Assessment of Factors Associated With Surgical Difficulty in Impacted Mandibular Third Molar Extraction

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Purpose: The aim of this prospective study was to investigate radiologic and clinical factors associated with increased difficulty in the removal of impacted mandibular third molars. We also aimed to form an index to measure the difficulty of removal of the impacted molars preoperatively.

Patients and Methods: A total of 87 patients who required 90 surgical extractions of impacted mandibular third molars from November 2003 to May 2004 were involved in the study. Radiologic and clinical data were taken preoperatively. All extractions were performed under local anesthesia by a single operator. Surgical difficulty was measured by the total intervention time.

Results: Increased surgical difficulty was associated with increasing age and body mass index. It was also associated with the curvature of roots of the impacted tooth and the depth from point of elevation ($P < .05$).

Conclusion: Both clinical and radiologic variables are important in predicting surgical difficulty in impacted mandibular third molar extractions.

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Surgical removal of mandibular third molar is one of the most common surgical events.[1] This is why, in spite of the diversified demands of practice, many dental surgeons will still need to face the problem of removal of impacted mandibular third molars.[2] Both the patient and dentist must therefore have scientific evidence-based information concerning the estimated level of surgical difficulty of every case.

There are a number of previous studies to evaluate surgical difficulty in the extraction of impacted mandibular third molars.[1-6] However, most of these studies were based only on dental factors evaluated by radiologic assessment.[2-5] Opinions vary on these radiologic factors, but most authors agree that they play some role in estimating difficulty.[1-6] Other authors believe it is difficult to estimate actual difficulty by radiologic methods only, and that it is only intraoperatively that actual difficulty can be estimated.[7] Some authors also believe that clinical variables such as age, gender, and weight of the patient are also very important.[1,6] Few authors have proposed indexes for measuring intraoperative/surgical difficulty.[5] Pederson proposed such an index, but it is seldom used because it has been reported that it does not match actual surgical difficulty.[5]

This study aims to use both clinical and radiologic variables in estimating intraoperative difficulty. We also propose a preoperative index based on both clinical and radiologic variables.

Patients and Methods

Patients who were referred for extraction of impacted mandibular third molars between October 2003 and April 2004 at the Oral and Maxillofacial Clinic of the Lagos University Teaching Hospital (Lagos, Nigeria) were included in the study. Approval for the study was obtained from the local ethics committee and informed consent was obtained from all participating patients.

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Table 1. CLASSIFICATION OF PREOPERATIVE VARIABLES

Variable/Definition	Classification
Gender	1: male 2: female
Age: age at last birthday	1: 16–24 2: 25–35 3: above 35
BMI (body mass index): weight in kg divided by height in meters squared	1: below 18 2: 18 to below 25 3: 25 to below 30 4: above 30
Occlusal level: the level of the occlusal plane of the third molar compared with the second molar	1: high—when the highest part of the crown of the third molar is above or at the same level as that of the second molar 2: medium—when the highest part is lower than that of the second molar but higher than the amelocemental junction 3: low—when the highest point is lower than the amelocemental junction of the second molar
Retromolar space available: the ratio of the distance between the most distal point on the crown of the second molar to the most anterior point on the ascending ramus and the mesiodistal width of the impacted tooth	1: Sufficient space when the ratio ≥ 1 2: reduced when the ratio was <1 but >0.5 3: no/very little space <0.5
Angulation of impaction: the angle (measured by a protractor) measured in degrees formed between the intersected long axes of the second and third molars	1: vertical 10°–−10° 2: mesioangular 11°–79° 3: horizontal 80°–100° 4: distoangular −11°–−79° 5: others 111°–−80°
Number of roots	1: 1 fused root 2: 2 roots 3: 3 or more roots
Curvature of roots: the long axis of the root in relationship to the root of the second molar	1: incomplete roots 2: straight roots 3: favorable roots when roots are curved in the direction and towards path of elevation 4: when roots were either curved in opposite direction or against path of elevation
Root inferior dental canal relationship	1: no contact when the root at its closest point is more than 2 mm from the canal 2: approximation: when the closest point is <2 mm from canal but there is no contact 3: contact when there is any relationship between root and canal (eg, contact, impinging, overlap)
Contact with second molar	1: no contact 2: contact with crown only 3: contact with crown and root 4: contact with root only 5: overlap
Bulbosity of roots: the ratio of the mesiodistal distance at the cervix and the widest point along the root of the impacted tooth	1: bulbous when ratio <1 2: when ratio ≥ 1
Width of crown: the ratio of the mesiodistal width of the crown of the third and second molars	1: bulbous when the ratio was >1 2: not bulbous when ratio is ≤ 1
Root periodontal space interface	1: clear when the periodontal space is clear all around the tooth 2: some clear when the periodontal space around the tooth is clear in some places 3: sclerosed when the periodontal space is not clear all round the tooth

