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Original Article

Incidence of impacted third molars: A radiographic study in People's Hospital, Bhopal, India

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ABSTRACT

Objectives: The aim of this study is to evaluate the position of impacted third molars based on the classifications of Pell & Gregory and Winter in a sample of Bhopal patients.

Study design: In this retrospective study, up to 1100 orthopantomograms (OPG) of the patients who were reported to the Maxillofacial Department of PDA and Chowdhary hospital from January 2011 to December 2012 were evaluated.

Results: Among 1100 patients, 730 were male and 370 were female patients. Of the 1100 OPGs studied, 3,910 third molars were noticed either impacted or erupted and 490 third molars were missing. The most common angulation of impaction in the mandible was in vertical position (41.4%) followed by mesioangular impaction (33.3%) and the most common angulation of impaction in the maxilla was the vertical (67.4%) which was followed by 15.2% in distoangular impaction.

The level of eruption of impacted third molar was found to be 43.9% at level A, 34.8% at level B and 21.3% at level C. There was no significant difference between the right and left sides in both the jaws.

Conclusion: The pattern of third molar impaction in the region of Bhopal is characterized by a high prevalence of impaction, especially in the mandible. The most common angulation was the vertical in the mandible as well as in the maxilla. The most common level of impaction in mandible was level A and in maxilla is level C and there was no any significant difference between the right and left sides in both jaws.

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1. Introduction

Third molars are the most frequently impacted teeth because of their particular topography, phylogeny and ontogeny. They

are directly or indirectly associated with numerous disorders in the mouth, jaw and facial regions. Therefore, the extraction of third molars is one of the most common surgical procedure for Oral and Maxillofacial surgeons.¹

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Development of mandibular third molars starts in the ramus of the mandible at about the age of seven years.² The third molars are the last teeth to erupt in all races despite racial variations in the eruption sequence. Racial variation in facial growth, jaw and teeth size, nature of diet, extent of generalized tooth attrition, degree of use of masticatory apparatus and genetic inheritance are the crucial factors which determines the eruption pattern, impaction status and the incidence of agenesis of third molars.³

Impacted teeth were seldom a problem for Neolithic man. Their highly abrasive diet caused attrition of teeth resulting in a reduction of mesiodistal distance of the dentition. This allows the mesial migration of teeth and adequate space was available for the eruption of the third molars. But with the arrival of refined food and consequential reduction in the masticatory functional load, today, the rate of impaction of third molars shows a significant increase (John Hunter theory of nature and nurture). Mead believed that delay in eruption causes impaction of teeth.⁴

Clinically impacted teeth may give various presentation including pain, food impaction, cheek bite etc. In order to examine impacted third molars, radiographs are still the gold standard for investigation. Radiographs like I.O.P.A, and orthopantomograms (OPG) are used to evaluate the type of impaction, any anatomical impediments that are preventing its eruption; whether it is completely or partially embedded in bone, marginal bone height, condition of adjacent second molars and relation of third molars to inferior alveolar canal; so that a proper management can be planned.⁵

This study aimed to determine A) The status of maxillary and mandibular third molars in a sub-population of the district of Bhopal by evaluating the following factors Prevalence, Incidence of agenesis of third molars, Angulation, Level of eruption and Available space of eruption and mesiodistal diameter of impacted third molars. B) Preoperative radiographic assessment of impacted mandibular third molar to inferior alveolar canal by evaluating following factors Darkening of root apex, Deflection of root, Narrowing of root apex, Bifid root apex, Narrowing of canal, Deviation of mandibular canal, Interruption of white line and No relations.

2. Material and methods

1100 panoramic radiographs of the patients, who reported to the Peoples Dental Academy, Bhopal, from January 2011 to December 2012. 730 were male and 370 were female. They were aged between 20 and 35 years. Subjects below the age of 20 years were excluded, as the eventual outcome of third molar eruption is still uncertain. Only patients with a full compliment of teeth were included. Those with missing second molars were excluded. Other exclusion criteria were any pathosis or trauma to the jaws that may disrupt its alignment.

Orthopantomograms were taken for all subjects in order to assess the level of eruption, angulation, third molar space, mesiodistal length of the impacted third molar and relation of inferior alveolar nerve to impacted third molar. It was also used for evaluating agenesis of third molars.

