

Epidemiological Study of Impacted 3<sup>rd</sup> Molars: A Retrospective Study in Guyana

Sadia Musahab\*, Leah Farinha, Saajidah Sattaur, Brandon Yong, Yassim Aguilá and Ruematta Overton

University of Guyana, School of Dentistry, Guyana

\*Corresponding Author: Sadia Musaha, University of Guyana, School of Dentistry, Guyana.

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Sadia Musahab, et al.

### Abstract

**Objective:** To establish the prevalence, patterns, and trends associated with Impacted Third Molars among the adult Guyanese population.

**Method:** A descriptive-retrospective study was conducted utilizing records obtained from a private dental clinic between January 2022-December 2023. Participants were adult patients with at least one impacted third molar.

**Results:** Among 120 participants with 281 impacted molars, the highest prevalence was identified among females aged 21-30 years (24.2%). Quadrant 4 exhibited the highest number of impactions. According to Winter's Classification, distoangular and mesioangular impactions were predominant in the maxilla and mandible, respectively. According to Pell and Gregory's Classification, Class 1 and Position B were most frequent. Maxillary cases depicted sinus approximation (89%), whereas 15% of mandibular cases were associated with the mandibular canal. Complications associated with impacted third molars included sinus cysts, supernumerary teeth, hypercementosis, impacted second molars and carious second molars.

**Conclusion:** This study demonstrated that impacted third molars were most common among the 21-30 year old female population, with a propensity for the fourth quadrant. Distoangular and mesioangular impactions were most prevalent in the maxilla and mandible, respectively. Class I and Position B also predominated. Most mandibular impacted third molars had no relation to the mandibular canal, whereas most maxillary impactions were within proximity to the sinus. Carious adjacent second molars were the most frequent complication.

**Keywords:** Impacted Third Molar; Epidemiological; Pattern; Classification; Prevalence; Guyana; Caribbean

### Abbreviations

CBCT: Cone Beam Computerized Tomography; MTM: Mandibular Third Molar; MxTM: Maxillary Third Molar; MoH: Ministry of Health; IT: Impacted Tooth/Teeth; ITM: Impacted Third Molar; IMTM: Impacted Mandibular Third Molar; IMxTM: Impacted Maxillary Third Molar

### Introduction

#### Background/Rationale

Globally extractions of ITM's are frequently performed in dental practices [1]. An IT is a tooth that fails to erupt into its functional position within the dental arch during the expected time frame [2]. Their etiology is multifactorial and can include close association to an adjacent tooth, dense overlying bone or soft tissue, genetic

abnormality, abnormal path of eruption into the mouth, pathological lesions and size discrepancy between the space available in the jaws [3]. Previous research noted a prevalence of impactions from 9.5% to 68% [3].

The prevalence of IT refers to the percentage of a population with IT, specifically in this research ITMs. The most common IT are the MTM and MxTM because they are the final teeth to erupt hence are more prone to encounter lack of dental arch space [5]. According to Passi [3]; Msagati [6] MITM have a higher incidence than IMxTMs. Most previous studies reported a female predominance between ages 25-30 years [3]; Ali [4]; Msagati [6]. However, to date, limited research has been noted in Guyana, leading to a lack of statistical information regarding the distribution and prevalence

of IT. This lack of knowledge may contribute to an increased risk of complications experienced by patients in this region and can lead to less than favorable treatment outcomes.

Various systems of classification are available for IT, the most common of which is proposed by Winter (1926) [2]. The classic positions include mesioangular, distoangular, horizontal, vertical with further positions including linguoangular, buccoangular and inverted. Pell and Gregory proposed a classification based on the relationship of the third molar and the occlusal plane of the second molar. Association of third molars to pathological lesions have been well documented [8]. Msgati reported that 45.2% of the study population had a carious lesion on an IT while 22.4% had a carious lesion on the adjacent second molar [6].

According to the evolutionary theory of impaction, both maxillary and mandibular jaws have become increasingly smaller with less space remains for the third molars, attempting to explain the frequency of impaction in modern society [7]. Gkantidis suggested that craniofacial size reduction is associated with cases of third molar agenesis as a developmental mechanism. Third molar agenesis is defined as the failure of a tooth to develop completely or failure to develop within the expected time period [8,9]. Given the complexity of the Guyanese population, it is prudent to understand the relation to ITM and associated complications. Findings of this study provides reliable statistical data that may be used to guide the evaluation and treatment of ITMs. It also highlights the possible complications that may arise based on the age, gender and race in Guyana.

