the Journal of CONTEMPORARY DENTAL PRACTICE at www.thejcdp.com
Volume 9 Number 4 May 1, 2008

Relative Impact of Patient Characteristics and Radiographic Variables on the Difficulty of Removing Impacted Mandibular Third Molars

Oladimeji A. Akadiri, BDS, FWACS;
Ambrose E. Obiechina, BDS, FMCDS, FWACS;
Juwon T. Arotiba, BDS, FMCDS, FWACS, Mnim;
Abiodun O. Fasola, BDS, FWACS, MSc

Abstract

Aim: The aim of this study was to assess the relative contributions of patient characteristics and radiographic variables to the difficulty of extraction of impacted mandibular third molars in a Nigerian population.

Methods and Materials: Seventy-nine consecutive patients undergoing mandibular third molar extractions were recruited for this prospective cohort study. Specific patient characteristics and radiographic variables were recorded. All extractions were performed under local anesthesia by the same oral surgeon, and the surgical difficulty was assessed based on the duration of surgery.

Results: Body weight (BW) (P=0.009) and body surface area (BSA) (P=0.004) were the significant patient characteristics while tooth impaction depth (P=0.002), number of roots (P=0.035), and tooth angulation (P=0.003) were the significant radiographic variables associated with surgical difficulty using a univariate analysis. A multiple linear regression model was constructed with these variables using surgical difficulty as the dependent variable. Radiographic factors were found to be the more important determinants of surgical difficulty with the depth of impaction (P=0.038) being the singular most important factor.

Conclusion: Although the difficulty of surgical removal of impacted lower third molars is dependent on BW, BSA, impaction depth, tooth angulation, and the number of roots, radiographic variables were of greater importance with impaction depth being the most important single factor.

Keywords: Impacted mandibular third molars, extraction, radiographic variables, patient variables, surgical difficulty

Citation: Akadiri OA, Obiechina AE, Arotiba JT, Fasola AO. Relative Impact of Patient Characteristics and Radiographic Variables on the Difficulty of Removing Impacted Mandibular Third Molars. J Contemp Dent Pract 2008 May; (9)4:051-058.

Introduction

The prediction of surgical difficulty and the identification of patients at risk for postoperative complications are the objectives of an accurate preoperative assessment for third molar surgery. All factors that may enhance the preoperative determination of the surgical outcome should be considered. Studies have identified certain radiographic features of an impacted tooth and some patient factors as being determinants of surgical outcomes.[1,2] Available information on this subject were based on studies carried out among non-African populations.[1,2,3,4]

The implications of certain radiographic factors in the assessment of difficulty has been fairly consistent, and the significance of features such as the depth and angulation of an impacted tooth, space distal to the second molars, root morphology, and the number of roots have been reported.[5,6,7] On the other hand, there have been limited investigations on the importance of patient factors and the findings have not been consistent.[3,4]

The present study sought to identify patient characteristics and radiographic factors that might serve as predictors of difficulty in the extraction of fully formed impacted mandibular third molars among a Nigerian population.

Methods and Materials

Patient Selection

Seventy-nine consecutive patients were recruited among those who required surgical extraction of mandibular third molars in the Dental Clinic of the University College Hospital, Ibadan, Nigeria. The criteria for selection included those who were above 19 years of age. This was to ensure the third molars were fully formed since root formation was expected to be complete within 2.5 to 3 years post-eruption.

Preoperative Records

Preoperative patient characteristics such as gender, age, body weight (BW), height, body surface area (BSA), body mass index (BMI), and interincisal distance were recorded. These are collectively referred to hereafter as 'patient' variables.

All patients had a standard periapical radiograph of their impacted molars taken and reviewed by transillumination using a fluorescent radiograph view box. The radiographic features recorded were as follows:

- Depth of impaction (Level A, B, or C)
- Ramus relationship (Class 1, 2, or 3)
- Tooth angulation
- Root curvature (favorable or unfavorable)
- Root divergence (fused, modest, or excessive)
- Number of roots
- Periodontal membrane space (normal, widened, or obliterated)

- Relative horizontal position (lingual or buccal tilt)
- Proximity to the inferior alveolar nerve (distant or close)

A standard 65 KV X-ray machine with a long plastic open-ended cone with an inner metallic collimator was used to obtain the periapical images. There was no facility for computer-assisted densitometric image analysis; hence, actual bone density measurements were not obtained.

