.24 minutes ( $P = 0.000$ ). **Conclusion:** When the M3 is placed higher, it takes lesser time to prepare basal bone to receive the maxilla at its predetermined level. Angulation of M3 influences the outcome. Deeply placed M3 reduces the manipulation of the greater pterygoid palatine vessels in the area thereby minimizing the bleeding in the surgical field.

**Keywords:** Impaction, Le Fort 1 osteotomy, maxillary third molar

## INTRODUCTION

The bone cuts in commonly used orthognathic surgeries, mandibular sagittal split osteotomy, and Le Fort I osteotomy, traverse the third molar (M3) anatomic regions.<sup>[1]</sup> The position of M3 in the mandible appears to influence the outcome of the mandibular sagittal split osteotomy. There are several controversies surrounding the removal and the timing of such removal of the M3 in the literature.<sup>[2,3]</sup> Maxillary Le Fort I surgeries necessitate separation of maxilla from its posterior attachment and are performed in a complicated anatomical region. However, the issue of M3 in maxilla is sparsely reported in the literature. M3 of a mandible is entirely different from maxilla. Maxilla is a cancellous bone wherein the formation of the dimension of tuberosity is dictated by the forming M3. Unlike in mandible, Champy's lines are not observed in maxilla, as it is a cancellous bone and pierced by several vessels and nutrient canals. The space constriction in M3 region usually brings about a change

in the position. It could be either buccally or palatally placed in the arch. If buccally placed, the amount of bone overlying the tooth is thinned, on the contrary, if the M3 is placed palatally, the thickness of bone is increased. When the M3 is placed in an oblique fashion, in three dimensions, a combination of such effect could be anticipated.

The only available evidence of influence of maxillary M3 on Le Fort1 osteotomy in the literature is a study by Cheung *et al.* in 1998.<sup>[4]</sup> They used computerized cephalometric analysis and computed tomography scans. They arrived at a finding that the presence of maxillary M3 influences the transverse angulation of the cut through the tuberosity. In cases where M3 was present, the angulation of the tuberosity cut relating to the mid palatal plane varies from 84.5° with a cut behind the preserved wisdom tooth, to 64.33° with extraction of the M3, with the osteotome going through the socket. In the absence of M3, the cut goes slightly anteriorly just behind the second molar at a mean angle

of 76.23° preserving the involvement of the greater palatine foramen through which the descending palatine artery exits as the greater palatine artery. If the pterygomaxillary junction is involved in the cut, it will increase the mean angulation to 98.24° without M3 and 102.43° when the M3 is present.<sup>[4]</sup> This study clearly underlines the role of the M3 in the length and angle of the vertical cut of the Le Fort I osteotomy. Considering the position of the M3, if present, it can be safely assumed that presence of M3 influences the course of Le Fort 1 osteotomy.

Owing to several limiting factors, the literature does not have enough evidence to predict the influence of M3 on the perioperative outcomes of the surgery. The aim of this study was to study the influence of M3 during Le Fort 1 osteotomy and to study the influence of presence of M3 on the anatomy of the posterior maxilla.

## MATERIALS AND METHODS

A prospective study was designed in which consecutive participants who were nonsyndromic and planned to be treated surgically with Le Fort 1 osteotomy for vertical dimension excess without prior orthodontic treatment were included in this study. Those patients who had agenesis or removed their third molars or undergone Le Fort I osteotomy earlier were excluded. Only those patients whose vertical cut was involving M3 that were to be extracted were included in this study. Patients with any systemic and local factors that could influence the position of M3 were excluded from this study. As there were no interventions or change in treatment protocol for the study, it was exempted from Ethics Committee clearance. The period of study was January 2005 to December 2010.

In all such eligible patients, the age and gender were noted. Presurgical cephalometric analysis and mock surgery were performed. Occlusal guides as wafers were prepared. The horizontal line of cut was drawn in the tracing of the lateral cephalogram. The length of the vertical cut along the posterior region of the osteotomy was taken as the height, in millimeters (mm) to be reduced in this region. The orientation of the third molars was described as mesioangular or distoangular or vertical

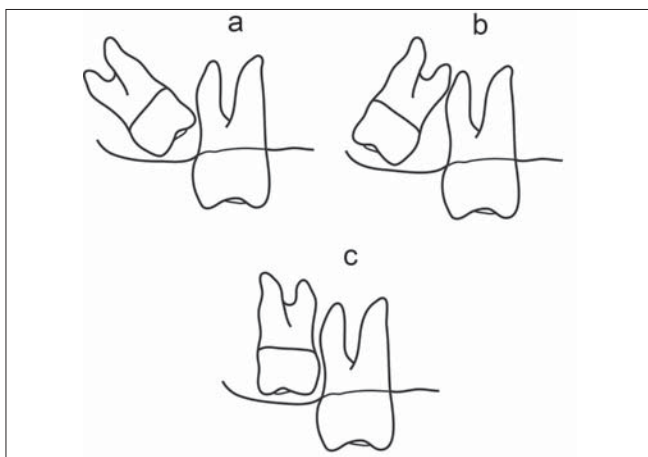
[Figure 1] when the long axis of the tooth was compared against a perpendicular line. The position was described as either buccoversion or palatoversion or normal when compared with the other tooth alignment in the arch. The pterygomaxillary fissure was noted either as a separation (not fused) or a synostosed (fused) entity. The M3 root morphology was classified as fused roots, divergent roots, fused roots with supernumerary roots, divergent roots with supernumerary roots, or a normal root. Based on the three-dimensional position of the M3 cuspal tip, it was classified as above the horizontal line of cut [Figure 2], along horizontal line of cut, below horizontal line of cut but not erupted [Figure 3], along alveolar ridge [Figure 4], and those above alveolar ridge [Figure 5].

