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EVALUATION OF AESTHETIC AND FUNCTIONAL OUTCOMES IN ORTHODONTIC TREATMENTS WITH AND WITHOUT PREMOLAR EXTRACTION: LITERATURE REVIEW

Elvira Ramovic *

*Private Dental Clinic "Elit Dent Ulcinj"

Abstract

Introduction

Despite being a common orthodontic treatment procedure, permanent tooth extraction remains a contentious issue due to its potential functional and aesthetic effects. The aim of this study is to evaluate, through a literature review, the aesthetic and functional outcomes of orthodontic treatments with and without premolar extraction.

Methodology

A systematic search was conducted in the PubMed, Scopus, and Web of Science databases to identify comparative studies on orthodontic treatments with and without extraction. An initial search yielded 943 results; five studies met the inclusion criteria: published within the last 15 years, written in English, and reporting on aesthetic and/or functional outcomes. The key data from these studies were synthesized and analyzed.

Results

Treatment involving premolar extraction typically resulted in lip retrusion and a straighter facial profile. However, both treatment approaches (with and without extraction) achieved acceptable aesthetic outcomes. Transversal arch width was preserved even in extraction cases, especially when using appliances such as the Damon system. Extraction contributed to better control of dental crowding and more stable positioning of the incisors, which were less protruded and proclined in the extraction group. No consistent differences were found in the vertical facial dimension between the two treatment approaches.

Conclusions

Findings from the five selected studies suggest that both treatment strategies, with and without premolar extraction, can lead to successful outcomes when carefully planned and tailored to the patient's characteristics.

Recommendations

Extraction decisions should be individualized, taking into account the patient's clinical conditions and aesthetic expectations. Further research with a stronger methodological design is needed to clarify the long-term impact of extractions on aesthetics, function, and treatment stability.

Key words: *extraction, orthodontics, aesthetic outcomes, functional outcomes, literature review*

Introduction

The extraction of permanent teeth during orthodontic treatment remains a controversial topic in the dental scientific community. (1) Although there have been periods, such as the 1920s and 1930s, when extraction was discouraged by dentists, and efforts were also made in the late 19th century to reduce the use of extractions in orthodontics; decision-making in this regard has continued to be influenced by individual patient characteristics. (1) Malocclusion is one of the most common reasons why children and adolescents seek orthodontic treatment. (2) Class II malocclusion is typically characterized by an increased overjet, proclined maxillary incisors, and deep bite. Dental crowding and overbite are commonly observed in both Class I and Class II malocclusions. (3)

These malocclusions require different treatment strategies. In adolescents, the use of fixed orthodontic appliances in combination with the extraction of permanent teeth is a common method. The extraction protocol varies depending on the type of occlusion, function and morphology of the teeth. (4)

The specific cases, the nature of the malocclusions, and individual aesthetic and functional needs guide orthodontists in making personalised therapeutic decisions. The aesthetic result of an orthodontic treatment is one of the most crucial success factors, particularly since the aesthetics of the teeth and smile are often the primary reason patients decide to undergo orthodontic treatment. (5,6) On the other hand, the orthodontist must take care not only that the patient is satisfied with the aesthetic aspects but also that optimal oral functionality is achieved.

It is very important that each patient is seen as an individual, and their treatment should be planned according to the type of malocclusion. (7) Many factors influence the selection of teeth to be extracted, and careful treatment planning in collaboration with the patient. Appliance selection and treatment management are essential if we want to achieve an acceptable, aesthetic, and functional outcome. (8)

Tooth extraction is a potentially traumatic experience. The decision should be made with awareness of the risks of treatment, including the psychological impact of the procedure. (8)

Some teeth are more likely to be selected for extraction for orthodontic reasons. A study of extraction patterns in orthodontic services (Figure 1.1) showed that first premolars are extracted most frequently (59%), followed by second premolars (13%). (8)

Figure 1.1:. Percentage of extractions by tooth type

Tooth	% removed
Central incisor	1
Lateral incisor	3
Canine	4
First premolar	59
Second premolar	13
First molar	12
Second molar	7

Permanent molars accounted for 19% of extractions (12% for first molars and 7% for second molars). Only 1% of patients had incisor extractions. (7)

The high rate of extraction of premolars is related to their position in the arch and the timing of their eruption. They are often ideal for relieving anterior and posterior overcrowding. (7)

