*Original article*

# Surgical Extraction of Mandibular Third Molars: Risk Assessment and Predictable Complexity

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**ABSTRACT**

*Objective. The study aims to develop and validate new practical and simple but robust index to determine the complexity level of surgical extraction of mandibular third molars (MTM).* ***Methods.*** *A cross-sectional study with sample of 100 patients referred for management of MTM. Complexity index scores recorded twice at 6 weeks intervals preoperatively by oral and maxillofacial specialist. Prediction of the surgical difficulty and the degree of agreement of different variable indexes were calculated.* ***Results.*** *Out of 100, 78 patients with 139 impacted MTM, 26 were males and 52 were female, with a mean age of 26.40±6.39 years (range, 18-45 years). The prediction of operative difficulty was significant as measured by impaction angulation, distance to ramus, and impaction depth. Most cases were classified as complexity level II (63 [80%]). Although only 3 out of 100 cases (4%) were classified as complexity level III. There was no significant difference in age based on the gender (male: 27.54±7.35 years, female: 25.83±5.86 years; P=0.268).* ***Conclusion.*** *Using MTM complexity index as a preoperative tool to evaluate the surgical difficulty, including different patient-specific variables could facilitate treatment planning, help prevent complications and assess the possibility of referral.*

*Keywords: Impacted teeth, Mandibular third molars, Classification, Tooth extraction, Prevalence of teeth impaction, panoramic radiographs.*

الاهداف. تهدف الدراسة إلى تطوير والتحقق من صحة مؤشر عملي وبسيط ولكن قوي لتحديد مستوى تعقيد الاستخراج الجراحي للأضراس الثالثة الفك السفلي (MTM) **طرق الدراسة**. دراسة مقطعية مع عينة من 100 مريض تمت إحالتهم لإدارة MTM. تم تسجيل درجات مؤشر التعقيد مرتين على فترات كل 6 أسابيع قبل الجراحة من قبل أخصائي الفم والوجه والفكين. تم حساب التنبؤ بالصعوبة الجراحية ودرجة اتفاق المؤشرات المتغيرة المختلفة. **النتائج**. من بين 100، كان هناك 78 مريضًا مصابًا بـ MTM139 ، 26 ذكرًا و52 أنثى، بمتوسط عمر 26.40 ± 6.39 سنة (المدى 18-45 سنة). وكان التنبؤ بصعوبة المنطوق كبيرا كما تم قياسه عن طريق التزوي الانحشار، والمسافة إلى الفرع، وعمق الانحشار. تم تصنيف معظم الحالات على أنها مستوى التعقيد الثاني (8063] ٪ .([على الرغم من أن 3 فقط من أصل 100 حالة (4٪) تم تصنيفها على أنها مستوى التعقيد الثالث. لم يكن هناك اختلاف كبير في العمر على أساس الجنس) الذكور: 27.54 ± 7.35 سنة، الإناث: 25.83 ± 5.86 سنة؛ (0.268 = P). **الاستنتاج**. استخدام مؤشر تعقيد MTM كأداة قبل الجراحة لتقييم الصعوبة الجراحية، بما في ذلك المتغيرات المختلفة الخاصة بالمريض يمكن أن يسهل تخطيط العلاج، ويساعد على منع المضاعفات وتقييم إمكانية الإحالة.

## INTRODUCTION

Mandibular third molars (MTM) being the last permanent teeth to develop, usually erupt in early adolescences [1-3]. These teeth may erupt normally into functioning position in the dental arch within the expected timeframe but sometimes due to lack of space or obstruction develop in an abnormal position. This leads to partially eruption or impaction which fail to erupt at all [2-4]. The Impaction of MTM may be associated with pathological changes that require surgical removal of the teeth. Different studies have reported a varying prevalence for MTM impaction depending on the source and studied population between 16.7% and 68.6% [3,4], and surgical removal of impacted molars is one of the most frequent procedures in the field of Dentistry [1,2]. A numerous studies estimated prevalence of impaction angulation with mean prevalence of each type of classification among various populations and considerable differences in their findings have reported the pattern of the type impaction [3,4,6,7]. MTM impaction occur at various level of and its position, within the mandibular alveolar bone, and mesioahgulation considered to occur more frequently [2,5].