All the surgeries were carried out by the author (with more than 15 years of surgical experience at the start of the study) in the same center. All the Le Fort 1 osteotomy was carried out as per a standard modified approach of Le Fort 1 osteotomy by Trimble *et al.*<sup>[5]</sup> [Figures 6-8].

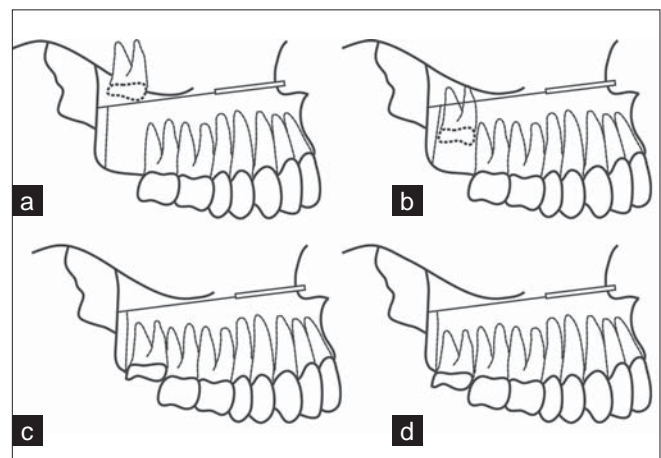
The standard intraoral flap was elevated. After identifying appropriate location of bone cuts above roots of teeth extending from the nasal passage (piriform aperture) to the pterygoid plates, bone cuts along maxillary face, septal cuts, and lateral nasal wall cuts (inferior to inferior turbinate) were placed. Fracture near the pterygomaxillary bone union with curved osteotome was achieved. Down fracture of the lower maxilla with palate was achieved using disimpaction forceps.

The time taken after the dislodgement of maxilla and all osteotomies to the point of time when the maxilla is placed in already desired plane was taken as the time for achieving the predetermined position of maxilla. This time includes the reduction of bone, clearing of blood, and checking the occlusion. This is a crucial factor in all Le Fort I surgeries that will decide the outcome of the surgery. The nearest minute was noted down for each quadrant of the maxilla. Hence, this time is a factor of bone reduction, clear field, and positioning of maxilla.

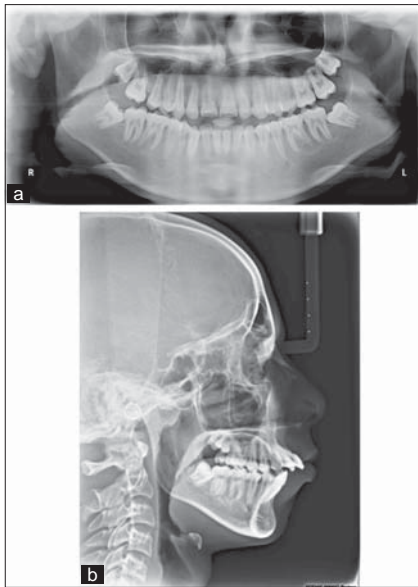
To verify the second part of the hypothesis, cone beam computed tomography (CBCT) data obtained from 100 consecutive patient



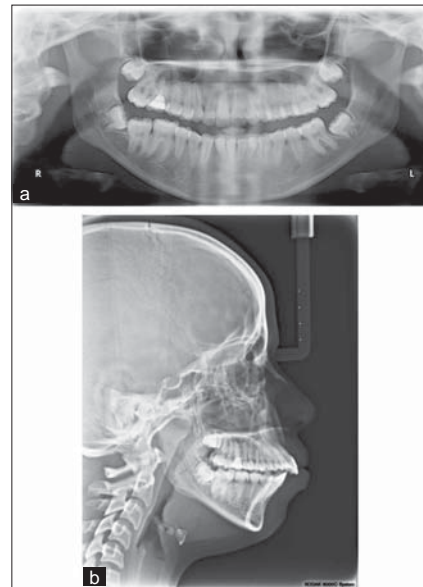
**Figure 1:** Angulation of third molars. a) mesioangular; b) distoangular; c) vertical



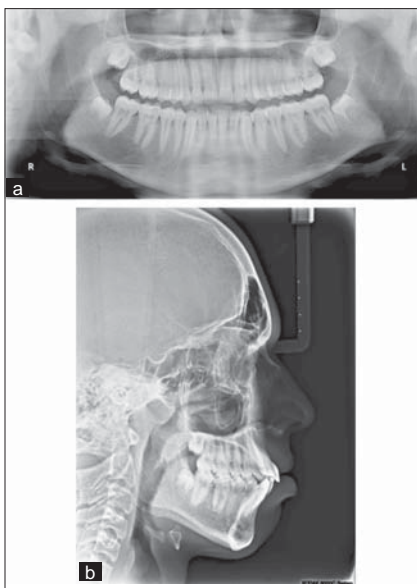
**Figure 2:** a) Third molar cusp above the horizontal line of cut. b) Third molar cusp along the horizontal line of cut. c) Third molar cusp along the alveolar ridge. d) Third molar erupted