Surgical Procedure

All extractions were performed under local anesthesia by a single surgeon who is a senior resident in the Department of Oral and Maxillofacial Surgery with six years of postgraduate experience in third molar surgery. A three-sided mucoperiosteal flap was raised in all cases followed by bone relief using the buccal guttering bur technique under continuous irrigation with sterile normal saline. Tooth delivery was done using Coupeland's elevators and/or dental extraction forceps. Crown sectioning was done in cases where the path of delivery was obstructed by the adjacent second molar. Thorough toileting of the surgical site was done following tooth delivery and the flap was replaced and sutured with two black silk sutures. The operative time was recorded in all cases by a trained assistant using a stopwatch. The recorded time included the period between the beginning of the incision to the placement of the last suture. At the end of the procedure, patients were placed on prophylactic antibiotics and analgesics. Postoperative instructions were given to all patients.

Postoperative Records

Immediately after surgery the operative time was recorded and actual surgical experience of difficulty was determined based on arbitrary time ranges selected as follows:

- Slightly difficult = 20 minutes or less
- Moderately difficult = 21–40 minutes
- Very difficult = more than 40 minutes

Statistical Analysis

Computer analysis was employed using the Statistical Package for Social Sciences (SPSS) version 11.0 (SPSS, Inc., Chicago, IL, USA). Using a univariate analysis the factors associated with surgical difficulty were determined using the Chi-square (χ^2) tests to assess the contributory radiographic factors and the Spearman's Correlation test to determine contributory patient factors. The results of these tests were combined, and the factors having statistical significance ($P<0.05$) were selected as independent variables for multiple regressions with "surgical difficulty" as the dependent variable. The relative importance of the various factors was determined by comparing the P-value of an individual variable in the regression model. The data was explored to determine if operating time decreased as the study progressed in cases with similarly impacted teeth and body types.

Results

The patient factors that correlated significantly with surgical difficulty were BW ($P=0.009$) and BSA ($P=0.004$) as shown on Table 1. Notably, interincisal distance had a negative correlation with surgical difficulty and the correlation was not statistically significant.

On the other hand, the Chi-square analysis showed three radiographic factors made significant contributions to surgical difficulty. These were depth ($P=0.002$), angulation ($P=0.003$), and number of roots ($P=0.035$) (Table 2).

In order to assess the collective contribution of these factors and to determine relative importance of an individual variable these five variables, which were found to be significant ($P<0.05$) in univariate tests, were selected for a multiple linear regression. The overall regression coefficient was 0.53, but the individual contribution of most of the factors was not significant except for the depth of impaction. The relative importance of the individual factor based on the P-values was in the order of depth of impaction ($P=0.038$), angulation of tooth ($P=0.077$), number of roots ($P=0.082$), BSA ($P=0.202$), and BW ($P=0.248$) (Table 3).

Exploration of the data determine whether or not the operating time decreases as the study progressed for cases with similarly impacted teeth and body types was done. The range of BSA values recorded in the study was 1.31 to

2.10 m^2. This was categorized into four groups at intervals of 0.2m^2. However, it was difficult to define similarly impacted teeth since each impaction could be defined only in terms of angulation, depth, and ramus relationship (available arch space) while ignoring other radiographic variables. None of these factors could be isolated in order to define similarity. Hence, the Pederson index[8] (Table 4) was used to assess each impacted tooth. Teeth with a total index score within the same range were regarded as similarly impacted that fit into three categories (A, B, and C).

Operating time did not decrease uniformly along the study period for similar body sizes (Figure 1) and similarly impacted teeth (Figure 2).

