OPEN ACCESS

Extraction Trends in Orthodontics: Association with Malocclusion and Treatment Planning

Pir Uzair[1], Tahira Hussain [2], Neelofar Rehman[3], Fahad Qiam [4], Samia Rahman[5], Arfa Rehman [6]

1. Department of Oral and Maxillo-facial surgery, Bacha Khan Dental College, Mardan, Pakistan
2. Department of Orthodontics and Dentofacial Orthopaedics, Bacha Khan Dental College, Mardan, Pakistan
3. Department of Oral medicine, Bacha Khan Dental College , Mardan, Pakistan
4. Department of Oral and Maxillofacial Surgery, Sardar Begum Dental College, Peshawar, Pakistan
5. Department of Orthodontics and Dentofacial Orthopaedics, .Saidu College of Dentistry, Swat, Pakistan
6. Department of Operative Dentistry and Endodontics, Bacha Khan Dental College , Mardan, Pakistan

Abstract

Background: Permanent tooth extraction in orthodontic treatment has long been a topic of debate that frequently leads to varying clinical views. Although there are situations in which both extraction and non-extraction methods might be justified, especially when the results of therapy are positive, practitioners frequently form personal prejudices in favor of one or the other.

Objectives: This study aims to analyze current extraction trends in orthodontic treatment and their association with various malocclusion types at Bacha Khan Dental College, Mardan.

Materials and Methods: This descriptive cross-sectional study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics at Bacha Khan Dental College , Mardan. Records of 222 patients assessed and treated over a one-year period were reviewed. Patients with complete diagnostic records, detailed treatment plans, and documented extraction decisions (excluding third molars) were included. Associations between extraction decisions and malocclusion types were evaluated using the Chi-square test, with a p-value of <0.05 considered statistically significant.

Results: The distribution of malocclusions among 222 patients (mean age 18.60 ± 4.57 years; 65.3% female) was Class I (43.7%), Class II (45.0%), and Class III (11.3%). With a maximum of four teeth extracted and an average of 1.43 extracted per patient, extractions were recommended in 45.5% of instances. First premolar extraction was the most prevalent pattern (22.5%). Class II cases had the highest extraction rate (64.0%), and there was a significant correlation ($p < 0.001$) between the kind of malocclusion and the need for extraction.\

Conclusion: Extraction decisions showed a significant association with malocclusion type, with Class II cases exhibiting the highest extraction rate. First premolar removal was the most common pattern, and nearly half of the patients required extractions, highlighting the continued relevance of extractions in individualized orthodontic treatment planning.

Keywords: *Orthodontics; Tooth Extraction; Malocclusion; orthodontic therapy*

Introduction

Permanent tooth extraction in orthodontic treatment has long been a topic of debate that frequently leads to varying clinical views. Although there are situations in which both extraction and non-extraction methods might be justified, especially when the results of therapy are positive, practitioners frequently form personal prejudices in favor of one or the other. This results in different treatment philosophies, with some practitioners strongly supporting extractions and others preferring to avoid them[1 2 3].

The choice of whether and how many teeth to extract may have an impact on the final results of orthodontic therapy, including duration of treatment, occlusion, patient and family satisfaction, and aesthetics. [4-6 7] In the early twentieth century, orthodontic therapy was predicated on the assumption that extractions impaired occlusion and aesthetics, which Edward Hartley Angle strongly supported. Calvin Case, one of his principal detractors, argued that extractions were necessary to address face abnormalities caused by dental or maxillary protrusion. He calculated that extractions were required in 3% of Class I, 5% of Class II, and almost none of Class III malocclusions. Overall, only 6-7% of treated cases need extraction.[8] Following Angle's death in 1930, his follower Charles Tweed reassessed cases that had not undergone extractions and discovered an 80% failure rate in terms of function, stability, aesthetics, and periodontal health. To improve facial harmony and the stability of treatment over time, he later promoted extractions.[9]
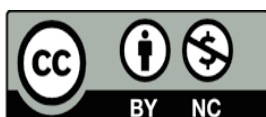
Even though some studies confirm that extraction

treatment has no negative effects on soft tissue profile changes over time or alters a patient's facial height, orthodontic planning is also influenced by the introduction of different techniques, such as self-ligated brackets, thermoplastic aligners, functional appliances, interproximal reduction, and temporary anchorage devices, as well as better bonding in orthodontics[10] [11].. Extractions are still a part of orthodontic plans that aim to improve facial look and produce consistent outcomes, even though these resources frequently encourage expansion and space gain in the arches. First premolars have been proposed as the primary indication for extraction for orthodontic purposes in several research studies. These teeth were chosen because they are close to the anterior and posterior teeth and because they are positioned in the middle of the arch, making it easier to treat crowding, dentoalveolar protrusion, and midline abnormalities[12]