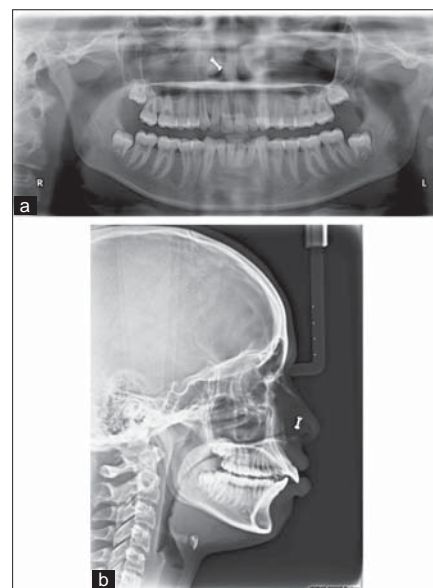
**Figure 3:** 19-year-old female with Maxillary excess, to undergo Le Fort 1 osteotomy. a) OPG showing impacted maxillary third molar (M3) bilaterally. Right-side M3 is nearer to the line of cut, whereas the left M3 is very deeply placed. b) Lateral cephalogram showing vertical and anteroposterior maxillary excess with impacted M3.



**Figure 4:** 18-year-old male with maxillary excess and mild retrognathism to undergo Le Fort 1 osteotomy. a) OPG showing position of impacted maxillary third molar (M3) bilaterally. Right and left M3 deeply placed. b) A Lateral cephalogram showing. bilateral impacted maxillary third molar (M3) in the line of osteotomy



**Figure 5:** 16-year-old female bimaxillary protrusion and vertical maxillary excess a) OPG showing impacted Maxillary third molar (M3) bilaterally which are deeply placed. b) Lateral cephalogram showing bimaxillary protrusion with impacted third molars

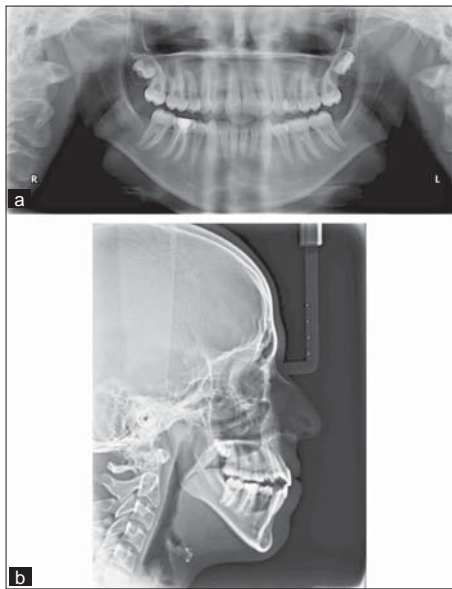


**Figure 6:** 19-year-old female bimaxillary prognathism to undergo Lefort I osteotomy a) OPG showing impacted Maxillary third molar (M3) bilaterally which are deeply placed in the line of osteotomy. b) Lateral cephalogram showing bimaxillary protrusion and low Mandibular plane angle with impacted third molars

scans were reviewed. The CBCT scans were obtained between September 2010 and April 2011 at the center for a variety of dental indications. Patients, in whom maxillary M3 position could be influenced by any systemic or local or pathologic factors including prior extractions of M3, were excluded. Patients in the age group of 21 to 40 years of either gender were included. Scans were performed at 0.2 mm voxels. CBCT system (Kodak 9500 Cone Beam 3D System, Kodak Dental Systems, Carestream Health, Rochester, NY) was used to scan and measure. Greater palatine

foramen (GPF) were identified in saggital plane and analyzed in coronal planes. 3D reconstructions were done to identify the position of M3 (Palatoversion, Buccoversion, and Normal) and graded as impacted, erupted, or missing.

Previously described method was used to identify the GPF<sup>[6]</sup> along the inferior surface of hard palate saggital plane and marked. Soft tissue depth was not considered for this study. The radiological



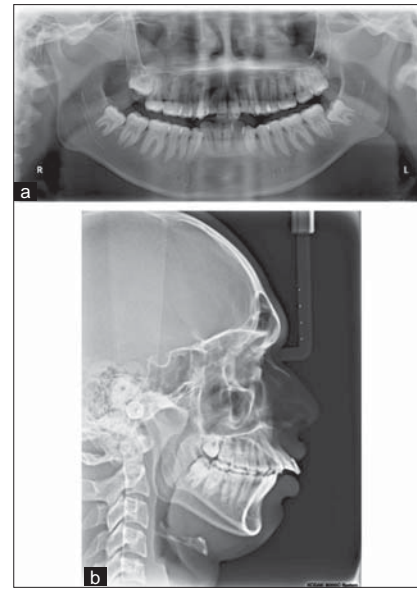
**Figure 7:** 22-year-old female with vertical maxillary excess a) OPG showing position of impacted Maxillary third molar (M3) bilaterally which are deeply seated b) Lateral cephalogram showing deeply placed partially developed impacted maxillary M3 in the line of proposed osteotomy

opening of the GPF was identified on the hard palate of both coronal and sagittal sections. After identifying the GPF, in the coronal plane, the thickness of slice was increased to include the 3M, if present.

A horizontal line was drawn along the radiological shadow of the crest of the tuberosity and a vertical line drawn from the GPF. The long axis of M3 or the tuberosity (if M3 is absent) was also drawn. The tip of root of M3, when present, was also identified. The degree of eruption of M3 was noted as erupted, partially erupted, or impacted.