Discussion

Traditionally, radiographic variables such as the depth of impaction, angulation, ramus relationship, and root morphology have been recognized as factors that may affect the difficulty of third molar surgery.[1,3,7] Recently emphasis is being placed on such patient variables as age, gender, BW, and BMI.[3,4] The present study added the BSA as another patient variable not

Table 1. Correlation between patient factors and surgical difficulty.

Patient Factors	Correlations (Spearman's rho)	Surgical Difficulty
Age	Correlation Coefficient	.013
	Sig. 2-tailed	.908
Weight	Correlation Coefficient	.291
	Sig. 2-tailed	.009*
Height	Correlation Coefficient	.248
	Sig. 2-tailed	.057
Body Mass Index	Correlation Coefficient	.168
	Sig. 2-tailed	.139
Body Surface Area	Correlation Coefficient	.319
	Sig. 2-tailed	.004*
Inter-incisal Distance	Correlation Coefficient	-.043
	Sig. 2-tailed	.707
Sex	Correlation Coefficient	.112
	Sig. 2-tailed	.106
Ethnicity	Correlation Coefficient	.008
	Sig. 2-tailed	.696

Note: *Significant variables.

Table 2. Contribution of radiographic factors to surgical difficulty (Pearson's Chi-square Test).

Radiographic Factors	Value	df	Asymp. Sig. (2-sided)
Angulation	16.117	4	.003*
Depth	21.140	6	.002*
Number of Roots	10.335	4	.035*
Relative Horizontal Position	1.378	4	.848
Root Curvature	5.902	4	.207
Ramus Relationship	1.079	4	.898
Proximity to IAN	2.763	4	.598
Divergance of Roots	4.453	4	.348
Periodontial Space	1.351	4	.853

Note: * Significant variables.

Table 3. Combined multiple regression of patient and radiographic factors.

Model	Std. Error	t	Sig.
(Constant)	1.613	-.879	.382
Weight	.107	-1.165	.248
Body Surface Area	8.346	1.288	.202
Number of Roots	.203	1.084	.082
Angulation	.085	-.714	.077
Depth	.162	2.112	.038

Dependent variable: Surgical difficulty

Table 4. Pederson Difficulty Index (1988) for removal of impacted third molars.

Classification	Value
Spatial Relationship:	
Mesioangluar	1
Horizontal/Transverse	2
Vertical	3
Distoangular	4
Depth:	
Level A: High occlusal level	1
Level B: Medium occlusal level	2
Level C: Deep occlusal level	3
Ramus Relationship:	
Class 1: Sufficient space	1
Class 2: Reduced space	2
Class 3: No space	3
Total Index Scores Used for Classification	Category A: 3-4 Category B: 5-6 Category C: 7-10

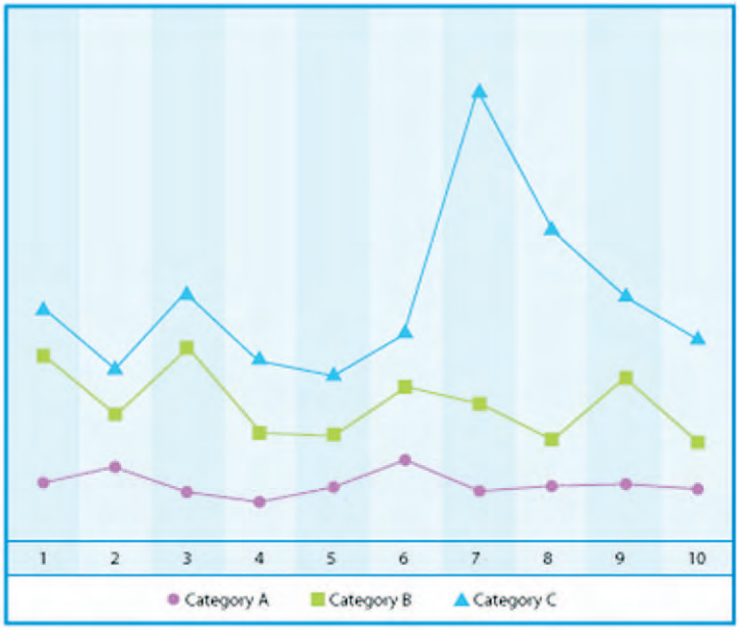

Figure 1. The variation pattern of operation time for the first ten cases in each category of body surface area.

