J. Maxillofac. Oral Surg. (July-Sept 2013) 12(3):359–364
DOI 10.1007/s12663-012-0435-x

REVIEW

Is Pederson Index a True Predictive Difficulty Index for Impacted Mandibular Third Molar Surgery? A Meta-analysis

Amit Bali · Deepika Bali · Ashutosh Sharma · Gaurav Verma

Received: 2 February 2012 / Accepted: 10 August 2012 / Published online: 22 September 2012

Abstract The aim of this meta-analysis was to find out the clinical reliability of Pederson index in assessing the difficulty of surgery for impacted mandibular 3rd molar. The relevant articles were selected by Hand search and electronic media (Medline, Pubmed, Embase Cochrane library, ISI web of science) from Jan 2000 to Dec 2010. All the relevant articles were properly screened and findings were extracted from the articles. Pederson index had shown low sensitivity and specificity in predicting the difficulty of surgery for impacted mandibular 3rd molar. Positive and negative likelihood ratio had also shown the unreliability of Pederson index. The meta-analysis of the current literature concluded that Pederson index is not a reliable test to predict the surgical difficulty of impacted mandibular 3rd molar.

Keywords Pederson index · Impaction · Mandibular third molar · Difficulty assessment · Surgery

Introduction

Surgical extraction of the impacted mandibular third molar is one of the most common surgical procedures in oral and maxillofacial surgery practice. Assessment of the difficulty of the surgery pre-operatively is the most important factor to be considered. It is hard to evaluate the factors which increase the difficulty of the surgery because of the large variation among patients. As a result of this, many surgeon now and then face difficulty while removing impacted mandibular third molar. Therefore, operating surgeon must have scientific evidence based information regarding the estimated level of surgical difficulty of every case. There are number of studies to evaluate the surgical difficulty of impacted mandibular third molar. Pederson has proposed a difficulty index for the removal of impacted mandibular third molar [1]. The difficulty score is judged on the basis of radiographic factors. In this index, Pederson has given difficulty index value for impacted mandibular third molar according to angulations, depth, and ramus relationship (Table 1).

The angulations of the mandibular third molar to the second mandibular molar are considered into four positions—mesioangular (Fig. 1), horizontal (Fig. 2), vertical (Fig. 3), and distoangular (Fig. 4).

The relationship of the mandibular third molar to the second mandibular molar is considered into three positions. In position A, the highest position of the third molar is at the same level or above the occlusal level of second mandibular molar (Fig. 5). In position B, the highest position of the third molar is below the occlusal plane but above the cervical line of second mandibular molar (Fig. 6). In position C, third molar is below the cervical line of second mandibular molar (Fig. 7).

The relationship of the mandibular third molar to the ramus of the mandible was considered to fall into 3 classes. Class I—there is sufficient space between the ramus and distal margin of the second molar for the accommodation of the mesial-distal diameter of the crown of the 3rd molar (Fig. 8). Class II—space between the ramus and distal surface of the 2nd molar was less than the mesial-distal diameter of the

A. Bali (✉) · A. Sharma · G. Verma
Department of Oral & Maxillofacial Surgery,
M.M. College of Dental Sciences & Research,
Mullana, Ambala, Haryana, India
e-mail: dr_amit_bali@indiatimes.com

D. Bali
Department of Periodontics, DAV (C) Dental College,
Yamuna Nagar, Haryana, India

Table 1 Pederson difficulty index

Difficulty index for removal of impacted mandibular third molar	
Classification	Difficulty index value
Angulation	
Mesioangular	1
Horizontal/transverse	2
Vertical	3
Distoangular	4
Depth	
Level A	1
Level B	2
Level C	3
Ramus relationship	
Class I	1
Class II	2
Class III	3

Difficulty index very difficult: 7–10, moderately difficult: 5–7, minimally difficult: 3–4

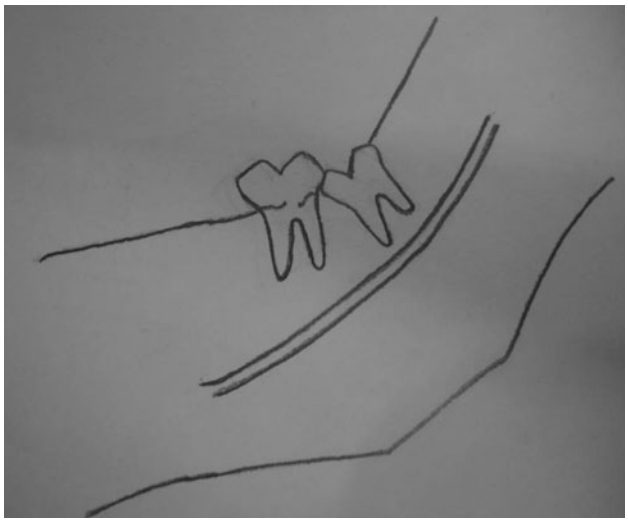

Fig. 1 Mesioangular impaction

crown of the lower third molar (Fig. 9). Class III—all or most of the 3rd molar lay within the ramus (Fig. 10).

