

Prevalence of impacted mandibular third molars in population of Arab Israeli: a retrospective study

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Abstract:

Introduction: Impaction may be defined as the failure of complete eruption into a normal functional position of one tooth within normal time due to lack of space in the dental arch, caused by obstruction by another tooth or development in an abnormal position. The mandibular third molar is the most frequently impacted tooth. The incidence varies from 9.5% to 68% in different populations.

Methods: The study was conducted in Center for Dentistry Research and Aesthetics, Jatt, Israel .Study represents retrospective analysis of panoramic radiographs (orthopantomograms) of patients referred to Center for Dentistry Research and Aesthetics, Jatt, Israel from January 2006 to December 2015 .

Results: A total of 1076 patients,649(60,3%) males ,and 427 (39,7%) females visited Center for Dentistry Research and Aesthetics, Jatt, Israel between January2006 and December2015. . A total of 206 patients met the inclusion criteria. The age ranged from 17 to 55years, with a mean age of 28.1 years and the standard deviation was 5.8 years.The prevalence of impacted mandibular third molars for this study was 19,2%.

Conclusion: This study demonstrated that males (62,2%) were more likely to present with impacted mandibular third molars than females (37,8%). The prevalence of third molar impactions was almost the same on both the left (47.8%) and right (52,2%) sides. This study also noted that mesio-angular impactions (50%) were the most common type of impaction. The least common form of impactions was the inverted types (0.3%). The prevalence of impacted mandibular third molars for this study was 19,2%.

Keywords: impacted mandibular third molars, incidence,Arab Israeli(Arab48)

I. Introduction

Impaction may be defined as the failure of complete eruption into a normal functional position of one tooth within normal time due to lack of space in the dental arch, caused by obstruction by another tooth or development in an abnormal position (1). The most often congenitally missing as well as impacted teeth are the third molars, which are present in 90% of the population with 33% having at least one impacted third molar (2). They account for 98% of all the impacted teeth (3). The mandibular third molar is the most frequently impacted tooth (4). The incidence varies from 9.5% to 68% in different populations. (Figure. 1)

Tooth eruption is a complex process that is not fully understood.(5,6) It is made up of a series of physical and biological events that are synchronized with the growth of the jaws.(6) Local as well as systemic factors influence this complex process.(7,8) However, a number of complications may arise during the eruption process and result in impaction. An impacted tooth is defined as “one that cannot and will not assume a normal functioning position and is therefore pathologic and requires treatment”.(9)

The third molar is the last permanent tooth to erupt into the oral cavity and is the most commonly impacted tooth.(5,9) Most impacted third molars are asymptomatic and remain unnoticed unless discovered incidentally on imaging. When discovered, impacted third molars are usually destined for extraction to avoid future complications or the development of pathological conditions. These complications include resorption or decay of the adjacent tooth and crowding while the potential pathological conditions include pericoronitis and dentigerous cyst formation.(8,10)



Figure 1: Orthopantomograph showing impacted kissing molars (second and third molar) in the left mandibular jaw region

Several factors have been reported to be responsible for the high rate of impaction of mandibular third molars. These include deficient space in the dental arch (11), unfavourable angulations and aberrant path of eruption, density of overlying soft and hard tissues, and the late eruption sequence (11). Mesiodistal width of the third molar may also play a role in the tendency for impactions. Svendsen and Maertens have reviewed in detail the etiology of third molar impactions. Two of the cited causes are:

1. lack of space: insufficient anterior-posterior dimension, transverse distance of the alveolar process in the third molar region. Wide alveolar shelves and a greater mandibular width at the ramus in relation to the intermolar width is important

for successful eruption of the third molars.

2. Late third molar mineralization and early physical maturation (12).

Impactions assume different angulations and positions, and may occur in both jaws (maxilla and mandible). A patient may present with one or more impactions in either jaws. Identification of impactions can be done clinically and confirmed with radiographs such as orthopantomographs, lateral obliques and periapicals. The radiograph of choice to assess third molar impactions is the orthopantomograph radiographs (13).

Obimakinde (14) observed that mandibular third molars are the most commonly impacted teeth followed by maxillary third molars, maxillary canines and mandibular canines. According to the three years study conducted by Nzima (15), a total of 171 patients had presented with impacted teeth in the Radiology department and this necessitated this study to determine if they do come to the Maxillofacial and Oral Surgery for treatment.

Third molar teeth are the last to erupt and have a relatively high chance of becoming impacted (10). Impacted third molar teeth are believed to be mainly due to space deficiency which is attributed to many factors such as soft diet, insufficient eruption forces and hereditary factors. The prevalence rates of mandibular third molar teeth varies from one population to another and several authors have reported prevalence rates ranging from 9.5% to 50%, higher in the western region (14). Studies done in Nigerian population reported a prevalence rate of impacted mandibular third molar teeth as 1.9% to 15.1% for rural and urban populations respectively (16). A study done in Kenya reported a prevalence rate of impacted mandibular third molar teeth as 15.8/1000 (1.6%) (17).

Eruption times of third molars are variable, ranging from age 16 to 24 years (18). The mean age for third molar eruption is 17 years. The wide age range found with third molar eruption, as well as positional changes that occur after eruption may be due to differences in race, nature of the diet, the intensity of the use of the masticatory apparatus and possibly due to genetic background ().

