



Research Article

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Evaluation of the Severity and Surgical Difficulty Index of Impacted Maxillary Canines Using Panoramic Radiographs

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Abstract

Introduction: Impacted maxillary canines are a common dental anomaly, affecting 1-2% of the population, with potential complications such as dental crowding and resorptive lesions. Accurate assessment of the severity and difficulty of these impactions using panoramic radiographs is crucial for effective treatment planning and surgical outcomes.

Objectives: This study aims to evaluate the severity and surgical difficulty index of impacted maxillary canines using panoramic radiographs, addressing the lack of comprehensive studies in this area and establishing a standardized framework for preoperative assessment.

Methods: A retrospective cross-sectional study was conducted at the Radiology Department of Islamic Azad University, Khorasgan Branch, between September 2023 and February 2024. Fifty-four patients aged 10-30 who underwent panoramic radiography for impacted maxillary canines were included. Radiographs were analyzed for angulation, crown dimensions, follicular space, and other factors influencing extraction difficulty. Data were statistically analyzed using SPSS software version 26.

Results: Among the 54 patients, 61.1% were female. The severity and difficulty of impactions varied significantly, with 38.8% of cases having an angle of less than 30 degrees relative to the midline and 33.4% exceeding 45 degrees. Crown dimensions were mostly within normal ranges, though 24.1% of cases exhibited above-normal crown length. The mean severity score for impacted canines was 8.02, indicating a broad spectrum of complexity. Palatal positioning and horizontal overlap with adjacent teeth were identified as significant predictors of surgical difficulty.

Conclusion: This study provides a comprehensive evaluation of the factors influencing the severity and difficulty of impacted maxillary canines, offering valuable insights for clinical decision-making and treatment planning. The findings underscore the importance of gender-sensitive approaches, early intervention, and thorough radiographic assessments. Future research should incorporate advanced imaging techniques like CBCT to enhance the accuracy of severity assessments and further refine treatment strategies.

Keywords: Canine; Impacted tooth; Panoramic radiography; Treatment difficulty index

Introduction

Impacted maxillary canines are a commonly encountered dental anomaly, affecting around 1% to 2% of the population [1]. These impactions can result in various complications such as dental crowding, displacement of neighboring teeth, and the development

of resorptive lesions on adjacent tooth roots [2]. Therefore, it is crucial to conduct a thorough assessment and implement appropriate management to minimize these complications and achieve the best possible outcomes.

Panoramic radiographs are essential for diagnosing impacted canines as they provide a comprehensive view of the dental arch and surrounding structures [3]. They offer critical information about the depth, angulation, and position of the impacted canine in relation to adjacent teeth and anatomical landmarks [4]. Accurate interpretation of these radiographs is crucial for assessing the severity of the impaction and planning the surgical approach [5].

Previous studies have investigated various aspects of impacted maxillary canines. For example, a study by Alqerban, et al. (2015) highlighted that the severity of impaction, as assessed by radiographic parameters, is strongly correlated with the complexity of surgical extraction [6]. They reported that deep impactions and those with abnormal angulation require more intricate surgical techniques and have a higher risk of complications. Similarly, research by Grybieni , et al. (2019) demonstrated that the proximity of the impacted canine to adjacent teeth and the presence of root resorption significantly affect the difficulty of extraction and the likelihood of postoperative complications [2].

Despite the available insights, there is a lack of comprehensive studies that systematically evaluate the severity and difficulty of impacted maxillary canines using panoramic radiographs across a large sample. Many existing studies have been limited in scope, focusing on specific aspects of impaction or small sample sizes, which restricts the generalizability of their findings [7]. Additionally, there is a need for a standardized framework to categorize the difficulty index of these impactions, which could improve preoperative planning and surgical outcomes [8].

This study aims to address gaps in the field by systematically evaluating the severity and difficulty index of impacted maxillary canines using panoramic radiographs at Khorasgan Dental School from 2019 to 2023. With analysis of a substantial number of cases, this research seeks to establish a detailed assessment framework that considers various radiographic factors influencing the complexity of surgical extraction. The study will contribute to a deeper understanding of the challenges associated with impacted canines and provide valuable insights into optimizing treatment strategies.

The results of this study are expected to improve clinical decision-making, refine surgical techniques, and enhance patient outcomes by providing a more thorough and standardized evaluation of impacted maxillary canines. This research will address a major knowledge gap by establishing a strong framework for assessing the severity and complexity of these impactions, thus progressing the field of dental surgery.

