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Surgical Difficulty Index of Third Molars. Preliminary Study

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ABSTRACT: Third molar surgery is more common in dentistry and its difficulty varies depending on several factors. The Third Molar Surgical Difficulty Index (TMSDI) is a tool used to predict the difficulty of the procedure with the aim of optimizing surgical planning and preventing complications. In the Mexicali Oral Surgery Clinic of the Faculty of Dentistry of the Autonomous University of Baja California (UABC), an TMSDI adapted to the needs of the department is used. To determine its effectiveness, an observational and cross-sectional study was carried out in the surgery clinic of the Faculty of Stomatology of the Benemérita Autonomous University of Puebla (BUAP), to establish the concordance between the preoperative evaluations of undergraduate students and specialists in oral surgery of patients who required third molar surgery. The Kappa Index was used to measure the concordance between students and specialists. The results showed that the specialists classified more molars as vertical (50%), while thestudents mainlyevaluated as mesioangular (50%). Specialists identified 25% of the cases as difficult, compared to 37.5% of the students. The agreement between both groups was poor, with a kappa coefficient of (-0.14), which showed discrepancies in the evaluation of surgical difficulty. The TMSDI is an educational tool, since the evaluations suggest that the students may be underestimating the difficulty, so it is necessary to complement it with other clinical and radiographic parameters to improve its effectiveness.

KEYWORDS: Winter's classification; Pell & Gregory; Index; Third molar; Dental surgery.

I. INTRODUCTION

The third molars (TM), also known as "wisdom teeth" depending on the literature, represent one of the most common surgical procedures in dental practice. These teeth typically erupt between the ages of 17 and 25; however, they often remain unerupted or impacted, which can cause various issues such as pericoronitis, caries on the distal surface of the second molar, neoplasms, bone resorption, among others. (1) (2)

TM extraction of TM can present a significant challenge to the dentist due to their position, root development, and proximity to important anatomical structures, such as the inferior alveolar nerve and the maxillary sinus. (3) (4) (5) (6) (7) Evaluating surgical difficulty is essential for proper procedural planning and to minimize or preventing operative complications. This assessment should include identifying anatomical factors that complicate extraction, as well as accurate radiographic interpretation. (8) (9) Panoramic and periapical radiographs are key tools (10) (11) but they have limitations in accurately depicting certain anatomical details, such as overlapping structures or correctly identifying the three-dimensional relationship with surrounding structures. (12) (13) (14)

Various classifications, scales, and indices have been developed to predict the surgical difficulty of TM extraction. Among the most commonly used are the Winter classification, which assesses the angulation of the TM, and the Pell & Gregory classification, which categorizes the depth and relationship of the TM with the mandibular ramus. (15) (16) (17). Although these tools are useful and widely used, their application depends on the operator's experience, as they require solid theoretical and clinical training for accurate interpretation and application. (18)

In addition to these traditional classifications, the Oral Surgery Clinic of the Faculty of Dentistry Mexicali (FOM) of the Autonomous University of Baja California (UABC) registered a format with the Academic Training Office (FOMCA) that includes the Third Molar Surgical Difficulty Index (TMSDI), under identification code FOMCA-10. Rev.0. This TMSDI incorporates parameters such as molar angulation, depth, relationship to the mandibular ramus, eruption level, number of roots, and follicle size. This index allows for the factors that influence surgical difficulty to predict the degree of difficulty.

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Its use as a didactic tool has shown promise in academic settings, though it has not yet been validated. (19)

Training dental students in TM surgical procedures involves the acquisition of theoretical and practical skills. (20) Through the use of tools such as the TMSDI, students can develop skills in preoperative assessment, enhancing their procedural planning skills. (21) However, applying these indices does not guarantee a precise evaluation, as the interpretation can vary significantly between a student, a recent graduate specialist, and an experienced practitioner. (22)

The present study aims to analyze the concordance of results obtained using the TMSDI applied at the Mexicali Faculty of Dentistry Mexicali at UABC, with the purpose of evaluating the strength of agreement between students and specialists evaluating the same clinical case. The findings will support improvements in the pedagogical and clinical strategies for teaching TM surgical procedures.