Clinical risk assessment and classification of surgical difficulty of impacted teeth are essential aspects in determining the level of complexity of the surgery, which can further improve clinical decision making and patient care. This will also provide greater understanding of the degree of MTM impaction and its associated risks, relative difficulties between different impaction types, specific treatment, and quality of life impact [3-7].

In literature several classification systems and indexes has been proposed to predict the complexity of surgical removal of MTM. These classify mandibular third molar difficulty of impaction, based on the anatomical relations and degree of surgical skill required. Historically, Pell and Gregory and WHARFE'S systems have been widely used. Recently proposed difficulty indexes (Pederson, Parant scale, Kharma scale, etc) lack consideration of other parameters (ASA status, LA status, surgical technique, anxiety level and operator experience) [7-10]. It is well known that surgical removal of third molars has generated concern about morbidity and latent impact on quality of life. Although several classification and scoring tools rigorously considered, however, no system exists currently to convey the level of complexity of the surgical procedure as a whole. An accurate method of predicting the surgical difficulty will help patients provide informed consent and allow operators to choose cases based on surgical ability, but this must be weighed against other factors that could influence surgical extraction complexity and this include level of patient cooperation, anxiety, medical status, etc. [8-10]. Impaction of permanent third molars is a problem commonly in encountered by general dentist and their management is challenging that require meticulous and careful assessment.

Several indexes that has been developed does not take into account other variable which are directly related to the difficulty of extraction such as mouth opening limitation, anxiety level, status of local anaesthesia, and with respect to available systems of classification are general and relate to only anatomical orientation of impacted teeth and not specifically to level of surgical skills required which could provide better patient care. [2,4,5,8,9]. The indexes developed should improve patient referral, facilitate the determination of the level of surgical skills required, and assess the prognosis of surgical difficulty and help the practitioner plan the surgical technique, estimate the operating time and foresee possible complications [4,5].

Currently, there is no standardized tool to determine level of the difficulty of the procedure. Therefore, researches concerning MTM surgery are difficult to compare, as one's definition of a difficult extraction may be very differently from another's. This has led to considerable variation among patients classified as having had difficult or potentially difficult surgical procedure. It is exceptionally important to use an index which provides a standardized and objective

way of describing patient groups and procedures, enabling comparison between studies and ultimately improving patient care. [3, 4, 6, 7, 9, 10]

Degree of difficulty or level of complexity may be defined as the amount of physical and technical manoeuvres required to remove a tooth relative to that for the extraction of a impacted MTM [3,4,6,7]. Their surgical extraction difficulty subjectively ranges from simple to extremely complex and objective attributes which contribute to increased difficulty need to be identified in order to enable us identify patient groups that can benefit from removal of the third molars. In addition, it will help to identify and quantify any unplanned occurrence during surgery which increase in difficulty (e.g. tooth crown fracture) or it may be a consequence of increased difficulty (e.g. loss of visibility of the tooth due to excessive bleeding).

This work aimed to develop and validate MTM complexity index to be used as a reliable and valid tool of the complexity level of extraction, and to investigate and assess the risk of the relative frequency of debilitating complications and avoiding unfavourable outcomes post-operatively.

## METHODS

A cross-sectional study of 100 patients referred for management and surgical removal of MTM under local anaesthesia in oral surgery out-patient clinic. Patient verbally agreed to participate in the study anonymously.

In order to determine the indication of surgical extraction of MTM preoperatively, the NICE guidelines are being followed. Patients who were medically compromised ASA IV, pregnant women, patients with impacted teeth associated with acute infections, cysts or tumors were excluded from this study. Also, patient excluded if there was radiographs of poor diagnostic quality.

The radiographic evaluation of orthopentamogram (OPG) included the assessment of the tooth angulation (Winter's classification), position and depth of impaction (Pell and Gregory classification),

in addition to the evaluation of space or contact of the impacted lower third molar in relation to the mandibular second molar and ramus [1,3,4,6,7,10]. The independent variables in this study were recorded preoperative include; maximum mouth opening, American Society of Anesthesiology (ASA) state, local anaesthesia state. All the surgical extractions were performed by a single operator with more than 10 years of experience.