2.1. Level of eruption

The depth of the third molars in relation to the adjacent second molar was assigned to one of the three groups. In level A, the highest part of the third molars was on the same level or above the occlusal plane of adjacent second molar; in level B, the highest part of the third molars was below the occlusal plane but above the cervical line of second molars; and in the level C, the highest part of the third molars was beneath the cervical line of second molars.

2.2. Third molar space

Third molar space was measured as the distance between distal surface of second molar crown and anterior border of the ramus on the occlusal plane.

2.3. Angulation

The mesioangular position of the third molars was determined by its sagittal relationship to the adjacent second molar obtained from tracing of the panoramic radiographs. A line was drawn through the midpoint of the occlusal surface and bifurcation of the second molars and third molars. These lines represent the long axis of the teeth. The angle formed between the intersected long axis gave the degree of third molars inclination relative to the second molars. Inclination angle was then read from a compass grid drawn on transparent film with the use of radiographic view box. The inclination angle was read in increments of 5° to a maximum of 65°, above which the third molars was considered to be horizontally impacted.

Preoperative radiographic assessment of impacted mandibular third molar to inferior alveolar canal by evaluating following factors:

- 1) Darkening of root apex: Usually the density of root in radiograph appears to be uniform throughout, but when the inferior alveolar canal impinges on the root, then there is loss of density & is interpreted as darkening.
- 2) Deflection of root: When the root reaches the inferior alveolar canal, sometimes it may get deflected to mesial or distal aspect & is interpreted as deflection.
- 3) Narrowing of root apex: It implies to the grooving/perforation of the canal.
- 4) Bifid root apex: When the inferior alveolar canal crosses the apex of the root, the shadow of periodontal ligament appears as bifid apex.
- 5) Narrowing of canal: While crossing the apex of the root, if the diameter of the inferior alveolar canal narrows, then it is interpreted as narrowing of the canal.
- 6) Deviation of mandibular canal: When the inferior alveolar canal crosses the mandibular third molar, if it changes its direction & get displaced, then it is interpreted as deviation.
- 7) Interruption of white line: White lines which appears on the radiograph are the roof & floor of the inferior alveolar canal. Any interruption of one or both the lines are considered to indicate perforation or deep grooving of the root.

8) No relations.

Collected data were subjected to different types of statistical analyses such as χ^2 test, t test and analysis of variance approach.

3. Results

The number of third molars found in 1100 subjects was 3910 (88.86%) of which 1700 (43.47%) were erupted and 2210 (56.52%) were impacted [Table 1]. Of the 2210 impacted third molars 1750 (78.18%) were observed in the mandibular arch and 460 (20.81%) (Graph 1) were observed in the maxillary arch, with equal predilection for both the sides [Table 2].

The proportion of third molar agenesis was 11.10% (490 teeth missing). Congenitally missing third molars showed a greater predilection for the upper jaw 67.34% [330 teeth out of a total of 490] than that of the lower jaw 32.65% [160 teeth of a total of 490 teeth]. The proportion of third molar agenesis on the right side was higher 57.14% than that for the left side 42.85% [Table 3].

The level of eruption of impacted third molar is depicted in Table 4. The level of eruption of impacted third molar was found to be 43.9% at level A; 34.8% at level B; and 21.3% at level C. An χ^2 test was applied to find the presence or association if any, between the eruption levels of impacted third molar in the maxilla/mandible. Though quite a non-significant association was observed between sides and level of eruption in maxillary arch ($cc = 0.161$, $P < 0.543$) and in mandibular arch ($cc = 0.033$, $P < .911$), a significant association was observed between the arches, and level of eruption. As per the analysis, Pearson's coefficient of contingency = 0.586, which turned out to be highly significant ($P < .000$) indicating that the level of eruption and the type of jaw (maxilla & mandible) were related. In maxilla, only ten case of level A (2.2%) was noticed as against 960 (54.9%) cases of level A in mandible. 360 cases (78.30%) level C was noticed in maxilla as against 110 case (6.3%) of level C in mandible.

The angular position of third molar is presented in Table 5. Impacted third molars showed a higher frequency of vertical position (46.6%) followed by mesioangular (28.2%), distoangular (16.74%), horizontal (7.69%) and other (inverted mesioangular 0.6%).

