# Evaluation capability of surgical difficulty in the extraction of impacted mandibular third molars: a retrospective study from a post-graduate institution

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## Summary

***Introduction.*** **The first aim of the present study was to analyze if any correlation exists between the post-graduate's and the tutor's difficulty evaluation of the same tooth to be extracted. Secondly, the study aimed to verify whether, and possibly which, anatomical/topographic characteristics of the impacted lower third molar influence the post-graduate's difficulty evaluation. Thirdly, patient's age and gender were studied for any influence either on the post-graduate's and tutor's extraction difficulty evaluation or on surgical time. Lastly, the possible effect of the post-graduate's difficulty evaluation on the incidence of surgical accidents was also studied.**

***Materials and methods.*** **Eighty-four impacted mandibular third molars have been retrospectively reviewed. For each molar, pre- and operative information have been collected. The Pearson's Product Moment Correlation, the general linear model with backward stepwise procedure, the variance analysis and the logistic regression were used for inferential statistics.**

***Main results.*** **Correlation between the post-graduate's and tutor's difficulty evaluation of each lower third molar to be extracted as well as between difficulty evaluation and operative time were statistically significant. Tooth position, impaction depth and relationship with the inferior alveolar nerve influenced operative times. Pre-surgical difficult degree had a positive significant effect on accident occurrence.**

***Conclusions.*** **The pre-operative post-graduates' difficulty evaluation did not differ from their post-operative evaluation although their judgement differed from that given by the tutor and did not correlate with the operative time. Lower third molar extraction difficulty seems to be influenced by some topographic factors such as tooth position, impaction depth and relationship between inferior alveolar nerve and impacted tooth.**

**Key words: dental anatomy, student, statistics.**

## Introduction

Establishment of the degree of surgical difficulty in mandibular third molar extraction is extremely important for correct management in order to reduce the risk of accidents and complications. A careful analysis of clinical and radiographic features of each case is therefore mandatory to program surgery. Several studies (1-7) have been carried out during the last decades in order to find a method as objective as possible to preoperatively establish the degree of surgical difficulty in mandibular third molar surgery.

In 1988 Pederson (1) proposed a difficulty index based on anatomical and radiographic features of the tooth to be extracted. Yuasa et al. (5) re-examined anatomical and radiographic parameters while Renton et al. (4) also took into consideration patient-related factors such as age, race, gender, weight and height. In 2005 a Spanish study by Diniz-Freitas et al. (8) showed that the Pederson index was not enough to define the real extraction difficulty since it did not consider clinical factors, such as mouth opening, age and cheek flexibility, to be relevant.

In a recent study Gbotolorun et al. (9) proposed a new index in which they considered both clinical (patient's age and body mass index) and radiologic variables (depth of inclusion and root curvature) (10). Susarla and Dodson (7, 11) outlined the surgeon's difficulty evaluation related to his/her own clinical and practical experience. Other studies have been carried out on this topic (12-14) and a specific test has been elaborated, that is "the Objective Structured Assessment of Technical Skill for surgical residents" (OSATS), with the first aim being to evaluate the surgeon's knowledge about surgical phases and how they plan and carry out the surgery and with the final aim of critically analyzing and eventually modifying teaching criteria.

The first aim of the present study was to verify if any correlation exists between the post-graduate's difficulty evaluation of each lower third molar to be extracted and, respectively: 1) the post-operative difficulty evaluation by the same post-graduate; 2) the tutor's difficulty evalu-

ation of the same tooth to be extracted; 3) the operative time for the same surgery. Secondly, the study aimed to verify if and possibly which anatomical/topographic characteristics of the impacted lower third molar influence the post-graduate difficulty evaluation. Thirdly patient's age and gender were studied for any influence either on the post-graduate's and tutor's difficulty evaluation of extraction or on surgical time. Lastly, the possible effect of the post-graduate's difficulty evaluation on the incidence of surgical accidents was also studied.