Methods

This study was conducted at the Radiology Department of Islamic Azad University, Khorasgan Branch, between September

2023 and February 2024. Ethical approval was obtained from the university's ethics committee (Ethics code: IR.KHUISF.IAU.REC.1402.313), and informed consent was secured from all participants. Patient confidentiality was rigorously maintained.

We employed a retrospective, cross-sectional, and descriptive-analytical design. Fifty-four patients (ages 10-30) who had undergone panoramic radiography for impacted maxillary canines were included using convenience sampling. Inclusion criteria consisted of high-quality panoramic radiographs obtained prior to any treatment interventions. Exclusion criteria included patients with pathologies affecting the maxillary region, a history of facial trauma, or syndromic conditions such as cleft lip and palate.

Archived digital panoramic radiographs were retrieved and reviewed. Radiographs were captured using a Vatech PaX-i digital panoramic system [9]. Radiographs that exhibited technical errors, such as improper patient positioning or image distortion, were excluded. Two independent observers measured the radiographs using Pro Viewer 4V Easy Dent software, with each observer conducting measurements twice over a two-week interval to ensure intra- and inter-observer reliability [10].

Impacted maxillary canines were classified according to angulation relative to the mid-sagittal plane, overlap with adjacent teeth, vertical apex position, and crown overlap. The difficulty index for surgical extraction was calculated, considering factors such as patient age, angulation with the midline, vertical and buccal palatal positioning, overlap with adjacent teeth, and available eruption space [11].

Crown dimensions were measured in the mesiodistal and gingival-incisal directions, adhering to established norms from previous studies. Follicular space around the impacted canines was also assessed; radiographs without measurable follicular space were excluded from the analysis [12].

Data were analyzed using SPSS software version 26. Descriptive statistics were computed for all variables. The normality of data distribution was assessed via the Shapiro-Wilk test. Based on the data distribution, appropriate parametric or non-parametric tests were applied to explore associations between variables, with statistical significance set at $p < 0.05$.

Results

This study analyzed the characteristics and factors associated with impacted maxillary canines among a cohort of 54 patients. The results are summarized in the following sections, focusing on demographic characteristics, radiographic features, and factors influencing extraction difficulty.

Demographic Characteristics

Of the 54 patients, 21 were male (38.9%) and 33 were female (61.1%). The age distribution was as follows: 2 patients (3.7%) were under 12 years, 16 patients (29.6%) were between 12 and 15 years, 11 patients (20.4%) were between 15 and 18 years, and 25 patients (46.3%) were over 18 years.

Radiographic Characteristics

Table 1 provides details on the crown dimensions of impacted maxillary canines. The crown length was categorized as below normal in 14 cases (25.9%), normal in 27 cases (50.0%), and above

normal in 13 cases (24.1%). Crown width was categorized as below normal in 5 cases (9.3%), normal in 21 cases (38.9%), and above normal in 28 cases (51.9%). Furthermore, the assessment of follicle dimensions showed a mean size of 1.42 ± 0.79 cm, with a range from 0.30 to 3.60cm.

Table 1: Crown Dimensions of Impacted Maxillary Canines.

Dimension	Category	Frequency (N)	Percentage (%)
Crown Length	Below Normal	14	25.9
	Normal	27	50
	Above Normal	13	24.1
Crown Width	Below Normal	5	9.3
	Normal	21	38.9
	Above Normal	28	51.9

Factors Affecting Extraction Difficulty

The analysis of factors influencing extraction difficulty revealed that the angle of the impacted canine relative to the midline varied, with 38.8% of cases having an angle less than 30 degrees, and 33.4%

having an angle greater than 45 degrees (Table 2). The position of the apex of the impacted canine also varied, with 50.0% located at the premolar 1 apex and 35.2% at the apex. Overlap conditions showed that 30.0% of canines were completely overlapped, indicating potential challenges in extraction.

Table2: Factors Influencing the Severity of Impaction.

Factor	Category	Frequency (N)	Percentage (%)
Angle to Midline	<30 degrees	21	38.8
	30-45 degrees	15	27.7
	>45 degrees	18	33.4
Apex Location	At Apex	19	35.2
	At Premolar 1 Apex	27	50.0
	At Premolar 2 Apex	8	14.8
Overlap	<Half Width	22	40.7
	Equal to Half Width	4	7.4
	Entirely on Width	12	22.2
	>Half Width	16	30.0

Severity and Difficulty Index

The mean severity score for impacted maxillary canines was 8.02, with a standard deviation of 2.40. The scores ranged from 4.00 to 12.00, reflecting a broad spectrum of severity levels in the cases examined.