In maxillary arch, the most frequent impacted third molar was found to be in vertical angulation (67.4%) which is followed by 15.2% in distoangular impaction, 10.9% of mesioangular impaction and 6.5% in horizontal impaction. However

Graph 1 – Significantly, higher number of frequencies was observed in mandibular arch compared to maxillary arch. 78.1% of the frequencies were with mandibular arch against 20.8% with maxillary arch. When chi-square test was applied to these frequencies, a significant chi-square value was observed ($\chi^2 = 72.982$; $P < .000$), further confirming fact that frequency of mandibular arch was statistically high.

no association was detected between sides and angulation of impacted third molar ($cc = 0.271$, $P < .304$).

In mandibular arch vertical impacted third molar (41.4%) was noticed slightly more in frequency than that of mesioangular impaction (32.8%) followed by horizontal (19.9%), distoangular (5.7%) and 0.57% in inverted position. In mandibular too no association was detected between sides and angulation of impacted third molar ($cc = 0.121$, $P < .631$). But when both the arches were tested through t test, Pearson's coefficient of contingency = 0.286, turned to be highly significant ($P < .001$).

The mean and standard deviation of maxillary and mandibular third molars was calculated for mesiodistal crown width. The mesiodistal crown width of right and left maxillary third molar was 11.3 and 10.83 respectively and that of right and left mandible was noticed as 13.17 and 13.16 respectively. Each of the data were subjected to one way analysis of variance (ANOVA): A, mandible versus maxilla, and right versus left. The difference between right and left side of maxilla and mandible with respect to mesiodistal crown width was statistically non-significant. Greater value was noticed in the mesiodistal crown width of the mandible when compared with that of maxilla ($t = 7.152$, $P < .000$).

The mean value of retromolar space in the right side and left side of mandible was also calculated. The retromolar space in the right side of mandible was 11.88 (± 2.96) and the retromolar space in the left side of the mandible was 12.06 (± 2.89). Each of the data was subjected to one way analysis of variance (ANOVA): right versus left. However, the difference between right and left side with respect to retromolar space was statistically not significant.

Table 6 shows the radiographic relationship (signs) of inferior alveolar canal to that of the impacted mandibular third molar. Preoperative radiological signs, suggestive of the nerve involvement, were seen in 44.91% of cases. 55.09% of the impacted third molar was found to be in no relation with the inferior alveolar canal. The most significant sign was deviation of mandibular canal 13.31%, followed by darkening of the

Table 1 – Status of third molars.

Status of third molars	Frequency	Percentage
Erupted 3rd molar	1700	43.47%
Impacted 3rd molar	2210	56.52%
Missing 3rd molar	490	11.10%

The total number of 3910 third molar found in 1100 subjects of which 1700 were erupted and 2210 were impacted. 490 third molars were found missing.

Table 2 – Impacted 3rd molar distribution.

	Total	Right	Frequency	Left	Frequency
Maxillary arch	460 (20.81%)	230	50%	230	50%
Mandibular arch	1750 (78.18%)	880	50.28%	870	49.71%
Total	2210	1110		1100	

root 7.54%, Deflection of the root 6.46%, Darkening & Bifid root 7.54%, Narrowing of root 2.63%, Interruption of white line 4.97% & lastly narrowing of the canal 2.63%.

4. Discussion

Management of impacted third molars is the most common and perhaps the most controversial surgical procedure in Oral and Maxillofacial surgery. A large population of individuals may have one or more impactions. The prevalence and types of impactions vary in different racial and ethnic groups. These may be due to racial genetic characteristics, inbreeding as well as epi-genetic factors such as food habits. It is therefore important to understand the pattern of impactions in various communities and population sub-groups.

The prevalence and pattern of impacted third molars have been studied by different authors in different parts of the world like, Kramer (1970)⁴ in Harlem hospital, N.Y, Haidar et al (1986)⁶ in Saudi community, Schersten et al (1989)⁷ in Sweden, Odusanya et al (1991)³ in Nigerians, Hattab (1995)⁸ in Jordanian students, and Quek et al (2003)⁹ in Singapore Chinese population.

This study was undertaken to study the epidemiology and pattern of impactions in the Bhopal population. Bhopal is situated in central India and is a predominantly the population of mixed racial and ethnic roots.

Orthopantomographs were taken of 1100 subjects from Bhopal District who consented to participate in our study. Only those subjects who conformed to the inclusion and exclusion criteria outlined previously were selected for the study. The normal time of eruption of third molars are variable, starting at the age of 16 years.¹⁰ The patients included in our study were consecutive individuals in the age group of 20–35 years (mean 26.59). This was consistent with other studies where the subjects were in the same age group (Nanda et al,¹¹ Venta et al,¹² Schersten et al,⁷ Quek et al⁹).