## Materials and methods

Eighty-four impacted mandibular third molars extracted from March 1, 2011 until June 30, 2011 have been retrospectively reviewed for this study. Surgical extractions were performed by ten graduates in dentistry attending their second (5) and third (5) year of training during their 3-year post-graduate course in Oral Surgery at the "Sapienza" University of Rome.
Third molar assignment to the post-graduates had been previously and randomly decided by a tutor since they usually work in shifts. For each molar, a clinical chart was drawn up by the assigned post-graduate. Inclusion criteria for the study were the complete record of epidemiological, clinical and radiographic information including pre-operative data, dental and operative variables, pre- and post-operative post-graduate's evaluation of the degree of surgical difficulty in a 1-10 score and data concerning the performed surgical technique, follow-up examinations as well as any accidents or complications.
Pre-operative data included dental variables, local clinical signs and symptoms as well as the extent of mouth opening, meaning the greatest distance between the edge of upper and lower incisors.
Dental variables included axis inclination, impaction depth, Pell and Gregory's classification, root morphology and relationship with the inferior alveolar nerve.
Operative variables included flap design, ostectomy width, tooth sectioning, operative time excluding suture time, intra-operative accidents, suture time, residual cavity revision, wound irrigation, drainage, suture materials and modalities, cold dressing and post-operative medical treatment (2, 3, 10, 15).
Inclination of tooth axis was evaluated on the orthopantomography and was classified as vertical, horizontal, mesial or distal.
As for the impaction depth, Winter's classification (16) was modified by dividing Group C into two subgroups, C1 and C2; in the first one, the most coronal portion of the third molar was located at the level of the coronal half of the second molar root and in the second one, it was located in the apical half of the second molar root. Groups A and B remained unmodified: in Group A the most coronal part of the third molar was located above the occlusal plane of the second molar while in Group B it was located at the level of the crown of the second molar.
As for Pell and Gregory's classification, it consists of three orthopantomographic classes: in the first one the distance between the anterior margin of the mandibular rhamus and the distal surface of the second molar crown is at least equal to the mesio-distal diameter of the third molar crown; in the second class the same distance is smaller than the mesio-distal diameter of the third molar crown; in the third class that distance is very close, or less than, zero.
Relationships between inferior alveolar nerve (i.a.n.) and third molar roots were classified as absence, contiguity on the horizontal plane and imbrications, with the help of computerized tomographic studies performed when the nerve was superimposed by the tooth on the panoramic radiograph.
For each surgery the operative time was measured chronometrically by an outside assistant, from soft tissue incision until the end of the procedure without the suture.
A score from 1 to 3 was attributed by the tutor to each of the following variables: position, depth, Pell and Gregory's classification, root morphology, relationship with the inferior alveolar nerve and degree of mouth opening. A total 6-18 score was therefore obtained for each of the 84 selected teeth.
At the moment of their difficulty evaluation, post-graduates did not know, what difficulty method of assessment the tutor would have used. The present study was approved by the local Ethical Committee with the protocol number 724/12. Ethical Principles for medical research stated by Helsinki Declaration have been followed.

## Statistical design

Pearson's correlation (r) was initially used to assess the relationship between the post-graduate's difficulty evaluation (both pre- and post-operative) of each lower third molar to be extracted, the tutor's difficulty evaluation of the same tooth, and the operative time for that surgery.
To assess if, and possibly which, anatomical/topographic characteristics of the impacted lower third molar influenced the post-graduate's difficulty evaluation, a general linear model (GLM) was then developed using "post-graduate's pre-operative evaluation" as dependent variable and the following factors as predictor variables: tooth position (vertical, horizontal, mesioangular and distoangular); Pell and Gregory class for the amount of space distally to the second molar (I, II and III); impaction depth (AB, C1 and C2); root morphology (a, b and c); relationship with the i.a.n. (1 and 2); post-graduate training year (second and third); degree of mouth opening (in mm). All predictor variables, excluding the degree of mouth opening, were entered in the model as qualitative variables. A backward stepwise procedure was then applied to build the model by including only those predictor variables that had a significant effect ($p < 0.05$) on the "difficulty evaluation".
Since the correlation between "post-graduate pre-operative difficulty evaluation" and "operative time" resulted moderate (see results below), a second GLM was de-

veloped entering the "operative time" as dependent variable and the above-mentioned predictor variables to study if any tooth characteristics could affect the operative time although they were not specifically considered in the evaluation of extraction difficulty degree by post-graduates.
Moreover, to rule out the possibility that the tutor had unconsciously assigned the most difficult cases to the third year post-graduates, the one-way analysis of variance (ANOVA) was used to test the effect of "post-graduate training year" on "tutor's difficulty evaluation".
The influence of patient's age and gender on both "extraction difficulty evaluation" and "operative time" was tested separately, using Pearson correlation and one-way ANOVA respectively, because these variables were not explicitly considered by the tutor in the assessment of surgical difficulty.
Finally, to verify whether the post-graduate's preoperative difficulty evaluation could predict the occurrence of surgical accidents, a simple logistic regression model was developed, using "accident occurrence/non occurrence" as dependent variable and "pre-operative difficulty evaluation" as predictor variable.
Model residuals and variables used in parametric significance tests were tested for normality using the Kolmogorov-Smirnov test. All statistical analyses were carried out with STATISTICA Release 8, Statsoft Inc., Tulsa, OK, USA.