The distance between the vertical line from GPF along the tuberosity to the point where it meets the long axis of M3 is taken as the vertical distance A and horizontal distance B, measured in mm. This reflects the measure of M3/tuberosity in mesiodistal dimension. The similar horizontal line from the root tip of M3 (C) will reflect the orientation of M3 with respect to the GPF in the coronal dimension. The angle formed by the long axis of M3 or tuberosity to the vertical line from GPF (Angle) will measure the angulations and position of M3/tuberosity [Figure 9]. The horizontal distance between the root tip to the GPF was measured as D in mm. The width of the tuberosity along the tip of the tuberosity was measured as E and the same along the GPF was taken as F in mm. The measurements were repeated after 2 weeks and average taken as the final measurement.

All data thus collected were entered in Statistical Package for Social Service (SPSS, version 16.0, IBM, Chicago, IL) Package. Descriptive statistics are presented for all variables. One-way analysis of variance (ANOVA) was used to find the difference between mean between the parameters and the time taken for achieving the predetermined position of maxilla. Pearson's correlation was used to find the association between the excess height and time required. Spearman's Rho was used to correlate



**Figure 8:** 27-year-old male with Skeletal Class II relation a) OPG showing position of impacted Maxillary third molar (M3) bilaterally. Left M3 partially erupted, while the right M3 shows soft tissue impaction, b) Lateral cephalogram showing antero posterior maxillary excess with impacted right M3 in the line of osteotomy

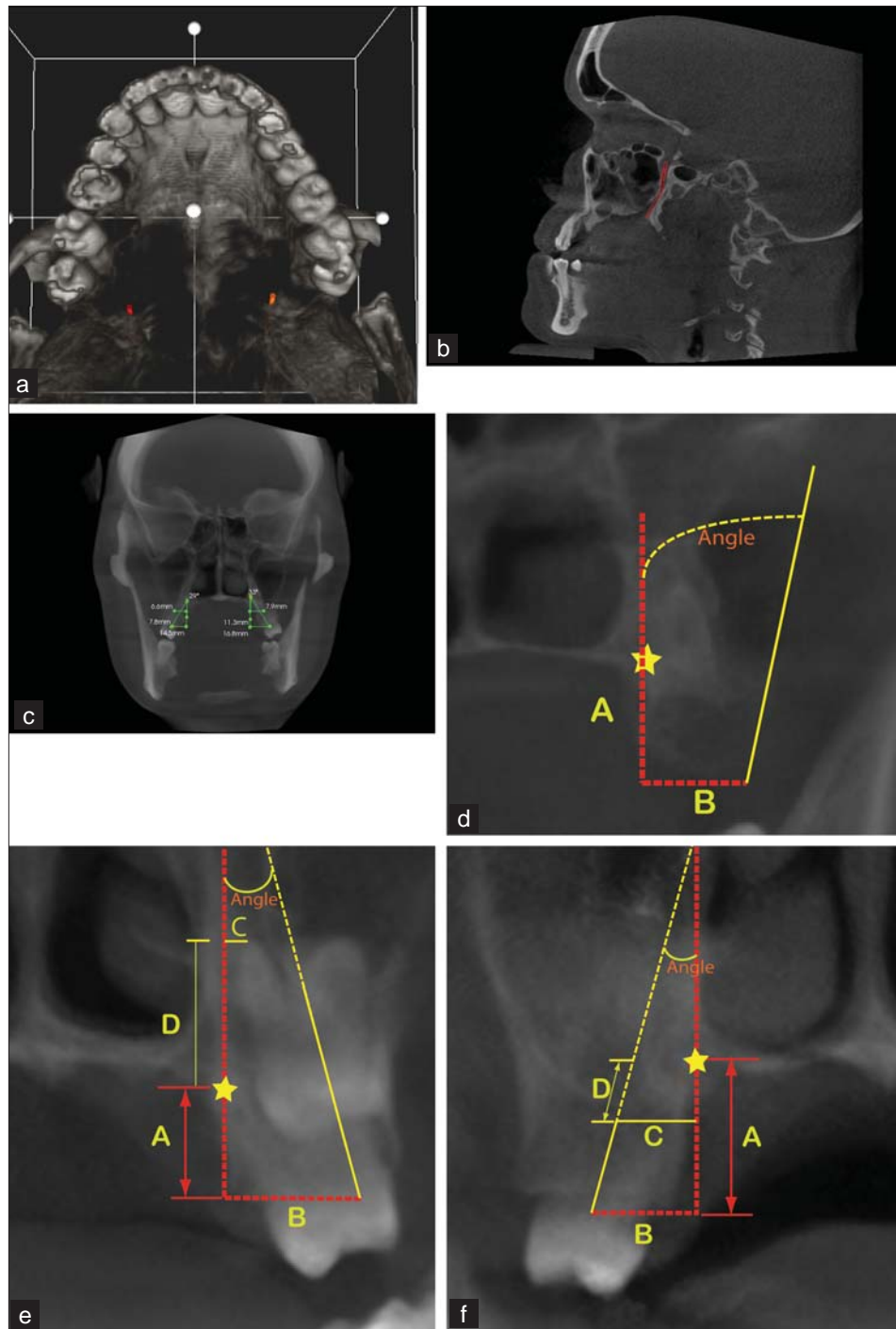
the time and height with level of M3.  $P$  value  $\leq 0.05$  was taken to be significant. One-way ANOVA was used to find the association of A, B, C, D, E, F, and Angle with the version and position of M3.

