

Research Article

ASSESSMENT OF PANORAMIC RADIOGRAPHS IN PREDICTING THE DIFFICULTY OF IMPACTED THIRD MOLAR EXTRACTION

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ABSTRACT

Background: Accurate preoperative assessment of impacted mandibular third molars is essential for planning surgical extraction and minimizing complications. Panoramic radiography is routinely used to evaluate the position of impacted teeth and estimate the difficulty of extraction. **Aim:** To assess the role of panoramic radiographs in predicting the difficulty of impacted mandibular third molar extraction. **Materials and Methods:** This prospective observational study included 190 patients with impacted mandibular third molars indicated for surgical extraction. Preoperative panoramic radiographs were evaluated using Winter's classification, Pell and Gregory classification, and the Pederson Difficulty Index. The radiographic prediction was compared with the actual intraoperative difficulty. **Results:** Mesioangular impaction (45.3%) and Pell and Gregory Level B impaction (43.7%) were the most common findings. The Pederson Difficulty Index classified 46.8% of cases as moderately difficult. A significant association was observed between the predicted radiographic difficulty and the actual surgical difficulty ($p < 0.001$). Operative time increased with increasing difficulty scores. **Conclusion:** Panoramic radiography is a useful preoperative investigation for predicting the difficulty of impacted mandibular third molar extraction and assists in surgical planning and patient management.

Keywords: Impacted mandibular third molar, panoramic radiography, orthopantomogram, Pederson Difficulty Index, surgical difficulty.

INTRODUCTION

Impaction of the third molar is one of the most common developmental anomalies encountered in dental practice and represents one of the most frequent indications for oral and maxillofacial surgery. An impacted tooth is defined as a tooth that fails to erupt into its normal functional position within the expected time due to lack of space, abnormal angulation, or obstruction by adjacent teeth, bone, or soft tissue. Mandibular

third molars are the teeth most commonly affected because they erupt last and often have insufficient space for normal eruption.¹

Surgical extraction of impacted third molars is one of the most commonly performed procedures in oral and maxillofacial surgery. The difficulty of extraction varies considerably depending upon several anatomical, radiographic, and patient-related factors. An accurate preoperative assessment of the anticipated surgical difficulty is essential for selecting the appropriate surgical technique, estimating operative time, reducing intraoperative and postoperative complications, and improving patient counselling.²

Panoramic radiography (orthopantomography, OPG) is the imaging modality most frequently employed for the preoperative evaluation of impacted third molars because it provides a comprehensive view of both jaws, adjacent teeth, and surrounding anatomical structures with relatively low radiation exposure and cost. Panoramic radiographs enable assessment of important parameters such as tooth angulation, depth of impaction, available retromolar space, root morphology, stage of root development, and the relationship between the roots of the impacted tooth and the inferior alveolar canal.³

Several radiographic classification systems have been developed to standardize the assessment of impacted third molars. The Winter classification categorizes impacted teeth according to their angulation, whereas the Pell and Gregory classification evaluates the depth of impaction and its relationship to the mandibular ramus. These classification systems continue to be widely used in clinical practice for estimating the anticipated difficulty of surgical extraction.^{1,4}

To improve the prediction of surgical difficulty, Pederson proposed a difficulty index that combines Winter's classification with the Pell and Gregory classification. Although this index is widely accepted, studies have shown that actual surgical difficulty may also be influenced by additional factors such as root morphology, bone density, patient age, mouth opening, and surgeon experience.⁵

Indian studies have demonstrated that panoramic radiography is a valuable diagnostic tool for evaluating impacted mandibular third molars. Gupta et al. reported that panoramic radiographs provide reliable information regarding angulation, eruption level, root morphology, and relationship with adjacent anatomical structures, thereby assisting in surgical planning.⁶ Similarly, Sandhu and Kaur observed that mesioangular impaction was the most common type among Indian patients and emphasized the usefulness of panoramic radiographs in assessing the position and status of impacted third molars.⁷ Deshpande et al. further highlighted the importance of panoramic radiographic signs in predicting the proximity of impacted third molars to the inferior alveolar canal, thereby helping to identify patients at increased risk of inferior alveolar nerve injury during extraction.⁸

Despite the widespread use of panoramic radiography, the correlation between radiographic findings and the actual surgical difficulty remains variable. Differences in patient characteristics, root morphology, bone quality, and operator experience may significantly influence operative complexity. Therefore, evaluation of panoramic radiographic parameters in relation to the actual difficulty encountered during surgery

is important for improving treatment planning and minimizing complications. Hence, the present study was undertaken to assess the usefulness of panoramic radiographs in predicting the difficulty of impacted third molar extraction by evaluating established radiographic parameters and correlating them with intraoperative findings.