## Results

Table 1 reports the distribution of cases (absolute and percent frequencies) for the qualitative variables, and the mean values ± standard error for the continuous variables.
There was a high positive correlation between the post-graduate's pre-operative difficulty evaluation and the post-graduate's postoperative difficulty evaluation ($r = 0.88$, $n = 84$, $P < 0.0001$), meaning that post-graduates did not substantially modify their evaluation after the surgical event. Conversely, the correlation between post-graduate's preoperative difficulty evaluation and operative time was moderate ($r = 0.44$, $n = 84$, $P < 0.0001$) and the correlation between post-graduate preoperative difficulty evaluation and tutor's difficulty evaluation was low, although statistically significant ($r = 0.22$, $n = 84$, $P = 0.04$). These results suggest that the operation was sometimes either more difficult or easier than post-graduates expected, and also that post-graduates evaluation of operation difficulty was substantially different from that made by the tutor (Figs. 1-3).
The GLM developed for "post-graduate's pre-operative difficulty evaluation" was statistically significant, although it allowed to explain a relatively small portion of the variability in the post-graduate's assessment of surgical difficulty ($R = 0.33$, $F_{3,80} = 3.27$, $P = 0.025$). This was because only tooth position, among the considered predictor variables, had a significant effect on post-graduate difficulty evaluation. Specifically, the vertical position had a negative effect on post-graduate difficulty evaluation (coefficient ± standard error = -1.04 ± 0.36, $t = -2.92$, $P = 0.0046$) (Fig. 4), i.e. post-graduates perceived a less difficult extraction if the tooth to be extracted was vertical.
The GLM for "operative time" was highly significant ($R = 0.65$, $F_{6,77} = 9.21$, $P < 0.0001$) and it showed that not only the position, but also the impaction depth and the relationship with the i.a.n. influenced the operative time. In particular, the shortest operative times were associated with vertical position (coefficient ± standard error = -9.56 ± 2.78, $t = -3.44$, $P < 0.001$) (Fig. 5), AB (coefficient ± standard error = -15.15 ± 4.07, $t = -3.72$, $P < 0.0004$) (Fig.6) and C1 depth of impaction (coefficient ± standard error = -9.34 ± 4.11, $t = -2.27$, $P < 0.026$) (Fig. 6), and the absence of relationship between tooth and i.a.n. (coefficient ± standard error = -4.00 ± 1.77, $t = -2.26$, $P = 0.026$) (Fig. 7). Second-year post-graduates tended to have longer durations than third-year post-graduates, although this tendency was not statistically significant (factor not included in the model: $t = 1.87$; $P = 0.065$) (Fig. 8). Note that the latter results cannot be due to the tutor assigning unconsciously the most difficult cases to the most experienced post-graduates, given that there was no significant relationship between tutor evaluation and post-graduate training year ($F_{1,82} = 0.55$, $p=0.459$).
Moreover, it was found that neither the age of patients (Tab. 2), nor their gender (Tab. 3) were related to the lenght of surgery or to the difficulty evaluation degree assigned either by the tutor or by the post-graduates.
Finally, the post-graduate's pre-surgical difficulty evaluation degree was significantly related to the probability of accident occurrence ($\chi^2 = 5.84$, $p = 0.0156$; Fig. 10) in that surgical accidents happened more frequently when post-graduates evaluated extractions as more difficult and less frequently when extractions were considered easy.

## Discussion

Many factors have been investigated over time as possible causes of difficulty in lower third molar extraction since the correct establishment of the overall surgical difficulty degree is essential in decision making. Actually, it allows the surgeon to decide whether he/she is capable of performing the procedure or whether he/she has to refer the case, comparing its difficulty with his/her technical skills derived from his/her surgical training. Adequate technical ability is also required for the second operator as well as for the dental assistant who help the surgeon in extracting mandibular third molars and therefore they should be carefully chosen by the surgeon. Moreover, the establishment of correct surgical difficulty degree is important in daily work scheduling in that each extraction should be introduced in the dentist's/oral surgeon's daily activity considering the sequence and type of all other dental treatments to be carried out during the day, the estimated time for its completion and the unavoidable decrease of concentration which occurs with the increase of working hours.