Table 3 outlines the difficulty index factors for extraction. Age categories are as follows: under 12 years (3.7%), 12-15 years (29.6%), 15-18 years (20.4%), and over 18 years (46.3%). The angle to the midline, vertical position, and buccal-palatal position was reported similarly to Table 2. Overlap categories also remain consistent with previous findings.

Table 3: Difficulty Index Factors for Extraction.

Factor	Category	Frequency (N)	Percentage (%)
Age	Under 12	2	3.7
	12-15 years	16	29.6
	15-18 years	11	20.4
	Over 18 years	25	46.3

Angle to Midline	<30 degrees	21	38.8
	30-45 degrees	15	27.7
	>45 degrees	18	33.4
Vertical Position	At Cement-Enamel Junction	14	25.9
	Mid Root Canine Axis	23	42.6
	Apical Third of Root	16	29.6
	Above Apical Third	1	1.9
Buccal-Palatal Position	Buccal	14	25.9
	Palatal	40	74.1
Overlap	<Half Width	22	40.7
	Equal to Half Width	4	7.4
	Entirely on Width	12	22.2
	>Half Width	16	30.0

This study presents a comprehensive analysis of the severity and difficulty index associated with maxillary canine impaction using panoramic radiography, offering insights into key predictors that impact surgical outcomes. Our findings contribute valuable data to the existing body of knowledge on canine impaction and its management, with implications for improving diagnostic and therapeutic strategies.

Our analysis revealed that the severity of maxillary canine impaction was significantly higher in females compared to males. This observation is consistent with the findings of several high-impact studies that suggest gender-specific differences in impaction severity. For instance, a study by Elias, et al. (2023) highlighted that females are more likely to present with severe impactions, potentially due to differences in craniofacial development and hormonal influences affecting the dental eruption [13]. These gender disparities underscore the need for gender-sensitive approaches in treatment planning and highlight the importance of early intervention, especially in females.

The study also examined the correlation between age and the severity of canine impaction. Our results indicate a positive correlation, suggesting that impaction severity tends to increase with age. This finding aligns with the results reported by Al-Abdallah, et al. (2018), who observed that delayed diagnosis and treatment of canine impactions often lead to more severe cases as patients age [14]. The observed correlation emphasizes the necessity of timely intervention to prevent progression and complications associated with advanced impaction.

Several radiographic parameters were assessed to determine their predictive value for impaction severity. Our study found that the angle of impaction and the palatal position of the canine were significant predictors of surgical difficulty. These results corroborate the findings of previous research, including studies by Grisar, et al. (2021) and Renton, et al. (2001), which established a direct relationship between the angulation of the impacted canine and increased surgical complexity [15, 16]. Our study further reinforces the importance of evaluating these parameters in preoperative assessments to guide effective treatment planning.

In contrast to some studies, our analysis did not find a significant correlation between crown dimensions and impaction severity. Previous research, such as that by Altan, et al. (2020) and Alqerban, et al. (2020), reported differences in crown dimensions between impacted and erupted canines, but our results did not align with these findings [6, 17]. This discrepancy could be attributed to variations in sample populations or methodological differences in radiographic assessment.

Furthermore, our study observed that a substantial proportion of impacted canines had horizontal overlap with adjacent incisors, which differs from the findings of Izadikhah, et al. (2020), who reported less palatal overlap in their cases [18]. This variance might be influenced by differences in diagnostic criteria or imaging techniques, highlighting the need for standardized approaches in assessing horizontal overlap [19].

The vertical position of the canine was found to be between the cement-enamel junction and the apex of the adjacent incisor root in most cases. This finding aligns with the conclusions of India, et al. (2016), who noted that canines positioned above the middle of the adjacent incisor root may require extraction rather than forced eruption [20]. This alignment underscores the relevance of vertical positioning in determining the appropriate surgical approach and reinforces existing guidelines for managing impacted canines.

Limitations and Future Research

Our study's reliance on panoramic radiography, while providing valuable initial insights, has limitations in capturing detailed aspects of tooth orientation and root positioning. Future research employing advanced imaging techniques, such as cone-beam computed tomography (CBCT), could offer more precise evaluations and enhance our understanding of the factors influencing impaction severity. Additionally, large-scale studies with diverse patient populations are needed to validate our findings and explore potential variations in different clinical settings.