Pederson index is cited in the text books of oral and maxillofacial surgery [2, 3]. Few studies have reported that it does not match actual surgical difficulty. This meta-analysis is aimed to evaluate the reliability of Pederson index.

Objectives

In order to start a systematic review, we selected a question, whether Pederson difficulty index is reliable to assess the difficulty of the impacted mandibular third molar extraction.

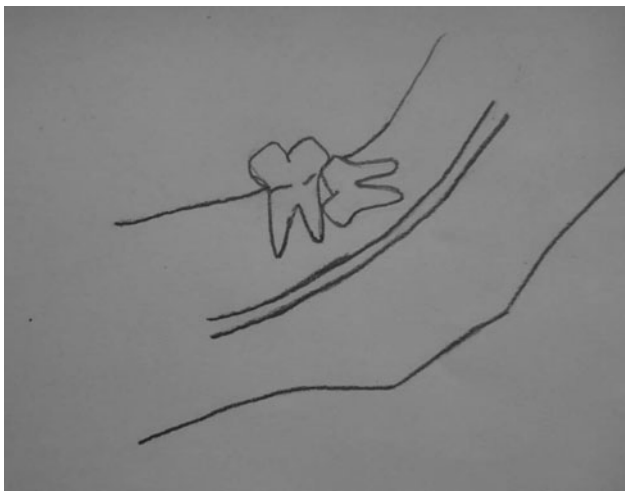

Fig. 2 Horizontal impaction

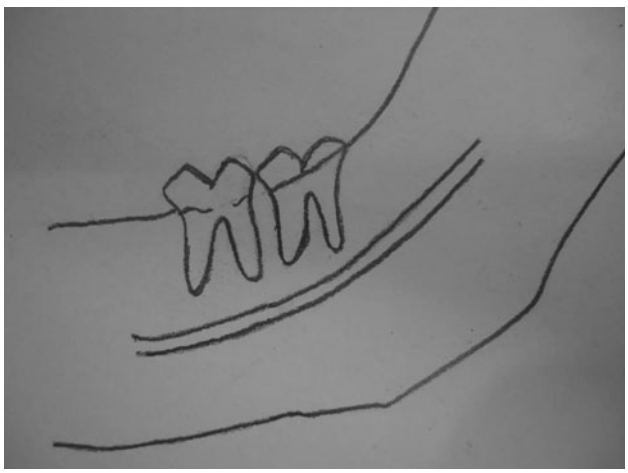

Fig. 3 Vertical impaction

Method

The studies with following criteria were included in this systematic review:

1. Studies analyzing the Pederson index
2. Randomized control trials (RCT), case control studies and reviews were included
3. Studies of last 10 years (2000–2010)

Search

To find out the answer of the selected question, detailed search strategies were developed for each database searched. Keywords selected for review were impacted mandibular third molar, surgical extraction, difficulty assessment, and index. The following databases were searched:

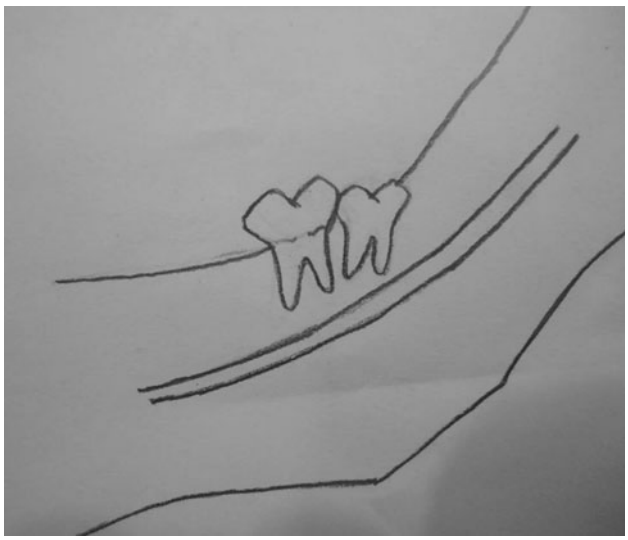

Fig. 4 Distoangular impaction

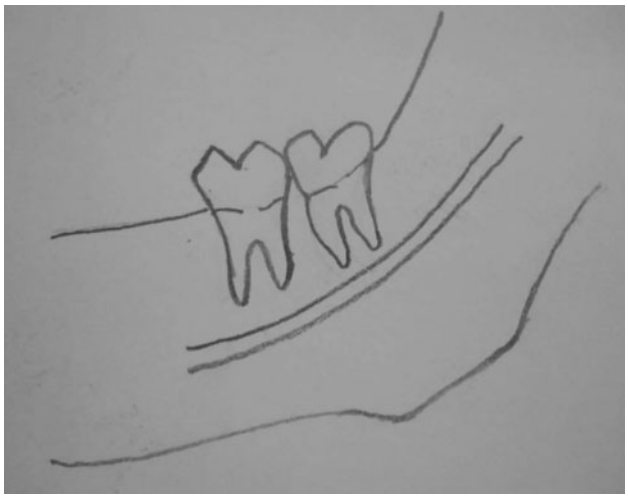

Fig. 5 Level A

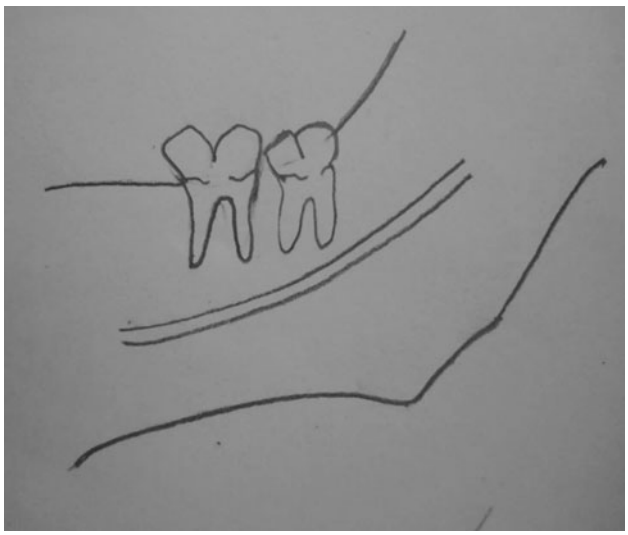

Fig. 6 Level B

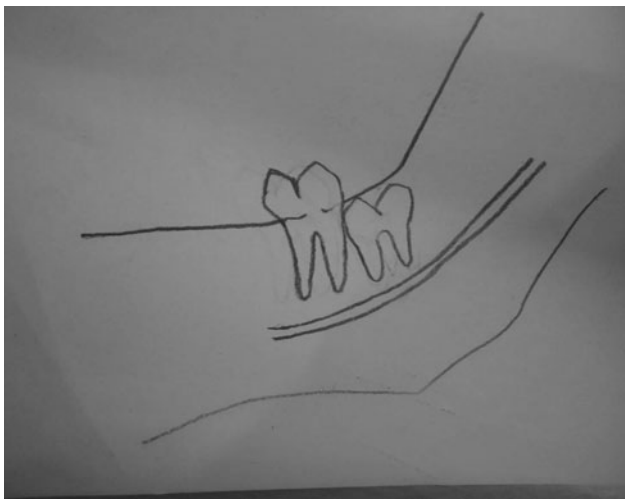

Fig. 7 Level C

Medline (January 2000–December 2010)
Pubmed (January 2000–December 2010)
Embase (January 2000–December 2010)
Cochrane library (January 2000–December 2010)
ISI web of science (January 2000–December 2010)

Hand Searching

Hand searching of the following journals was conducted by the authors. A page by page search of the following journals was conducted for eligible studies:

Journal of Maxillofacial & Oral Surgery (2000–2010)
Indian Journal of Research & Review (2000–2010)
Journal of Indian Dental Association (2000–2010)
Dental Practice (2000–2010)
Journal of International College of Dentists (2000–2010)
Dental Update (2000–2010)

Reference section in books on oral surgery was scanned for the relevant studies and proceedings of the conferences were looked through in an attempt to identify the unpublished studies.

Data Collection and Analysis

From the searched articles, relevant articles were selected. All articles selected by the authors were obtained. The articles on which the authors disagree were read in full and a decision to include or exclude was made after discussion.