II. MATERIALS AND METHODS

An observational cross-sectional study was conducted to analyze the characteristics evaluated by the FOM-UABC TMSDI, developed by the Oral Surgery Clinic. The sampling method was nonprobabilistic and based on convenience, including students and specialists in oral surgery from the Faculty of Stomatology at BUAP.

The study was carried out in April 2024 at the BUAP Surgery Clinic, where periapical and panoramic radiographs were evaluated. The inclusion criteria included students enrolled in the Surgery Clinic course who treated patients aged 22 to 55 years who required third molar surgery. The operators were divided into two groups: Group 1 consisted of faculty members of oral and maxillofacial surgery (OMS) members with licenses issued by the National Registry of Professionals of the Ministry of Public Education, and Group 2 comprised undergraduate students in the dental surgery program enrolled in the Surgery Clinic course. Exclusion criteria included undergraduate students and OMS specialists who did not wish to participate or were unable to attend at the designated times. Participants retained the right to withdraw from the study at any time.

Ethical considerations for all participants involved signing informed consent prior to participating in the study. The purpose was explained to them and they provided signed authorization to participate. The identities and individual results were kept confidential.

Data were obtained by questionnaires administered before surgical procedures for patients in Groups 1 and 2. Data collection was performed using TMSDI, shown in Figure 1, as the primary tool to assess TM surgical difficulty in combination with radiographic studies. For the procedure, students and specialists independently applied the TMSDI, selecting parameters that corresponded to the TMevaluated prior to surgery.

The surgical procedure was performed according to the TMSDI assessment, under local anesthesia, following a treatment plan individually designed by each student and the OMS specialist. The data obtained were analyzed using descriptive statistics for patients' TMs and descriptions of the TMSDI parameters. Additionally, the Kappa Index was used to measure the agreement between the parameter evaluations from Groups 1 and 2. The concordance results indicated that the evaluations of both groups aligned as expected, either by chance or due to the knowledge of the students (Group 2) and specialists (Group 1) knowledge. Statistical analyzes were performed using SPSS version 27.

Winter	Vertical	1
	Mesiangular	2
	Horizontal	3
	Distoangular	4
Depth (Pell & Gregory)	Level A	1
	Level B	2
	Level C	3
Relation to the ramus (Pell & Gregory)	Class I	1
	Class II	2
	Class III	3
Eruptión	Fully erupted	1
	Partially erupted	2
	Fully covered by mucosa	3
Roots	One or more fused roots	1
	More than two separate roots	2
	Multiple roots	3

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Follicle size	+ de 1 mm	1
	0 -0.9 mm	2
Surgical Difficulty Index	**Slightly Difficult**	**6-9**
	Difficult	**10-14**
	Very Difficult	**15-18**

Figure 1. Third Molar Surgical Difficulty Index (TMSDI)

III. RESULTS

The predominant gender among the patients who participated in the study was female, representing 75%, compared to 25% male. The average age was 27 years. In Group 1, the predominant gender was male (62.5%), with females representing 37.5%. Among the students, 56.25% were men and 43.75% were women (Figure 1).

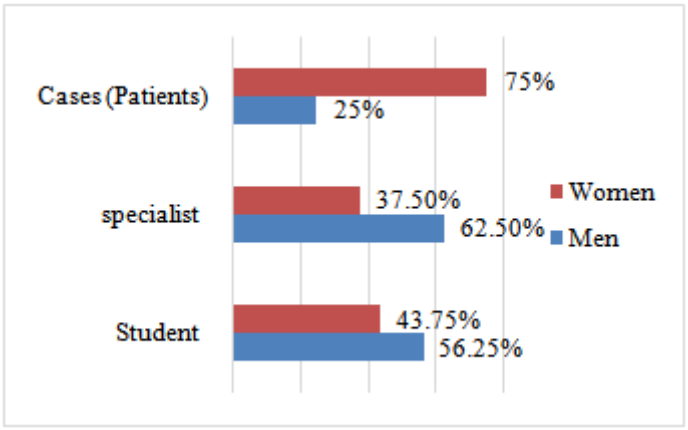

Figure 1. Gender distribution of patients, specialists, and students.

The distribution of TMs by quadrant indicated that the lowest TMs were the most frequent, representing 87.5% of the total (43.75% on the left and 43.75% on the right). The upper TMs were less frequent, comprising 12.5% of the total (6.25% on the left and 6.25% on the right). This reflects a higher number of interventions in the lower molars compared to the upper molars (Figure 2).