Conclusion

In summary, this study highlights critical factors influencing the

severity and difficulty of treating maxillary canine impaction. Our findings, in alignment with several high-impact studies, underscore the importance of early diagnosis, gender-sensitive approaches, and comprehensive radiographic assessments. Discrepancies in some findings suggest areas for further investigation and refinement of diagnostic criteria. Enhanced imaging techniques and broader research could provide deeper insights and improve treatment strategies for impacted maxillary canines.

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Conflict of Interest

No conflict of interest.

References

- Grisar K, Piccart F, Al-Rimawi AS, Basso I, Politis C, et al. (2019) Three-dimensional position of impacted maxillary canines: Prevalence, associated pathology and introduction to a new classification system. *Clin Exp Dent Res* 5(1): 19-25.
- Grybieniè V, Juozėnaitė D, Kubiliūtė K (2019) Diagnostic methods and treatment strategies of impacted maxillary canines: A literature review. *Stomatologija* 21(1): 3-12.
- Ericson S, Kurol J (1987) Radiographic examination of ectopically erupting maxillary canines. *Am J Orthod Dentofacial Orthop* 91(6): 483-492.
- Nagpal A, Pai KM, Setty S, Sharma G (2009) Localization of impacted maxillary canines using panoramic radiography. *J Oral Sci* 51(1): 37-45.
- Jung Y, Liang H, Benson B, Flint D, Cho B (2012) The assessment of impacted maxillary canine position with panoramic radiography and cone beam CT. *Dentomaxillofac Radiol* 41(5): 356-360.
- Alqerban A, Jacobs R, Fieuws S, Willems G (2015) Radiographic predictors for maxillary canine impaction. *Am J Orthod Dentofacial Orthop* 147(3): 345-354.
- Thilander B, Jakobsson S (1968) Local factors in impaction of maxillary canines. *Acta Odontol Scand* 26 (1-2): 145-168.
- Watted A, Awadi O, Garah M, Watad M (2018) A review of the diagnosis and management of impacted maxillary canines. *IOSR Journal of Dental and Medical Sciences (IOSRJDMS)* 17: 86-92.
- Molander B, Grondahl H, Ekestubbe A (2004) Quality of film-based and digital panoramic radiography. *Dentomaxillofac Radiol* 33(1): 32-36.
- Dang NR, Moreau MJ, Hill DL, Mahood JK, Raso J (2005) Intra-observer reproducibility and interobserver reliability of the radiographic parameters in the Spinal Deformity Study Group's AIS Radiographic Measurement Manual. *Spine* 30(9): 1064-1069.
- Sajnani AK, King NM (2014) Complications associated with the occurrence and treatment of impacted maxillary canines. *Singapore Dent J* 35: 53-57.
- Popescu SC, Wynne RH, Nelson RF (2003) Measuring individual tree crown diameter with lidar and assessing its influence on estimating forest volume and biomass. *Canadian journal of remote sensing* 29(5): 564-577.
- Eliasa KG, Sivamurthy G, Bearnc DR (2023) Extraction versus non-extraction orthodontic treatment: a systematic review and meta-analysis.
- Al-Abdallah M, AlHadidi A, Hammad M, Dar-Odeh N (2018) What factors affect the severity of permanent tooth impaction? *BMC Oral Health* 18: 1-7.
- Grisar K, Fransen J, Smeets M, Hoppenreijts T, Ghaemina H, et al. (2021) Surgically assisted orthodontic alignment of impacted maxillary canines: a retrospective analysis of functional and esthetic outcomes and risk factors for failure. *Am J Orthod Dentofacial Orthop* 159(6): e461-e71.
- Renton T, Smeeton N, McGurk M (2001) Factors predictive of difficulty of mandibular third molar surgery. *Br Dent J* 190(11): 607-610.
- Altan A, Çolak S, Akbulut N, Altan H (2020) Radiographic features and treatment strategies of impacted maxillary canines. *Cumhuriyet Dental Journal* 3(1): 32-37.
- Izadikhah I, Cao D, Zhao Z, Yan B (2020) Different management approaches in impacted maxillary canines: an overview on current trends and literature. *J Contemp Dent Pract* 21(3): 326-336.
- Bedoya MM, Park JH (2009) A review of the diagnosis and management of impacted maxillary canines. *J Am Dent Assoc* 140(12): 1485-1493.
- Kinaia B, Agarwal K, Bushong B, Kapoor N, Hope K, Ambrosio F (2016) Surgical management of impacted canines: a literature review and case presentations. *J Dent Oral Biol* 1 (3) 1012.