### Problem statement

Globally third molars are a constant nuisance due to their tendency to partially erupt or completely remain in the dental arches throughout the life of a patient. Consequently, one of the most common procedures performed by oral and maxillofacial surgeons is surgical removal of IT [10]. Symptoms experienced include pain, swelling of the gums and cheeks, redness and difficulty opening the mouth. IT are frequently associated with pathological lesions resulting in further deterioration of the surrounding dental tissue and jaws. Several pathologies including pericoronitis, dental caries, cysts and tumors are associated with several classes of impactions [3].

The study of IT has been explored extensively in several continents and has aided clinicians in treatment planning [6,10]. How-

ever, in the Caribbean and South America limited data is available, hence, the relevance of this study. This study highlights the complexity of the third molar with regards to the diverse Guyanese population.

### Purpose of the study

This study analyzed and cataloged all cases of ITM among the population ranging from 18 years and older in a private dental clinic in Georgetown, Guyana, between the period of January 2022 and December 2023. The findings may be used to guide the MOH in the creation of policies on the treatment and management of impacted molars in dental clinics in Guyana. The findings will also serve as a foundation for successive research on impactions and provide upcoming and current dental surgeons with current information on ITMs.

### Research objectives

The specific objectives of this research were as follows

- To determine the distribution of ITM according to the sex and age of the patients in Georgetown, Guyana.
- To determine the distribution of ITM amongst the dental quadrants in patients in Georgetown, Guyana.
- To classify ITM according to Pell and Gregory and Winter Classification, and to further determine which of the classifications are most prevalent in Georgetown, Guyana.
- To identify the anatomical relationships of the Mandibular ITM to the mandibular canal and Maxillary ITM to the maxillary sinus.
- To identify the types and prevalence of complications associated with ITM that is radiopacity, radiolucency, root resorption, displacement of adjacent teeth, cysts and tumors.

### Methodology

#### Description of study site

Guyana is located on the northern mainland of South America [11]. It is divided into 10 administrative regions with its capital Georgetown located in region 4. Georgetown is the country's most vibrant and densely populated town. Given the country's possession of rich dense forests, the majority of Guyana's population resides on the coastal strip. Consequently, there is a concentration of urban and commercial activities, inclusive of private dental clinics in Georgetown.

### Study population

The study population included adults above the age of 18 years who were patients of record at a private dental clinic. The non proportional purposive sampling method was utilized and the samples included patients that were treated for ITMs between the period of January, 2022 to December, 2023.

### Study design

A descriptive- retrospective study design was utilized, which describes the observational study that focuses on data that has already been gathered in the past. It is used to describe the characteristics of a group using records, information or data previously collected [12]. This design allowed for swifter and more efficient analysis [13].

### Inclusion criteria

The study population consisted of participants above 18 years old who were patients of the private dental clinic studied between the period of January, 2022 to December, 2023. Participants possessed at least one ITM.

### Exclusion criteria

Persons who had all ITMs extracted; congenitally missing third molars and unclear radiographs but ideal anatomy were excluded from the study.

### Procedure

With the intention of gathering a conclusion the following steps were taken

- The research proposal was submitted to the Institutional Review Board, MOH for permission to pursue the study on December 20<sup>th</sup>, 2023.
- Following approval, a request was submitted to the private dental clinic on January 30<sup>th</sup>, 2024. The request entailed permission to analyze radiographic data of patients within the study period.
- CBCT Images and Digital panoramic radiographs of patients with ITMs were retrieved.
- The radiographic data was interpreted and analyzed to reflect the objectives for this research.

### Limitations

The following constraints were encountered:

- Inability to make generalized assumptions about the entire Guyanese population as this study was restricted to a single private dental clinic with readily accessible and accurate documentation.

- Data on ethnicity was unavailable at the research site and therefore was not analyzed.
- Collection of data during working hours of the private dental clinic was challenging, given that dental surgeons were pre-occupied with patients.
- Detection of periodontal and pericoronal pathology would have been better assessed if visual and tactile assessment was used.
- The quality of CBCT and Panoramics were variable, thus the complete root, and relationship to the mandibular canal and maxillary sinus was difficult to fully observe in some cases.

### Results

A total of 700 panoramic radiographs and CBCTs were reviewed. Participants were selected and eliminated according to the inclusion and exclusion criteria outlined earlier. The total number of 281 ITMs were found among 120 participants. The results gathered were tabulated and graphically presented.