MATERIALS AND METHODS

Study Design

This was a hospital-based, prospective observational study conducted in the Department of Oral Medicine and Radiology at a tertiary care teaching hospital over a period of **12 months**, after obtaining approval from the Institutional Ethics Committee.

Study Population

The study included patients presenting to the Department of Oral and Maxillofacial Surgery who required surgical extraction of impacted mandibular third molars and underwent preoperative panoramic radiographic examination.

Sample Size

A total of **190 patients** with impacted mandibular third molars fulfilling the inclusion and exclusion criteria were enrolled in the study by consecutive sampling.

Inclusion Criteria

- Patients aged **18–45 years**.
- Patients with at least one impacted mandibular third molar indicated for surgical extraction.
- Patients who underwent preoperative panoramic radiography (Orthopantomogram).
- Patients willing to participate and who provided written informed consent.

Exclusion Criteria

- Patients with systemic diseases contraindicating oral surgical procedures.
- Patients with associated cysts, tumors, fractures, or other pathological lesions involving the impacted tooth.
- Patients with previous surgery in the third molar region.
- Patients with poor-quality or distorted panoramic radiographs.
- Pregnant or lactating women.

- Patients unwilling to participate in the study.

Study Procedure

After obtaining informed written consent, detailed demographic and clinical information, including age, sex, chief complaint, and relevant medical and dental history, was recorded. All patients underwent a preoperative panoramic radiographic examination using a standardized digital orthopantomography (OPG) machine.

Each panoramic radiograph was evaluated for the following radiographic parameters:

- Angulation of impaction according to Winter's classification.
- Depth of impaction according to Pell and Gregory classification (Levels A, B, and C).
- Relationship of the impacted tooth to the anterior border of the mandibular ramus according to Pell and Gregory classification (Classes I, II, and III).
- Root morphology (single, fused, divergent, dilacerated, or multiple roots).
- Number of roots.
- Stage of root development.
- Relationship between the roots and the inferior alveolar canal.
- Presence of curved or bulbous roots.
- Follicular space around the impacted tooth.

The anticipated difficulty of extraction was assessed using the Pederson Difficulty Index, which combines Winter's angulation and Pell and Gregory classifications. Cases were categorized as:

- Slightly difficult (score 3–4)
- Moderately difficult (score 5–7)
- Very difficult (score 8–10)

All surgical extractions were performed under local anesthesia by experienced oral and maxillofacial surgeons following standard surgical protocols. The actual surgical difficulty was assessed intraoperatively based on:

- Duration of surgery (from incision to completion of wound closure).
- Requirement for bone guttering.
- Requirement for tooth sectioning.
- Difficulty in tooth elevation and delivery.

- Intraoperative complications, if any.
- The predicted difficulty based on panoramic radiographic findings was compared with the actual intraoperative difficulty.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. The association between categorical variables was analyzed using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables were compared using the Independent Student's *t*-test or one-way ANOVA. Correlation between the Pederson Difficulty Index and actual surgical difficulty was assessed using Pearson's or Spearman's correlation coefficient, depending on data distribution. Logistic regression analysis was performed to identify independent radiographic predictors of difficult extraction. A *p*-value <0.05 was considered statistically significant.

OBSERVATIONS AND RESULTS

A total of 190 patients with impacted mandibular third molars who fulfilled the inclusion criteria were included in the study. The radiographic findings obtained from panoramic radiographs were compared with the actual surgical difficulty encountered during extraction.

Table 1. Demographic Characteristics of Study Participants (n = 190)

Variable	Number (n)	Percentage (%)
Age (years)		
18–25	72	37.9
26–35	81	42.6
36–45	37	19.5
Gender		
Male	104	54.7
Female	86	45.3

Most patients were between **26 and 35 years (42.6%)**, with a slight male predominance (54.7%).

Table 2. Distribution of Radiographic Characteristics on Panoramic Radiographs (n = 190)

Radiographic Parameter	Number (n)	Percentage (%)
Winter's Classification		
Mesioangular	86	45.3
Vertical	42	22.1
Horizontal	34	17.9

Distoangular	18	9.5
Others	10	5.2
Pell and Gregory Depth		
Level A	74	38.9
Level B	83	43.7
Level C	33	17.4

Mesioangular impaction (45.3%) and Pell and Gregory Level B impaction (43.7%) were the most common radiographic findings.

