*Int. J. Oral Maxillofac. Surg. 2017; xxx: xxx–xxx*
http://dx.doi.org/10.1016/j.ijom.2017.07.013, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
Oral Surgery

# Pernambuco index: predictability of the complexity of surgery for impacted lower third molars

**R. W. F. de Carvalho, B. C. Vasconcelos**
PhD Program in Oral and Maxillofacial Surgery, Department of Oral and Maxillofacial Surgery, University of Pernambuco, Pernambuco, Brazil

*R. W. F. de Carvalho, B. C. Vasconcelos: Pernambuco index: predictability of the complexity of surgery for impacted lower third molars. Int. J. Oral Maxillofac. Surg. 2017; xxx: xxx–xxx.* 

*Abstract.* This study aimed to develop and validate an index of surgical difficulty for the removal of impacted lower third molars. The study was performed in two steps. The first was a cross-sectional analysis of clinical, demographic, and radiographic variables collected from patients undergoing the removal of an impacted lower third molar between 2008 and 2012. The second step was a prospective cohort study involving the same surgical procedures to validate the index; this was performed between 2013 and 2016. Univariate regression analysis was applied, followed by multiple linear regression analysis. A total of 753 surgical procedures were analyzed in the first stage, which led to the identification of the most important variables and their levels of significance. The index was then applied to 280 surgical procedures. The preoperative difficulty was in concordance with the index results in all cases. Among cases with a low level of difficulty, 93.1% had been indexed as low difficulty; likewise, among cases with a high level of difficulty, there was 87.9% concordance with the index. With the use of reference statistics in the development and quality assurance processes, this validated index has proven to be a reliable and easily applicable instrument, with high sensitivity, specificity, and accuracy.

Key words: surgical; risk index; molar third; mandible.

Accepted for publication

Despite careful planning, surgeons occasionally face intraoperative problems[1]. Preoperative evaluation of the potential for difficulty allows the surgeon to assess the complexity of a procedure[2]. Methods of measurement for such evaluations have been developed for the most frequently performed procedures in several specialties[3–7].

The joint efforts of researchers over the past decade have improved the evaluation of the surgical difficulty of third molar extraction; however, most of the proposed methods of evaluation have been based on dental factors alone, determined subjectively and through radiographic analysis[8]. This form of evaluation is no longer appropriate in contemporary medical practice[9]. Current evidence has shown the need to identify clinical, demographic, and radiographic variables that play a significant role in the difficulty of the surgical removal of impacted lower third molars, and several such significant variables have already been reported[1,10,11].

With the continuing discovery of significant variables[9], it would be useful to

0901-5027/000001+07 

Please cite this article in press as: de RWF, Vasconcelos BC. Pernambuco index: predictability of the complexity of surgery for impacted lower third molars, *Int J Oral Maxillofac Surg* (2017), http://dx.doi.org/10.1016/j.ijom.2017.07.013

simplify the interpretation of this information through the formulation of an index that would allow the surgeon to assess the measurements efficiently and reliably. In this way, the surgeon would be able to avoid making decisions that could be harmful to the patient and even possibly lead to legal action[12,13]. Such indexes are increasingly being developed and employed in other surgical specialties[3].

MacGregor made the first attempt to create a model to measure surgical difficulty in 1979. Until then, only methods of classification for lower third molars existed (Winter, 1926; Pell and Gregory, 1933)[14]. MacGregor created a model based only on radiographic findings, which then served as a basis for future models. In 1988, Pederson proposed the simultaneous analysis of angulation along with the Pell and Gregory classification[15]. However, studies have claimed that this is not a reliable tool to assess the surgical difficulty of the removal of lower third molars[16–18].

In the absence of a validated simplified index for the measurement of surgical difficulty in the removal of impacted lower third molars, the aim of the present study was to develop and validate such an index and to encourage the use of this simple information tool.

## Materials and methods

### Study design, location, and eligibility criteria

To achieve the research goals, a two-step study was designed and implemented between March 2008 and March 2016.