Table 1. Third molars by patient, dental, and operative variables.

| | | | |
|---|---|---|---|
| **Patient variables** | gender | M | 26 (31,0%) |
| | | F | 58 (69,0%) |
| | age | 27,36 ± 11,21 | |
| | | (K-S: d = 0,20; p < 0,01) | |
| **Dental variables** | inclination | mesial | 29 (34,5%) |
| | | vertical | 29 (34,5%) |
| | | horizontal | 18 (21,4%) |
| | | distal | 8 (9,5%) |
| | Pell & Gregory's class | I | 26 (31,0%) |
| | | II | 53 (63,1%) |
| | | III | 5 (6,0%) |
| | impaction depth | A/B | 59 (70,2%) |
| | | C1 | 23 (27,4%) |
| | | C2 | 2 (2,4%) |
| | root morphology | a | 73 (86,9%) |
| | | b | 4 (4,8%) |
| | | c | 7 (8,3%) |
| | relationship with the inferior alveolar nerve | 1 | 39 (46,4%) |
| | | 2 | 45 (53,6%) |
| | | 3 | 0 (0,0%) |
| **Operative variables** | postgraduate's training year | II° | 43 (51,2%) |
| | | III° | 41 (48,8%) |
| | surgical time (min.) | 30,65 ± 1,97 | |
| | | (K-S: d = 0,82; p < 0,20) | |
| | mouth opening (mm) | 45,90 ± 0,75 | |
| | | (K-S: d = 0,15; p < 0,10) | |
| | surgical accidents | yes | 14 (16,7%) |
| | | no | 70 (83,3%) |
| | post-graduate's pre-operative difficulty evaluation (1-10 scale) | 4,60 ± 0,22 | |
| | | (K-S: d = 0,10; p < 0,05) | |
| | post-graduate's post-operative difficulty evaluation (1-10 scale) | 4,60 ± 0,25 | |
| | | (K-S: d = 0,10; p < 0,05) | |
| | tutor's difficulty evaluation (6-18 scale) | 8,26 ± 0,18 | |
| | | (K-S: d = 1,52; p< 0,05) | |

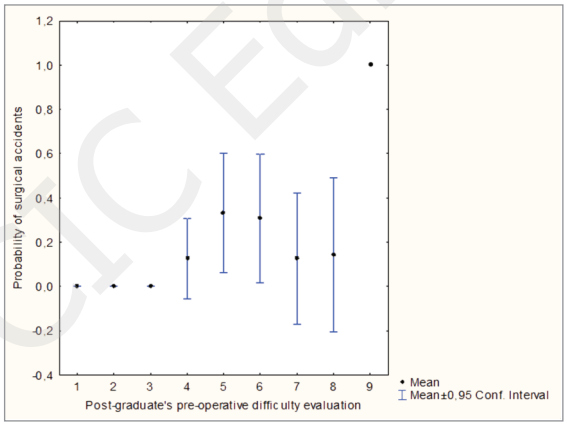


Figure 1. Post-graduate's post-operative difficulty evaluation in relation to post-graduate's pre-operative difficulty evaluation.

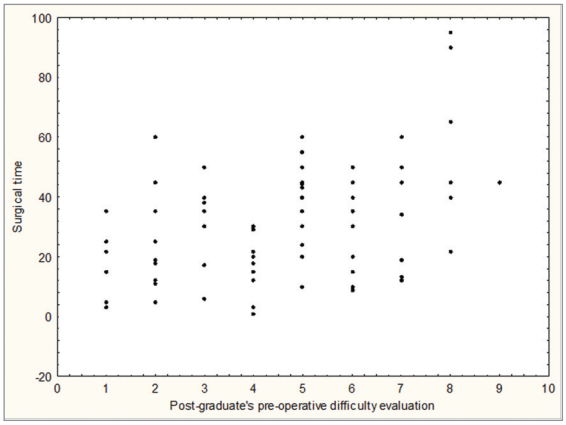


Figure 2. Surgical time in relation to post-graduate's pre-operative difficulty evaluation.

Other factors which should be considered are the direct proportionality existing between the difficulty degree and the treatment costs which are closely related, for a given surgical skill, to the required operative time as well as to the amount and quality of materials and instruments needed. Lastly, the correct difficulty evalua-

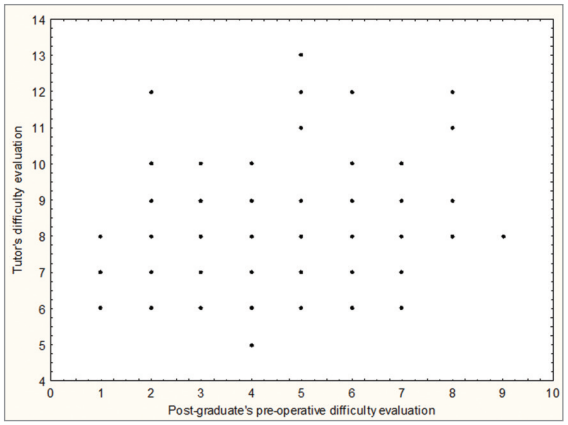


Figure 3. Tutor's difficulty evaluation in relation to post-graduate's pre-operative difficulty evaluation.