## RESULTS

Three hundred twenty-nine patients fulfilled the inclusion and exclusion criteria. Of them, 136 were males and 193 were females. Totally 658 maxillary M3 along the vertical line of cut were studied. Of the 658 M3 studied, 67.6% were oriented mesioangularly, 14.9% distoangularly, and 17.5% vertically. Of all the M3, 312 were impacted, 28.9% were partially impacted, and 23.7% were erupted. Of all the M3, 2.9% had their cuspal tips above the horizontal cut, 13.8% along the line of cut, and 20.7% below the line but not erupted. The other variables are depicted in Table 1. Table 2 depicts the ANOVA study of mean time taken for achieving the desired position between various parameters. The buccoverted tooth had the shortest time (4.74 minutes), while the palatoversion required more time (5.44 minutes). The difference was statistically significant ( $P = 0.000$ ). When the cuspal tip of M3 was located above the horizontal line of cut, the mean time required to achieve the planned position was 4 minutes, while the completely erupted teeth took a mean of 5.24 minutes. The difference was statistically significant ( $P = 0.000$ ).

Graph 1 depicts the influence of the version of tooth on the level of M3. Graph 2 compares the level of M3 with respect to the mean time taken in terms of angulation. The Pearson's correlation between the height of the vertical cut and the time to achieve the predicted site was significant ( $r = 0.806$ ,  $P = 0.000$ ). Time and level of third molar (Spearman's Rho = 0.274,  $P = 0.000$ ) were significant, while the height and the level of third molar (Spearman's Rho = -0.004,  $P = 0.911$ ) were not significant.





**Figure 9:** a) 3D reconstruction of CBCT data. b) Tracing of canal till palate in sagittal section. c) Measurements in CBCT in sagittal view. d) Parameters with absence of M3. e) Impacted M3 measurements of parameter. f) M3 measurements in CBCT

For the CBCT study, 42 were males and 58 females. In total, 200 GPF areas were measured. In 35 cases (17.5%), the M3 was absent, 17 (8.5%) were buccally oriented and 91 (45.5%) M3 were palatally oriented. In the remaining 57 (266.5%) instance, M3 was normally placed; 86 M3 (43%) of were impacted while 79 (38.5%) were erupted. The six parameters were measured in all the instances. Tables 3 and 4 depict the association of the M3 with A, B, C, D, E, F, and Angle with respect to version and the depth of M3. All the mean values exhibited high statistical significance.

## DISCUSSION

The posterior part of the maxilla is formed by a fusion of several facial bones including the maxillary bone, palatine bone, and pterygoid plates of the sphenoid bone.<sup>[4]</sup> The junction of the maxillary and palatine bones creates the descending palatine canal and the sphenopalatine fossa, with several vessels and nerves running through the area. It is paramount importance to avoid unnecessary manipulation of these vital structures during

a Le Fort I osteotomy.<sup>[4]</sup> The transalveolar approach for Le Fort I osteotomy of Trimble reduced the height of the vertical cut and increased the distance from the sphenopalatine fossa. This

**Table 1: Demographic parameters of the study group (n = 329 patients, 658 cuts)**

Parameters	Values, N (%)
Gender	
Male	136, 272 cuts (41.3)
Female	193, 386 cuts (58.7)
Male: Female	1:1.42
Orientation of third molars	
Mesioangular	445 (67.6)
Distoangular	98 (14.9)
Vertical	115 (17.5)
Degree of impaction	
Cuspal tip above the horizontal line of cut	85 (12.9)
Cuspal tip along horizontal line of cut	91 (13.8)
Cuspal tip below horizontal line of cut but not erupted	136 (20.7)
Cuspal tip along alveolar ridge (partial impaction)	190 (28.9)
Erupted	156 (23.7)
Position of tooth	
Normal	134 (20.4)
Buccoversion	412 (62.6)
Palatoversion	112 (17)
Fissure characteristics	
Not fused	466 (70.8)
Synostosis	192 (29.2)
Root morphology	
Fused roots	259 (39.4)
Divergent	122 (18.5)
Fused supernumerary roots	86 (13.1)
Divergent supernumerary roots	120 (18.2)
Normal	71 (10.8)
Age of patient (in years)	20.7 ± 3.88 16 to 35
Vertical excess (in mm)	9.37 ± 2.77 4.8 to 17.8
Time required (in minutes)	7.95 ± 1.57 2 to 10

would increase the safety margin. Moreover, when the tuberosity osteotomy is the choice, when the cut is placed behind the second molar, through the middle part of the M3 socket, with the osteotome positioned at a slightly upward angulation, coinciding with the curvature of the palatal vault. This place would coincide with the tuberosity, just in front of pterygomaxillary fissure (PtM).<sup>[5]</sup>

PtM is a routine and stable radiographic landmark used to identify the maxillary tuberosity. In young individuals, it appears on cephalometric films as an “inverted teardrop” just behind the tuberosity, which is caused by the naturally occurring gap between the pterygoid plates and the maxilla. When synostosis of the bones occurs, the inverted teardrop is obliterated. During postnatal growth, the biomechanical force producing this maxillary movement involves the developmental expansion of all the enclosing soft tissues which, attached to the maxilla, carry the maxillary complex anteriorly. The placement of the maxilla is primarily by the basicranium but adjustive capacity occurs in sutural growth potential, both intrinsically and clinically. The final remodeling of the tuberosity occurs with the formation and positioning of M3.<sup>[7]</sup>