ITM cases were grouped according to both age and sex as shown in figure 1.

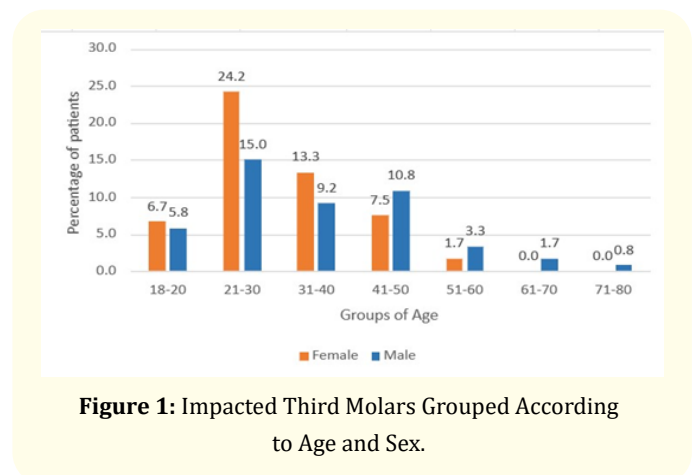


Figure 1 shows ITMs according to age and sex. Females constituted 53.3%; males 46.7% of the total population of 120. The greatest percentage of ITMs occurred among females aged 21-30(24.2%). Females between the 21-30 age range were 3 times more likely to have an ITM than those between 18-20 (6.7%), and almost 2 times more likely than those ages 31-40 (13.3%). Males were most affected at ages 21-30 (15%) and a comparable 10.8% was seen between 41-50. These results indicate that males of advanced age are more likely to present with an ITM than females.

Data was evaluated to observe the distribution of ITM amongst each dental quadrant as displayed in figure 2.

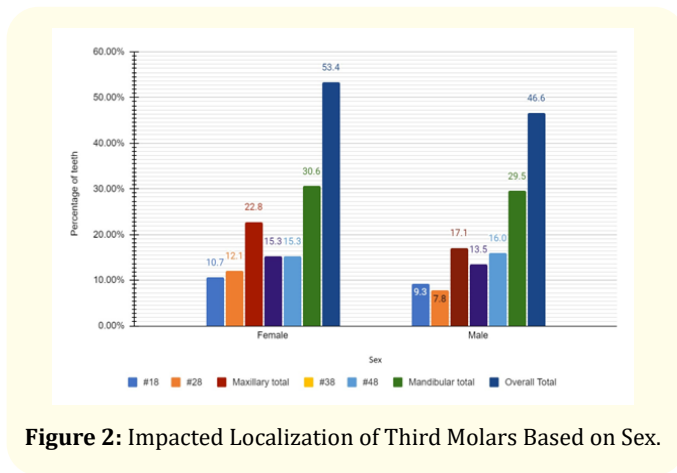


Figure 2: Impacted Localization of Third Molars Based on Sex.

The localization of IMxTM and IMTH expressed as percentages is depicted in Figure 2. These percentages were grouped based on quadrants and compared by sex. In the maxilla, molar localization in females displayed more impacted molars on the left side (tooth #28 with 12.1%) while males displayed more impacted molars on the right (tooth #18 with 9.3%). In the mandible, molar localization in females did not display a predilection for left or right sides while in male ITMs predominated the right side (tooth #48 with 16%) over the left (tooth #38 with 13.5%). Overall this data shows that females have 6.8% more ITMs in both maxillary and mandibular arches when compared to males.

The prevalence of each type of ITM according to jaw (maxilla and mandible respectively) is shown in figure 3.

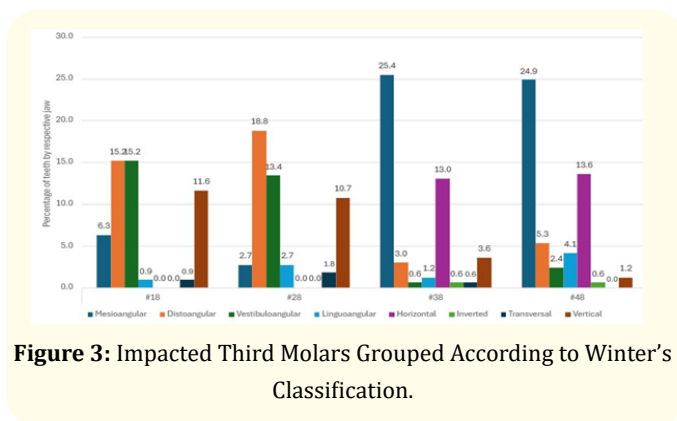


Figure 3: Impacted Third Molars Grouped According to Winter's Classification.

