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Variant Root Morphology of Third Mandibular Molar in Normal and Impacted Teeth

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ABSTRACT

The mandibular third molar poses a challenge to dental surgeons due to it's unpredictable morphology which leads to increased difficulty during its extraction. The root morphology of the third molar is considered to be the most variable in the human dentition. The study aims to document these variations which will be useful while undertaking procedures on the third molar. Three hundred and fifty nine panoramic views of the mandible were obtained from the Radiology division for patients seeking treatment in the School of Dental Sciences since 2010. The prevalence of third molar impaction was found to be 27%, with mesioangular being the commonest at 21.9% using the Winter's classification. Dilacerations of roots was recorded at 44%, with a ratio of normal to dilacerated of 1:1 seen in impacted teeth while**,** non impacted teeth had a ratio of 1.3:1. Most teeth had 2 roots (85.5%), with one root seen in 12.1%. Partially fused roots was also observed in 2.4% of cases with only one case showing three roots. The total mean distance from the tips of roots to the mandibular canal was -0.5mm. Higher negative means of -1.5mm was recorded in impacted teeth than in normal teeth (-0.2mm). Teeth with dilacerated roots also showed closer proximity to mandibular canal than straight rooted teeth. The left side of the jaw also showed higher negative means. Present findings suggest that careful considerations should be made on impacted teeth. In addition to the type of impaction, proximity to the inferior alveolar nerve (IAN), number of roots and shape of the roots should be assessed. Similar considerations should also be made to non impacted teeth due to the high unpredictability observed in root morphology.

Keywords: Third molar, root morphology, impaction

INTRODUCTION

The mandibular third molars are the most frequently impacted teeth in the human dentition (Kaya et al., 2010) accounting for 98% of all impacted teeth (Fayad et al.,2004). The incidence of impaction of the third molar has been reported to vary between 8-84% in various studies (Venta et al., 2004; Ahlquist and Grondhal, 1991) There is higher prevalence in females as compared to males (Hashemipour et al.,2013). Various theories have been put forward to explain the cause of impaction. The main factor has been lack of space in the jaw (Sadeta et al.,2013). Others include late eruption of the tooth (Hassan, 2011) and the size of the third molar (Forsberg, 1988)

The level of difficulty in extracting impacted third molar has been described in the Pell and Gregory and the Winter's classification (Susarla and Dodson, 2005). Various aspects such as level of eruption, position of the tooth in relation to the ramus of the mandible and the angulation of the tooth have been considered. Despite the useful parameters used, root morphology of the tooth is not put into consideration in assessing difficulty in these classification methods. The third molar shows the greatest variation in the root morphology (Saraswati et al., 2010). The variation in morphology accounts for the complications that occur during disimpaction,

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most common being laceration of the inferior alveolar nerve (Hoseini et al., 2011)

Majority of the third molars (60-70%) studied have two roots (Kuzekanani et al., 2012; Danilo et al., 1998). The variations documented on the mandibular third molar include presence of three roots (Plotino, 2008), fused roots (Danilo et al., 1998), one root (Kuzekanani et al 2012). Most studies on the morphologic variants of the third molar have focused on the number of roots. Literature describing the shape of the root of third molars is scarce especially in Africa despite its importance in third molar disimpaction. The shape of the root may be influenced by the nature of impaction since developmentally, growth of tissue has been shown to be determined by the surrounding structures as described in the functional matrix theory proposed by Moss, (1962). Following this theory, it is expected that the nature of the third molar impaction will have a considerable effect on the shape of the morphology of the third molar. Knowledge on the root morphology will help the surgeon to evaluate the difficulty of the operation and anticipate the complications that may occur. The study therefore aimed describing the various root morphologies occurring in different types of impaction.