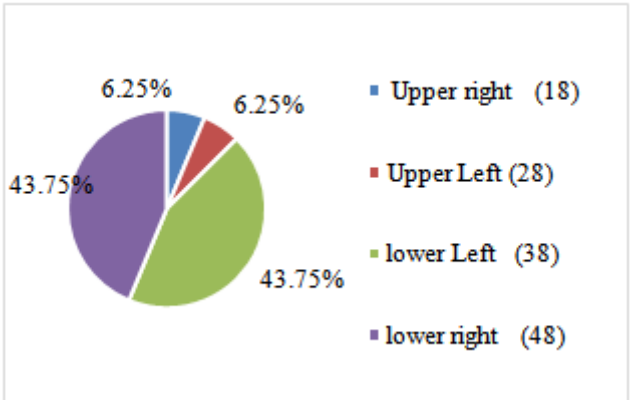

Figure 2. Distribution of third molars treated by location.

The TMSDI includes various parameters that were evaluated separately. Regarding the Winter classification, which assesses the position of the TM, the same surgical case was evaluated by students and specialists. The students classified 50% of the molars as mesioangular, 31.25% as vertical, 18.75% as distoangular and 0% as horizontal. In contrast, specialists found a greater proportion of molars in a vertical position (50%), followed by mesioangular (31.25%), distoangular (12.5%) and horizontal (6.25%). These data showed that specialists were more likely to classify TM as vertical, while students tended to classify them as mesioangular (Figure 3).

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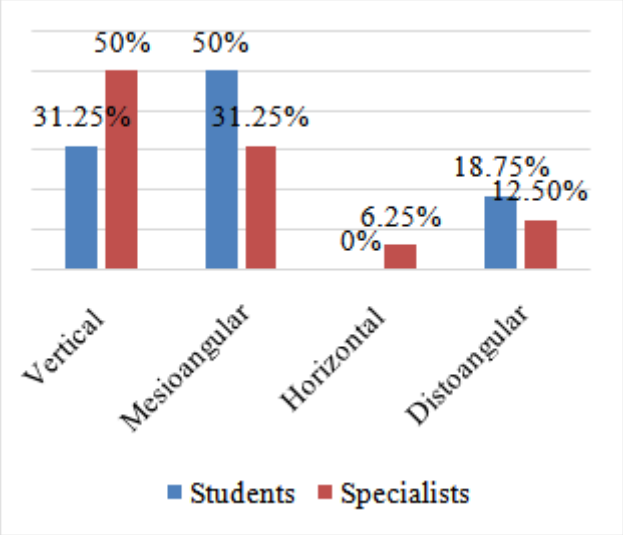

Figure 3. Student and specialist evaluations using Winter's Classification.

For the Pell & Gregory classification, which evaluates depth (Levels A, B, and the C) and relationship with the mandibular ramus (Classes I, II, and III), the students identified the majority of molars as depth "A" (68.75%), followed by depth "B" (31.25%), without cases in depth "C" (0%). However, specialists reported that depth "A" predominated (81.25%), followed by depth "B" (18.75%), with no cases at depth "C" (0%). Most molars were classified as depth level "A" by both groups. Regarding the relationship with the mandibular ramus, the students identified Class I in 43.75%, Class II in 50% and Class III in 6.25% of cases. Specialists classified 50% of molars as Class I and 50% as Class II, with no Class III cases reported (0%). These results showed differences in evaluation, with students identifying more Class III cases, while specialists favored Classes I and II (Figure 4).