The subjects were clinically examined and their OPG's were taken. Evaluation was done as per guidelines mentioned in the materials and methods. The parameters sought were

prevalence of impacted third molars, angulations, level of eruptions, mesiodistal width of impacted third molar and retromolar space available. The OPG's were also used for evaluating the agenesis of third molars.

Obiechina et al¹³ observed impacted third molars in 72.09% of the Nigerian population. Morris¹⁴ (USA) noticed 65.5%, Kramer et al⁴ reported 89.76%, Grover¹⁵ observed 96.5% of the third molars were impacted. The study conducted in north India by Nanda et al¹¹ and Sandhu et al¹⁰ noted 40% and 68.5% of impacted third molar respectively. In our study, we encountered 50.20% impacted third molar which is lower than the studies of Obiechina,¹³ Kramer,⁴ Pushpinder,¹⁵ Nanda¹¹ and Sandhu¹⁰ but significantly more than that of Schersten⁷ (33%), Hattab⁸ (28.2%), Haidar⁶ (31.9%), and Stephen¹⁶ (16.7%).

Evaluation of the distribution of impactions between maxilla and mandible showed that the number of impactions in maxilla at 20.8% was much less than in the mandible which is 79.1%. This was opposite to the findings of Kramer et al⁴ (USA), Schersten⁷ (Sweden), Hattab⁸ (Jordan) which showed a preponderance of maxillary third molar impactions (63.5%, 53%, 54% respectively) as compared to that of mandible. However the studies from Singapore by Quek et al⁹ noted that the frequency was three fold higher in the mandible than in maxilla. Even the study conducted by Hashemipour et al¹⁷ reported 1.9 times higher incidence of impaction in mandible than in maxilla.

The incidence of congenitally missing M3 in our study group was [11.10%] which is marginally more than the data reported by for the Grover¹⁵ [USA 3.5%], Schersten⁷ for Sweden population [10%] & Hattab et al⁸ for Jordanian students [9.1%]. However, the incidence of congenitally missing third molars in the present study is less than that noted by Venta et al¹² for the Finnish students [12%], Pogrel¹⁸ for Lanes population [18%] & Nanda¹¹ for U.P [India] [40%]. A study conducted by Ramamurthy¹⁹ also reported 12–12.5% of incidence of agenesis in South Indian population.

In our study, the frequency of missing third molars showed a predilection for maxilla over mandible which was consistent with the study of Hattab⁸ & Sandhu,¹⁰ and Nanda.¹¹

In this study out of 2210 impacted third molars, greater frequency of impacted third molars were found to be in a vertical position 1030 (46.6%), followed by 630 (28.5%) in mesioangular, 370 (16.7%) horizontal, 170 (7.69%) distoangular and 10 (0.45%) in an aberrant position. Our study is consistent with the study done by Haidar⁶ in the Saudi population, who noted more frequency of vertical impaction (53.9%) followed by mesioangular (32.7%), distoangular (8.2%) horizontal (5.1%) and 1 (0.6%) in aberrant position. However Hattab et al⁸ and Obiechina¹³ noted more frequency of mesioangular impaction at 50% and 42.2% respectively.

Assessing the level of impaction using PELL and GREGORY classification showed that 97 (43.8%) impacted tooth was in

Table 3 – Incidence of agenesis = 490.

		Frequency	Percentage
Maxillary arch	Right	190	57.57%
330 (67.34%)	Left	140	42.42%
Mandibular arch	Right	90	56.25%
160 (32.65%)	Left	70	43.75%
Out of 490 missing third molars, 330 (67.34%) were noticed in maxillary arch and 160 (32.65%) were noticed in mandibular arch.			

Table 4 – Level of eruption in both the arches.

	Level	Right	Left	Total
Maxillary arch	A	0	10	10 (2.2%)
	B	40	50	90 (19.6%)
	C	190	170	360 (78.3%)
Mandibular arch	A	470	490	960 (54.9%)
	B	350	330	680 (38.9%)
	C	60	50	110 (6.3%)

Table shows that, there is a significant relation between level of eruption and arches ($\chi^2 = 0.586$, $P < .000$). A significant higher frequency of level C (78.3%) was noticed in the maxillary arch where as a higher frequency of level A (54.9%) was noticed in mandibular arch.

position A, 77 (34.8%) was in position B, and 47 (21.2%) was in position C.