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Table 1. (CONTINUED)

Depth from point of elevation: the length of a perpendicular line drawn from the distal amelocemental junction of the second molar distally and the point of application of elevator. The point of elevator for the mesioangular and horizontal impactions was the mesial amelocemental junction of the third molar while for the vertical and distoangular was at the bifurcation	1: 0–3 mm 2: 4–6 mm 3: >6 mm

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Exclusion criteria were patients with only soft tissue impaction and those with missing second molar adjacent to the impacted tooth. Preoperative clinical and radiologic data were collected as shown in Table 1. Based on the preoperative data, estimated level of difficulty of all extractions was done prior to surgery using the Pederson scale (Table 2) before the extractions. The extractions were classified as easy, moderately difficult, and very difficult preoperatively.

The surgical extractions were carried out under local anesthesia by a single operator. All procedures were standardized, a buccal flap was raised and bone removal was performed using a fast hand piece (80,000–150,000 rms) under continuous cool water jet spray throughout the surgery. In all procedures the total intervention time (TII) was measured in minutes using a stopwatch. Extractions were also classified intraoperatively as easy, moderately difficult, and very difficult based on the TII as shown in Table 3. Statistical analysis was conducted using SPSS Inc version 11.5 (Chicago, IL). Univariate analysis of the preoperative variables in association with intraoperative difficulty, as measured by the TII, was performed. All variables with *P* values less than .1 were used in multiple linear regressions to identify the most important variables in determining intraoperative difficulty of extractions (Table 4). *P* values less than .05 were taken as statistically significant (Table 4).

The relationship of these significant variables to TII (Figs 1-4) was used to form a preoperative index of difficulty (Table 4). The sensitivity and specificity of this new index in determining actual intraoperative difficulty (as measured by the TII) was compared with that of the Pederson index.[8]

Results

A total of 90 teeth from 87 patients were extracted during the period of the study. The male to female ratio was 1:1.1. The mean (SD) age of the patients was 26.6 ± 6.2 years. The mean (SD) TII was 9.2 ± 3.0 minutes. The surgeries based on the TII were classified into easy, moderately difficult, and very difficult.

Table 2. THE PEDERSON INDEX[8]

Classification	Value
Spatial Relationship	
Mesioangular	1
Horizontal/transverse	2
Vertical	3
Distoangular	4
Depth	
Level A: high occlusal level	1
Level B: medium occlusal level	2
Level C: low occlusal level	3
Ramus relationship/space available	
Class 1: sufficient space	1
Class 2: reduced space	2
Class 3: no space	3
Difficulty index	
Very difficult	7–10
Moderately difficult	5–6
Slightly difficult	3–4

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Table 3. SIGNIFICANT LEVEL OF EACH VARIABLE IN RELATION TO TII AS THE INDEPENDENT VARIABLE

Variable	Univariate Analysis (*P* Value)	Multiple Linear Regression (*P* Values)
Gender	.096	.478
Age*	.0007	.048
BMI*	.0003	.047
Occlusal level	.0007	.088
Angulation of impaction	.001	.265
Curvature of roots*	.0002	.001
Root/inferior dental canal relationship	.0008	.063
Periodontal space/root bone interface	.001	.365
Depth from point of elevation*	.0001	.005

*Statistically significant variables after multiple linear regressions.

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Sixty extractions (66.7%) were classified as easy, 25 (25.6%) as moderately difficult, and 5 (5.6%) were very difficult. Univariate analysis showed 9 variables (3 clinical, 6 radiologic variables) which had *P* less than .1 in association with TII. However, after the multiple regressions only 4 variables had *P* values less than .05 (*P* values are as shown in Table 4). The most important variable resulting in increased TII in this study was depth from point of extraction greater than 6 mm. In the 3 cases where depth was greater than 6 mm, 2 were classified as very difficult and 1 as moderately difficult (Fig 4). The extraction with the longest TII was also the one at the lowest depth (depth from point of elevation was 8 mm).