Impacted third molar teeth can occur in both the mandible and maxilla but most impactions occur in the mandible. The prevalence of impacted mandibular third molars in the population varies in different studies from 16.7% to 68.6% (10).

The studies of Quek, et al. (19), showed that mesio-angular impactions had the highest frequency, followed by horizontal and then the vertical impactions. According to the study done on Jordanian patients, the mesio-angular impaction was most common, followed by vertical, disto-angular and horizontal impactions (20). Chu, et al. (21) in a study done in Hong Kong reported the classification according to angulation of the impacted wisdom teeth as: horizontal, mesio-angular, vertical, disto-angular and others in order of decreasing prevalence. In another study done in Nigeria, the most prevalent third molar impactions were the mesio-angular, vertical, horizontal, disto-angular and others in the decreasing order of prevalence (16).

The main cause of impaction of teeth is lack of space (22). A study of radiographs from 3,874 dental patients aged over 20 years determined the prevalence of impaction to be 17%; hence, this condition can be considered among the most significant affecting dental care. The most frequently affected regular teeth are the third molars (especially in the mandibular teeth) and the permanent maxillary canines. Impactions can occur simply due to dental crowding, space reduction following premature loss of primary teeth, or an errant path of eruption (23).

The third molar teeth are the last to erupt and may either be partially emerged through the gums or completely hidden. The etiology of the third molar impaction has been investigated in many international studies and several factors were reported as possible causes which include; lack of space distal to the permanent second molar and the ascending ramus, retarded third molar mineralization and the improper angulation of the tooth (10).

It has been theorised that the coarse nature of Stone Age man's diet had the effect of producing extensive tooth wear. Tooth wear would reduce the collective length of the teeth, thus creating enough space to accommodate the wisdom teeth by the time they erupt. Our modern diet does not usually cause a significant amount of this type of tooth wear. It has also been argued that the coarse nature of Stone Age man's diet, as compared to modern man's diet which is relatively soft; probably require more activity of the chewing muscles. The activity could have stimulated greater jawbone growth, thus providing more space for wisdom teeth (24). Other theories include lack of sufficient eruption force, hereditary factors and not enough mesial movement

of the dentition due to lack of interproximal attrition (15). Richardson (25) had found that patients with skeletal class II occlusion were more prone to present with impacted mandibular third molar teeth.

Classification of impacted wisdom teeth may be as follows:

1. Winters (26) classification is based on the relationship of the impacted tooth to the long axis of the second molar tooth;

- a-**Mesio-angular impaction means that the wisdom tooth is angled forward, toward the front of the mouth, more towards the adjacent second molar and generally in contact with the distal surface of the second permanent molar .
- b-**Vertical impaction is where the long axis of the tooth runs parallel to the long axis to the second molar. The vertical type is directed towards the occlusal plane .
- c-**The horizontal type has its long axis lying perpendicular to the second molar, within the mandible and has the crown facing the roots of the adjacent second molar.
- d-**The distal or disto-angular impaction has its long axis angled away from the second molar, the crown facing towards the ramus of mandible .
- e-**Transverse/bucco-angular impactions have the crown directed mainly towards the buccal or lingual side of the face .
- f-**The inverted type of impaction takes a vertical position with the crown directed towards the inferior alveolar canal

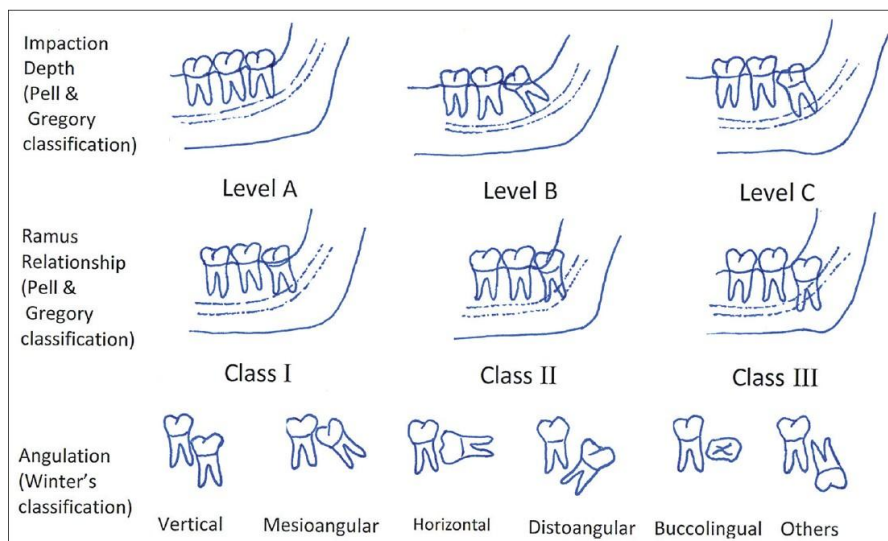


Figure .2: The impaction depth, ramus relationship, and angulation classification of mandibular third molars