Maxillary arch shows a higher frequency of deeply impacted third molar that is in level C (78.3%), than that of the mandible (6.3%). This finding agrees with the observation made by Hattab et al⁸ and Venta et al¹² but differ from the observation made by Kruger et al²⁰ who reported more frequency of deeply impacted third molars in the mandible.

In our study we observed that 350 subjects had 1 of their third molar impacted, 500 subjects had 2 impacted third molars, 140 subjects had 3 impacted third molars, and 110 subjects had all 4 impacted third molars (Graph 2). Therefore the most frequent number of impacted third molars was 2 impactions per person.

Quek et al⁹ had also observed a greater frequency of two impactions per person that is 45% of his subjects had two impacted third molars per person. We had observed that only 11 subjects had all four impacted third molars, much less than that of Morris,¹⁴ who noted 22.3% of his subjects had all four impacted third molars.

Nanda et al¹¹ in his study noted that one impaction per person was the most common in frequency which was different from our study as we noticed that one impaction per person was second in frequency (only 35 subjects had only one impaction per person).

The mesiodistal space available for third molars is as same as or larger than mesiodistal width of the crown then, the crown has more chances to erupt.¹⁶ In the present study the mean mesiodistal crown width of right and left maxilla is 11.3 mm (SD = 1.26) and 10.83 mm (SD = 1.23) and that of right

Table 6 – Incidence of radiographic signs of impacted mandibular third molar to inferior alveolar canal.

S. no	Radiographic sign	Occurrence	Total [1750]
1.	Darkening of roots	132	7.54%
2	Deflection of root	113	6.46%
3	Narrowing of apex	83	4.74%
4	Bifid root apex	92	5.26%
5	Narrowing of canal	46	2.63%
6	Deviation of mandibular canal	233	13.31%
7	Interruption of white line	87	4.97%
8	No relations	964	55.09%

and left side of the mandible is 13.17 mm (1.07) and 13.16 mm (1.18). the corresponding average retromolar space of right and left mandible is 11.88 mm (SD = 2.96) and 12.06 (SD = 2.86) respectively.

The most significant radiological sign noticed in our study was the diversion of the mandibular canal & the least associated sign was found to be narrowing. Our study was in consistent with the study conducted by Rood²¹ & Carrio.²²

5. Conclusion

Evaluating incidence, position, depth and measurements of impacted teeth in a population helps us to compare the patterns of impacted teeth in other regions and sub-populations of the world.

The Bhopal sub-population has a distinct predilection for impactions in the mandible as compared to the maxilla. The most common kind of impaction in the mandible is vertical impactions followed by mesioangular, distoangular and horizontal. Most third molars were noticed in level A, followed by level B and level C. In the maxilla the most common impaction is also vertical followed by mesioangular and distoangular. The level of impaction most commonly seen in impacted third molar in maxilla was level C. In all impactions the mesiodistal width of the tooth was more than the retromolar space, there by accounting for the impactions.

On comparing this study with other regional studies it was evident that there was no universal consensus on incidence or patterns of impactions. These differences may be attributed to inadequate International standardization of evaluation

Table 5 – Angulations of impacted third molars in both the arches.

		Angulation					Total
		V	M	H	D	O	
Maxilla	Frequency	310	50	30	70		460
	%	67.40%	10.90%	6.50%	15.20%		100%
Mandible	Frequency	720	580	340	100	10	1750
	%	41.40%	33.30%	19.9%	5.7%	0.57%	100%
Total	Frequency	1030	630	370	170	10	2210
	%	46.80%	28.20%	16.74%	7.70%	0.50%	100%

A significant association was observed between arches and angular positions. χ^2 Value of 0.286 was found to be highly significant ($P < .001$). From the table it is evident that in maxilla, there was no angular position of O, where as in mandible at least 0.6% of the cases were with angular position O. The most common angulation of impaction was vertical (46.80%) followed by mesioangular (28.2%), horizontal (16.74%), distoangular (7.70%) and others (0.5%).

Graph 2 – Number of impacted teeth per person. In our study we noticed that 350 subjects had one of their third molar impacted, 500 subjects had 2 of their third molar impacted, 140 subjects had three of their third molar impacted and 110 subjects had all of their third molar impacted.

criteria and to the difference in evaluation tools. There is plenty of scope to do standardized global multicentric studies with uniform guidelines and larger number of subjects. This may help us to understand similarities and differences in the patterns of impaction on global level.

Conflicts of interest

All authors have none to declare.

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