The relationship of these significant variables to TII (Figs 1-4) was used to form a preoperative index of difficulty (Table 3). The sensitivity and specificity of the new index to determine actual intraoperative difficulty as determined by the TII compared with the Pederson index was as follows: in determining easy extraction, the new index had 74% and 79% sensitivity and specificity, respectively (accuracy = 76%), while those of the Pederson[8] index were 43% and 74%, respectively (accuracy = 49%). In determining moderately difficult extractions, the sensitivity and specificity of the new index were 70% and 75%, respectively (accuracy = 73%), while those of the Pederson[8] index were 52% and 48%, respectively (accuracy = 49%). For difficult cases the new index was 80% sensitive and 97% specific (accuracy 98%), while the Pederson[8] was 20% sensitive and 89% specific (accuracy = 86%).

Table 4. NEW INDEX SCORE

Variable	Value	Range
Age	1	<24
	2	25-34
	3	>34
BMI	1	<24
	2	25-30
	3	>30
Depth from point of elevation	1	0-3 mm
	2	4-6 mm
	3	>6 mm
Curvature of roots	1	Incomplete
	2	Straight/favorably curved
	3	Unfavorably curved
Total	12	

New Index Score:
Easy, 4-6
Moderately difficult, 7-9
Very difficult, 10-12.

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Discussion

Preoperative assessment of surgical difficulty is fundamental to the planning of extraction of impacted third molars. The assessment is not only important to the dental surgeon who needs it to be able to decide whether or nor to refer patients for specialist care,[2] but it is also important in predicting the possible complications so that the patient can be informed.[6] The percentage of extractions in each group of the intraoperative score in this study (68.9%, 25.6%, and 5.6% for easy, moderately difficult, and very difficult extractions, respectively) is comparable to those of Akinwande[2] (65.3%, 30.6%, and 4.1%, respectively) who divided his score into similar groups. However, the present study contrasts those of Renton et al[1] and Yuasa et al,[5] although these studies used different modes of classification of intraoperative difficulty. However, most researchers agree that postoperative complications are more commonly associated with more difficult extractions. With the range of difficult extractions from the studies between 4.1% and 44.5%, it is imperative that patients are, to the highest level of scientific certainty, informed of the possibility of complications after removal of their impacted mandibular third molars, based on a preoperative estimation of difficulty.

Previous assessment models are based on dental factors recorded on preoperative x-rays.[1-6] Three imaginary lines to determine the depth of the mandibular third molars in bone have been described earlier.[9] This method is taught to most undergraduate students, but is reported to be used little in practice.[1] Pell and Gregory[11] described an alternative method, but it also has recently been found to be an unreliable method of determining surgical difficulty.[4] Edwards et al[7] corroborated this by reporting that it is difficult to estimate actual surgical difficulty by radiologic assessment alone.

Both clinical and radiologic variables were used in our model in the present study. This was a modification of the model used by Santamaria and Arteagatia.[3] However, another variable (ie, depth from the point of elevation) was added to the protocol used in this model. The point used in this model was based on the lines described by Ward.[10] Depth from the point of elevation has been described as the single most important indicator for prediction of the difficulty in the extraction of impacted mandibular third molars.[2,9,10] This variable was also very important in determining difficulty in the present study.

The clinical variables that were statistically significant in this study were age and body mass index (BMI) of the patients. It was observed that with increasing age and BMI the total time for extraction increased. Renton et al[1] and Benediktsdottir et al[6] also