Quek, et al. (19) proposed a classification system using orthodontic protractor. In their study angulation was determined by the angle formed between the intersected long axis of second and third molars. They classified mandibular third molar impaction as follows:

- a.** Vertical (0° to 10°)
- b.** Mesioangular (11° to 79°)
- c.** Horizontal (80° to 100°)
- d.** Distoangular (-11° to -79°)
- e.** Others (-111° to -80°)

2. Pell and Gregory classification relates the position of the tooth to the ascending ramus and the second molar (27) ;

- a-**Class I : there is sufficient amount of space between the ramus and the distal surface of the second molar for the accommodation of the mesiodistal size of the crown of the third molar
- b-**Class II: the space between the ramus and the distal surface of the second molar is less than the mesiodistal size of the crown of the third molar.
- c-**Class III : all or most of the third molar is located within the ramus

3. Thoma, as quoted by Obimakinde (14), classified the curvature of the roots of the impacted mandibular molars into three categories:

- a. Straight roots (separated or fused)
- b. Curved roots in a distal position
- c. Roots curved mesially.

The number of roots may be two or multiple. The impacted tooth can also present with fused roots.

4. Impacted third molars can also be classified according to their depth in relation to the adjacent second molar according to Pell and Gregory (23). ;

a-Position A: the highest point of the tooth is on the level at or above the occlusal plane of the second molar.

b-Position B: the highest point of the tooth is below the occlusal plane, but above the cervical line of the second molar.

c-Position C: the highest point of the tooth is below the cervical line of the second molar. (Figure 2)

| N=1076 | Male | Female | Total |
|--------|-------|--------|-------|
| | 649 | 427 | 1076 |
| % | 60.3% | 39.7% | 100% |

Table. 1; Basic statistics for Patients (N=1076)

In addition to the above mentioned classification of impactions, wisdom teeth can also be described as soft tissue or bony impactions. The term bony impaction indicates that the wisdom tooth is still fully encased in the jaw's bone. A soft tissue impaction is one where the upper portion of a wisdom tooth (the tooth's crown) has penetrated through bone, but has not yet fully erupted through the gums (23). Impacted third molars can also be classified as erupted when the crown can be seen totally in the mouth, partially erupted when the crown has penetrated the oral mucosa and is partially visible in the mouth or unerupted when the tooth has not penetrated the oral mucosa (13). The teeth can either be completely encased in bone or soft tissue or part of their crown exposed to the oral environment. Several authors have reported that the partial impaction were most common type (19).

Most studies on gender distribution have reported no sexual predilection in third molar impaction (10). However, some studies have shown that impacted mandibular third molars are more prevalent in females than in males (10). In contrast, the study by Nzima (15) showed that males had a higher risk than females to develop mandibular third molar impactions. The aim of the study was to investigate the prevalent types of impacted mandibular third molar teeth for patients at Center for Dentistry Research and Aesthetics, Jatt, Israel during the period of January to December 2006-2015. The study was to determine:

1. The pattern of impacted mandibular third molars for patients who visited **Center for Dentistry Research and Aesthetics, Jatt, Israel**
2. The prevalence of impacted third molars.
3. The age and gender distribution of impacted third molars

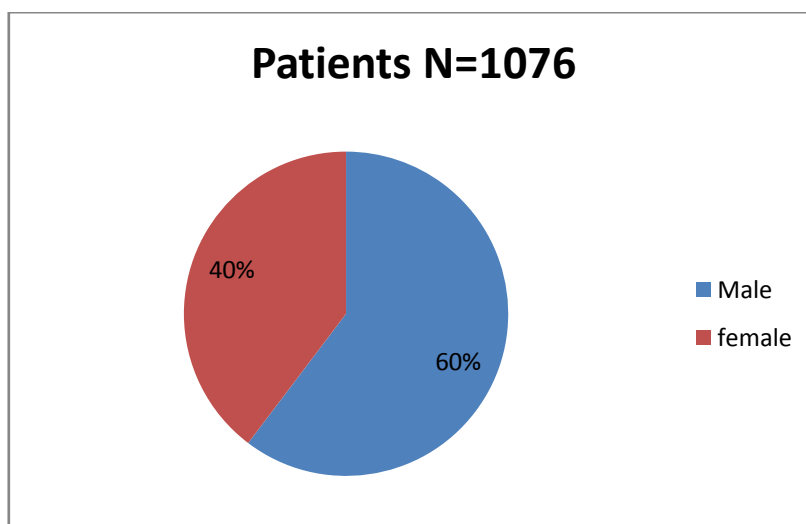


Figure. 3: Gender distribution of patients

II. Materials And Methods

A retrospective study based on patient files with impacted teeth who presented at Center for Dentistry Research and Aesthetics, Jatt, Israel The study was conducted a 10-years period, between January2006 and December2015 . Patients' files with orthopantomographs were considered for evaluation.

| N=206 | Male | Female | Total |
|------------|-------|--------|-------|
| N | 128 | 78 | 206 |
| Age, years | 17-52 | 17-55 | 17-55 |

Table .2; Basic statistics for age, years

The inclusion criteria for this study were the records of patients with orthopantomographs ,IOPAs of the patients requiring surgical removal of the impacted tooth. and above the age of 17years . Patients with no history of trauma. Patients with no syndromes and/or no systemic disorders,. The exclusion criteria were files for patients below 17years and those without orthopantomographs radiographs

The orthopantomographs were examined using a standard radiograph viewing box to evaluate the presence and type of impactions. Impactions were classified according to **Winter's classification** system as follows:

1. Mesioangular
2. Horizontal angulation
3. Distal angulation
4. Vertical angulation
5. Buccolingual/Transverse angulation
6. Inverted angulation.