Despite extensive global research, regional data on orthodontic extraction patterns remain limited, especially within Pakistan. Variations in patient demographics, malocclusion types, and treatment philosophies may influence extraction decisions in different populations. Therefore, this study aims to analyze current extraction trends in orthodontic treatment and their association with various malocclusion types at Bacha Khan Dental College, Mardan. By identifying the frequency, pattern, and rationale of extractions in local clinical practice, this research seeks to contribute valuable insights to evidence-based orthodontic treatment planning and improve patient outcomes.

Material and Methods

This descriptive cross-sectional study was conducted in the Department of Orthodontics, Bacha Khan Dental College, Mardan, from January 2024 to December 2024. Ethical approval for the study was obtained from the Ethical Review Committee of Bacha Khan Dental College **(Reference No. 7101/-BKCD).** The sample size was calculated using the standard formula for a single proportion:

$$n = \frac{Z^2 \times p(1-p)}{d^2}$$

Assuming a 6–7% prevalence (p = 0.07)[8] of extraction cases reported in historical orthodontic literature, with a 95% confidence level (Z = 1.96) and 5% absolute precision (d = 0.05), the minimum required sample size was approximately 100. To improve the precision of estimates, enable subgroup comparisons by malocclusion class, and account for possible data exclusions, a total of 222 patient records were reviewed.

Records were included if they contained complete diagnostic information and comprehensive orthodontic treatment plans specifying extraction decisions. Only patients with a full complement of permanent teeth, excluding third molars, were considered. Records were excluded if they were incomplete, unclear regarding extraction status, or if the patient had dental agenesis, mutilation, or tooth loss due to developmental absence.

Data were collected on patient demographics, Angle's

classification of malocclusion, extraction patterns, and the timing of treatment initiation. The frequency and distribution of extractions were analyzed with respect to these variables. Statistical analysis was performed using SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as age were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between extraction decisions and malocclusion types were assessed using the Chi-square test, with a 95% confidence interval and $p < 0.05$ considered statistically significant.

Results

A total of 222 patients sought orthodontic treatment at the Department of Orthodontics, Bacha Khan Dental College , Mardan, over a one-year period. Of these, 145 (65.3%) were female and 77 (34.7%) were male, indicating a higher prevalence of orthodontic consultations among females. The patients' ages ranged from 8 to 38 years, with a mean age of 18.60 ± 4.57 years and a median age of 16 years.

Regarding the distribution of malocclusion types, Class II malocclusion was the most prevalent (45.0%), followed closely by Class I (43.7%), while Class III accounted for 11.3% of cases (Table 1).

Table 1: Distribution of Malocclusion Classes (n = 222)

Malocclusion Class	Frequency	Percentage (%)
Class I	97	43.7
Class II	100	45.0
Class III	25	11.3
Total	222	100

Dental extractions were required in 101 patients (45.5%), while 121 patients (54.5%) were managed with non-extraction treatment plans. The number of teeth extracted per patient varied, with a mean of 1.43 ± 1.72 and a maximum of four teeth in a single patient (Table 2).

Table 2: Number of Teeth Extracted for each Patient (n = 101)

Number of Teeth	Frequency	Percentage
1	7	3.2
2	30	13.5
3	5	2.3
4	59	26.6
Total	101	45.5

Among extraction patterns, first premolars were the most frequently extracted teeth, representing 22.5% of all extractions, followed by maxillary first premolars (11.3%) and combined maxillary first and mandibular second premolars (2.3%) (Table 3).

A statistically significant association was found between malocclusion class and the need for extractions

(p < 0.001), with Class II malocclusions showing the highest extraction rate (64.0%), followed by Class III (44.0%) and Class I (26.8%) (Table 4). Similarly, a strong correlation was observed between malocclusion type and premolar extractions (p < 0.001). The frequency of premolar extractions was greatest among Class II patients (63.0%), compared with Class I (24.7%) and Class III (28.0%) cases (Table 5).