The percentages were calculated from the total of 112 IMxTM and 169 IMTM. The greatest percentages of ITMs were mesioangular, occurring predominantly in the mandible and affecting both tooth #38 (25.4%) and #48 similarly. Horizontal and inverted ITMs were seen exclusively in the mandible.

In the maxilla, distoangular impactions were the most prevalent and favored tooth #18 and #28 similarly (15.2%; 18.8% respectively). The second most common were, vestibuloangular impactions which affected both tooth #18 and #28 (15.2%; 13.4% respectively). Vertical impactions also involved tooth #18 (11.6%) and #28 (10.7%) similarly. Mesioangular IMxTMs broke this trend, since they were 2 times more likely to affect tooth #18 (6.3%) than #28 (2.7%).

The prevalence of each type was further categorized based on sex in the maxilla is shown in figure 4, as well in the mandible in figure 4.

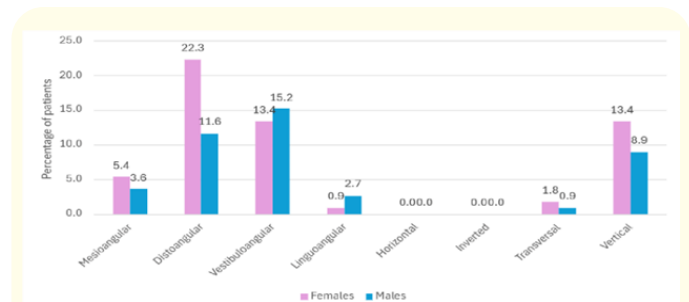
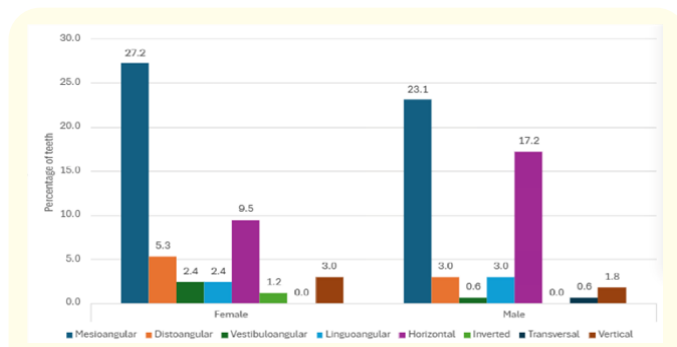


Figure 4: Impacted Molars in the Maxilla Represented by Winter's Classification.

The most common ITM was distoangular with 22.3% females. In the maxilla this type of impaction was 2 times more prevalent in females than males who also had greater predisposition to mesioangular, transversal and vertical impactions. Within the male population the most common type of impaction was vestibuloangular (15.2%), however, females also showed a similar propensity for this type of impaction with a difference of only 1.8%. Linguoangular impactions were more prevalent in males (2.7%) versus 0.9% in females. This infers that linguoangular IMxTMs are 3 times more likely to occur in males than in females.

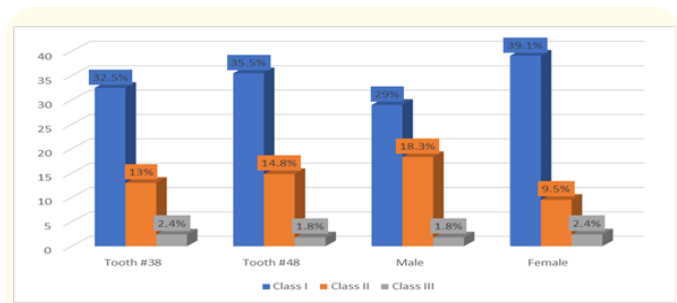
There were zero horizontal and inverted ITMs amongst both sexes within the maxilla.