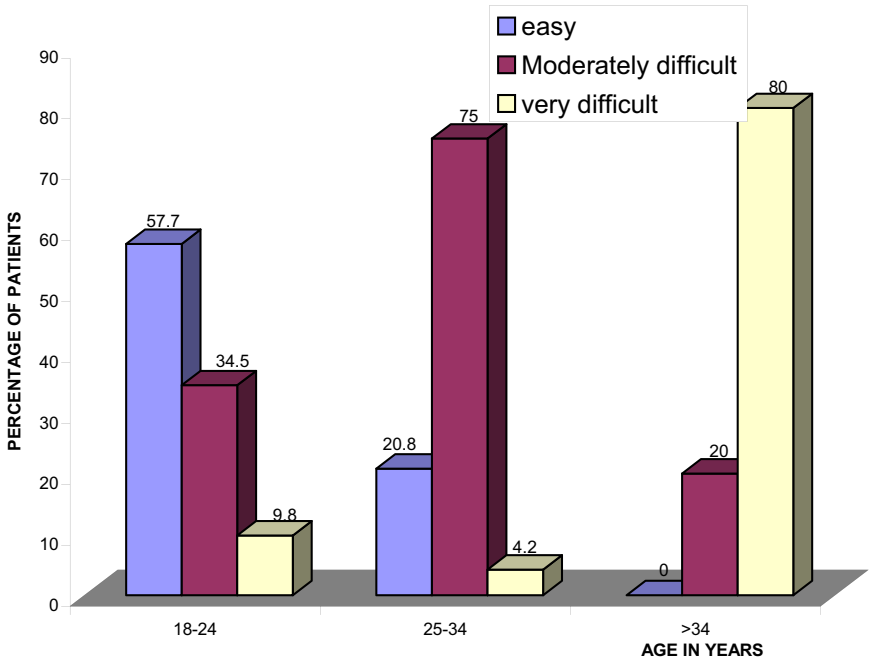

FIGURE 1. Percentage distribution of intraoperative score and age of participants.

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reported the same findings in their study. However, age of patients was not considered as a risk factor by the surgeons who answered questionnaires in the preliminary survey by Yuasa et al.[5] There was a significant increase in TII in impacted third molar exodontias in relation to age of patients in this study, with more patients older than 34 years in the moderately and very difficult groups. This is comparable to the study by Renton et al.[1]

The radiologic factors that were statistically significant to intraoperative difficulty using univariate analysis in this study were angulation of impaction, curvature of roots, relationship of roots to the inferior dental canal, root periodontal space interface, and the

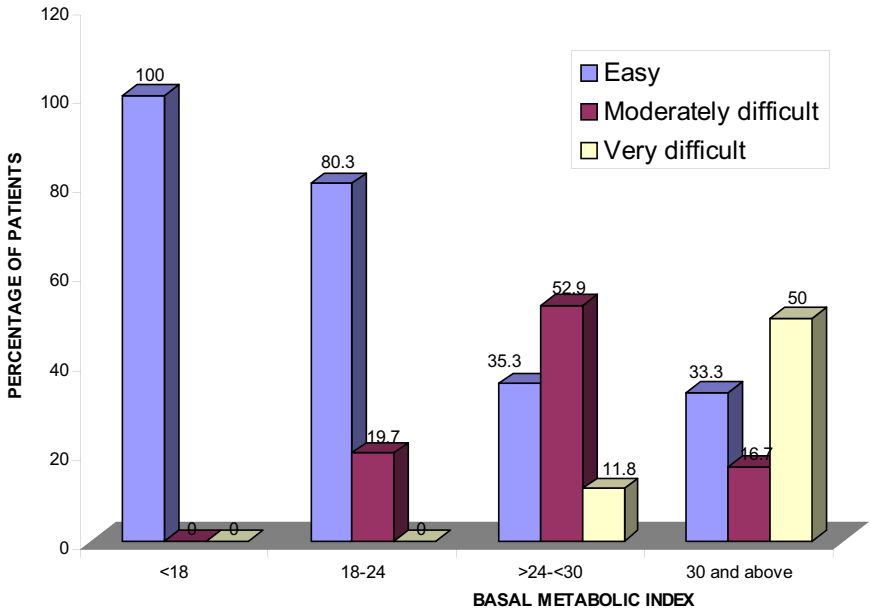

FIGURE 2. Percentage distribution of intraoperative score and BMI.