### First step: development of the index

A cross-sectional study was performed involving patients who presented to the Department of Oral and Maxillofacial Surgery for the evaluation and surgical management of an impacted lower third molar between March 2008 and March 2012.

A single examiner evaluated all patients, and a total of 465 met the eligibility criteria, which were (1) an indication for surgery under local anaesthesia, and (2) an American Society of Anesthesiology (ASA) physical status classification of 1 or 2. Additionally, 15 patients were excluded based on the exclusion criteria, which were the following: age less than 18 years, absence of the lower second molar, systemic and/or behavioural disorder that made local anaesthesia unviable, pregnancy or lactation, recent irradiation, cognitive impairment that rendered comprehension of the study objectives impossible, and rejection of the methodology. All patients signed a statement of informed consent, and the study received approval from the Ethics Committee of the University of Pernambuco, Brazil.

Two methods were used to evaluate the surgical difficulty (outcome variable): the surgical technique (technical actions employed for extraction) and the surgical time required (time elapsed between incision and suturing of the tissues) (Table 1).

For the purposes of interpretation, a surgery was considered to be of high difficulty when the factors indicating moderate and high difficulty for the technique and surgical time were statistically significant, as this is believed to be the most accurate method.

After defining the intraoperative difficulty level as low, medium, or high using the combination of indicators for surgical technique and surgical time, an adjusted univariate linear regression analysis of clinical, demographic, and radiographic variables was performed. The following were evaluated: sex, age, body mass index (BMI), associated pathologies, level of the occlusal plane (Pell and Gregory classification), available retromolar space (Pell and Gregory classification), impaction angle (Winter classification), number of roots, root curvature, relationship of the tooth to the mandibular canal, relationship to the second molar, crown width, and periodontal space (Table 2).

Variables with a $P$-value of $<0.01$ in the univariate regression analysis were used to adjust a multiple linear regression model to identify the most important variables in determining the intraoperative difficulty of the third molar extraction. A preliminary index was produced with those variables that were significant at the 5% level on linear regression ($P < 0.05$), with categories of low difficulty, moderate difficulty, and high difficulty (Table 3). Statistical calculations were performed using IBM SPSS Statistics version 21.0 (IBM Corp., Armonk, NY, USA).

A flowchart showing the stages in the first step of this study, i.e. the development of the index, is given in Fig. 1.

### Second step: validation of the index

This step involved the design and implementation of a prospective cohort study. Patients who presented for the evaluation and management of an impacted lower third molar between August 2013 and March 2016 were included. For inclusion in the study sample, patients were evaluated against the same eligibility criteria as used in the first step of the research. Every protocol of the study was reviewed by the ethics committee of the institution. The study was performed in compliance with the Declaration of Helsinki and all patients signed a declaration of informed consent.

#### *Sample size*

The proportions of impacted lower third molar surgeries of low and high degree of difficulty were determined in a previous study ($P = 0.462$)[19]. Based on this information, a sample size calculation formula was used to establish a reliable estimated proportion of the population. Considering a 90% confidence interval ($Z\ \alpha/2 = 1.645$) and a maximum error of estimation (E) of $\pm$5% (0.05), a total 280 surgical procedures were required for the study.

#### *Group division*

The patients were divided into two groups of similar size according to the degree of surgical difficulty determined using the index in the preoperative period. Group A had a low degree of difficulty and group B had a high degree of difficulty.

*Table 1.* Classification of difficulty: surgical technique and surgical time.

| Definition | Classification | Difficulty |
|---|---|---|
| Surgical technique (technical actions employed for extraction) | 1: Use of elevator alone | Low |
| | 2: Ostectomy | Moderate |
| | 3: Ostectomy and tooth sectioning | High |
| Surgical time (time elapsed between incision and suturing of the tissues) | 1: <15 min | Low |
| | 2: 15–30 min | Moderate |
| | 3: >30 min | High |

Please cite this article in press as: de RWF, Vasconcelos BC. Pernambuco index: predictability of the complexity of surgery for impacted lower third molars, *Int J Oral Maxillofac Surg* (2017), http://dx.doi.org/10.1016/j.ijom.2017.07.013