MTM index of complexity level of the surgical extraction scored using the criteria of Winter's classification, Pell and Gregory classification and, in addition to the evaluation of ASA state, local anaesthesia state, anxiety level, mouth opening and type of surgical technique (figure 1). Complexity index was classified into three categories according to the total points scored (figure 1). The three complexity levels were defined as follows: Level I ($\leq$ 12 points, slightly difficult), level II (13-36 points, moderately difficult), and level III ($\geq$ 37 points, very to extremely difficult). The complexity index tabulated and scored based on combines of the scales/indices developed so far, and the added variables have been related to an increase in surgical difficulty of each clinical case into three level of complexity (I, II & III). Each data set is scored with 1 point for low difficulty, 3 points for moderate difficulty and 5 points for high to extreme difficulty. MTM index scores were assessed twice at 6 weeks intervals for intra-class correlation coefficient (Intra-observer consistency).

The Data processed and analysed using IBM SPSS Statistics V. 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). The independent t-test (Age difference) in the distribution of pattern of MTM index of complexity level of the surgical extraction scored, and further stratified by gender. A non-parametric test by Chi-Square, was applied to estimate distribution of complexity levels according to tested parameters and p-value of <0.05 considered significant.

***Figure1. MTM index for assessment of complexity levels of surgical removal of mandibular wisdom teeth.***

| MTM Complexity Index | | | |
|---|---|---|---|
| Complexity level | Level I | Level II | Level III |
| **Patient variables** | | | |
| Age | □ < 25 years | □ 25-50 years | □ > 50 years |
| Anxiety/ cooperation | □ Mild/cooperative | □ Moderate/ cooperative | □ Severe/ uncooperative |
| Mouth opening | □ > 45 mm | □ 35-45 mm | □ < 35 mm |
| ASA status | □ ASA I | □ ASA II | □ ASA III |
| **Radiological variables** | | | |
| Root apex proximity to IDN/IDC | □ Apex far away | □ Overlapping □ Darkening | □ Loss of tramlines □ IDC narrowing □ IDC Deviation |
| Angulation | □ Mesioangular | □ Vertical | □ Distoangular □ Horizontal |
| Distal space to Ramus | □ Pell & Gregory I | □ Pell & Gregory II | □ Pell & Gregory III |
| Impaction depth | □ Pell & Gregory A | □ Pell & Gregory B | □ Pell & Gregory C |
| Associated follicle/lesion | □ Normal/absent | □ Possibly enlarged /< 10 mm | □ Enlarged/ > 10 mm |
| **Surgical variables** | | | |
| LA status | □ No reaction | □ Intolerance experience | □ Failure experience |
| Surgical technique | □ Conventional extraction | □ Bone removal | □ Tooth sectioning & bone removal |
| Operator competence | □ > 10 years' experience | □ 5-10 years' experience | □ < 5 years' experience |
| Complexity score | ≤ 12 | 13-36 | ≥ 37 |

## RESULTS

Out of the examined 100, 78 patients were included in the study, 26 were males and 52 were female, with a mean age of 26.40±6.39 years (range, 18-45 years). According to NICE guidelines, 139 impacted mandibular third molars were surgically removed under local anaesthesia.

The agreement for the total points calculated twice (intra-class correlation coefficient values [95% confidence interval]) were 0.775 (0.684-0.866), 0.744 (0.673-0.815), and 0.663 (0.573-0.753) for spatial relationship, depth, and ramus relationship, respectively, indicating substantial agreement (table 1).

*Table1. Distribution of intra-class correlation coefficient analysis was used for the intra-observer consistency.*

| Measure | Intraclass correlation | 95% confidence intervals | | significance |
|---|---|---|---|---|
| | | Lower border | Upper border | |
| Impaction angulation | 0.975 | 0.962 | 0.980 | 0.000 |
| Distance to ramus | 0.984 | 0.978 | 0.989 | 0.000 |
| Impaction depth | 0.992 | 0.989 | 0.994 | 0.000 |

The distribution of the impacted mandibular third molars according to angulation was as follows; Mesioangular (64 teeth, 47%), followed by vertical (n = 29, 20%), Distoangular /Horizontal (n = 46, 33%). According to Pell and Gregory classification; most of the impacted mandibular third molars, 82 teeth (60%) were classified as class I, followed by class II (n = 43, 31%) and class III (n = 14, 10%) (table 2).