Table 3: Distribution of Extracted Teeth Combinations among Orthodontic Patients (n = 222)

Extracted Teeth Combination	Frequency	Percentage (%)
14, 24, 34, 44 (All first premolars)	50	22.5
14, 24 (Maxillary first premolars)	25	11.3
14, 24, 35, 45 (Maxillary first premolars and mandibular second premolars)	5	2.3
Other combinations	20	9.0
No extraction	121	54.5
Total	222	100

Table 4: Association between Malocclusion Class and Extractions among Orthodontic Patients (n = 222)

Malocclusion Class	Extractions Required	Extractions Not Required	Total	Percentage Requiring Extraction (%)
Class I	26	71	97	26.8
Class II	64	36	100	64.0
Class III	11	14	25	44.0
Total	101	121	222	45.5
p-value				<0.001

Table 5: Association between Malocclusion Class and Premolar Extractions (n = 222)

Malocclusion Class	Premolar Extracted	Premolar Not Extracted	Total	Percentage with Premolar Extraction (%)
Class I	24	73	97	24.7
Class II	63	37	100	63.0
Class III	7	18	25	28.0
Total	94	128	222	42.3
p-value				<0.001

Discussion

A number of complex choices must be made in order to diagnose and arrange for orthodontic therapy. The first step is to objectively assess the need for treatment. The orthodontist must next decide if successful therapy will necessitate tooth extraction, among other things, if treatment is deemed required. The issue of removing permanent teeth as part of corrective orthodontics has long sparked debate and professional controversy, frequently with strong religious overtones. In orthodontics, tooth extraction is frequently considered as a therapeutic option for dental crowding. Furthermore, orthodontists may think about extraction in situations involving jaw growth discrepancies, including Angle Class Il connections, as well as in a number of other circumstances, like tooth pathology or damage[13, 14, 15]

222 patients at the Department of Orthodontics and Dentofacial Orthopaedics, were examined in this study over one year, with an emphasis on demographics, malocclusion classifications, and extraction patterns. The cohort's mean age was 18.6 years (SD = 4.571), with a range of 8 to 38 years, and a mode of 16 years, suggesting that adolescents were more likely to seek orthodontic treatment. The fact that women made up 65.3% of the patient population suggests that women in Mardan are more likely to seek orthodontic treatment. This pattern is consistent with earlier research showing that women are typically more proactive in resolving issues related to oral health and dental appearance. According to the distribution of malocclusion types, Class II had the highest prevalence (45%), followed by Class I (43.7%) and Class III (11.3%). With an average of 1.43 teeth removed per patient, dental extractions were necessary in 45.5% of instances. Four teeth per patient (26.6%) were extracted in the most prevalent extraction pattern; these were usually all first premolars (22.5%). Class II malocclusion patients had the greatest extraction rate (64%), and there was a significant correlation between the type of malocclusion and the need for extractions (p < 0.001). This result is in line with earlier studies showing that to establish functional occlusion and rectify dental protrusion, Class II malocclusions frequently necessitate extractions. These revelations highlight the significance of early detection and treatment in order to perhaps lessen the necessity for extractions. [16].

In a study conducted at Poltava State Medical University (654 patients, 2020–2023), it was discovered that 41.74% of orthodontic patients needed extractions, primarily of first upper premolars (17.48%) and third molars (3.66% lower third molars; 76.19% of cases involved all four third molars), with no sex gap. There was a high correlation (p < 0.001) between the kind of malocclusion and the requirement for extractions (64% in Class II instances) and 45.5% of patients required extractions in a similar study conducted at Bacha Khan College of Dentistry (222 patients over two months). First premolars were often extracted to relieve crowding. To attain the best orthodontic results, both studies emphasize the significance of customized extraction techniques. [17].

For more than a century, the practice of extracting teeth for orthodontic purposes has been debatable,

with changing criteria influencing treatment decisions. Recent research has shed light on the frequency and patterns of extraction among various groups. For example, between July 2012 and June 2014, a research done at the Armed Forces Institute of Dentistry in Rawalpindi, Pakistan, examined 489 orthodontic patients aged 7 to 21. The findings revealed an overall extraction frequency of 39.5%, with first premolars, particularly from the upper arch, being the most often excised teeth. There was no significant correlation detected between extraction status and gender.[18].

In orthodontics, individualized treatment planning is critical, taking into account malocclusion type and facial profile. Tooth extraction decisions should be based on a thorough evaluation for optimal function and aesthetics. The high extraction rate in Class II malocclusions emphasizes early diagnosis in reducing extractions. Furthermore, the gender disparity emphasizes the importance of raising male awareness about the benefits of orthodontics.