**Figure 5:** Impacted Molars in the Mandible Represented by Winter's Classification.

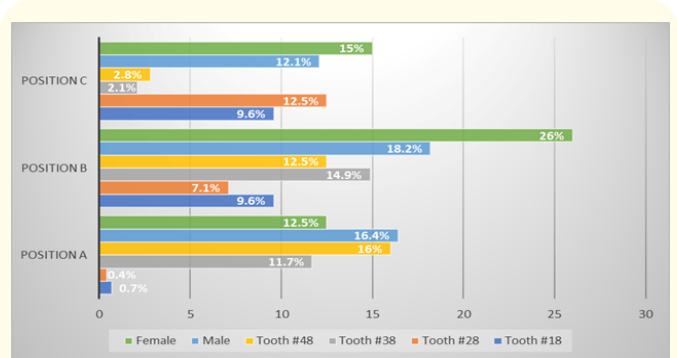
Mesioangular impactions were the chief ailment in both females (27.2%) and males (23.1%). Horizontal impactions were the second most common type of impaction in both females (9.5%) and males (17.2%). This data suggests that horizontal impactions are almost 2 times more likely to occur in males than females.

The classification based on mandibular ramus is displayed in figure 6.



**Figure 6:** Pell and Gregory classification based on relation to mandibular ramus (Class I, II, III).

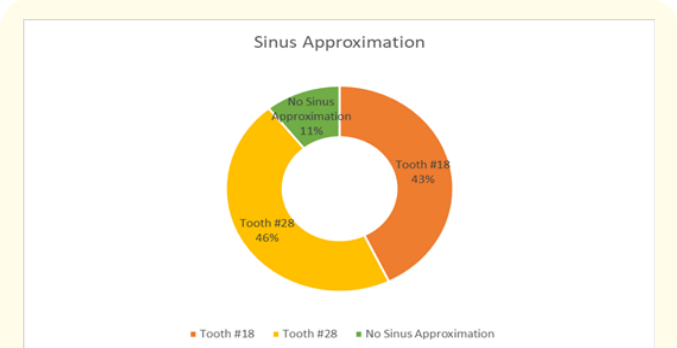
A majority of the IMxTMs are classified as class I, with females (39.1%) and males (29%). Class III was the least, with 2.4% prevalence for the lower left (tooth #38) and 1.8% for lower right (tooth #48). In addition to classification based on mandibular ramus, IMxTMs can also be classified based on their position in relation to the second molar, according to the Pell and Gregory classification seen below in figure 7.



**Figure 7:** Pell and Gregory's Classification With Relation to The Second Molar.

The data showed that the most prevalent classification was position B, with both males and females showing a predilection for position B.

Analysis of IMxITMs and the location of their apices, in relation to the maxillary sinus was done. This is depicted in figure 8.

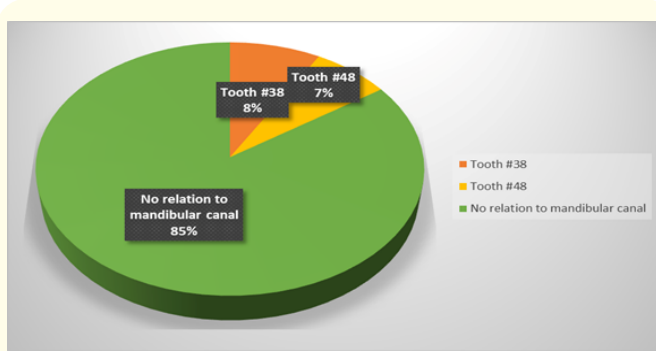


**Figure 8:** Relationship of Maxillary Impacted Third Molars to The Maxillary Sinus.

Out of the total number of IMxTMs (112), 11% did not have sinus approximation, while 89% were found to have sinus approximation. Tooth #28 had a greater prevalence of sinus approximation with 46%, whilst tooth #18 accounted for the remaining 43%.

The data obtained on the IMxTMs showed cases in which there was a relationship between the mandibular canal and the IT. This data was compiled and analyzed below in figure 9.