The radiographs were also assessed to determine the presence of impacted mandibular third molars on either one side or on both the right and left sides.

Since the orthopantomographs were used to identify the third mandibular molar impactions, these are fixed records and will remain valid and objective.

A biostatistician was consulted from the beginning of the study for statistical analysis. Categorical variables (e.g. gender, type of impaction) were summarized by frequency counts and percentages. The Student t-test was used for comparisons of mean values. The comparison of the types of impaction between subgroups (e.g. males versus females of left versus right sides) was performed by the Fisher Exact test. Incidence rates were expressed as percentages with 95% confidence intervals. All statistical procedures were performed on SAS, Release 9.1.3, running under Microsoft Windows Vista Business for a personal computer. All statistical tests were two-sided and p values $\leq 0,05$ was considered significant.

All information gathered from this study was treated with strict confidentiality, patient file numbers were used and no personal information was recorded. Neither the names nor surnames were used during this study.

III. Results

A total of 1076 patients,649(60,3%) males ,and 427 (39,7%) females visited Center for Dentistry Research and Aesthetics, Jatt, Israel between January2006 and December2015. (Table.1) . A total of 206 patients met the inclusion criteria. The age ranged from 17 to 55years, with a mean age of 28.1 years and the standard deviation was 5.8 years. (Table.2)(Figure.3)

| Patients with impacted teeth | | | | |
|------------------------------|------------|-----------|------------|---------------|
| Age group (years) | Male | Female | Total | % |
| 17-20 | 16 | 12 | 28 | 13.6% |
| 21-30 | 55 | 48 | 103 | 50.0% |
| 31-40 | 39 | 13 | 52 | 25.2% |
| 41-50 | 16 | 4 | 20 | 9.7% |
| 51-55 | 2 | 1 | 3 | 1.5% |
| Total | 128 | 78 | 206 | 100.0% |

Table .3; Distribution of impaction in different age groups and gender

Among the 206 patients, there were 128 (62,2%) male patients and 78 (37.8%) female patients (Table3). The male to female ratio of the study group was 1.7:1 (128:78).

The patients were divided into 10 year age groups ranging from 17 to 55years. Note that one group was created to accommodate those above 55years. The 21 to 30 year age group had the highest prevalence of tooth

impaction (50%), but decreases with increasing age (Table 4). The patients were divided into five groups, ranging from 17 to 55 years; each group spanning over a 10 year period.

This distribution of impaction in different age groups and gender showed that impactions tended to increase gradually between 21 and 30 years, and the incidence decreases in frequency with increasing age, except in the 31 to 40 year age group for females who showed an increase in impactions. (Figure4))(Figure5)