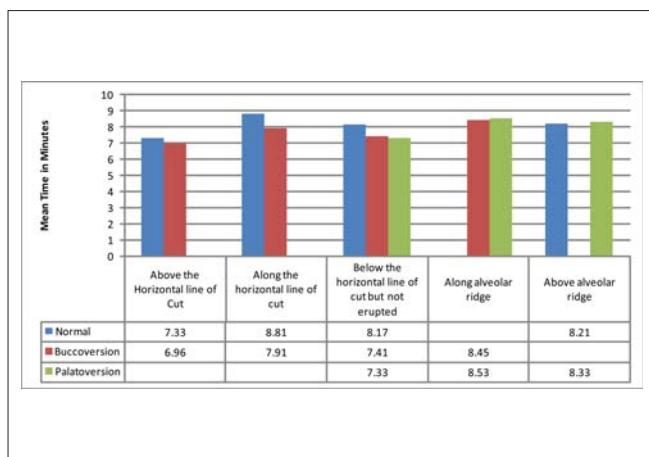
The horizontal and sagittal orientation of M3 with the GPF as reflected by the highly statistical correlation between the parameters A,B, C, D, and angulation of the M3/Tuberosity with respect to the GPF indicates that the presence of M3 definitely influences the regional anatomy of the posterior maxilla.

During osteotomy, the vertical cut is modified as per the presence of M3. However, till date there is no systematic analysis of the effect of the presence of M3 influencing the Le Fort 1 osteotomy. This study was performed to address this issue. This study group had more females in the ratio of 1:1.42, probably owing to more esthetic treatment seeking behavior in females.

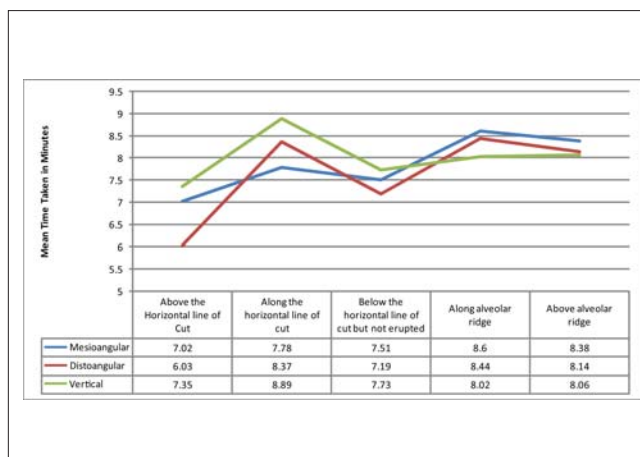
The mesioangular orientations (67.6%), M3 being positioned

**Table 2: Comparison of mean of time (in minutes) to achieve the predestined position of maxilla in study group**

Parameters studied	Group	N	Mean	Standard deviation	95% confidence interval for mean		P value
					Lower bound	Upper bound	
Gender	Male	272	8.04	1.59	7.85	8.23	0.203
	Female	386	7.88	1.56	7.73	8.04	
Orientation of third molar	Mesioangular	445	7.98	1.61	7.83	8.13	0.467
	Distoangular	98	7.77	1.48	7.47	8.06	
	Vertical	115	7.98	1.48	7.7	8.25	
Position	Normal	134	8.17	1.51	7.91	8.42	0.000
	Buccoversion	412	7.74	1.53	7.59	7.89	
	Palatoversion	112	8.44	1.66	8.13	8.75	
Pterygomaxillary fissure	Not fused	466	7.88	1.57	7.74	8.03	0.106
	Synostosis	192	8.1	1.56	7.88	8.32	
3 <sup>rd</sup> molar root morphology	Fused roots	259	8.09	1.60	7.9	8.29	0.109
	Divergent	122	8.03	1.63	7.74	8.32	
	Fused supernumerary roots	86	7.64	1.48	7.32	7.96	
	Divergent supernumerary roots	120	7.76	1.48	7.5	8.03	
	Normal	71	7.97	1.57	7.6	8.34	
Degree of impaction – position of cuspal tip	Above the horizontal line of cut	85	7	1.79	6.61	7.38	0.000
	Along horizontal line of cut	91	7.94	1.30	7.67	8.21	
	Below horizontal line of cut but not erupted	136	7.46	1.03	7.29	7.64	
	Along alveolar ridge	190	8.48	1.64	8.25	8.72	
	Above alveolar ridge	156	8.24	1.55	8	8.49	



**Graph 1:** Mean time in minutes classified by placement of third molar and degree of impaction



**Graph 2:** Mean time in minutes classified by placement of third molar and angulation

**Table 3: Spatial association of eruption status maxillary third molars with parameters measured from cone beam computer tomography with respect to greater palatine foramen**