Extraction of premolars in orthodontic treatment, especially in borderline cases with a lack of space, remains one of the most debated interventions in the orthodontic literature. (8-14) Extraction of premolars is often considered necessary in cases with a lack of space, where the harmonious alignment of the teeth within the dental arch is compromised. This therapeutic strategy is considered essential not only to achieve appropriate tooth positioning, but also to ensure long-term stability of orthodontic results. (15) However, the use of premolar extraction in orthodontic treatment remains a subject of debate, due to several concerns raised regarding possible aesthetic effects, such as increasing the size of the buccal corridor. (16,17,18)

Regarding the effect of premolar extraction on the horizontal and vertical dimensions of the jaws, the results are contradictory. (19,20,21,22) Some studies show anterior rotation of the mandible after extraction, while others find no such changes. (19,23,27) Also, some studies do not report differences in vertical dimensions between the extraction and non-extraction groups, (24,25,26,28) while others note an increase in lower facial height and posterior rotation of the mandible in cases without extraction. (29,30) Thus, there is a continuing uncertainty in the literature regarding the effects that orthodontic treatment (with or without extraction) has on the anteroposterior and vertical dimensions of the jaws. This continuing uncertainty emphasizes the need for critical reviews of the literature that can help in making clinical decisions based on scientific evidence.

The aim of the study

The aim of this study is to evaluate, through a literature review, the aesthetic and functional results of orthodontic treatments with and without premolar extraction.

Methodology

A systematic literature review was performed using PubMed, Scopus and Web of Science databases, to identify studies comparing orthodontic treatments with and without premolar extraction. In the initial search, we had 943 results. After removing duplicates, 223 studies were initially screened by analyzing the titles and abstracts to assess eligibility. 36 of these studies were selected for full-text reading. After detailed analysis, 5 studies met the inclusion criteria and were included in the final review.

Inclusion criteria:

- Studies published in the last 15 years
- Studies written in English
- Comparative studies between extraction and non-extraction treatments of premolars in orthodontic treatments.
- Studies reporting aesthetic and/or functional outcomes (including cephalometric analyses, aesthetic assessments, and functional parameters)

Exclusion criteria:

- Non-comparative studies, without a control group
- Articles, editorials, or reviews without original clinical data
- Studies not in English or published outside the specified period

After the studies were selected, a summary table was created with the main data such as: study design, selected sample, type of orthodontic appliance, treatment protocol (with or without extraction), aesthetic and functional assessment parameters, results, and limitations of each study.

Results and Discussions

Table 4.1 below presents general data on the methodological characteristics of the five selected studies that address the comparison between orthodontic treatments with and without premolar extraction. The table includes information on: title and authors, year of publication, study design, number of participants and division into groups, mean age of patients.

During the literature review, it was noted that a large part of the studies in this area are retrospective studies, which is also reinforced by our selection, three out of the five studies are retrospective. This type of design brings some methodological limitations, as it relies only on previously documented data, which may be incomplete or non-standardized.

However, due to the ethical and practical difficulties in conducting randomized controlled trials (RCTs) in this area, these retrospective studies constitute an important source of information and help in understanding the different impacts of the two orthodontic treatment strategies.

Two of the five studies included in this review are literature reviews, which represent a high level of scientific evidence, especially one of them, which is accompanied by a meta-analysis. However, as reported by the authors themselves, the overall quality of the evidence included in these reviews was low to moderate, mainly because most of the original studies had a retrospective design, methodological heterogeneity and lack of randomization. For this reason, although systematic reviews provide a broad and valuable overview, their results should be interpreted with caution, taking into account the limitations of the primary sources from which they are constructed.

No	Author & year	Title	Type of study	Sample	Extraction group	Non extraction group
1	S. Bühling et al., 2024	Changes in arch width and buccal corridor after orthodontic treatment with the Damon self-ligating system: premolar extraction compared with treatment without extraction (31)	Comparative retrospective	72	35 Extraction 4 ose 2 premolars (12.5 years old)	37 patients (12.8 years old)
2	Kouvelis et al., 2022	The effect of orthodontic treatment with extraction of 4 premolars compared with treatment without extraction on the vertical dimension of the face: A systematic review (32)	Systematic review	14 studies(n > 700)	Studies involving treatment with 4 extracted premolars	All studies include a comparison group without extraction.

3	Ekstam et al., 2023	Effects of premolar extraction and orthodontic treatment in adolescents - a retrospective cephalometric study (33)	Retrospective	79 (median age 14.4 years)	19	60
4	Elias et al., 2023	Orthodontic treatment with extraction vs. without extraction: Systematic review and meta-analysis (34)	Systematic review + Meta-analysis	30 studies	Studies involving treatment with extracted premolars	Studies that had a comparison group without extraction
5	Verma et al., 2013	Comparison of aesthetic outcome after orthodontic treatment with or without extraction in patients with class II division 1 malocclusion (35)	Comparative retrospective	100	50 (with extraction average age 14 years 1 month)	50 (without extraction, average age 13 years 5 months)

Table 4.1.: General information about the studies included in this literature review

Table 4.2 summarizes the main aesthetic and functional outcomes reported by the selected studies, the device used for treatment, and the limitations of each study.