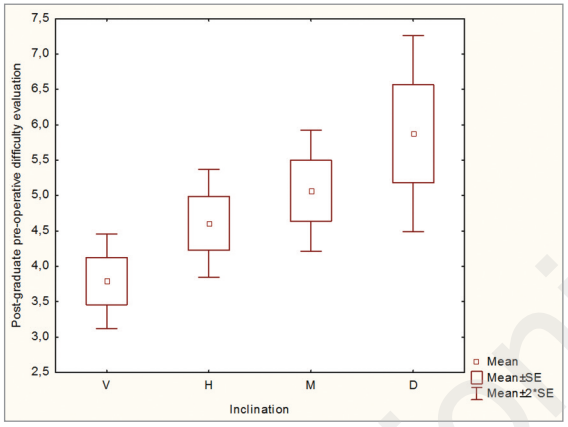


Figure 4. Effect of third molar's inclination on post-graduate's pre-operative difficulty evaluation. Boxes show the mean values and the standard error range; whiskers indicate the range of values found within two standard errors plus or minus the mean. V = vertical; H = horizontal; M = mesial; D = distal.

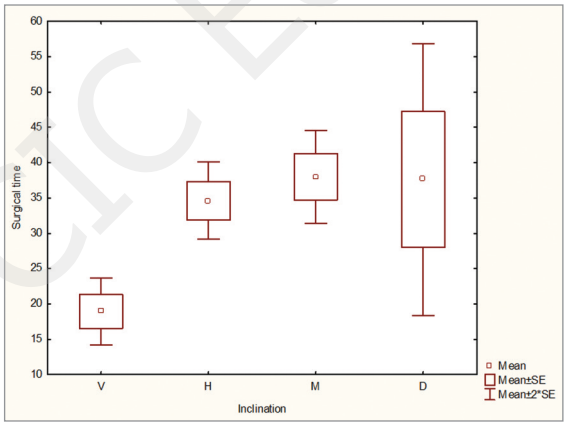


Figure 5. Effect of third molar's inclination on surgical time. Boxes show the mean values and the standard error range; whiskers indicate the range of values found within two standard errors plus or minus the mean. V = vertical; H = horizontal; M = mesial; D = distal.

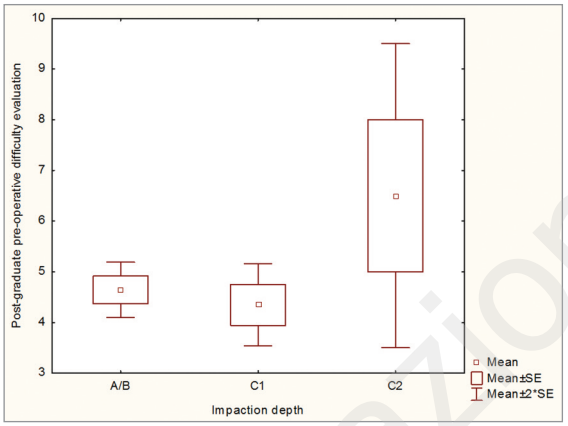


Figure 6. Effect of impaction depth on post-graduate's pre-operative difficulty evaluation. Boxes AB depht of impaction show the mean values and the standard error range; whiskers indicate the range of values found within two standard errors plus or minus the mean.

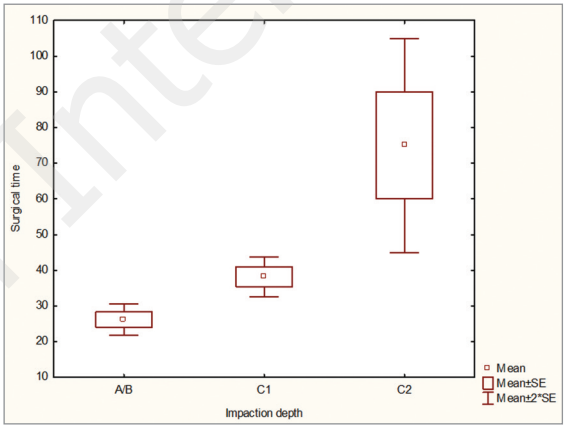


Figure 7. Effect of impaction depth on surgical time. Boxes C1 Impaction depth show the mean values and the standard error range; whiskers indicate the range of values found within two standard errors plus or minus the mean.

