

Assessment of Difficulty in Third Molar Surgery—A Systematic Review

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Purpose: The aim of this review was to identify the most important variables that determine surgical difficulty of impacted third molar extractions by their consistent showing in previous studies.

Materials and Methods: Electronic library search for current evidence in the world literature was conducted, and relevant articles were selected, scrutinized, and the findings were compared.

Results: Seven articles were most relevant, and the results of the comparison of the selected articles showed that demographic variable, age; operative variables: surgeon procedure type and number of teeth extracted; and radiographic variable, depth angulation; and root morphology, are the most consistent determinants of difficulty.

Conclusion: Current evidence is in support of 3 categories of variables strongly associated with surgical difficulty of impacted third molars. The most important variables in each of these categories have been identified.

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Difficulty of assessment is perhaps the most important individual factor to consider in referring cases of impacted third molars for specialists' handling. Historically, there have been various efforts at determining a reliable model for this assessment. Although many have been postulated, none could be said to be universally impeccable. The first attempt to create a model of this nature was by Macgregor, in 1976.¹ He attempted to create a multivariate model based on panoramic radiographic findings; his observations were later corroborated and formed the basis for subsequent propositions.²⁻⁴

Prominent among the proposed models are the Winter's, Pell and Gregory's, Pederson's, and the WHARFE (Winter's classification, Height of the mandible, Angulation of second molar, Root shape and morphology, Follicle development, Exit path) classification/scoring systems. These adopted quantitative scores for each of the parameters and difficulty was

estimated based on the total radiographic scoring of an impacted tooth. These earlier attempts were based exclusively on radiographic variables,^{1,3,5} whereas recent evidence has associated a wide variety of nonradiographic variables with difficulty of impacted third molars extractions.⁶⁻¹¹ The magnitude of the contributions of the various categories of variables, however, is still to be quantified.

Recent literature may have reduced the dearth of information on the estimation of third molar surgical difficulty; still, there are conflicting reports and wide variations of the enumerated factors. This study is a systematic review of relevant literature to identify the important variables that have been consistently signified as determinants of surgical difficulty measured using the operative time. It is hoped to enhance the establishment of the strongest and most current evidence applicable in clinical practice in relation to the evaluation and surgical management of impacted mandibular third molars.

Methodology

A search for pre-existing systematic review and/or meta-analysis on the subject of difficulty assessment in third molar extraction yielded no result. A systematic literature search for relevant articles in English language was then conducted in Medline, PubMed, Google health, and Cochrane databases. The keywords for the search were: impacted third molar; surgery; difficulty; risk factors.

Sixty-two articles resulted from the search. The abstracts were obtained, and articles relevant to the

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study interest were selected based on prespecified criteria. These inclusion criteria were: 1) prospective experimental studies aimed at identifying risk factors for surgical difficulty; 2) studies in which the objective measure of surgical difficulty was based on operative time; 3) studies in which variables significantly associated with surgical difficulty were determined by appropriate statistical methods involving univariate and/or multivariate correlation-regression analyses; 4) the confidence interval at which the *P* values of significant factors were determined must be at 95%. Seven articles were thus selected, the full texts of the articles were obtained, thoroughly studied, and scrutinized; the similarities, differences, and limitations of the various studies were identified and the results compared. Although the articles were not evaluated based on their methodological quality and external validity, the likelihood of random errors in any was minimal since all adopted 95% confidence interval around the results.

Findings

The general characteristics of the studies included in this review are tabulated (Table 1). Reports from the 4 continents of the world are represented, and all of the studies were conducted within the last 10 years. Where stated, the age range and mean age of patient subjects were comparable. Although the numbers of teeth extracted vary widely, the sample size was considerable in all cases except S3, which included only 44 tooth extractions. The authors, however, ascertained that the sample was statistically sufficient for the study using EpiCalc2000 software.