Literature has focused on the pattern of impaction of the third molar with little mention of the role the roots of the third molar play in the management of the condition. Ricardo et al., (2011) put forward that the number of root (P< 0,004) and the morphology (P<0.031) were significant predictors of surgical difficulty. The main parameters in root morphology are dilaceration and length. Dilaceration is a developmental disturbance in the shape of teeth whereby there is a sharp bend or curvature in the root of a formed tooth. A curvature of greater than 10° posses a greater risk than lower values. Yamaoka et al., (2009) found the relation between the root angulation and impaction whereby impacted tooth had a higher incidence of angulated roots. The reported prevalence of dilaceration of the roots are very high at 81% (Saraswati et al., 2010). There is little literature on the length of the roots of the third molar which may influence its closeness to the mandibular canal and thus the risk of injuring the inferior alveolar nerve (IAN) during extraction. Some authors have recommended coronectomy of impacted wisdom teeth in case the roots are surrounding the mandibular canal (Matzen et al., 2013; Pogrel et al., 2004). The morphology of the roots has been shown to influence autotransplantation of the third molar (Mendes and Rocha, 2004) in that the morphology of the root may not favor successful transfer of the third molar into the socket of another missing molar

The surgical removal of lower third molars endangers the IAN. Relationship between the roots of the third molar and the mandibular canal exist in various morphologies (Figure 1). Many studies have reported the frequency of nerve injury during the removal of third molars and most indicate that IAN function is disturbed after 4–5% of procedures (range 1.3–7.8%) (Ricardo, 2011). Most patients will regain normal sensation within a few weeks or months and less than 1% (range 0–2.2%) have a persistent sensory disturbance (Robinson, 1997). One study showed that a patient whose lower third molar tooth is touching the mandibular canal the probability of numbness between one week and two years is 60% but this will greatly reduce with the root is farther away from the canal (Jerjes et al., 2006). After injury, unless the nerve is displaced into the socket, the severed nerve ends do not retract, but will remain in apposition. Regeneration within the canal will thus be unimpeded unless obstructed by displaced fragments of bone from the roof of the canal. Good recovery after injury would therefore be expected (Loescher et al., 2003). Panoramic radiography is the standard imaging technique for evaluating third molars. The sensitivity of these radiographs have been reported to be fair but the specificity of the radiographs is quite high (Atieh, 2010).

The study therefore aims to describe the various root morphologies occurring in different types of impaction which will help in surgical approach to the third molar region.

MATERIALS AND METHODS

A descriptive study was carried out at the Radiology division of the Oral and Maxillofacial(OMFS) Department, School of Dental Sciences (SDS), University of Nairobi (UoN), Kenya. The study population comprised of patients who have come to seek dental treatment in the SDS. Sample size was computed using the following formula

$$n = \frac{Z^2 P(1-P)}{C^2}$$

Where,

Z = z value according to the confidence level chosen

P = prevalence of impacted teeth by Kramer et al., 1970 (62.6%)

C = 1- confidence interval

Using a confidence level of 95% and a Z value of 1.96

$$n = \frac{(1.96)^2 0.626(1-0.626)}{(1-0.95)^2}$$

n= 358.98 ~ 359 radiographs

Panoramic radiographs of patients taken from year 2010 until 2013 at the radiology division were assessed. Those that met the selection criteria were listed from the oldest to the newest in terms of the date taken. Radiographs of patients older than 30 years were used to ensure all teeth were fully erupted. Those with pathologies such as tumors and cysts were excluded

The angulation of impacted third molar was documented based on Winter's classification with reference to the angle formed between the intersected longitudinal axes of the second and third molars [The vertical impaction (10° to -10°), mesioangular impaction (11° to 79°), horizontal impaction (80° to 100°), distoangular impaction (-11° to -79°). Those teeth that were not impacted were denoted as normal. The morphology of the roots was studied under each classification and categorized as either straight or dilacerated, with the number of roots recorded in each. The distance in millimetres from the tip of the root to the mandibular canal was measured using the Vernier Caliper. Those radiographs in which the tip was beyond the mandibular canal was recorded as negative.

Data for was entered into SPSS software (Version 16.0, Chicago, Illinois) for statistical analysis, coded and tabulated, although test for significance was not carried out. Photographs and tables were used for data presentation.

Ethical approval was sought from the Kenyatta National Hospital-University of Nairobi- Ethics and Research Committee before the commencement of the study

RESULTS

Type of impaction

Three hundred and fifty nine (359) panoramic radiographs were analyzed bilaterally making a total of 718 mandibular molar teeth. Impaction was seen in 194 teeth (27%). The commonest type of impaction was the mesioangular impaction accounting for 80.9% (157 teeth) of the impacted teeth (Table 1). Different types of impaction can be observed on the same jaw as seen in figure 1.