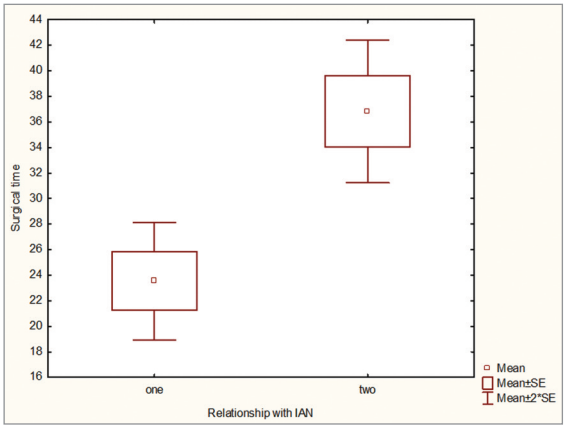


Figure 8. Effect of the third molar's relationship with the inferior alveolar nerve (IAN) on surgical time. Boxes show the mean values and the standard error range; whiskers indicate the range of values found within two standard errors plus or minus the mean.

Table 2. Relationship between age and difficulty variables.

| Difficulty variables | p |
|---|---|
| Surgical time | 0.65 |
| Post-graduates' pre-operative evaluation | 0.12 |
| Post-graduates' post-operative evaluation | 0.17 |
| Tutor's evaluation | 0.81 |

Table 3. Relationship between gender and difficulty variables.

| Difficulty variables | $F_{1, 82}$ | p |
|---|---|---|
| Surgical time | 0.068 | 0.80 |
| Post-graduates' pre-operative evaluation | 0.23 | 0.63 |
| Post-graduates' post-operative evaluation | 0.03 | 0.86 |
| Tutor's evaluation | 1.54 | 0.22 |

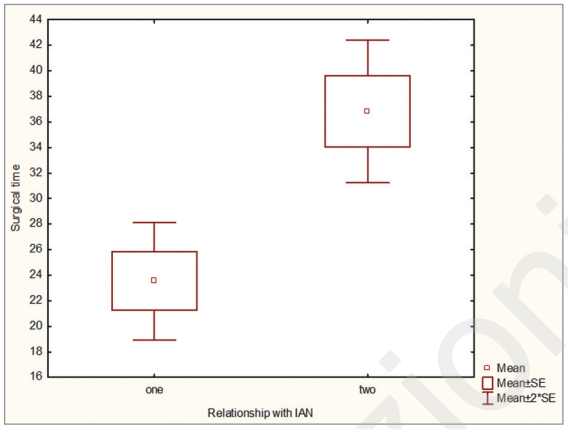


Figure 9. Effect of the post-graduate's training year on surgical time. Boxes show the mean values and the standard error range; whiskers indicate the range of values found within two standard errors plus or minus the mean.

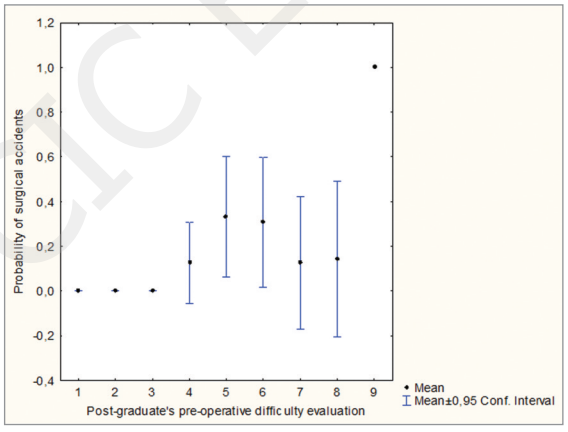


Figure 10. Observed probability of surgical accidents versus the post-graduate's pre-operative difficulty evaluation. Points indicate mean values; whiskers indicate standard errors.

tion increases the satisfaction of patients as far as the treatment received is concerned, especially if the expected surgical time is observed. All factors that characterize mandibular third molar surgery and how each factor affects the degree of difficulty must be therefore provided and extensively explained to the post-graduates, although some authors believe that the correct definition of the degree of difficulty can be reached only intra-operatively (15).

The main aim of the present study was, therefore, to evaluate to what extent post-graduates in oral surgery were able to correctly establish the difficulty degree of lower third molar surgical extraction and possibly whether and which factor they considered to be more important. Since the length of surgery has already been considered as an objective difficulty index by many authors, (2, 4, 5, 7, 9, 11, 17) any other factor which may have influenced the operative time was finally investigated as a possible determinant of surgical difficulty although surgical experience influences the length of surgery as well.