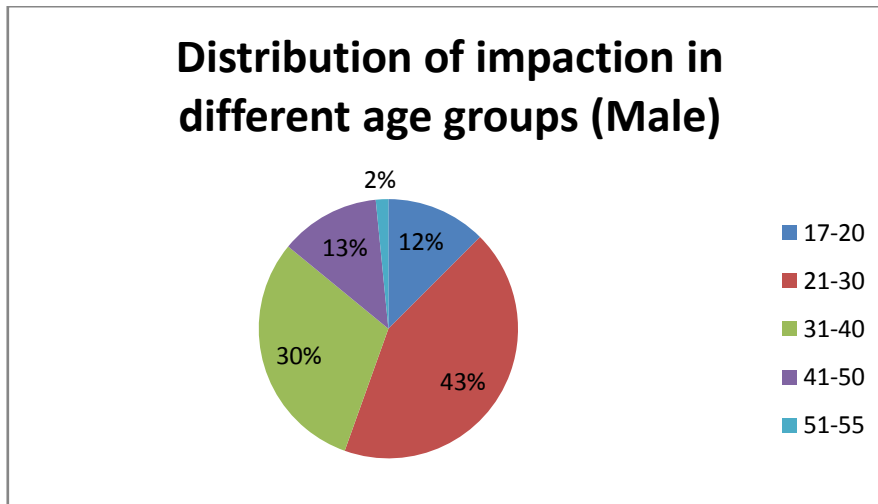


Figure .4: Distribution of impaction in different age groups of male

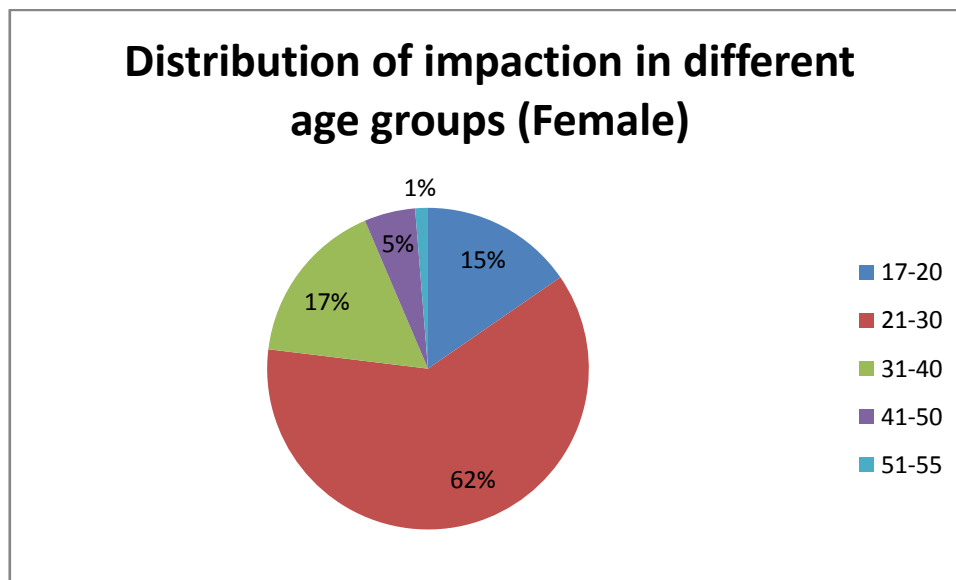


Figure .5: : Distribution of impaction in different age groups of female

The most prevalent type of impaction recorded was the mesio-angular position (52,1%). The distributions of the angulations of impaction on the right and left sides do not differ significantly . (Figure.6,7)

The distributions of the angulations of impaction for males and females do not differ significantly . The mesial angulation is most prevalent – 50% ,Vertical position – 16,2,% Horizontal position – 16.5% Distal position – 15.9%

Transverse position – 1,2% ,and inverted position was the least prevalent –0,3%

The prevalence of impacted mandibular third molars for this study was 19,2%. This is comparable to that reported by Quek, et al. (19), who had noted that the occurrence of third molar impaction was between 18% and 32%. (Table4)(Figure.6,7)

IV. Discussion

This is the first study to evaluate incidence of impacted third mandibular molars in population of Arab Israeli(Arab48). Also, there is no conducted and published researches from other institutions in Israel which deal

with impacted teeth. The sample size used was equivalent to the samples used in many other international studies, and selection of patients was also like other studies which enables comparison of results.

In 1986, Haidar and Shalhoub were the first to attempt to estimate the prevalence of impacted third molars in the Saudi population.(28) Using a sample of 1000 patients from the central region of Saudi Arabia, they estimated the prevalence at the time to be 32.3%.(28) Then in 2010, Hassan repeated the attempt using a sample of 1039 patients from the western region of Saudi Arabia and calculated the prevalence to be 40.6%.(29) Recently in 2012, Syed et al. published another prevalence report using a sample of 3800 patients from the Asir region of Saudi Arabia and estimated the prevalence at 18.76%.(9)

| Angulations of impaction | Right [48] | % | Left [38] | % | Total % | |
|--------------------------|------------|-------------|------------|---------------|------------|---------------|
| Mesial | 87 | 52.1% | 77 | 47.8% | 164 | 50.0% |
| Distal | 25 | 15.0% | 27 | 16.8% | 52 | 15.9% |
| Horizontal | 25 | 15.0% | 29 | 18.0% | 54 | 16.5% |
| Vertical | 27 | 16.2% | 26 | 16.1% | 53 | 16.2% |
| Transverse | 2 | 1.2% | 2 | 1.2% | 4 | 1.2% |
| Inverted | 1 | 0.6% | 0 | 0.0% | 1 | 0.3% |
| Total | 167 | 100% | 161 | 100.0% | 328 | 100.0% |

Table .4; Prevalence of impacted mandibular third molar teeth and their orientation

In the study of Azaz on 200 mandibular impacted third molars, 60% of them had distinct relations to inferior alveolar canal nerve, 19% had true relations and 41% were as superimposition. The majority of the molars showed complete root formation in the third decade of life (31).

In the study of Sheikh, the prevalence of distal caries of the second molar adjacent to the impacted third molar was evaluated. Out of 200 evaluated impacted third molars, there was distal caries of the second molar in 42.5% of cases. Fifty one percent of the third molars had mesioangular impaction (32). In this study, the prevalence of distal caries of the second molar (11.2% in mandible and 5.3% in maxilla) was much less than their study, which can be due to differences in the hygienic level of both studied populations. Also, according to these findings, it seems that the angulation of impaction is important in distal caries of second molar, because in our study the angulation of impacted teeth in the mandible was mesioangular in most cases (41.89%) and, compared to maxilla whose angulations of third molars were upright in most cases (59.33%), the prevalence of distal caries of second molars were more prevalent.