The varieties of factors investigated in the studies differ; while 2 studies concentrated on radiographic factors alone (S1, S3), the other studies investigated 2 or 3 categories of variables, namely, radiographic, demographic, and operative. Apart from S2, in which all the cases were performed exclusively under general anesthesia, the other studies included the use of local anesthesia, nitrous oxide, or general anesthesia/intravenous sedation. There was more than 1 participating surgeon in most of the studies except S7, and the actual number of participating surgeons was not specified in S5 and S6. Buccal guttering technique was the preferred surgical approach in all studies except S2, where the lingual flap technique was used in some cases. Differences in study design could account for dissimilarities of findings in some cases; despite this, however, some factors or related factors feature prominently as determinants of difficulty in most studies.

Table 2 presents a summary account of the various factors associated with surgical difficulty. The table is broadly divided into 2 sections: univariate and multi-

Table 1. CHARACTERISTICS OF SELECTED STUDIES

Study	Author/ (Place of Study)	Year of Publication	Age Range (Years)	Mean Age (Years)	No. of teeth Extracted	Type of Variable	Type of Anesthesia	Surgical Approach	No. of Participating Surgeons
S1.	Santamaria and Ateagoitia ⁵ (Bilbao, Spain)	1997	14-72	26.27	100	Radiographic	LA	Buccal	> 1 (not specified)
S2.	Renton et al ⁶ (London, UK)	2001	16-63	28	354	Radiographic Demographic	GA	Buccal and lingual	3
S3.	Yuasa et al ⁷ (Nagoya, Japan)	2002	17-55	26.75	44	Radiographic	LA	Buccal	> 1 (not specified)
S4.	Ingibjorg et al ⁸ (Aarhus, Denmark)	2004	18.1-44.8	25.2	388		LA	Buccal	14
S5.	Susaria and Dodson ⁹ (Boston, MA)	2004	not stated	26.2	250	Radiographic Demographic Operative	LA LA/N2O IV Sedation/GA	Buccal	> 1 (not specified)
S6.	Susaria and Dodson ¹⁰ (Boston, MA)	2005	not stated	25.6	450	Radiographic Demographic Operative	LA LA/N2O IV Sedation/GA	Buccal	> 1 (not specified)
S7.	Gbotolorun et al ¹¹ (Lagos, Nigeria)	2007	not stated	26.6	90	Radiographic Demographic	LA	Buccal	1

Table 2. COMPILED SIGNIFICANT VARIABLES FROM SELECTED STUDIES

Objective Yardstick	Significant Variables					
	Univariate			Multivariate		
	Demographic	Radiographic	Operative	Demographic	Radiographic	Operative
S1. Operative time	-	Occlusal level Depth Relation to second molar Follicle development Periodontal ligament Mandibular ramus relation Angulation	-	-	Periodontal ligament width Depth	-
S2. Operative time	Age >35 years Weight > 70 kg Ethnicity—(non-Caucasian) Mouth—opening <3 cm Cheek flexibility	Bony impaction Angulation (Horizontal) Depth >6mm Root morphology Proxy to Mandibular canal	- Not conducted -	Age Ethnicity Weight	Depth Root morphology	Surgeon Procedure type (bony impaction)
S3. Operative time	-	Depth Mandibular ramus relation Root curvature Root width Linguobuccal inclination - Not conducted -	-	-	Depth Root width	-
S4. Operative time	-	-	-	Age	Angulation (Horizontal) Number of roots Proximity to mandibular canal	-
S5. Operative time	Gender	Tooth morphology Angulation Root proximity to mandibular canal Pederson's difficulty index score - Not conducted -	Number of teeth extracted Procedure type (soft/bony; partial/full) Surgeon	-	Tooth morphology Pederson's index score	Surgeon Number of teeth extracted Procedure type
S6. Operative time	-	-	-	Gender	Angulation Tooth morphology	Surgeon Number of teeth extracted Procedure type
S7. Operative time	Age Body mass index	Occlusal level Angulation Root curvature Proximity to IAN Depth Periodontal space	- Not conducted -	Age Body mass index	Root curvature Depth	Not conducted

Akadiri and Obiechina. Assessment of Difficulty in Third Molar Surgery. J Oral Maxillofac Surg 2009.

variate test columns. The univariate section displays the factors that were found to be significantly associated with surgical difficulty when individually tested as dependent variables, whereas the multivariate section contains the real determinants of difficulty when the interaction of all factors was assessed by multivariate tests. The implication is that many factors could contribute to difficulty, but when all factors are put into consideration a few of them actually determine the difficulty.