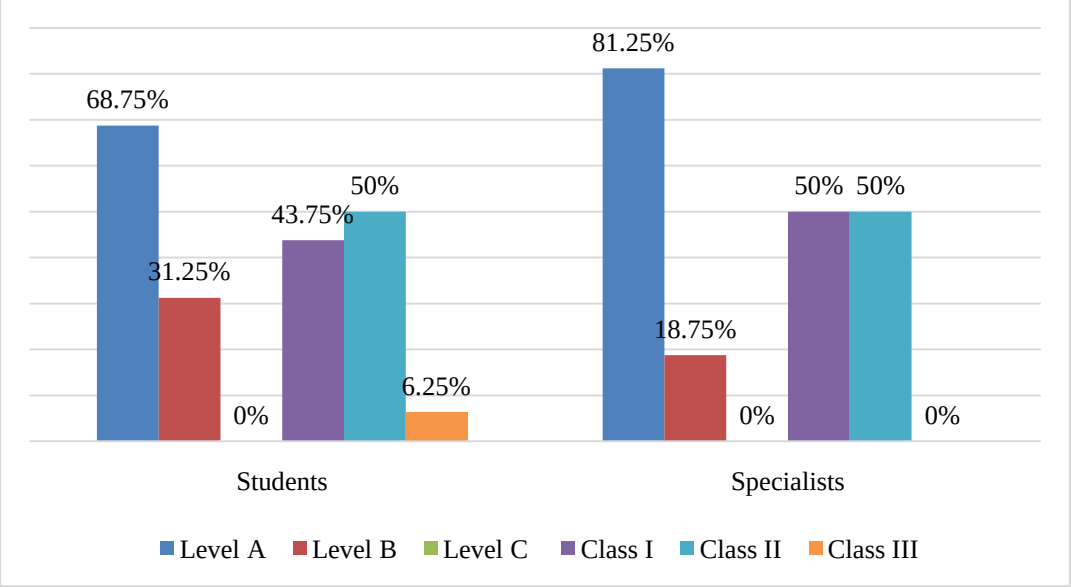

Figure 4. Pell & Gregory classification by depth and spatial relationship with the mandibular ramus.

For eruption level, there are three categories: Fully Erupted (interpreted as "erupted"), Partially Erupted (interpreted as "partial"), and Completely Covered by Mucosa (interpreted as "covered"). The students identified most of the molars as fully covered by mucosa (41.25%), followed by partially erupted (31.25%) and fully erupted (27.5%). Specialists concluded that the

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category occurred in 45% of cases, 'partially erupted' in 28.75%, and "fully covered by mucosa' in 26.25%. Both groups agreed morefrequently on the "partially erupted" category (Figure 5).

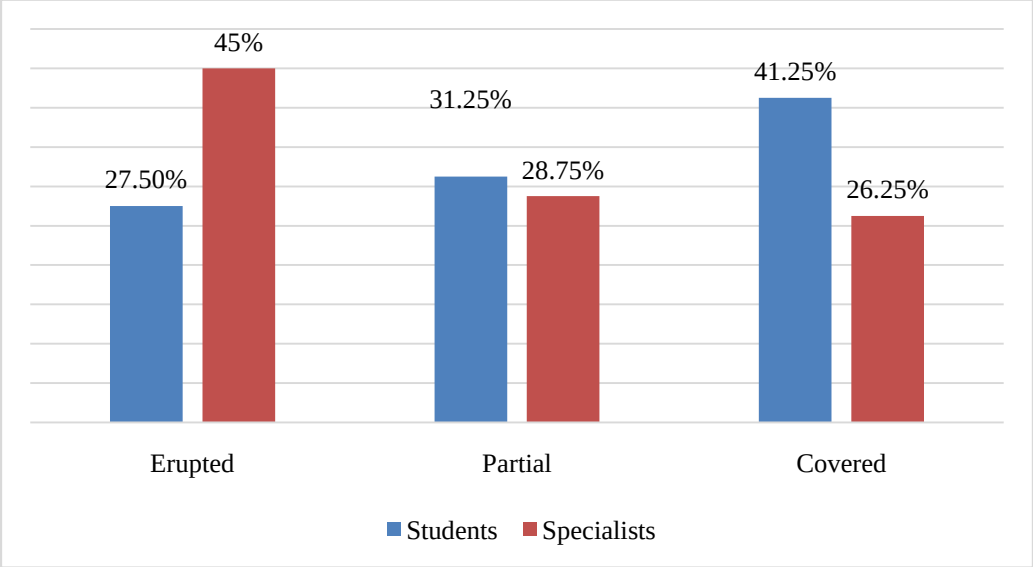
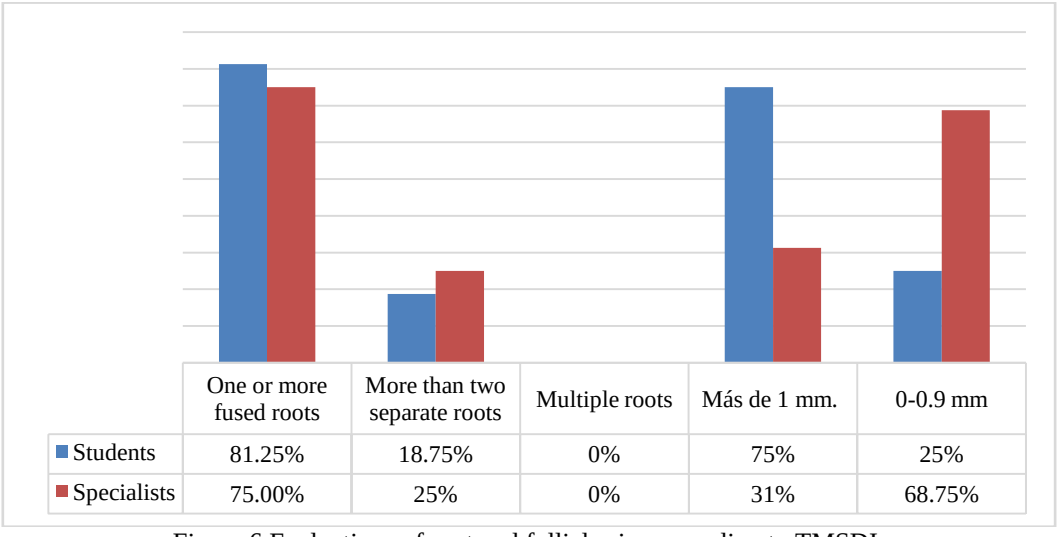