Table 3. Pederson Difficulty Index and Actual Surgical Difficulty

Difficulty Category	Pederson Index n (%)	Actual Surgical Difficulty n (%)
Slight/Easy	56 (29.5)	49 (25.8)
Moderate	89 (46.8)	95 (50.0)
Very Difficult/Difficult	45 (23.7)	46 (24.2)
Total	190 (100)	190 (100)

Nearly half of the cases were categorized as **moderately difficult** by both the Pederson Difficulty Index and intraoperative assessment.

Table 4. Association Between Predicted and Actual Surgical Difficulty

Predicted Difficulty	Easy	Moderate	Difficult	Total
Slight	35	19	2	56
Moderate	13	60	16	89
Very Difficult	1	16	28	45
Chi-square = 74.62, p < 0.001				

There was a statistically significant association between the predicted difficulty based on panoramic radiographs and the actual intraoperative difficulty (**p < 0.001**).

Table 5. Mean Duration of Surgery According to Pederson Difficulty Index

Difficulty Category	Mean Duration (minutes)	Standard Deviation	p-value
Slight	18.7	4.3	<0.001
Moderate	29.8	6.2	
Very Difficult	43.5	8.1	

The mean duration of surgery increased significantly with increasing Pederson Difficulty Index scores (**ANOVA, p < 0.001**).

DISCUSSION

The present study evaluated the role of panoramic radiographs in predicting the difficulty of impacted mandibular third molar extraction in 190 patients. The findings demonstrated that radiographic assessment using Winter's classification, Pell and Gregory classification, and the Pederson Difficulty Index was significantly associated with the actual surgical difficulty encountered during extraction.

The majority of patients belonged to the 26–35 years age group, with a slight male predominance. Similar observations were reported by Sandhu and Kaur⁷ and Hashemipour et al.⁹, who found that impacted mandibular third molars are most frequently diagnosed in young adults because eruption occurs during the second and third decades of life.

Mesioangular impaction (45.3%) was the most common type observed in the present study. This finding agrees with studies by Quek et al.¹⁰, Gupta et al.⁶, and Hashemipour et al.⁹, all of whom identified mesioangular impaction as the predominant pattern. This type of impaction is generally associated with inadequate retromolar space and the normal eruption path of mandibular third molars.

According to the Pell and Gregory classification, Level B impactions were the most common in the present study. Comparable findings have been reported by Gupta et al.⁶ and Monaco et al.¹¹, suggesting that partially impacted mandibular third molars constitute the majority of cases requiring surgical intervention.

The Pederson Difficulty Index classified nearly half of the cases as moderately difficult, which was consistent with the intraoperative findings. A statistically significant association was observed between the predicted radiographic difficulty and the actual surgical difficulty ($p < 0.001$). Similar results have been reported by Yuasa et al.¹² and Akadiri and Obiechina¹³, who concluded that radiographic assessment is useful for predicting operative difficulty and estimating surgical time.

The duration of surgery increased significantly with increasing Pederson Difficulty Index scores. Cases classified as very difficult required longer operative times than those categorized as slight or moderate difficulty. These findings are consistent with those of Renton et al.¹⁴ and Susarla and Dodson¹⁵, who reported that greater depth of impaction, unfavorable angulation, and limited surgical access contribute to increased operative complexity and prolonged surgical time.

Although panoramic radiography proved to be an effective preoperative assessment tool, minor differences were observed between predicted and actual surgical difficulty. These variations may be attributed to factors such as bone density, root morphology, buccolingual root curvature, mouth opening, and surgeon experience, which cannot be completely evaluated on panoramic radiographs. Therefore, radiographic findings should always be interpreted in conjunction with clinical examination.

Overall, the present study confirms that panoramic radiography provides valuable information for predicting the difficulty of impacted mandibular third molar extraction and assists in appropriate surgical planning, estimation of operative time, and reduction of intraoperative complications.

CONCLUSION

Panoramic radiography is a reliable and practical imaging modality for predicting the difficulty of impacted mandibular third molar extraction. Winter's classification, Pell and Gregory classification, and the Pederson Difficulty Index demonstrated significant correlation with the actual surgical difficulty encountered during extraction. Mesioangular impaction and Pell and Gregory Level B impaction were the most frequent radiographic findings. Higher Pederson Difficulty Index scores were associated with increased operative time and greater surgical complexity. These findings support the routine use of panoramic radiography for preoperative evaluation and surgical planning in impacted third molar surgery. Radiographic assessment should be complemented by careful clinical examination to achieve the most accurate prediction of surgical difficulty and optimize patient outcomes.

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