The distribution of the patients according to the surgical difficulty which is determined preoperatively by MTM complexity indexes and the operative complexity categorization according to spatial relationship are summarized in Table 2.

When calculating the MTM index score, a total of 13-36 points was the most common (63 cases, 80%), followed by ≤ 12 points (12 cases, 16%) and ≥ 37 points (3 cases, 4%). In terms of difficulty, complexity level II (moderately difficult) was the most common followed by complexity level I (low difficulty) and complexity level III (very difficult) The mean age was the highest in complexity level III (33±3.46 years) and was subsequently lower in each successive MTM index level: complexity level II (26.60±6.72 years), and complexity level I (23.67±3.05 years) with a significant difference P value less than 0.05.

## DISSCUSION

A Prediction of operative difficulty before the extraction of MTM help a planning of treatment that minimizes the risk of complications, but it constitutes constant challenges for clinicians [14]. Therefore, this study aimed to develop a reliable and valid complexity index to predict operative surgical complexity of removal MTM, and assess risk associated with operative management and possibility of referral in very difficult and complex cases. Generally, there were limited accuracy of prediction of the surgical difficulty which will be compared with the other operative difficulty indexes to able to determine operative difficulty determinants between impaction angulation, distance to ramus, and impaction depth and other factors [4,17]. As previously stated, that numerous indexes have been used to evaluate the difficulty of extraction of MTM (Pederson and Pernambuco indexes) which uses exclusively spatial radiographic variables unlike index used in this study that include demographic and clinical variables along with the other relevant variables such as anxiety, mouth opening, and ASA state [3,11-14].

We also observed that Many studies determine the surgical difficulty by the spatial relation of plain radiograph [12-14], for the operator's judgment as an indicator of difficulty as compared with other variable that add operative difficulty which could be determined by the MTM complexity index. This is in keeping with previous in estimating the surgical difficulty of unreliability of the indexes in most studies. Furthermore, systematic review and meta-analysis, showed that this index was not reliable in assessing the difficulty of surgical extraction of MTM, this may be related to the fact that indexes does not consider any clinical or demographic variables that may affect the difficulty of extraction [4,16,17].

This study investigated and introduced other variables other than those seen in others work to provide better reliability for difficulty indexes, of these were the ASA status, LA status, surgical technique, anxiety level and operator experience [18,19]. It is agreed that increased patient's age and BMI were important variables that considered increasing surgical difficulty, but accessibility and visibility to the surgical field is probably related to the overweight [12,18]

*Table 2. Distribution of the patients according to the surgical difficulty levels determined by MTM indexes*

| MTM Complexity Index | | | | | |
|---|---|---|---|---|---|
| Complexity level | Level I | Level II | Level III | Total NO | P value |
| Patient NO | 12(16%) | 63(80%) | 3(4%) | 78(100) | 0.000 |
| Age | 23.67±3.05 * | 26.60±6.72 ** | 33±3.46 * | 26.40±6.39 | * 0.016, ** 0.446 |
| **Gender** | | | | | |
| Male | 5 | 20 | 1 | 26 | 0.000 |
| Female | 7 | 43 | 2 | 52 | |
| **Angulation** | | | | | |
| Mesioangular | 21 | 41 | 2 | 64 | 0.000 |
| Vertical | 0 | 29 | 0 | 29 | |
| Distoangular/Horizontal | 0 | 42 | 4 | 46 | |
| **Distal space to Ramus** | | | | | |
| Pell & Gregory I | 21 | 61 | 0 | 82 | 0.000 |
| Pell & Gregory II | 0 | 43 | 0 | 43 | |
| Pell & Gregory III | 0 | 8 | 6 | 14 | 0.593 |
| **Impaction depth** | | | | | |
| Pell & Gregory A | 21 | 56 | / | 77 | 0.000 |
| Pell & Gregory B | 0 | 41 | 2 | 43 | |
| Pell & Gregory C | 0 | 15 | 4 | 19 | 0.012 |