As for the descriptive results, the findings that few molars (5/84) were in Pell and Gregory's third class, only 2/84 were in the C2 class of impaction depth, none had imbrications with the inferior alveolar nerve and the majority of them (73/84) had a simple root morphology (Tab. 1) clearly explain the low of mean post-graduate (4.60 ± 0.2) and tutor (8.28 ± 0.18) judgements of technical difficulty. The sample is therefore biased toward easier cases as previous samples by other authors were (7).

As for the first aim, the highly statistical significance ($p<0,05$) of all variables of interest, either those of post-graduates (pre- and post-operative) or those of the tutor, and those of the operative time, is certainly due to the high sample size (N=84). Moreover, some observations are worthy of note. A very high correlation (r=0,88) exists between pre- and post-operative post-graduate difficulty evaluations, that is, post-graduates did not modify their judgement concerning the extraction difficulty after they performed surgery, although in many cases surgery was easier or more difficult than the post-graduates had expected, as shown by the moderate correlation between the pre-operative difficulty evaluation and the operative time (r = 0,44), considering that the operative time of each surgery is certainly proportional to the objective surgical difficulty in addition to the surgeon's technical skill. Two possible reasons can explain this. First, post-graduates might have assumed that longer operative times were due to their technical inability rather than to the actual difficulty of surgery. Second, they might have not wanted to reveal their wrong assessment of the case. If longer operative times were really due to a lower post-graduate technical ability, the high correlation between pre- and post-operative difficulty evaluation might suggest that a careful preliminary analysis of all parameters can be highly predictive of surgical difficulty, although Barreiro-Torres et al. (18) found little correspondence between pre- and post-surgical difficulty evaluations for maxillofacial surgeons (38,7%), for oral surgeons (45,1%), or for primary care dentists (31,9%). Moreover, first there is not a universal scale for grading surgeon's experi-