Although many factors within the 3 categories of variables were found to contribute to surgical difficulty at univariate levels, the factors with greater coefficient and therefore the real determinants of difficulty established at multivariate levels were fewer and fairly consistent in all categories of variables among the studies.

Hence, the demographic variable—age (S2, S4, S7)—and operative variables like surgeon and procedure type (S2, S5, S6) and the number of teeth extracted (S5, S6) were the most consistent nonradiographic factors established by multivariate tests.

Predominantly, radiographic variables were the most prominent and most consistent determinants of difficulty and variables such as depth (S1, S2, S3, S7), angulation (S4, S6), and tooth/root morphological factors (S2, S3, S4, S5, S6, S7) were often implicated. The Pederson score, which was indicated in S5 and S6, is a composite summation of the quantitative scores allotted to depth, angulation, and ramus relation of an impacted tooth; therefore, it was not considered a separate radiographic variable.

Discussion

The selected articles are without doubt the most pertinent on the topic of surgical difficulty assessment in third molar surgery in the current world literature. Interestingly, at least 1 of the reported studies was from each continent of the world; Africa (S7), America (S5, S6), Asia (S3), and Europe (S1, S2, S4). This spread should permit wide comparison and possible generalization of findings. The research protocol and data analysis vary, but the observations are quite com-

parable. Variable definition is not uniform; for instance, criteria such as root or tooth morphology, root curvature, root width, and number of roots are related but yet distinguishable. Some authors studied these as separate variables, while others assessed them as the sole factor under root/tooth morphology. The assumption in this review is that all root related factors could be considered as 1 radiographic variable because it is the combination of the various properties of a root or tooth that determines the contribution of the root/tooth to difficulty of extraction. The other radiographic variables are sufficiently distinctive.

In considering the operative variables, the term "procedure type" was used by some authors to describe the third molar tooth based on the tissue of impaction, that is, soft tissue, partial bony, or full bony impactions.^{9,10} These same factors were viewed under radiographic variable by other authors.^{5,6} In this review we considered procedure type under the operative variables category. Other operative variables were surgeon (or surgeon experience), and number of teeth extracted in 1 schedule.

In respect to radiographic variables, which were investigated in all studies, the principal determinants of difficulty are readily deducible by their consistent showing in most studies. These include depth of impaction, angulation, and root/tooth morphology. Of these, the tooth/root morphology should be considered a composite factor whose contribution depends on a combination of root properties such as the number, width, and curvature. The actual impact of tooth crown morphology (shape and size) has not been shown in any previous study. Hence, our opinion is that the impact of this composite factor described as tooth/root morphology has more to do with the root than the crown.

Investigative studies on operative variables are fewer, but the findings so far are sufficiently supportive of "surgeon" (surgeon experience) and "procedure type" as the principal operative variables determining difficulty assessment. There is no universal scale for grading surgeon's experience, as this depends on the exposure of individuals and will vary from center to center. In a given center, however, an assumption may be based on seniority ranking as observed in S2, S5, and S6. Likewise, observations on the demographic variable of significance are still shrouded in controversy. Age is the singular most

consistent factor determining difficulty at the multivariate level, even though others such as gender, weight, body mass index, and ethnicity have also been mentioned in separate studies.

From the foregoing discussion, it is obvious that more research is desirable to confirm the principal variables for an accurate model for preoperative prediction of difficulty of impacted third molar extractions. On the strength of current available evidence, age can be assumed as the principal demographic variable to consider. Depth of impaction, angulation, and root morphology as well as surgeon experience, tissue of impaction (procedure type), and the number of teeth to be extracted in a single schedule are the other more important factors.

To the best of our knowledge, this systematic review is the first on this subject, as none was found during an initial search for previous publications. However, inferences from the current review are limited by the heterogeneity of the study protocols and data analysis techniques adopted in the studies considered. Further systematic reviews and a meta-analysis of the data from the various studies are desirable.

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