Figure 5. Eruption evaluations according to TMSDI.

Regarding the root characteristics of the TMs, the students identified that 81.25% of the cases had one or more fused roots, while 18.75% corresponded to molars with more than two separate roots, with no cases of multiple roots (0%). Specialists identified 75% of cases with one or more fused roots, 25% with more than two separate roots, and no cases with multiple roots (0%). These results indicate a general trend toward classifying molars as having fused roots, although specialists identified a higher proportion of cases with separate roots than students (Figure 6).

The follicle size identified by the students was greater than 1 mm in 75% of the cases, with the remaining 25% having follicle sizes of 0 to 0.9 mm. Specialists evaluated that 31.25% of the cases had follicle sizes greater than 1 mm, with the remaining 68.75% at 0–0.9 mm. Students struggled to differentiate the of the follicles of the space sizes (Figure 6).



	One or more fused roots	More than two separate roots	Multiple roots	Más de 1 mm.	0-0.9 mm
Students	81.25%	18.75%	0%	75%	25%
Specialists	75.00%	25%	0%	31%	68.75%

Figure 6.Evaluations of root and follicle size according to TMSDI.

All parameters were summed at the end to determine the level of surgical difficulty of TMSDI. The established categories are Low difficulty (LD = 6-9), difficulty (D = 10-14), and verydifficult (VD = 15-18). Specialists classified 75% of the cases as 'LD', 25% as "D," and no cases as 'VD'. Students