Studies in Nigeria showed that mesioangular type of impaction was the most frequently seen (16). Likewise, it was also the most common type among Chinese (80%) and Korean populations (46.5%) (19). A study in Thailand revealed that out of 680 impacted molar extractions, 402 teeth were mesioangularly impacted (33). One Spanish study done by (34) showed similar results where mesioangular was most common (71.5%) while another study in Barcelona documented that vertical angulation type of impaction was predominant (47.9%) and mesioangular was about 20.5% (35) also concluded that mesioangular impaction was the most frequently seen (52.3%) followed by horizontal (26.4%), vertical (12.2%) and distoangular impaction (9.1%). Hassan (29) also concluded that the most common angulation of impaction in the mandible was the mesio – angular type (33.4%), followed by the horizontal (27.5%). However, a study among Jordanians found that vertical impaction was the most common type (61.4%) and mesioangular type was only 18.1% (36). Sasano, et al. (37) in their studies had observed that mandibular third molars with vertical (46%), horizontal (34%), mesial (19.5%) and distal (0.5%) which was not in agreement with this study.

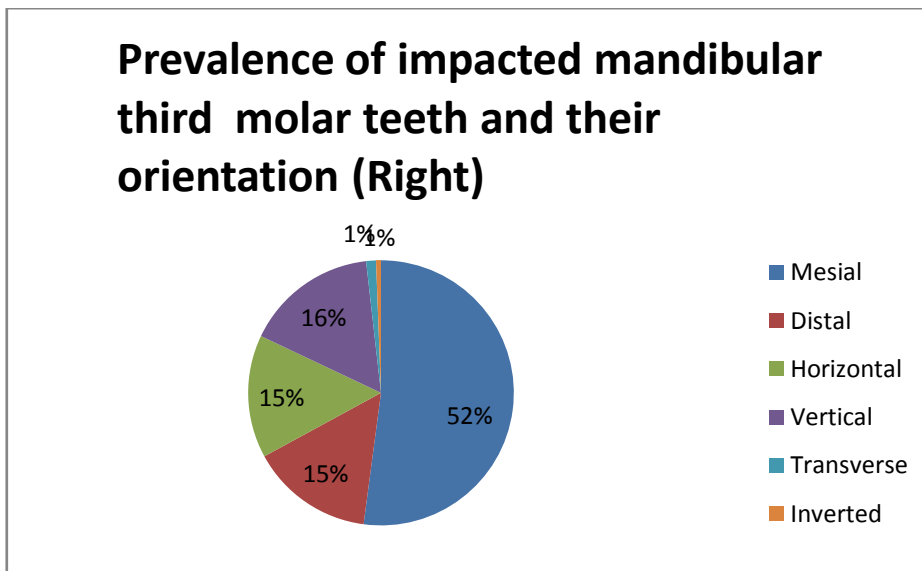


Figure .6: Prevalence of impacted mandibular third molar teeth and their orientation (RIGHT)

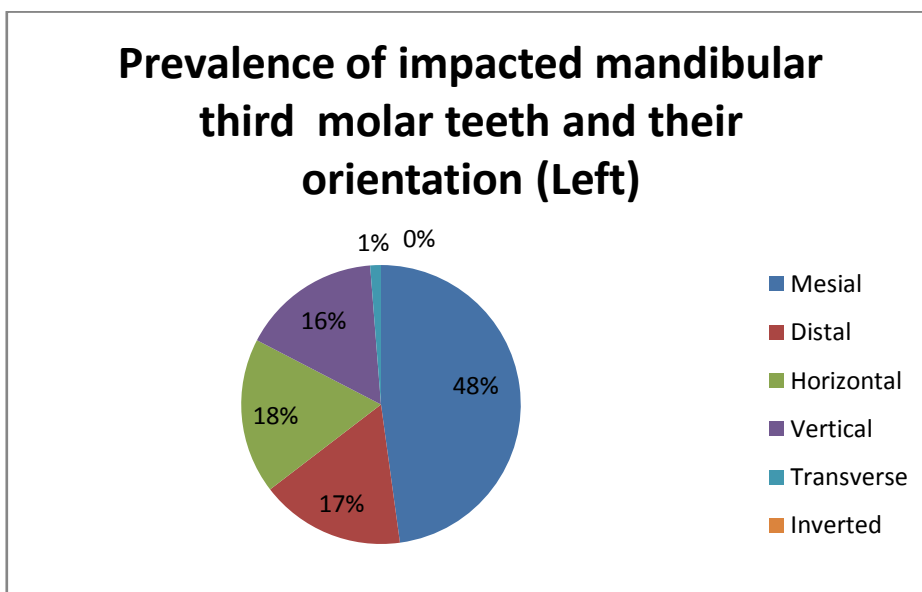


Figure .7: Prevalence of impacted mandibular third molar teeth and their orientation (Left)

The prevalence of impacted mandibular third molars for this study was 19,2%. This is comparable to that reported by Quek, et al. (19), who had noted that the occurrence of third molar impaction was between 18% and 32%.

The female to male ratio of the study group was 1:1.7(78:128). This distribution is similar to that reported by Nzima, where the female to male ratio was 1:1.5 (15). Contrary to our findings, Qirreish (15) have reported that there were more females than males who presented with impacted mandibular third molars. Some studies have reported no sex predilection about third molar impaction (29). The mean ages of males and females do not differ significantly (t- test, p = 0,082).