Table 1: Frequency of the various types of impaction

Type of Impaction		Frequency	Percent (%)
	Normal	524	73.0
	Mesioangular	157	21.9
	Distoangular	7	1.0
	Vertical	9	1.3
	Horizontal	21	2.9
	Total	718	100

Figure 1: panoramic view showing distoangular impaction with mesial root dilacerations on the right lower molar and mesioangular impaction on the left

Morphology of the roots

The third molars showed a very high variability in the shape of the roots with dilacerated teeth accounting for 44% (318) of the teeth analyzed as shown in Figure 2.

Figure 2: Distribution of teeth by shape of the roots

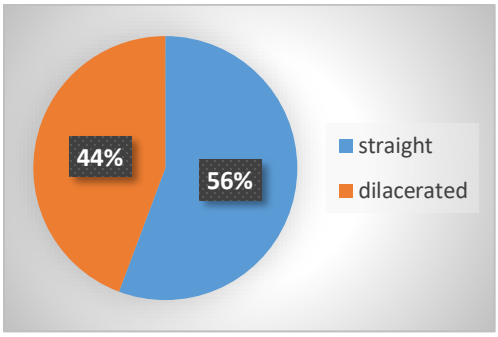

Figure 2:

The ratio of straight to dilacerated roots in non impacted teeth was 1.3:1 (301:223) while in impacted teeth it was 1.0:1 (99:95) showing that impacted teeth have more dilacerated roots (Table 2)

Table 2: Distribution of teeth by type of impaction and shape of the roots

Type of impaction	shape of roots		Total
	straight	dilacerated	
Normal	301	223	524
Mesioangular	83	74	157
Distoangular	4	3	7
Vertical	4	5	9
Horizontal	8	13	21
Total	400	318	718

Most teeth (85.2%) had two roots. One root was observed in 12.1% (87teeth) while the minority (18teeth) had partially fussed roots as shown in Table 3. In only one instance, a third molar was seen having 3 roots. Table 4 shows distribution of number of roots in each type of impaction.

Table 3: Distribution of teeth by number of roots

No of roots	Frequency
1	87
2	612
Fused	18
3	1

Table 4: Distribution of number of roots in different types of impaction

Type of impaction		number				Total
		1 root	2 roots	Partially fused	3 roots	
	normal	64	448	11	1	524
	mesioangular	15	135	7	0	157
	distoangular	3	4	0	0	7
	vertical	3	6	0	0	9
	horizontal	2	19	0	0	21
Total		87	612	18	1	718

Distance of roots from the IAN

The mean distance of the mandibular canal from the tip of the roots of the third molar was -0.53mm with higher means seen in impacted teeth than normal teeth as shown in Table 5.

Table 5: Mean distances of the mandibular canal from the tip of the third molars in each type of impaction

Type of impaction	Mean±SD(mm)
Normal	-0.2±1.81
mesioangular	-1.5±1.30
distoangular	-2.0±2.23
Vertical	-1.1±1.05
Horizontal	-1.3±1.52
Total	-0.5±1.80

Teeth with dilacerated roots also show higher negative means than straight rooted teeth (Table 6). The left jaw also shows higher mean values (-0.7mm) than the right (-0.4mm)

Table 6: Mean distances of the mandibular canal from the tip of the third molars in straight and dilacerated roots

Shape of roots	Mean±SD(mm)
Straight	-0.2±1.93
Dilacerated	-1.0±1.51
Total	-0.5±1.80