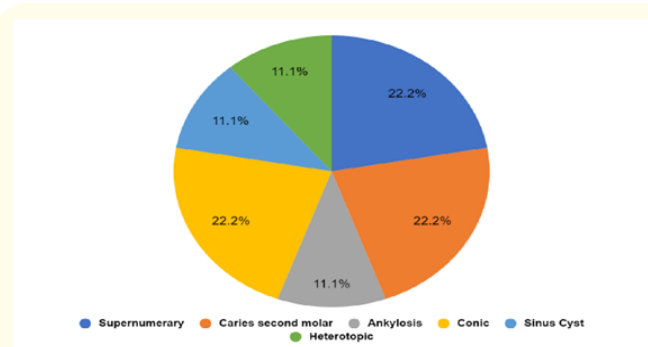




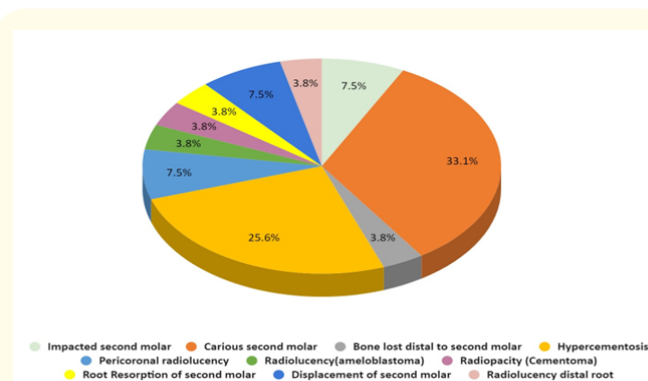
**Figure 9:** Relation of Impacted Mandibular Third Molars to The Mandibular Canal.

Of the total number of IMTMs (169), only 15% were related to the mandibular canal. ITMs had a slightly higher prevalence with the left IMTM (tooth #38) with 8%, only 1% higher than the right IMTM (tooth #48), which accounted for only 7% of the population sampled.

During the research, several pathologies were found. figure. 10 and figure. 11 displays said pathologies.



**Figure 10:** Complications Associated with The Maxillary Impacted Third Molars.



**Figure 11:** Complications Associated with the Mandibular Impacted Third Molars.

Of the total number of IMxTM (112), 8% were found to be with sequelae. A total of 6 complications were observed with dental caries on the second molar; the presence of supernumerary teeth and conical third molars were the major complications presenting equally at 22.2% figure 11.

Of the total number of IMTM (169), 16% were associated with sequelae. The most common complication was dental caries of the second molar which affected tooth #48 two times more than that of #38 (33.1%).

Complications displayed a ratio of 2:1 with regards to mandibular against maxillary localization.

### Discussion

A review of data on ITMs at a private dental clinic during the period of January, 2022 to December, 2023 revealed 281 ITMs among 120 participants. The prevalence of ITMs favored females within the age range of 21-30. The findings differ from Passi who found that ITMs were more prevalent in males than in females [3]. This prevalence in females may be attributed to several factors. For instance, females may have frequented the dentist more often due to awareness of their appearance or to their concern on oral health. Another contributing factor for female prevalence are their smaller jaw sizes, particularly mandibular length. Azhari reported, mandibular length in males exhibited far more growth than females at the end of adolescents [14].

The most common location of ITMs in this study was in the mandible, accounting for 60.1% of the total 281 IT. Similarly, Ms-gati revealed the mandible (84.4%) as the most common area of impactions [6]. Further in males, the most common location for impaction was the fourth quadrant, tooth #48. This coincides with findings of Shah [15] and Tasneem [16] that males exhibited a greater incidence of impactions of tooth #48. With regards to females, the most common area of impaction was found to be in the mandible with (15.3%) displayed by both quadrant 3 quadrant 4. Contrastingly, Tasneem reported a higher percentage of impactions of tooth #38 than #48 in females [16]. ITMs were distributed in dental quadrants as follows: quadrant 4 displayed the highest percentage (31.3%), followed by the third quadrant (28.8%), then 19.9% for both first quadrant and second quadrant.

In the maxilla, females displayed more IT than males (5.7%) for both the right and left sides. This is consistent with Ali, who found that females had a higher percentage of right IMxTM compared to males and more for the left side [17]. However, neither males (19.9%) nor females (20%) have shown a predilection for a specific

side of the maxilla. In contrast, Hashemipour reported more cases of IMxTM on the right side (tooth #18) compared to the left side (tooth #28) [18].

Results obtained from this research showed that most angulations of IMxTM according to Winter's Classification included distoangular, vestibuloangular and vertical impactions. Distoangular impactions accounted for 34% of cases of IMxTMs, followed by vestibuloangular (28.6%), and lastly vertical impactions accounted for 22.3%. Shaari found that vertical impactions were the most common type of IMxTM accounting for 22.2% [19]. However, unlike those researches mentioned, similarities were seen in studies by Al-Madani, whereby distoangular impaction was the most prevalent (40.4%) in the maxillary arch [20]. Additionally, this research found that the most prevalent pattern of impaction affecting both tooth #18 and #28 was distoangular. This coincides with findings by Khouri, who found that the distoangular pattern of IMT was the most frequently observed in both right and left IMxTMs. Similar to the findings from that research, no horizontal impactions were seen in the maxilla [21].