		N	Mean	Standard deviation	95% confidence interval for mean		P value
					Lower	Upper	
A	Absent	35	7.25	0.51	7.08	7.43	0.000*
	Impacted	86	7.71	0.53	7.59	7.82	
	Erupted	79	8.23	1	8.01	8.46	
B	Absent	35	6.96	0.57	6.76	7.16	0.000*
	Impacted	86	8.23	0.73	8.07	8.38	
	Erupted	79	7.25	0.98	7.03	7.47	
C	Impacted	86	7.30	1.75	6.92	7.67	0.001*
	Erupted	79	8.01	0.61	7.87	8.15	
D	Impacted	86	1.24	1.94	0.82	1.66	0.000*
	Erupted	79	6.65	1.61	6.29	7.01	
E	Absent	35	17.18	0.57	16.98	17.38	0.000*
	Impacted	86	18.45	0.73	18.29	18.60	
	Erupted	79	17.47	0.980	17.25	17.69	
F	Absent	35	18.24	0.57	18.04	18.44	0.000*
	Impacted	86	21.39	0.73	21.23	21.54	
	Erupted	79	20.65	0.98	20.43	20.87	
Angle	Absent	35	90.34	20.52	83.29	97.39	0.000*
	Impacted	86	78.34	18.56	74.36	82.31	
	Erupted	79	69.41	16.17	65.79	73.04	

\*Significance

along the alveolar ridge (28.9%) and buccally placed (62.6%), were the commonest M3 presentation. About a third of the cases had evidence of synostosis of the PTM. This finding is in agreement with reports of Apinhasmit *et al.* who had 27% of their cases with synostosis.<sup>[6]</sup> The age incidence and vertical dimension have been described for these patients.

The mean time taken for achieving the predetermined position of the maxilla by adjusting the basal bones is taken as the outcome measure. This includes trimming of bone to desired height, clearing the pooling of blood as well as checking the occlusion. As observed in Table 2, position of M3 was significantly different with respect to the time. Probably, the thick buccal bone in case of palatal version would provide much resistance for trimming to achieve the predetermined position causing a prolonged duration of manipulation. The same has been highlighted in Graph 1.

Similarly, the time measurement was influenced by the position of M3. When M3 is deeply placed inside the bone, it requires lesser time to achieve the predetermined position. On the contrary, it requires more time when the M3 is partially erupted or completely erupted. The time duration was statistically significant. This probably could have been related to the space created along the horizontal cut. M3 being nearer to the cut would facilitate easier positioning of the detached maxilla in the posterior maxillary region, owing to the space created by its removal. This also was assisted by an observation that higher the M3, clearer the surgical field owing to less pooling of blood.

From Graph 2, it is evident that the angulation of the long axis of M3 greatly influences the mean time measured. However, the same is not influenced when the M3 is superficially impacted or partially impacted or erupted. Large deviation of time is observed with deeply placed M3 tooth. This indicates that the buccal bone thickness is an important factor in determining the outcome of

**Table 4: Spatial association of version eruption status maxillary third molars/maxillary tuberosity with parameters measured from cone beam computer tomography with respect to greater palatine foramen**

		N	Mean	Standard deviation	95% confidence interval for mean		P value
					Lower	Upper	
A	Tooth absent	35	7.25	0.52	7.08	7.44	0.000*
	Buccoversion	17	7.36	0.52	7.09	7.63	
	Normal	57	7.85	0.76	7.65	8.05	
	Palatoversion	91	8.13	0.88	7.95	8.32	
B	Tooth absent	35	6.96	0.57	6.76	7.16	0.000*
	Buccoversion	17	8.46	0.89	8.00	8.91	
	Normal	57	7.91	1.04	7.64	8.19	
	Palatoversion	91	7.53	0.89	7.35	7.72	
C	Buccoversion	17	6.77	2.04	5.72	7.82	0.001*
	Normal	57	7.92	1.20	7.60	8.23	
	Palatoversion	91	7.62	1.27	7.36	7.89	
	Buccoversion	17	0.99	3.16	-0.64	2.61	
D	Normal	57	3.70	3.63	2.73	4.66	0.000*
	Palatoversion	91	4.45	2.70	3.88	5.01	
	Tooth absent	35	17.18	0.57	16.98	17.38	
	Buccoversion	17	18.68	0.89	18.22	19.13	
E	Normal	57	18.13	1.04	17.86	18.41	0.000*
	Palatoversion	91	17.75	0.89	17.57	17.94	
	Tooth absent	35	18.24	0.57	18.04	18.44	
	Buccoversion	17	21.65	0.88	21.19	22.10	
F	Normal	57	21.18	0.99	20.92	21.44	0.000*
	Palatoversion	91	20.83	0.84	20.65	21.00	
	Tooth absent	35	90.34	20.52	83.29	97.39	
	Buccoversion	17	104.97	5.00	102.41	107.54	
Angle	Normal	57	86.69	5.75	85.16	88.21	0.000*
	Palatoversion	91	60.38	9.63	58.38	62.39	

\*Significance

the Le Fort 1 osteotomy and maxilla positioning.

When M3 was positioned higher, involvement of the greater palatine foramen area was lesser. This was in accordance with the findings of Choi *et al.*<sup>[9]</sup> In their study on the clinical anatomy of maxillary artery in the ptergopalatine fossa, they concluded that the positioning of the osteotome inferiorly, force directed medially and anteriorly, would minimize the damage to the vital vessels. To avoid the descending palatine artery, they recommend the osteotome to angle inferiorly from the zygomaticomaxillary crest as it is drawn posterior. By the presence of a deeply impacted, distoangularly placed buccoversion M3 the osteotome would be positioned in the way that Choi *et al.* recommended. This would avoid the vital vessels providing a clear surgical field. This would in turn aid to achieve a faster positioning of maxilla in the predetermined position.