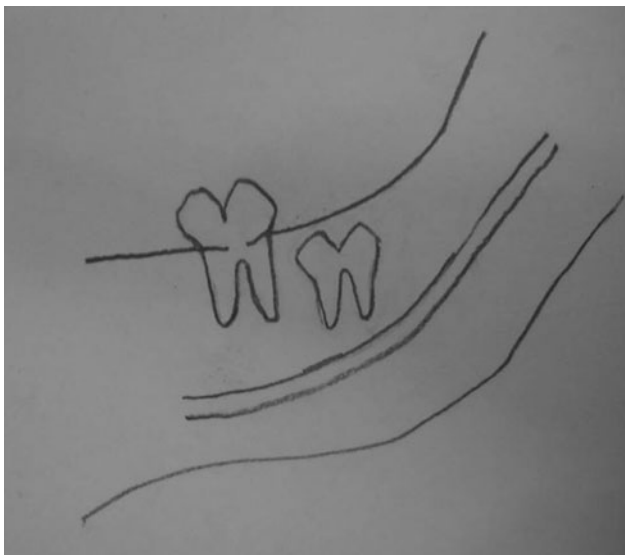

Fig. 8 Class I

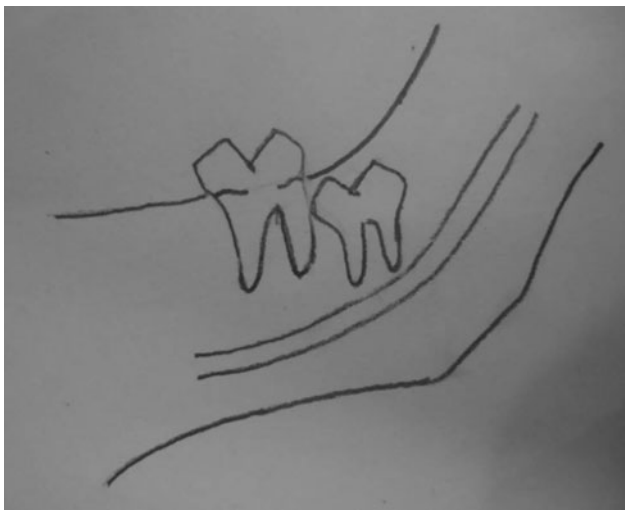

Fig. 9 Class II

Data Extraction

Three authors had independently extracted the relevant studies from the total articles. The results of the finally selected studies were discussed with authors until agreement was obtained. In case of uncertainty, open discussion was done with all the authors for clarification. If the uncertainty still persisted, the data was not used in the review.

Results

The search of the literature resulted in a total of 108 published articles. No unpublished manuscripts were

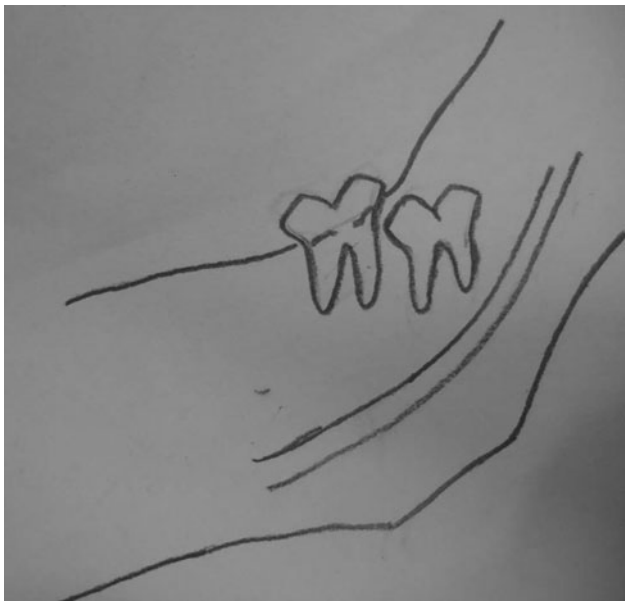

Fig. 10 Class III

identified. Of the 108 articles, 10 were considered to be potentially relevant [4–9]. Independent reviews of these 10 articles led to the inclusion of 4 articles (Table 2) and exclusion of remaining six articles. All of these 4 studies had calculated the sensitivity and specificity of the Pederson's index in the surgery of impacted mandibular third molar [10–13]. All the variables which were included by Pederson in his index were examined by the authors of these studies. All the selected studies had measured the Pederson's index preoperatively and then operating surgeon had compared the intra-operative difficulty with the difficulty calculated by Pederson's index.