Regarding the mandible, mesioangular impactions accounted for 50.3% of cases, followed by horizontal impactions (26.6%). These findings mirrored those of Passi et. al. who concluded that mesioangular impactions were the most prevalent [3]. Similarly, Al-Madani [20] found that most IMTM were in a mesial inclination, but unlike this study, the second most common pattern was vertical (26.4%). Rezaei [22] also showed comparable results where the most common angle of impaction was mesioangular and vertical in the right side and vertical and mesioangular in the left side. In this research, both tooth #48 and #38 were predominately found to show a mesioangular pattern of impaction, however, horizontal impaction was the second most common impaction on both sides, with vertical pattern affecting both sides to a lesser degree. As with other research reviewed, there was a statistical association between ITMs and the jaws.

When considering gender and the pattern of IMTMs, a mesioangular pattern of impaction was the predominant pattern in both males (23.1%) and females (27.2%). Likewise, Rezaei also noted that there were no significant differences between males and females and the pattern of impaction [22]. However, other studies disproved this and found that there was an association between gender and angle of impaction, Al-Madani showed that mesioangular impactions were more common in females than males [20]. On the other hand, for males the most frequently seen angular position of ITM was vertical (34.2%), followed by mesioangular (28.7%).

According to the Pell and Gregory classification of ITMs, the study revealed that the most prevalent class of impaction was Class I accounting for a total of 68% of the IMxTMs. There was no predilection for a specific quadrant, as tooth #48 was found to have a prevalence of 35.5% and #38 (32.5%). The least prevalent class of impaction was class III, accounting for only 4.2%. In contrast, another study conducted in Georgetown, Guyana, in 2015, showed that the most prevalent class of impaction amongst the study population was class II [15].

In terms of sex, it was found that females had a predilection for class I (39.1%) compared to males (29%) of the overall IMxTMs. Position B accounted for the highest position classification, with cases between both IMxTM and IMTM. The IMxTMs account for 16.7% and the IMTMs account for 27.4%. Position C had the lowest incidence (27%), with IMxTMs accounting for 22.1% of the cases and only 4.9% were IMTMs. The lowest prevalence of cases for this classification in terms of position, was found to be in the maxilla, with ITMs only accounting for 1.1% of cases with Position A.

It was found that 85% of the IMTMs were not related to the mandibular canal. Only 15% of the cases had relation with the mandibular canal with 8% being tooth #38 and 7% #48. This shows no predilection for a specific quadrant as the percentages found are very close, only having a 1% difference.

According to the data obtained 89% of IMxTMs were found to have sinus approximation. The data showed no significant difference in prevalence between the upper right quadrant (43%) and the upper left quadrant (46%). Interestingly, only 11% of the IMxTM cases were found to be distant to the maxillary sinus. Was-eem [23] also showed higher prevalence of approximation to the sinus than no approximation to the sinus. The findings correlate with each other, showing a trend of a higher prevalence of sinus approximation.

This study revealed 15 distinct complications of ITMs with a prevalence rate of 0.3 among the population. The most frequent sequelae being dental caries associated with the second molar accounting for 55.3% of total complications. The prevalence of dental caries of the second molar was found to be 0.09 among the participants. In contrast, Passi [3], reported dental caries of the IT and pericoronitis as the major pathologies associated with ITMs. Pericoronitis is best detected clinically and therefore this may have contributed to the difference in findings since this study relied on

digital imaging. IMTM (16%) accounted for two times more complications than IMxTMs (8%). Hypercementosis was determined to be the second most common pathology resulting exclusively in the mandible and accounting for 25.6% of complications. The least prevalent complications included bone loss distal to the second molar, ameloblastoma, cementoma, root resorption of the second molar and distal root radiolucency accounting for 3.8% each. This contrasts research conducted by Passi which reported a significantly higher percentage 7.2% incidence of second molar root resorption [3].

## Conclusion

A thorough analysis of 281 cases of ITM between the period of January, 2022 and December, 2023 from 120 adult patients at a private dental clinic were made. Specific objectives were sought out, answered. Primarily, the most common age and sex predilections to ITMs were determined to be seen among the female population between the ages of 21- 30 years old. Further, the most common site of ITMs was the mandible, particularly the fourth quadrant. In the maxilla, Winter's distoangular followed by vestibuloangular and vertical impactions were identified as the most prevalent. Its mandibular counterpart, however, differed as mesioangular followed by horizontal impactions were seen to be the most common. The Pell and Gregory Class I pattern of impaction was identified as the most prevalent, with Position B most commonly affecting both jaws equally. Most MITMs were not related to the mandibular canal. On the other hand, most IMxTMs were found to be in close proximity to the maxillary sinus. Finally, 15 distinct sequelae were identified, with the most common of these being dental caries of the adjacent second molar. Hypercementosis associated within the MITMs was second.