Similar observation was made by Apinhasmit *et al.* in dry skulls of Thai origin. They concluded that the posterior vertical cut of the osteotomy should be positioned posterior to the greater palatine foramen to minimize damaging the lower part of the descending palatine artery DPA. When they made maxillary tuberosity osteotomy cuts at the line from immediately behind the second molar to the posterolateral corner of the hard palate, the perpendicular distance from the greater palatine foramen to the maxillary tuberosity osteotomy was  $1.76 \pm 1.12$  mm in 4.50% of total subjects. The mean of the same distance increased to  $2.98 \pm 1.35$  and  $3.59 \pm 1.40$  mm when the posterior vertical osteotomy was cut at the line distal to the M3 and at the PtM junction, respectively. They effectively concluded that for a safer margin when the maxillary tuberosity osteotomy is planned, the

cut shall be placed distal to the M3.<sup>[8]</sup>

M3 root morphology did not appear to influence the outcome. A diverged root or a diverged root with supernumerary root did not statistically influence the mean time. This probably indicates that the surface area occupied by the M3 roots did not influence the outcome.

From the clinical result of this study, it could be proposed that the presence of M3 appears to alter the pterygopalatine vessels in the posterior maxilla. The exact location of vessel varies with dependent on the position of M3. From this study, it is also evident that when the M3 is placed higher, it takes lesser time to prepare the basal bone to receive the dislodged maxilla at its predetermined maxillary levels. Moreover, the angulation of the tooth also influences the time. Deeply placed M3 reduces the manipulation of the greater pterygoid palatine vessels in the area thereby minimizing the bleeding in the surgical field.

The CBCT study indicates that the influence of position of M3 influences the spatial orientation of the maxillary tuberosity. The findings of the width of the tuberosity along the tip of the tuberosity (E) were comparable to earlier reported study of Apinhasmit among Thai.<sup>[8]</sup>

As observed from Table 3, the height of the tuberosity is influenced by the presence of M3. The value A was lowest in agenesis of M3 (7.25 mm), while when impacted, it is slightly higher (7.71 mm). In the presence of the erupted M3, it reached a maximum of 8.23 mm. Similarly, palatoversion increased the height of the tuberosity



[Table 3]. The horizontal distance along the height of tuberosity to the GPF was highest with impacted tooth while least when M3 was not formed. Similarly, buccoversion had widest dimension while palatoversion had the lowest dimension. Similarly, the angulation of M3 also differed significantly between the impacted and erupted M3 as well as the buccoversion and palatoversion. These values cannot be compared as these values have not been previously described in the literature. However, the difference between the values confirms that the presence of M3 influences the position of the GPF. Moreover, the spatial positioning of M3 influences the height and the width of the tuberosity.

## CONCLUSION

The influence of maxillary third molar impaction on the outcome of the Le Fort 1 osteotomy has been studied for the first time in a small group of patients where the third molar was concomitantly removed in the course of Le Fort 1 surgery. The presence of third molar along the vertical cut appears to be a favorable factor. When a M3 is impacted, it could be harnessed by surgeons (minimal bone reduction etc.) so that the surgical manipulation of the area, especially the nerves and vessels palatally will be minimal. The study of spatial position of the maxillary third molar with regards to the greater palatine foramen was attempted using accurate measurements of angulation and length using the low radiation 3D imaging modalities of CBCT. A further large-scale study would aid in deciphering the mechanism of the exact influence of M3 on tuberosity and the cut of the Le Fort I osteotomy. This would help in harnessing the maxillary third molar for favorable

outcomes during Le Fort 1 osteotomies.

## REFERENCES

1. Marciani RD. Third molar removal: An overview of indications, imaging, evaluation and assessment of risk. *Oral Maxillofac Surg Clin N Am* 2007;19:1-13.
2. Precious DS. Removal of third molars with sagittal split osteotomies: The case for. *J Oral Maxillofac Surg* 2004;62:1144-6.
3. Schwartz HC. Simultaneous removal of third molars during sagittal osteotomies: The case against. *J Oral Maxillofac Surg* 2004;62:1147-9.
4. Cheung LK, Fung SC, Li T, Samman N. Posterior maxillary anatomy: implications for Le Fort 1 osteotomy. *Int J Oral Maxillofac Surg* 1998;27:346-51.
5. Trimble LD, Tideman H, Stolina PJ. A modification of the pterygoid plate separation in low level maxillary osteotomies. *J Oral Maxillofac Surg* 1983;4:544-6.
6. Howard-Swirzinski K, Edwards PC, Saini TS, Norton NS. Length and geometric patterns of the greater palatine canal observed in cone beam computed tomography. *Int J Dent* 2010;2010 pii: 292753.
7. Vardimon AD, Shoshani K, Shpack N, Reimann S, Bourauel C, Brosh T. Incremental growth of maxillary tuberosity for 6 to 20 years – A cross sectional study. *Arch Oral Biol* 2010;55:655-62.
8. Apinhasmit W, Chompoonong S, Methathrathip D, Sangvichien, Karuwannarint S. Clinical anatomy of posterior maxilla pertaining to Le Fort I osteotomy in Thais. *Clin Anat* 2005;18:323-9.
9. Choi J, Park H. The clinical anatomy of the maxillary artery in the pterygopalatine fossa. *J Oral Maxillofac Surg* 2003;61:72-8.

**Cite this article as:** Balaji SM. Influence of third molars in Le Fort 1 osteotomy. *Ann Maxillofac Surg* 2011;1:136-44.

**Source of Support:** Nil, **Conflict of Interest:** None declared.