DISCUSSION

Present population showed higher prevalence of third molar impaction (27%) when compared to Saudi population showed the prevalence of mandibular third molar impaction to be 18.8% (Syed et al., 2013). Mesioangular impaction was found to be the most common 80.9% of the impacted teeth, which may be attributed to the position of the tooth bud in the socket during tooth formation. This finding is similar in all studies of the third molar although values recorded were higher compared to others for instance Hashemipour et al., (2013) who obtained 48.3% and Ramamurthy et al., (2012) who found 60.3%. A higher incidence of IAN injury has been reported with third molars that are horizontally or mesioangularly impacted and have complete bone cover. Therefore, the higher reported prevalence of these type of impaction in the present study may signify higher probability of nerve damage in the present population. The prevalence of dilacerations of the roots of the third molar was found to be very high (44%) in contrast to a study by Kuzekanani et al., (2012) who found an incidence of 8%, which maybe attributed to the fact that it was not a radiographic study. Malcic et al., (2006) found an incidence of 30.9% in a similar panoramic view study. Present study has revealed that dilacerated roots are commoner in impacted teeth due to lower ratio of straight to dilacerated roots seen in impacted teeth (1:1) compared to that of unimpacted teeth (1.3:1). This suggest that in our population there may be higher difficulty in performing disimpactions.

Most third molars had two roots (85.5%) similar to an Iranian study which found prevalence of 73% (Kuzekanani et al., 2012). Due to similar root morphology to the second and first molars, this allows for easy transplanting of the third molar tooth into the second or first molar socket after they have been extracted (Mendes and Rocha, 2004)

The mean distance of the mandibular canal from the tip of the third molar is -0.5mm, similar to a study by Deshpande (2013) who found a mean of -0.5mm. These findings are more severe in mesioangular and distoangular type of impaction in that higher negative means of -1.5mm and -2.0mm respectively were found. Rood and Shehab, (1990) described radiographic relationship between the root of the third molar and the IAN as shown in Figure 3. Miloro and DaBell (2005) found a mean of 0.88mm in unimpacted teeth whereas in the present study it was -0.2mm, this suggest a higher risk to damage the IAN in the present population. Higher negative means have also been observed in teeth with dilacerated roots as compared to straight roots, suggesting that the surgical difficulty and risk of nerve injury is greater in such situation where both root apposition on the canal and dilacerations occur on the same tooth. The left side of the jaw also showed higher negative means, with the reasons still unknown to us, which may suggest a higher risk of nerve injury on that side. Nevertheless, due to the high unpredictability of impaction, both left and right side disimpaction should be handled with equal care. Jerjes et al., (2006) in their study showed that a patient whose lower third molar is greater than or equal to 1 mm from IAN has a 98% probability of no numbness, while if the tooth is touching the mandibular canal the probability of numbness between one week and less than two years is 60%. The means (-0.5mm) obtained in this study may suggest that the present population may lie in the second group with higher likelihood of numbness, although other factors such as

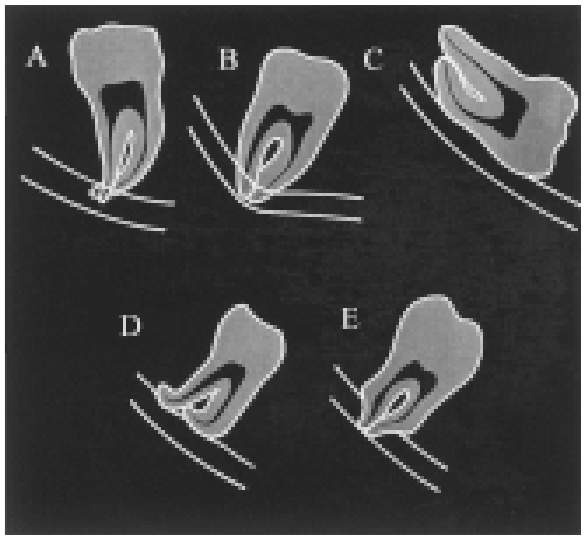

Figure 3: Five radiographic signs suggesting juxtaposition of the mandibular canal to the third molar roots, as described by Rood and Shehab (1990)

the clinician experience will play a role (Bataineh, 2001).

In conclusion, mandibular third molars have shown very high variability in their morphology and relation to IAN. Impacted teeth show a high likelihood of having their roots in close apposition to the inferior alveolar nerve, also the roots of impacted teeth are more prone to dilacerations.

Present findings suggest that careful considerations should be made on impacted teeth. In addition to the type of impaction, proximity to the IAN, number of roots and shape of the roots should be assessed. Same considerations should also be made to non impacted teeth due to the high unpredictability observed in root morphology.

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