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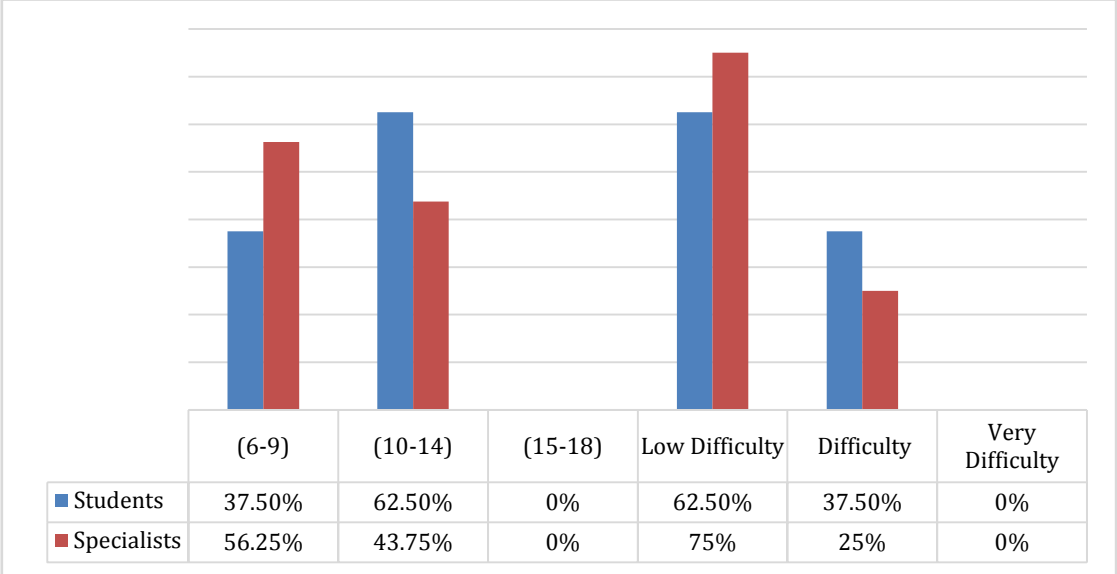
classified 62.5% of cases as 'LD', 37.5% as "D," with no "VD" cases reported, similar to specialists. The results showed that specialists evaluated more cases as 'LD' compared to students (Figure 7).



	(6-9)	(10-14)	(15-18)	Low Difficulty	Difficulty	Very Difficulty
Students	37.50%	62.50%	0%	62.50%	37.50%	0%
Specialists	56.25%	43.75%	0%	75%	25%	0%

Figure 7. Score ranges and difficulty level.

The statistical test was used to analyze concordance to determine whether the results were due to chance or the knowledge of TMSDI parameters relative to the knowledge of specialists. KI ranges from '-1 to +1"; values closer to '+1' indicate greater concordance, while values near "-1" indicate greater discordance, and a value of '0' suggests that agreement is attributable solely to chance (Figure 2). Table 1 shows the concordance values between students and specialists.

Kappa Coefficient	Concordance Strength
0.00	Poor
0.01-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost perfect

Figure 2. Kappa index values and interpretation of concordance strength. Source: Landis and Koch, 1977. (23)

In this study, the KI was -0.14, indicating a 'poor' level of concordance between the student and specialist evaluations. This negative result suggests a significant discordance, implying that the agreement is worse than expected by chance.

Table 1. Contingency table showing the concordance strength between specialists and students.

Specialist and Student	LD	D	VD	Total
LD	43.75%	18.75%	0%	62.5%
D	31.25%	6.25%	0%	37.5%
VD	0%	0%	0%	0%
Total	75%	25%	0%	100%

IV. DISCUSSION

This study aligns with Carvalho et al. (24), showing a predominance of female participants. In contrast, studies by Roy et al. (25) indicated a higher prevalence of male participants. It should be noted that the patient sample predominantly comprised

young women (with a mode age of 22), which may have influenced the results due to the developmental patterns of the third molar (TM). Castillo-Alcoser et al. (26) reported similar findings in Ecuador, where 57.6% of interventions were carried out on women at the Universidad Nacional de Chimborazo.

Regarding the classification of Winter, a significant difference was observed between students and specialists inevaluating the position of TM. Students classified 50% of the molars as mesioangular, while specialists identified 50% as vertical. Almendros-Marqués (27) and Lima et al. (28) presented similar results in observational studies conducted in Brazil, where observer groups showed high concordance in position of TM, with agreement rates between 66% and 89% for Winter classification.

The inclination of a TM is a critical factor in the difficulty of extraction, and advanced training in clinical and radiographic interpretation could improve the precision of the assessment. Specialists can analyze these characteristics more effectively than students due to intensive training in a specific area of dentistry.

Although the concordance rate between both groups was low, this discrepancy does not necessarily reflect deficiencies in the TMSDI, as previous studies support both points of view. Studies by Martínez -Jiménez et al. (29) and Melgar and Gómez (30) presented findings consistent with the students' assessments of mesioangular TM positioning. Similarly, Quintana et al. (31) and Valero (32) reported that the vertical position was the most common, supporting the results obtained by the BUAP specialists.