The impacted mandibular third molars are common amongst young adults. It was found that patients in the age group 21 and 30 years were most likely to present with impactions, with 103 (50%) patients, followed by patients between 31and 40years with 52 (25.2%). From this study, it is evident that impacted third molars decrease with corresponding increase in the age of patients. Furthermore, the study also showed that males between 21 and 30 years presented more frequently with impacted mandibular third molars than females. Obiechina, et al. (16) observed that patients in the 21-30 year age group presented with the highest number of impactions.

The mesio angular impaction was the most common type seen with a 50% incidence, followed by horizontal impactions with 16,5% then vertical inclination with 16,2%, and distal inclination (15,9%). The transverse inclination 1,2% and inverted was the least with 0,3%. This study is in agreement with the findings of Nzima (15), who found that mesioangular impactions were the most predominant type of impaction which was followed by vertical and horizontal impactions.(38,39,40)

The distributions of the angulations of impaction on the right and left sides do not differ significantly . Also the distributions of the angulations of impaction for males and females do not differ significantly.

V. Conclusions

The study was conducted over a period of 10- years probably a longer period would give a better picture of the problem of impacted molar teeth. The prevalence of impacted third molar teeth in a population of patients from Arab Israeli(Arab48) is 19.2%. This study demonstrated that the female to male ratio is 1:1.7, more males were likely to present with impacted mandibular third molars than females. The prevalence of third molar impactions was almost the same on both the left and right sides. Mesio-angular impactions were the most prevalent type of impaction, followed by horizontal, vertical, distal ,transverse,and inverted angulations.

References

- [1]. Abu-Hussein M., Watted N., WatteA., Abu-Hussein Y., Yehia M., Awadi O., Abdulgani A .. Prevalence of Tooth Agenesis in Orthodontic Patients at Arab Population in Israel. International Journal of Public Health Research. Vol. 3, No. 3, 2015, pp. 77-82.
- [2]. Haq Z. A Survey of reasons for Surgical Removal of Impacted Mandibular third Molar in Armed Forces Personnel at AFID Rawalpindi. Pak Oral Dent J 2002;22:137-9.
- [3]. Sadermi Fayad J, Levy JC, Yazbeck C, Cavezian R, Cabanis EA. Eruption of third molars: relationship to inclination of adjacent molars. Am J Orthod Dentofacial Orthop 2004;125:200-2.
- [4]. Peterson LJ. Principles of management of impacted teeth. In: Peterson LJ, Eills E, Huup JR, Tucker MR, editors. Contemporary oral and maxillofacial surgery. 4th ed. New York: Mosby, 2003;184-213.
- [5]. Pedro FL, Bandeca MC, Volpato LE, Marques,AT, Borba AM, Musis CR, et al. Prevalence of impacted teeth in a Brazilian subpopulation. The journal of Contemporary Dental Practice. 2014;15(2):209-13.
- [6]. Polat HB, Ozan F, Kara I, Ozdemir H, Ay S. Prevalence of commonly found pathoses associated with mandibular impacted third molars based on panoramic radiographs in Turkish population. Oral surgery, oral medicine, Oral Pathology, Oral Radiology, and Endodontics. 2008;105(6):e41-7.
- [7]. Shapira Y, Kufninec MM. Rootless eruption of a mandibular permanent canine. American Journal of Orthodontics and Dentofacialorthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2011;139(4):563-6.
- [8]. Abu-Hussein M., Watted N., Yehia M., Proff P., Iraqi F.; Clinical Genetic Basis of Tooth Agenesis, Journal of Dental and Medical Sciences2015,14(12),68-77
- [9]. Syed KB, Zaheer KB, Ibrahim M, Bagi MA, Assiri MA. Prevalence of Impacted Molar Teeth among Saudi Population in Asir Region, Saudi Arabia – A Retrospective Study of 3 Years. Journal of international oral health: JIOH. 2013;5(1):43-7.
- [10]. Hasan S, Ahmed SA, Reddy LB. Dentigerous cyst in association with impacted inverted mesiodens: Report of a rare case with a brief review of literature. International Journal of Applied & Basic Medical Research. 2014; 4 (Suppl 1):S61-4.
- [11]. Bishara SE, Andreasen G. Third molars: a review. Am J Orthod 1983;83:131-7. Svendsen H, Maertens JKM. Etiology of third molar impaction. In: Andreasen JO, Petersen JK, Laskin DM, eds: Textbook and Color Atlas of Tooth Impactions. Copenhagen: Munksgaard 1997;223-227.
- [12]. Gupta S, Bhowate R, Nigam N,Saxena S. Evaluation of Impacted Mandibular Third Molars by Panoramic Radiography. International Scholarly Research Network. 2010; 1-8.
- [13]. Obimakinde O S. Impacted mandibular third molar surgery; an overview. A publication by the dentscope editorial Board. 2009; 16.
- [14]. Nzima N. Radiographic overview of impacted third molars presenting at MOHC: A three year retrospective study. Masters degree dissertation in the department of Maxillofacial and Oral Radiology in the faculty of Dentistry at the University of Limpopo, Medunsa campus.2005.
- [15]. Obiechina A E, Arotiba J T,Fasola AO. Third molar impaction: evaluation of The symptoms and pattern of impaction of Mandibular third molar teeth in Nigerians. Odonto-Stomatologie Tropicale. 2001; 93:22-24.
- [16]. Mwaniki D,Guthua S W. Incidence of impacted mandibular third molars among dental patients in Nairobi Kenya.Odonto-Stomatologie tropical, 1992; 6:17-19.
- [17]. Fayad J B, Julia Cohen Levy J C, Chadi Yazbeck C, Robert Cavezian R, Cabanis E. Eruption of third molars: Relationship to inclination of adjacent molars. American Journal of Orthodontics and Dentofacial Orthopedics. 2004; 125:200-2
- [18]. Quek S L, Tay C K, Tay K H,Toh S L. Pattern of Third Molar Impaction in a Singapore Chinese Population: A Retrospective Radiographic Survey. International Journal of Oral Maxillofaial Surgery.2003; 32: 548-552.
- [19]. Ma'aïta J K. Impacted third molars and associated pathology in Jordanian patients. Saudi Dental Journal. 2000; 12 (1).
- [20]. Chu F C S, Li T K L, Lui V K B, Newsome P R H, Chow R L K, Cheung L K. Prevalence of impacted teeth and associated pathologies-a radiographic study of Hong Kong Chinese population. Hong Kong Medical Journal. 2003; 9 (3): 158-163
- [21]. Qirreish E J. Radiographic profile of symptomatic impacted mandibular third molars in the Western Cape, South Africa. Masters degree dissertation. Western Cape: University of Western Cape.2005.
- [22]. Farman A G. Tooth Eruption and Dental Impactions. Panoramic Imaging News. 2004; 4 (2): 1-9.
- [23]. Kaifu Y, Kasai K, Townsend G C, Lindsay C, Richards L C. Tooth Wear and the “Design” of the Human Dentition: A Perspective from Evolutionary Medicine. Yearbook of physical anthropology. 2003; 46:47–61.
- [24]. Richardson M. The Etiology and Prediction of Mandibular Third Molar Impaction. Angle Orthodontic. 1977; 47: 165-72.
- [25]. Winter G B. Impacted mandibular third molars. St Louis, American Medical book company. 1926
- [26]. Hupp J R, Ellis E,Tucker M R. Contemporary Oral and Maxillofacial surgery. 5th edition. Mosby Elsevier. 2008; 160 - 165.
- [27]. Haidar Z, Shalhoub SY. The incidence of impacted wisdom teeth in a Saudi community. International Journal of Oral and Maxillofacial surgery. 1986;15(5):569-71.
- [28]. Hassan AH. Pattern of third molar impaction in a Saudi population. Clinical, Cosmetic andInvestigational Dentistry. 2010;2:109-13.