First study had tested the index in 44 patients [10]. Difficulty of the surgery was decided over the total time taken by the surgeon. If the surgery time was 30 min or more, it was considered to be a difficult extraction. This study had also tested a new index formed by the authors. This new index was based on the questionnaire filled by different oral and maxillofacial surgeons. The whole data was analyzed by authors by using statistical analysis software (SAS) version 6.12 procedures. The odd ratio, sensitivity, and specificity of new index and Pederson's index were calculated. Pederson's index had a sensitivity of 0.5, specificity of 0.92 and odd ratio 11.0 compared to new index with sensitivity of 0.85, specificity of 0.92 and 62.3 odd ratio [10]. The positive likelihood ratio for Pederson index was calculated as 6.25 and negative likelihood ratio was 0.543 (Table 3).

In the second study, 105 extractions of impacted mandibular third molar from a total of 73 patients had been done from September 2002 to July 2003. Operative difficulty was predicted pre-operatively from panoramic

Table 2 Studies used in systematic review

Study	Authors	References	Type of study	Pederson index analysis
1	Yuasa et al.	[10]	RCT	Yes
2	Freitis et al.	[11]	RCT	Yes
3	Gbotolorum et al.	[12]	RCT	Yes
4	Akadiri et al.	[13]	RCT	Yes

radiographs using the Pederson scale. Sensitivity, specificity and odd ratio of Pederson index was calculated [11]. Sensitivity, specificity and odd ratio was also calculated using the modification of the Parant scale by Garcia–Garcia et al. [12]. Authors used a non-parametric ranking test (Kruskal-Wallis) and a probability of less than 0.05 was accepted as significant. For prediction of difficulty, the Pederson scale showed a sensitivity of 23.8 % and specificity of 76.2 %. Odd ratio for prediction of the Parant categories from the Pederson categories was close to one and was not significant. No significant correlation was found between duration of operation and Pederson score. Positive and negative likelihood ratio for Pederson index was 1 (Table 3).

In the third study, 90 surgical extractions of impacted mandibular third molar had been done between October 2003 to April 2004. Authors used univariate analysis and multiple linear regression analysis to find out the most important factors [13]. The relationship of these variables to total intervention time was used to form a pre-operative index of difficulty. Sensitivity and specificity of new index was compared with Pederson index. Sensitivity and specificity of Pederson index was 43 and 74 % (49 % accuracy) respectively, with positive and negative likelihood ratio of 1.88 and 0.698, while sensitivity and specificity of new index was 70 and 75 % (76 % accuracy) for easy extraction. In case of moderately difficult extractions, sensitivity and specificity of new index was 70 and 75 % (73 % accuracy) while in Pederson index, it was 52 and 48 % respectively (49 % accuracy). The positive likelihood ratio for Pederson index was 1 and negative likelihood ratio was 1. For difficult cases, the 80 % sensitivity and 97 % specificity was calculated (98 % accuracy) with new index while the 20 % sensitivity and 89 % specificity was calculated with Pederson index (86 %accuracy) and positive and negative likelihood ratio was 1.72 and 0.113 (Table 3).

In the fourth study, Pederson index was used to predict the difficulty of 79 cases of impacted mandibular third molar [14]. The index was found to be highly reproducible ($p = 0.00$). Sensitivity of Pederson index was 94.9 % and specificity was 45 %. The positive predictive value (PPV) was 67.2 % and negative predictive value was 90 % with 69.6 % accuracy. The positive and negative likelihood ratios for Pederson index were 1.73 and 0.113 respectively (Table 3).

Discussion

Preoperative assessment of the difficulty of the surgery for impacted mandibular third molar is important not only for the surgeon but is also equally important for the patient. Pederson index is mentioned in many text books of oral and maxillofacial surgery but it was never universally accepted as a true difficulty index. We have done a systematic review and meta-analysis to evaluate its reliability in assessing surgical difficulty. All the studies included in this review have evaluated the reliability of the Pederson index. Out of the 4 studies, 2 have compared the Pederson index with a new index [10, 13]. This new index was based on univariate and multivariate factors selected from radiographs, local anatomy, and demographic variables. Sensitivity and specificity of the new index was much higher than Pederson index in both the studies [10, 13]. Out of remaining 2 studies, one study compared the Pederson index with the Parant index and concluded that Pederson index has very low predictive value [11]. Fourth study evaluated the Pederson index in 79 patients and concluded that Pederson index has low accuracy and was not a reliable index to assess the difficulty of the impacted mandibular third molar surgery [14]. Likelihood ratio was calculated with the help of sensitivity and specificity of the Pederson index. Positive likelihood ratio is low in all the studies (Table 3). The low value of positive likelihood ratio for Pederson index has shown that the index is not very useful. The negative likelihood ratio in all of the four studies is not close to zero which has also indicated that Pederson index is not a reliable index to truly assess the difficulty of the surgery of impacted mandibular third molar (Table 3).