ence, although an assumption may be based on seniority ranking (11, 19), and secondly, Susarla and Dodson (11) found that surgeons had a good ability to estimate the relative importance of third molar variables in determining surgical difficulty regardless their experience.
Low correlation (r = 0,22), although statistically significant (p< 0,042), existed between post-graduate and tutor evaluations, that is, post-graduates evaluated surgical difficulty in a substantially different manner than the tutor regardless their training year. It appears very strange that the ability to correctly judge the difficulty degree did not increase from the second to the third training year. However, higher surgical times were associated with surgeries performed by second training year post-graduates (Fig. 5), although, just by little, this was not statistically significant (p=0.065). Although it is intuitive that increasing surgical skill decreases operative time, it is possible that senior post-graduates intentionally wanted to overestimate surgical difficulty to demonstrate their increased ability with shorter surgical times. However, statistical significant inverse correlation between surgical experience and operative time was first speculated and then found by Susarla and Dodson (7, 11). Given the low correlation between post-graduate and tutor evaluations, it appears necessary that post-graduates be correctly instructed to and how to assign a difficulty value to each anatomical and topographic factor in third molar surgery so that they can be able to correctly define the overall difficulty degree of each surgery. Despite different difficulty scales were frequently used in the past for third molar extraction (1, 2, 4, 5. 7-9, 11, 17, 18), none took into account all factors which, over time, have been found to influence third molar surgical difficulty to varying degrees. Further studies, aimed to validate a difficulty scale which can be accordingly adopted for clinical and didactical proposals, are therefore highly recommended in the future.
As for the second aim, a high correlation existed between tooth position and pre-operative difficulty evaluation since post-graduates perceived surgical extractions as simple when third molars were vertical (p=0.0046). Vertical position was also highly related to the operative time (p=0.00096), being associated with the shortest operative time. Tooth position was already found to be a reliable parameter in the expectation of extraction difficulty in many previous studies (2-7, 9).
As for the impaction depth, although it was not related to the post-graduates' difficulty evaluation, it was highly related to the operative time since the shorter the operative time the less deep the third molar was (A/B: p= 0.00037; C1: p=0.026) (Fig. 4). Impaction depth resulted to be the most important indicator of surgical difficulty in many previous studies (2-6, 9, 19).
Pell and Gregory's classification, on the contrary, did not influence either the post-graduate's pre-operative difficulty evaluation nor the operative time, so that it seems unreliable in determining surgical difficulty, as already reported by Garçia et al. (3), but only in relation to vertical third molars, yet in contrast with results reported by Yuasa et al. (5). It appears rather strange that Pell and Gregory's classification is not important in difficulty extraction of lower third molars since surgical difficulty usually attributed to this parameter is related to the more complex access and instrumentation and to the lower illumination and visibility due to the space reduction between second molar and mandibular rhamus. This classification, however, is difficult to apply when the impacted third molar is not vertical due to the lack of datum-lines corresponding to mesial and distal crown surfaces. Incorrect positioning of the patient's head during orthopantomographic examination can also modify the relationship between second molar and mandibular rhamus so that more than one factor can justify that data concerning Pell and Gregory's classification are not significant. Further studies are therefore necessary to exactly verify whether or not Pell and Gregory's classification is a reliable factor in predicting surgical difficulty.
Root morphology resulted not to be an important factor in influencing surgical difficulty evaluation of mandibular third molar extraction since it was not related to the pre-operative difficulty degree (a: p=0.77; b: p=0.34) or with the actual surgical difficulty degree, since it was also not related to the operative time (a: p=0.46; b: p=0.91). This is in contrast with previous reported data (2-6, 9, 17, 19) which showed this parameter was a very important factor in determining surgical difficulty. However, in the majority of cases (73/84 = 86,9%) of the present study, third molar roots were fused or separated but not divergent ("a") so that the present sample can be biased toward a simple root morphology.
The relationship between third molar and the inferior alveolar nerve did not influence post-graduate's pre-operative difficulty judgment as well, while a good correlation exists, with a high significativity (p=0.026), between the absence of any kind of relationship and the operative time, to show that when the tooth did not have relationship with the alveolar nerve the extraction was much less difficult, as already shown by Susarla and Dodson (7) and Benediksdottir et al. (6), although this was not confirmed by Santamaria and Arteagoitia (2).
Since the extent of mouth opening did not influence either the pre-operative difficulty evaluation nor the operative time, this variable seems to be unrelated to the difficulty degree of surgery, as already shown in all the previous studies in which it has been evaluated (1, 4, 5, 7). However, since the reduction of mouth opening limits its access, instrumentation, illumination and visibility in third molar region, it appears reasonable that this variable should be considered an actual predictive factor of surgical difficulty. Actually, the mean value of mouth opening in the present study was 45,90 ± 0,75 mm, with 30,00 mm as the lowest value which is sufficient to allow a good surgical approach in the posterior region of the mouth. Wider or selected samples for this parameter are therefore necessary for its better evaluation.
As for the third aim, the effect of the patient's age and gender was separately tested in the present study for two different reasons. First, they were not considered in the tutor difficulty evaluation. Secondly, it was intended to limit the number of variables included in the models

to avoid the over-fitting that is the possible false results due to the presence of too many variables in relation to the number of statistical units. The present results showed that patient's age and gender did not exert a significant effect either on operative times, nor on post-graduates difficulty evaluations.

As for the age of patients, these results do not confirm those of previous studies (4, 6, 9), in which this variable has shown to influence the difficulty of surgery although the limit of age in those study samples was variable from 23 (6) to 34 years (9). Results from the study of Carvalho et al. (17) seemed to agree with the present ones but the mean age of that study population was very low (21.8 ± 2,4) compared to the present (27.36 ± 11.21).

As for the gender, the present data confirm those of previous studies (6, 7, 9, 11, 17) in which gender was not an important factor in determining surgical difficulty. However, the Body Mass Index (BMI) (9) - that is, the individual's weight divided by the square of his/her height - and the weight of patients (4) have been reported to be significantly related to surgical difficulty independently from the gender, although no possible explanations have been given for this correlation. Since BMI is a measure of body fatness, its correlation with the extraction difficulty appears rather unexplainable. Moreover BMI has been found to differ in relation to the gender (20), so a correlation between gender and extraction difficulty would be expectable.

As for the last aim, it is worthy of note that despite the greater care required when surgeries were judged as difficult, accidents, such as root and alveolar wall fracture or flap tearing, occurred anyways, regardless of the post-graduate's training year.

## Conclusion

In conclusion, the pre-operative post-graduates' difficulty evaluation did not differ from their post-operative evaluation although their judgement differed from that given by the tutor and did not correlate with the operative time. Moreover, it seems that post-graduates did not consider the impaction depth in their difficulty evaluation although this parameter resulted highly related to the operative time. Finally, from the present data it seems that lower third molar extraction difficulty was influenced by some topographic factors such as tooth position, impaction depth and relationship between inferior alveolar nerve and impacted tooth, whereas demographic variables, such as patient's age and gender, were not important in predicting surgical difficulty.

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