Limitations

This study's limitations include a retrospective design and a one-year monitoring duration. Further study with bigger sample numbers and longer follow-up periods is required to corroborate these findings and understand the underlying mechanisms leading to the observed patterns. Future studies should use prospective multicenter designs to better evaluate extraction decision determinants.

Conclusion

The study found that females and adolescents in Mardan seek orthodontic treatment at a higher rate. Class II malocclusion is the most common type, with a strong link between malocclusion class and the need for dental extractions, particularly premolar extractions. These findings can help guide clinical decision-making and the development of focused interventions to improve orthodontic care outcomes in this population.

References

1. Tom K, Mancl L, Woloshyn H, et al. Association between crowding estimation and extraction recommendations in orthodontics. 2024; 165: 64-72. e12.

2. Ali DJC, Cosmetic and Dentistry I. Reasons for extraction of permanent teeth in a university dental clinic setting. 2021: 51-57.

3. Johnson JR. Current Perceptions of General Dentists Regarding Extractions in Orthodontic Treatment: Influencing Factors and Trends. The University of Oklahoma Health Sciences Center, 2024.

4. Eliasa KG, Sivamurthyb G and Bearnc DR. Extraction versus non-extraction orthodontic treatment: a systematic review and meta-analysis. 2023.

5. Kiyamehr Z, Razeghinejad MH, Rahbar M, et al. Factors affecting the duration of fixed orthodontic treatment in patients treated in a university department between 2016 and 2020. 2022; 17: 380.

6. Amin B, Naureen S, Kiani Hg, et al. Orthodontic Treatment Duration and Its Impact on Patient Well-Being: Assessing Depression in Extended Care. 2023; 43: 180-185.

7. Agrawal P, Jadhav V and Bhaiyya PJMR. A thorough analysis of the impact of nonextraction and extraction methods in orthodontic therapy–A review. 2025; 8: 2025069-2025069.

8. Dardengo CdS, Fernandes LQ and Capelli Júnior J. Frequency of orthodontic extraction. *Dental press journal of orthodontics* 2016; 21: 54-59.

9. Angst C, Eliades T and Papageorgiou SNJEJO. Stability of occlusal outcome during long-term retention: the time-dependent variation of the American Board of Orthodontics index. 2021; 43: 1-7.

10. Gao J, Wang X, Qin Z, et al. Profiles of facial soft tissue changes during and after orthodontic treatment in female adults. 2022; 22: 257.

11. Rüedi A, Papageorgiou SN, Eliades T, et al. Effect of four premolar extractions on the vertical dimension of the face: A retrospective cephalometric study. 2024; 85: 181-188.

12. Persson M, Al-Taai N, Pihlgren K, et al. Early extractions of premolars reduce age-related crowding of lower incisors: 50 years of follow-up. 2022; 26: 4525-4535.

13. Salim NA, Sawair FA, Meyad FH, et al. Pattern, frequency and causes of dental extraction among children/adolescents Syrian refugees: an observational study. 2022; 22: 100.

14. Marchesini PM, Ferreira MF and de Mendonça MRJR-RCM-I-. Extractions in Orthodontics: Literature Review. 2023; 4: e473590-e473590.

15. Meade MJ and Dreyer CWJAOJ. Orthodontic extraction practices: a cross-sectional survey of orthodontists in Australia. 2022; 38: 227-236.

16. Dardengo CdS, Fernandes LQ and Capelli Júnior JJDpjoo. Frequency of orthodontic extraction. 2016; 21: 54-59.
17. Lokes K, Karasiunok AY, Smaglyuk L, et al. Tooth Extraction Operation as A Component of Orthodontical Treatment. 2024: 32-35.
18. Najam Z, Khan RU, Tariq A, et al. Tooth Extraction: Frequency in Orthodontic Treatment. 2018; 25: 424-427.

How to cite this article?

Author Contributions

1. **Pir Uzair:** Conception and design of the study, supervision of the project, data collection and analysis, literature review, and critical revision of the manuscript.
2. **Tahira Hussain:** Conception and design of the study, data collection and processing, analysis and interpretation of results, and manuscript writing.
3. **Neelofar Rehman:** Funding support, contribution to data interpretation, and analytical discussions.
4. **Fahad Qiam:** Study design, funding and technical support, contribution of materials, data analysis, literature review, and manuscript writing and review.
5. **Samia Rahman:** Conception and design of the study, assistance in funding and provision of materials, literature review, data interpretation, and critical review of the manuscript.
6. **Arfa Rehman:** Supervision of the project, funding support, provision of study materials, literature review, and assistance in manuscript preparation.