For the Pell & Gregory classification, which focuses on the depth of theTM and relationship to the mandibular ramus, students tended to overestimate Class II, while specialists identified a balance between Class I and Class II. This discrepancy suggests that students may not fully account for the relationship with the mandibular ramus, which could affect the difficulty of access and extraction. Proper identification of these variables is essential to prevent surgical complications, given the proximity to adjacent anatomical structures. Although similarities were observed in Class II classifications, studies conducted by Mosquera-Valencia et al. (33) in Colombia and Ruchadaporn and Weeraya (34) in Thailand both found Class II to be the most prevalent, possibly due to common factors influencing bone and dental structure in both populations.

Regarding TM root characteristics, students identified fused roots in most cases, and specialists observed this condition in a majority of cases. Accurate assessment of root characteristics is essential to prevent surgical complications. The presence of multiple roots can make extractions more difficult and increase the risk of root fractures during the procedure. Acosta et al. (19) reported that 50% of cases had at least two fused roots, consistent with the finding of over 75%.

In terms of follicle size, notable differences were found between students and specialists. Students struggled to identify differences in follicle size compared to specialists. Acosta et al. (19) reported a higher prevalence of small follicles in their studies, with similar results observed in this study. The Casierra-Nazareno (35) findings showed that 58% of the cases corresponded to this study and Acosta et al., with the majority at 0-1 mm. This parameter is crucial, as an enlarged follicle can indicate associated pathologies, such as cysts and tumors (36), which could alter the treatment plan.

For the overall TMSDI results, the category was the most selected by students (62.5%) and specialists (75%). Fernández Sainz (53.2%) (37) and Stacchi et al. (45.8%) (38) similarly found ‘low difficulty’ to be the most frequent classification in their studies. This finding suggests that students may underestimate surgical difficulty in a substantial proportion of cases, which could increase the risk of intraoperative complications.

In this study, the Kappa Index showed poor concordance (K= -0.14) between the preoperative evaluations of students and specialists, indicating a significant lack of agreement between both groups.

Rivera-Herrera et al. (15) evaluated the Pell and Gregory, Sánchez Torres and Winter classifications, obtaining Kappa ranges of 0.05 to 0.32 in similar populations of OMS specialists and students, and used standardized manuals, which may explain the observed differences. Lima et al. (28) also studied the Pell & Gregory classification. The findings emphasize the need to improve the training in surgical difficulty assessment, as underestimating difficulty could have important clinical implications. Although both studies share population similarities with the research conducted at BUAP, the latter demonstrated greater consistency between specialists and students. However, performance depended largely on the level of knowledge, suggesting that difficulties may be related more to the use of the system than the system itself.

Almendros-Marqués et al. (27) noted that lack of concordance not only reflects discrepancies in case classification, but also potential misinterpretation of criteria. In this study, greater concordance was observed in the Pell & Gregory classification than in the Winter classification using

the TMSDI. However, the results do not align with those reported by Almendros-Marqués et al., possibly due to the fact that their study only specialists.

V. CONCLUSION

This study identified notable differences in the TMSDI evaluations between students and specialists, with students tending to underestimate surgical difficulty. TMSDI is a resource that should be supplemented with academic training and an integrated approach that considers clinical and radiographic factors. Incorporating tomographic images could improve its accuracy, contributing to safer surgical planning.

VI. RECOMMENDATIONS

Despite these variations, the TMSDI serves as an educational tool that familiarizes students with clinical cases. However, the accuracy of the TMSDI-FOM-UABC depends on the student's knowledge, limiting its effectiveness as a predictive tool. The Kappa indexobtained reflected a negative concordance (K= -0.14), indicating considerable discordance between the evaluations from both groups. This underscores that the interpretation of the TMSDI parameters is inconsistent, which can lead to an underestimation of surgical difficulty, which could increase the risk of complications.

- Extend the study period **to gather a larger sample size, which will enrich the results and allow stronger conclusions.**
- Incorporate additional clinical and radiographic parameters **into preoperative evaluations to improve the precision of surgical difficulty predictions, also considering systemic factors such as ASA classification and BMI.**
- **Conduct workshops using the TMSDI**, which will enhance students' familiarity with the instrument and its parameters.
- **Consider implementing advanced technologies**, such as three-dimensional imaging, to assess the position and characteristics more accuracy in different anatomical planes.
- **Add specific sections to the TMSDI** to adequately assess the surgical difficulty of upper third molar extractions, as the tool is not optimally designed to evaluate these molars.

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