Four studies were critically evaluated to find out why Pederson index was showing low sensitivity and specificity. We found that multiple variables other than the variables which Pederson advocates are often responsible for incorrect calculation of difficulty index. Variables which were used by Pederson are only radiographic variables. Pederson has not given any consideration to anatomical and demographic variables, which were found to be highly significant in these studies. Other important variables which were not calculated by Pederson are, bone density, mouth opening, abnormal root curvature, width of root, age, basal metabolic rate (BMI) of patient, depth from point of elevation, relationship of root with inferior

Table 3 Likelihood ratio of studies used in systematic review

Study	Sensitivity of Pederson index	Specificity of Pederson index	Positive likelihood ratio (LR+)	Negative likelihood ratio (LR−)
1	50 %	92 %	6.25	0.543
2	23.8 %	76.2 %	1	1
3	Easy extraction—48 %	Easy extraction—74.5 %	1.88	0.698
	Moderately difficult—52 %	Moderately difficult—48 %	1	1
	Difficult extraction—20 %	Difficult extraction—89 %	1.8	0.898
4	94.9 %	45 %	1.72	0.113

alveolar canal, and root periodontal space interface. To evaluate the surgical difficulty, above mentioned variables should also be calculated along with Pederson index.

Conclusion

Systematic review and meta-analysis of the available studies showed that Pederson index is not a reliable index to accurately assess the difficulty of impacted mandibular third molar surgery. Overall studies available to assess the Pederson index are few. More studies are required to be done and further systematic reviews and meta-analysis are required to more accurately assess the reliability of Pederson index.

References

1. Pederson GW (1988) Surgical removal of tooth. In: Pederson GW (ed) Oral surgery. WB Saunders, Philadelphia
2. Frost DE, Hersh EV, Levin LM (2000) Fonseca oral and maxillofacial surgery. PA Saunders, Philadelphia
3. Malik NA (2008) Text book of oral and maxillofacial surgery. Jay Pee Brothers Medical Publisher, New Delhi
4. Susarla SM, Dodson TB (2004) Risk factors for third molar extraction difficulty. J Oral Maxillofac Surg 62:1363–1371
5. Yuasa H, Kawai T, Suguira M (2002) Classification of surgical difficulty in extracting impacted third molar. Br J Oral Maxfac Surg 40:26–31
6. Benediktsdottir IS, Wenzel A, Petersen JK, Hintze H (2004) Mandibular third molar removal: risk indicator for extended operation time, postoperative pain, and complications. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 97:438–446
7. Renton T, Smeeton N, Mcgurk M (2001) Factors predictive of difficulty of mandibular third molar surgery. Br Dent J 190(11): 607–610
8. Susarla SM, Dodson TB (2005) Estimated third molar extraction difficulty: a comparison of subjective and objective factors. J Oral Maxillofac Surg 63:427–434
9. Akadiri OA, Obiechina AE (2009) Assessment of difficulty in third molar surgery: a systematic review. J Oral Maxillofac Surg 67:771–774
10. Yuasa H, Kawai T, Suguira M (2004) Clinical postoperative findings after removal of impacted mandibular third molar: prediction of postoperative facial swelling and pain based on preoperative variables. Br J Oral Maxfac Surg 42:209–214
11. Freitis MD, Mendez LL, Sampedro FG, Martin JMS, Rey JMG, Garcia AG (2007) Pederson scale fails to predict how difficult it will be to extract lower third molar. Br J Oral Maxfac Surg 45: 23–26
12. Garcia GA, Gude SF, Gandara J, Gallas M (1997) Trismus and pain after removal of impacted lower third molars. J Oral Maxillofac Surg 55(11):1223–1226
13. Gbotolorum OM, Arotiba GT, Ladeinde AL (2007) Assessment of factors associated with surgical difficulty in impacted mandibular third molar extraction. J Oral Maxillofac Surg 65: 1977–1983
14. Akadiri OA, Fasola OA, Arotiba JT (2009) Evaluation of Pederson index as an instrument for predicting difficulty of third molar surgical extraction. Niger Postgrad Med J 16:105–108