Recently studies reported that increased patient's age increases the difficulty of extraction. The relationship between surgical difficulty and age has been probably related to the increased bone density, and believed that patients older than 30 years were found to have more difficult extractions [16]. This study showed that mean age was the highest in complexity level III (33±3.46 years) and was subsequently lower in each successive MTM index level: complexity level II (26.60±6.72 years), and complexity level I (23.67±3.05 years) with a significant difference P value less than 0.05. In this study, the mean age was within reported range in accordance with other studied populations. It is presumed that deeply impacted third molars especially in elderly tend to have a relatively lower probability of causing discomfort or further concerns, including pericoronitis; hence, patients might delay a visit to the their management [2,16,19]. The inclusion of these patient factors may account for the better reliability of the MTM complexity index. One limitation of this study is the small sample size which was derived from consecutive patients who attended oral surgery clinic during a specified timeframe. Another limitation considered in this work, is the level of experience of the operator who carried the assessment and surgical procedure which might affect the results of this study. Previous research assessed related the difficulty of extraction to the experience of the surgeon but they observed that there is no threshold for classifying the experience of the operator considering that arbitrarily 10 years or more would represent a high level of experience [1,10,19]. This study did aim to evaluate this factor along with those already present in the investigated difficulty indexes for better reliability and standardization to reduce bias as compared to others.

It is important to recognize the difficulty and impaction pattern preoperatively before extraction of impacted mandibular third molar because several investigators have reported that postoperative complications associated with these procedures could be debilitating [1,16,17]. According to researches , a moderately to very difficult complexity score based on radiography was associated with high incidence of a dry socket, along with increased risk of inferior alveolar nerve injury during mandibular third molar extraction [5,20,21]. In MTM index of difficulty, complexity level II (moderately difficult [63 cases, 80%]) was the most common followed by complexity level I (low difficulty [12 cases, 16%]) and complexity level III (very difficult [3 cases, 4%]).

Several studies on impacted third molars used the difficulty index was developed based on the Pell and Gregory classification and the Winter's classification [16, 17,20,21]. However, the classification categories of the difficulty index based on visual impression are not always accurately predictable. Therefore, other studies evaluated the validity of the classifications of the impacted mandibular third molar in clinical situations and propose a more practical classification system. In this study, relationship of the impacted third molars extraction difficulty by spatial relationship, depth, and ramus relationship, respectively, indicating substantial agreement (table 1) with the previous results of other work as compared of their different methods [20,21,22].

The level of operative complexity of MTM index was defined by three grades depending on the score: slightly difficult (≤12 points), moderately difficult (13-36 points), and very difficult (≥ 37 points). According to the results of this study, mesioangular impaction (64 teeth, 47%) was the most common angulation type, consecutively followed by vertical (n = 29, 20%), Distoangular /Horizontal (n = 46, 33%). This finding was in agreement with results of other studied population (13, 16). In terms of the depth of impaction, 82 teeth (60%) were classified as class I, followed by class II (n = 43, 31%) and class III (n = 14,

10%), as is consistent with the findings of previous studies [23,24].

Although most studies that investigated the difficulty of extraction of impaction of MTM, there is some variation in predicting complexity when comparing the results of this study to those reported. The different observation may arise from difference of methodology of the studied population including sample selection, definition of impacted tooth, radiograph diagnostic quality and the age of the individual.

The present study supports the use of MTM index by general dentist and dentist with specialists' interest in surgical dentistry to appreciate the level of operative complexity of MTM impaction and to understand the necessity for early risk assessment and referral to prevent undesirable consequence and complicated management which would affect patient health.

## CONCLUSION

The pre-existing MTM complexity index assessing the difficulty of MTM will help clinician to draw a correct treatment planning to avoid underestimation of the difficulty and to minimize the number of intra- and post-operative complications. Several scales such as those of Pell and Gregory, Winter's and Pederson are widely used although several studies have shown that they poorly predict surgical difficulty. The results obtained in the present work as compared to other existing indices/scales include radiological variables collected from panoramic radiographs, and only some contain variables from demographic data, such as age or BMI, among others. However, taking into account the results of this study, these scales are not aligned with the factors that have been shown to influence the increase in surgical difficulty.

Although, as there is no standardized tool to determine level of the difficulty of the procedure associated with considerable variation among patients classified as having had difficult or potentially difficult surgical procedure. An accurate

method or tools of predicting the surgical difficulty will help patients provide informed consent and allow clinician to choose cases based on surgical ability, in accordance with other factors highlights which individual patient and dental factors that are pertinent to the preoperative assessment of surgical difficulty for mandibular third molar surgery and this include level of patient cooperation, anxiety, medical status, etc.

## Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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