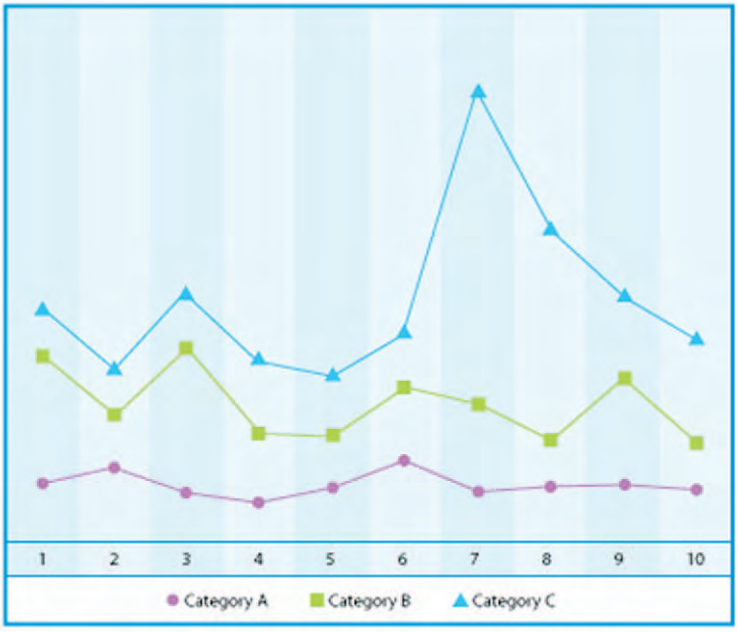

Figure 2. The variation pattern of operation time for the first ten cases of similarly impacted teeth.

previously included in other investigations. The results showed BW and BSA to be contributory patient variables, while depth of impaction, spatial relation, and the number of roots were the radiographic variables identified to have significant influence on the surgical difficulty of third molar surgery.

The findings on radiographic variables appear to be consistent with some previous reports because the depth of impaction and certain elements of root morphology are both implied in most cases.[1,2,3] The number of roots rather than root morphology was found to be important in this study. An earlier report by Ingibjorg et al.[9] reported a similar observation when they recorded greater surgical difficulty with molars with two roots than with molars with single or fused roots. Lower third molars usually present with two roots while there are rare instances of a single/fused root or even three or four roots. In the present study some molars with three roots were observed and their extractions were very difficult. As a result, this characteristic should be an important consideration in the prediction of extraction difficulty. It is possible for an unsuspecting surgeon to fracture a third root, the removal of which could prolong operation time and thus increase surgical difficulty.

In the study by Renton et al.[3] the depth of impaction was identified as a major factor that may affect surgical difficulty. Although the results of the present study seem to be in agreement with this report because the angulation of impaction correlated well with surgical difficulty in the univariate tests for radiographic variables, it did not appear to be a major factor in the regression model.

In contrast, Susarla and Dodson[4] identified both tooth angulation (Winter's classification) and extraction of third molars with a greater depth of bony impaction as major determinants of difficulty. The experience of the surgeon using an appropriate ostectomy technique unique to a specific angulation of an impacted tooth could influence the duration of an operation. Surgeons

need to know the extent of bone removal needed when dealing with impacted teeth with different angulations. A single surgeon with adequate experience in third molar surgery performed all the extractions in the present study. The consistency of surgical expertise in ostectomy technique may account for the weak performance of 'tooth angulation' in the regression model. Renton et al.[3] employed three surgeons with the same level of expertise in their study, which may have likewise limited the confounding factor of varying surgical expertise. Susarla and Dodson[4] employed 14 surgeons of different grades, and they observed surgical experience had a major influence on the difficulty of extractions. This may also explain the significance of tooth angulation in their study.