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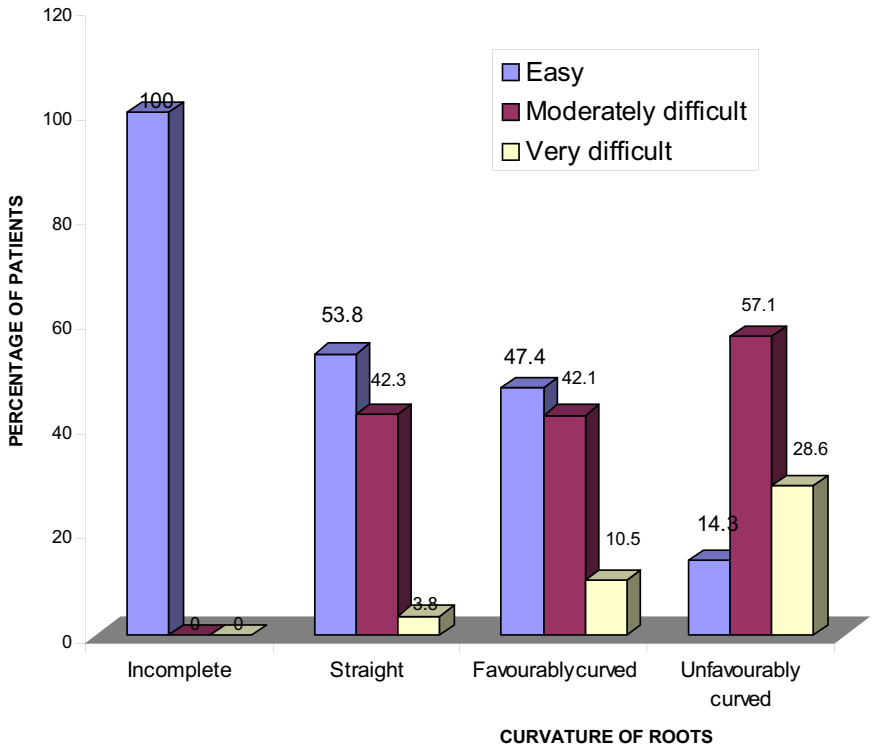

FIGURE 3. Percentage distribution of intraoperative score and curvature of roots.

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depth from the point of elevation. All these factors have also been found to be related to increased difficulty in other studies.[1-6] After multiple linear regression, however, only 4 of these variables (age, BMI, curvature of roots, and depth from point of elevation) were still in significant relationship with TII. The multiple linear regressions were performed to determine which of the variables were most important in determining the TII and thereby enabling a more user friendly index to be formed with the most important variables.

The new index formed in this study uses all the variables that were found to be statistically significant. Each variable was put in a scale in the degree that it

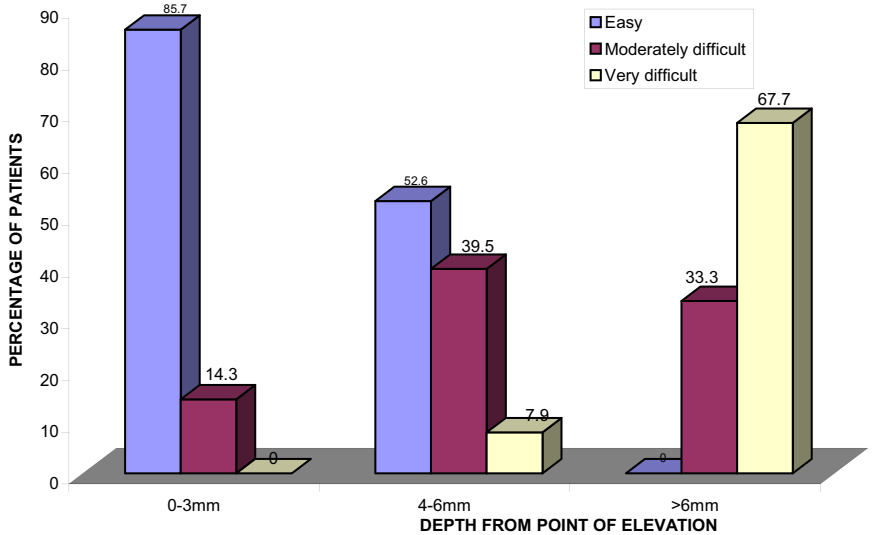

FIGURE 4. Percentage distribution of intraoperative score and depth from point of elevation.

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affected surgical difficulty. All variables used in the index are easily identifiable in either periapical x-rays (as used in this study) or with orthopanthomographs. The new model was found to be more sensitive and specific in determining the degree of difficulty in almost all extraction groups than the Pederson index.[8] It was also observed in this study that the sensitivity of the Pederson index[8] in identifying very difficult cases was 20%, which was also reported by Yuasa et al[5] (who claimed that the Pederson index[8] incorrectly identifies very difficult extractions as moderately difficult).

This new index uses 4 variables (both clinical and radiologic). The authors of this study believe the major difference of this index and the Pederson index[8] is the incorporation of the clinical variables (namely age and BMI) that were important in determining surgical difficulty rather than radiologic variables alone, which were used by the Pederson index.[8]

The new index formed from both clinical and radiologic variables seems to be superior to that of the Pederson index, which used only radiologic variables. However, more research has to be performed using this model to prove its superiority and remove bias.

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