No	**Author & year**	**Methods**	**Aesthetic effects**	**Functional effects**	**Limitation**
1	S. Bühling et al., 2024	Damon self-ligating	No increase in buccal corridors was seen after extraction; Damon helped maintain the transverse dimension	Damon avoided arch narrowing after extraction, preserving the transverse dental width	Small sample; only one appliance; blinding not possible; did not assess functional parameters such as occlusal stability or retention

2	Kouvelis et al., 2022	Not specified for all studies; most used conventional fixed appliances	No aesthetic parameters were assessed in the study.	No consistent difference in vertical facial dimension was found between the two approaches; the differences were small and not clinically significant.	High heterogeneity among studies; most of them are retrospective; lack of RCTs;
3	Ekstam et al., 2023	Fixed appliances	Lip position relative to the E-line changed more in the extraction group, but ultimately, the values were similar.	Dento-skeletal changes: Incisors were less protruding and proclined in the extraction group; no increased risk of root resorption (EARR) was found.	Retrospective; small extraction group; variations in the type of premolars removed
4	Elias et al., 2023	Fixed appliances	Retrusion of the upper and lower lips in extraction treatments. Smile aesthetics did not change significantly compared to the non-extraction group.	Dental width: extractions reduce intermolar width (~2 mm); non-extraction treatment increases inter-incisal width (~0.7 mm). Treatment time: ~4 months shorter in non-extraction treatments.	High heterogeneity, low-grade assessment, lack of standardization, limited number of studies on aesthetic assessment
5	Verma et al., 2013	Fixed appliances Edgewise	More retruded lips in the extraction group. Extraction results in a straighter profile (less convex) Both groups ended up with an aesthetically acceptable profile, within normal limits	No specific functional parameters were analyzed.	Retrospective study, heterogeneity in baseline patient characteristics

Tabela 4.2.: Summary table of results of studies included in the literature review

From the data reviewed in the selected studies, it is noted that we can have positive results regardless of the extraction or non-extraction method. But we must always keep in mind that the implementation of

protocols and treatments must be carried out rigorously, respecting the individual characteristics of the patients and taking into account the aesthetic, functional, biological concerns and the stability of the results achieved.

Even though in the extraction group, lip retrusion is observed according to Verma et. al (35) and Elias et. al. (34) and that the position of the lips to the E-line changed according to Ekstam et. al. (33) at the end of the interventions with or without extraction, the aesthetic profile is aesthetically acceptable and the values are similar. Compared with the data in the study by Agrawal et al., the importance of a detailed profile analysis before the decision for extraction is emphasized, as excessive lip retrusion can compromise the aesthetic harmony of the face, especially in individuals with profiles that favour this problem. Regarding functionality and dento-skeletal parameters, in these studies, it is noted that premolar extraction helps to eliminate crowding and improve incisor overlap. Incisors were less protruding and proclined in the extraction group (33). Extractions also reduce intermolar width (~2 mm); treatment without extraction increases interincisive width (~0.7 mm) (34). Also in the study by Agrawal et. al. it is emphasized that extraction has an impact on improving crowding and occlusal stability.

The impact of extraction on the transverse width of the dental arch and smile aesthetics is another point of discussion. The study with the Damon system by Bühling et. al. avoided narrowing of the arch after extraction, while maintaining the transverse dental width. According to Agrawal et al. (36), it should be taken into consideration that the patient's skeletal typology can also affect vertical dimensions.

Conclusions

The data from the 5 studies selected in this review suggest that both therapeutic strategies, with or without extraction, can provide successful results, with small differences, when implemented in a careful and individualized manner. In both groups, the final aesthetic results were considered acceptable. The transverse width of the dental arch can be maintained even in cases with extraction, especially with the use of modern appliances such as the Damon system. Extraction helps to control overcrowding and to achieve more stable positioning of the incisors, which were less protruding and proclined in the extraction group. No consistent changes in the vertical dimension of the face were identified between treatments with and without extraction.

Recommendations

New studies with standardized methodology, RCT or prospective longitudinal studies, and larger samples are needed to assess the functional, aesthetic and stability effects of orthodontic interventions with or without extraction more accurately. In decision-making for these treatments, detailed assessments of the patient's profile, cephalometric analysis, skeletal typology, and aesthetic needs should be performed.

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