While there is fair consistency with the findings on radiographic factors, the identification of the important patient factors determining the difficulty of third molar surgery is still shrouded in controversy. Renton et al.[3] pointed to BW, age, and the ethnicity of a patient as the three most important patient factors in this regard. This was soon contradicted by Susarla and Dodson[4] who identified gender as the only patient factor that affected difficulty in their study. In the present study, BW and BSA were identified as significant patient factors influencing surgical difficulty. Although the identification of a patient's BW is in agreement with the findings of Renton et al,[3] the contribution of BSA was not investigated in any previous study.

No clear explanation could be adduced for the relationship of BW to surgical difficulty. Although bone weight contributes a significant proportion to total BW, the proportion varies from person to person and it may be difficult to conclude a greater BW is entirely due to bigger or thicker bone. However, it is a known fact increased bone density can influence bone cutting time thus affecting surgical difficulty. Actual bone density measurement was not done in the present study and represents a shortcoming.

Although both BMI and BSA are derivatives of BW and height, the BMI did not contribute significantly to surgical difficulty in this study. BMI is a measure of total body fat which does not necessarily reflect the size of oral tissues, jaws, or bone density. However, this observation requires further investigation.

A clear reason for the influence of body surface area on surgical difficulty is lacking, but it may be due to large jaws and teeth associated with a large tongue along with thick lips and full cheeks that may interfere with surgical access and impede bone cutting resulting in a longer operating time and may also be characteristic of patients with a large BSA. Although a single surgeon treated all patients in the study, a progressive decrease in operating times for similarly impacted teeth and body types was not observed. Since every individual case scenario consists of several factors that influence surgical difficulty than just impaction types and body sizes alone, preoperative assessment may differ in the determination of surgical challenges.

The other patient factors implicated in previous studies are age, gender, and ethnicity. The implication of patient age is reasonable because older patients tend to have more dense cortical bone due to the involution of the haemopoietic medullary component of the mandible. The reason why age made no difference in this study may be due to the aggregation of most of the patients (93%) within a similar age range.

It is also often assumed females tend to have simpler extractions compared to their male counterparts. This theory needs to be substantiated by scientific studies. Although Susarla and Dodson[4] also identified gender as a risk factor for difficulty, no reason was provided for this observation. The results of the present study found no difference between males and females in terms of surgical difficulty.

Likewise, ethnicity was not significant in this study perhaps because the ethnic consideration was based on people of different tribal origins within a single race of black Africans while previous studies considered individuals from different races. This study therefore suggests there may be no significant intra-racial difference in terms of extraction difficulty.

A possible reason for varying patient factors being implicated from different studies may be the contributions of these factors were the result of

interplay among them rather than by an individual effect. The factors identified in different studies might have been influenced by the composition of the subject populations. For example, a study population comprised of predominantly male patients below age 20 years and female patients above 30 years of age would not be the best population to compare the influence of sex and age on third molar surgery. The female patients may present greater difficulty due to the advanced age while the cases involving male patients might be easier due to the softer bone associated with their age. To achieve an accurate comparison a carefully matched population needs to be selected for such a study.

A negative correlation between interincisal distance and surgical difficulty was observed. This is noteworthy as it suggests there is an inverse relationship between mouth opening and the extent of surgical difficulty. Paradoxically, interincisal distance did not turn out to be a major determinant of difficulty. However, such an outcome must be interpreted with caution since it is only reasonable that trismus should limit access to the surgical site making surgery difficult or even impossible in severe cases. The reason why this is not obvious in the present study as well as in the Renton et al.[3] study is because the mean interincisal distances observed were 49mm and 42mm, respectively, which were adequate to permit unhindered access to the surgical site.

Among the five significant factors highlighted by the univariate tests stated previously, depth of impaction was the only factor demonstrating greater significance in the regression model. This implies the depth of impaction may be the most important factor affecting difficulty of third molar surgery. This is in support of the time-honored submission of Winter[10] who stated depth of impaction as the singular yardstick for predicting surgical difficulty.