- [29]. Syed KB, Zaheer KB, Ibrahim M, Bagi MA, Assiri MA. Prevalence of Impacted Molar Teeth among Saudi Population in Asir Region, Saudi Arabia – A Retrospective Study of 3 Years. *Journal of international oral health: JIOH*. 2013;5(1):43-7.
- [30]. Azaz purcha, B. Shteyer, A. and Piamenta, M. (1976) “Radiographic and clinical manifestations of the impacted mandibular third molar” *Int J Oral Surg* 5(4) 153-160
- [31]. Sheikh, M.A. Riaz, M. and Shafiq, S. (2012) “Incidence of distal caries in mandibular second molars due to impacted third molars- A clinical and radiographic study” *Pakistan Oral & Dental Journal* 32(3) 364-370.
- [32]. Unwerawattana W. Common symptoms and type of impacted molar teeth in King Chulalongkorn Memorial Hospital. *Journal of the medical association in Thailand*. 2006; 89(3): 134 – 139.
- [33]. Chaparro-Avendaño AV, Pérez-García S, Valmaseda-Castellón E, Berini-Aytés L, Gay-Escoda C. Morbidity of third molar extraction in patients between 12 and 18 years of age. *Medical Oral Pathology Oral Cir Bucal*. 2005; 10(5): 422-431.
- [34]. Almendros-Marqués N, Berini-Aytés L, Gay- Escoda C. Influence of lower third molar position on the incidence of preoperative complications. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology Endodontics*. 2006; 102(6): 725-732.
- [35]. Bataineh AB, Albashaireh Z S, Hazza'a, A M. The surgical removal of mandibular third molars: a study in decision making. *Quintessence International*. 2002; 33(8):613-617.
- [36]. Sasano T, Kuribara N, Iikubo M, Yoshida A, Satoh-Kuiriwa S, Shoji N, Sakamoto M. Influence of an Angular Position and Degree of Impaction of Third Molars on Development of Symptoms: Long Term Follow-Up under Good Oral Hygiene Condition. *Tohoku Journal Of Experimental Medicine*. 2003;200:75-83.
- [37]. Khawaja NA. Third molar impaction: a review. *J Pak Dent Assoc* 2006;15:97-101.
- [38]. Ramamurthy A, Pradha J, Jeeva S, Jeddy N, Sunitha J, Kumar S. Prevalence of mandibular third molar impaction and agenesis: a radiographic south Indian study. *J Indian Aca Oral Med Radiol* 2012;24(3):173-176
- [39]. Byahatti S, Ingafou MSH. Prevalence of eruption status of third molars in Libyan students. *Dental Research Journal*, 2012.9;2:152-157