## Bibliography

- KalaiSelvan S., *et al.* "Prevalence and Pattern of Impacted Mandibular Third Molar: An Institution-based Retrospective Study". *Journal of Pharmacy and Bioallied Sciences* 12.1 (2020): S462-S467.
- Hupp J., *et al.* "Contemporary Oral and Maxillofacial Surgery". Elsevier (2014).
- Passi D., *et al.* "Study of pattern and prevalence of mandibular impacted third molar among Delhi-National Capital Region population with newer proposed classification of mandibular impacted third molar: A retrospective study". *National Journal of Maxillofacial Surgery* 10.1 (2019): 59-67.
- U.S. Department of Health and Human Services. (n.d.). "What is prevalence?" National Institute of Mental Health.
- Akkitap MP and Gümrü B. "IMPACTED THIRD MOLAR: TO EXTRACT OR NOT TO EXTRACT, THAT IS THE QUESTION". *Dent and Med J-R* 3.2 (2021): 66-82.
- Msagati F., *et al.* "Pattern of occurrence and treatment of impacted teeth at the Muhimbili National Hospital, Dar es Salaam, Tanzania". *BMC Oral Health* 13.1 (2013).
- Santosh P. "Impacted Mandibular Third Molars: Review of Literature and a Proposal of a Combined Clinical and Radiological Classification". *Annals of Medical and Health Science Research* 5.4 (2015): 229-234.
- Gkantidis N., *et al.* "Third molar agenesis is associated with facial size". *Biology* 10.7 (2021): 650.
- Singh N., *et al.* "A radiographic survey of agenesis of the third molar: A panoramic study". *Journal of Forensic Dental Sciences* 9.3 (2017): 130-134.
- Vandeplass C., *et al.* "Does Retaining Third Molars Result in the Development of Pathology Over Time? A Systematic Review". *Journal of Oral and Maxillofacial Surgery* (2020).
- Bureau of Statistics. "Guyana Population and Housing Census 2012: Preliminary Report" (2012).
- Talari K and Goyal M. "Retrospective studies - utility and Caveats". *The Journal of the Royal College of Physicians of Edinburgh* (2020).
- Frost J. "Retrospective study: Definition and amp; examples". *Statistics By Jim* (2023).
- Azhari Azhari., *et al.* "Differences between male and female mandibular length growth according to panoramic radiograph". *Majalah Kedokteran Gigi Indonesia* 1.1 (2019): 43.
- Tasneem K. "Evaluation of Mandibular Impacted Third Molars". *Texila American University* (2014): 19-26.
- Ali M Idris. "Third molar impaction in the Jazan Region: Evaluation of the prevalence and clinical presentation". *Science Direct* (2021).



17. Hashemipour MA, *et al.* "Incidence of impacted mandibular and maxillary third molars: a radiographic study in a South-east Iran population". *Medicina Oral, Patologia Oral Y Cirugia Bucal* 18.1 (2013): e140-e145.
  18. Shaari R, *et al.* "Prevalence and pattern of third molars impaction: A retrospective radiographic study". *Journal of Advanced Pharmaceutical Technology and Research* 14.1 (2023): 46-50.
  19. Al Madani S and Jaber M. "The Patterns of Impacted Third Molars and Their Associated Pathologies: A Retrospective Observational Study of 704 Patients". *Journal of Clinical Medicine* 13.2 (2024): 330.
  20. Khouri C., *et al.* "Evaluation of Third Molar Impaction Distribution and Patterns in a Sample of Lebanese Population". *PMC* (2022).
  21. Rezaei F, *et al.* "Patterns of Mandibular Third Molar Impaction in an Iranian Subpopulation". *SciELO 2020 - Brazil - Patterns of Mandibular Third Molar Impaction in an* (2020).
- Waseem N., *et al.* "EVALUATION OF PATTERNS OF IMPACTED THIRD MOLARS AND THEIR ASSOCIATION WITH VITAL STRUCTURES BY RADIOGRAPHIC EXAMINATION". *Pakistan Armed Forces Medical Journal* 71.1 (2021): 255-260.