The overall regression coefficient (R=0.532) produced by the combination of factors implies these five variables alone constituted only a 53% influence on the difficulty outcome of third molar surgery. It is likely other contributory factors such as patient temperament, actual bone density, tongue activity, cheek flexibility, gag reflex, and the surgeon's experience, which are difficult to measure objectively, were not investigated in this study.

Conclusion

The difficulty of surgical removal of impacted mandibular third molars depends upon BW, BSA, impaction depth, tooth angulation, and the number of roots on the tooth to be extracted. The radiographic variables were of greater importance, and the depth of impaction was the singular most important factor. Consideration of these factors should be included in a comprehensive preoperative evaluation of patients for third molar surgery.

Clinical Significance

The findings of this study may enhance the prediction of surgical difficulty and facilitate appropriate referrals to oral and maxillofacial surgeons when warranted.

References

1. Santamaria J, Arteagoitia I. Radiological variables of clinical significance in the extraction of impacted third molars. Oral Surg Oral Med Oral Pathol Radiol Endod. 1997; 84:469-463.
2. Yuasa H, Kawai T, Sugiura M. Classification of Surgical difficulty in extracting impacted third molar. Br J Oral Maxillofac Surg. 2002; 40: 26-31.
3. Renton T, Smeeton N, McGurk M. Factors predictive of difficulty of mandibular third molar surgery. Br Dent J. 2001; 190:607-610.
4. Susarla S, Dodson TB. Estimating third molar extraction difficulty. J Oral Maxillofac Surg. 2005; 63:427-434.
5. Seward GR, Malcolm H, McGowan DA. An Outline of Oral Surgery, Part I. London, Reed Educational and Professional Publishing Ltd. 1988.
6. Larry JP, Edward E, James RH, Myron RT. Comtemporary Oral and Maxillofacial Surgery, (2nd ed.) St. Louis, Mosby Inc. 1993.
7. Pell GJ, Gregory BT. Impacted mandibular third molars: classification and modified technique for removal. Dent Dig. 1933; 39:330.
8. Pederson GW. Oral Surgery. Philadephia, W.B Saunder (cited by Yuasa et al (2002) in: Classification of surgical difficulty in extracting impacted third molars. Br J Oral Maxillofac Surg. 1988; 40:26-31.
9. Benediktsdottr IS, Wenzel A, Petersen JK, Hintze H. Mandibular third molar removal: Risk factors for extended operation time, postoperative pain and complications. Oral Surg Oral Med Oral Pathol Endod. 2004; 97:438-446.
10. Winter GB. Principle of exodontia as applied to the impacted third molar. St. Louis, MO: American Medical Books. 1926.

About the Authors

Oladimeji A. Akadiri, BDS, FWACS

Dr. Akadiri is a post-residency Fellow in the Department of Oral and Maxillofacial Surgery of the Faculty of Dentistry at the University College Hospital in Ibadan, Oyo State, Nigeria.

e-mail: oaakadiri@yahoo.com

Ambrose E. Obiechina, BDS, FMCDS, FWACS

Dr. Obiechina is a Professor in the Department of Oral and Maxillofacial Surgery of the Faculty of Dentistry at the University College Hospital in Ibadan, Oyo State, Nigeria.

e-mail: ambrose@yahoo.com

Juwon T. Arotiba, BDS, FMCDS, FWACS, MNim

Dr. Arotiba is an Associate Professor in the Department of Oral and Maxillofacial Surgery of the Faculty of Dentistry at the University College Hospital in Ibadan, Oyo State, Nigeria.

e-mail: Juwonarotiba@yahoo.com

Abiodun O. Fasola, BDS, FWACS, MSc

Dr. Fasola is an Associate Professor in the Department of Oral and Maxillofacial Surgery of the Faculty of Dentistry at the University College Hospital in Ibadan, Oyo State, Nigeria.

e-mail: aolubayofasola@yahoo.com