

Systematic Review

A COMPARATIVE STUDY BETWEEN CLEAR ALIGNERS AND CONVENTIONAL BRACES IN ORTHOSURGICAL PATIENTS: A SYSTEMATIC REVIEW

Abstract

Introduction: Orthodontic clear aligners have gained significant popularity due to their aesthetic appeal and efficiency. Although their use as an alternative to traditional braces is well established, their application in orthosurgical patients remains underexplored. This review systematically evaluated clinical studies comparing clear aligners and conventional orthodontic braces in conjunction with orthognathic surgery.**Materials and Methods:** Searches were conducted in the PubMed, EMBASE, Cochrane Central, Web of Science, and VHL databases, with no date or language restrictions. In addition, gray literature (Google Scholar) and manual searches of the references of the selected articles were included.**Results:** Seven studies met the inclusion criteria. The review evaluated the efficacy of both methods, as well as quality of life, stability, periodontal status, and treatment time. The results indicated no significant differences in overall efficacy between clear aligners and conventional braces. However, patients reported a higher quality of life with the aligners. There were no significant differences in other outcomes, suggesting that clear aligners are a viable option for orthognathic surgery patients.**Conclusion:** This review supports the use of clear aligners in orthognathic surgery patients, although further research is needed to strengthen the evidence base and explore longer-term outcomes.

Keywords: Clear Aligners, Orthodontics, Orthognathic, Oral Surgery, Orthosurgical Procedures.

1. Introduction

Orthognathic surgeries are indicated as the main treatment option for skeletal deformities (anteroposterior, vertical, and transverse discrepancies, and facial asymmetries) but must be carefully recommended according to the degree of deformity[1]. Surgical intervention occurs through osteotomies of the maxilla and mandible, which are used to three-dimensionally change the shape and function of the maxillofacial complex and achieve facial harmony for both aesthetic and functional purposes, with improvements in occlusion, aesthetics, and breathing[2, 3].

In the 1960s, surgeons performed surgeries without prior orthodontic preparation and without refinement for posterior occlusal stability. However, in the 1980s, William Bell brought about the evolution of this approach with a view to the development of orthodontic treatments[4, 5]. Thus, the standard protocol for correcting dentofacial asymmetries is the combination of orthodontic treatment with orthognathic surgery[6].

Traditionally, conventional orthodontics is used with wires and brackets combined with orthognathic surgery[7]. However, orthodontics with aesthetic aligners has become a viable and safe option in the last 20 years[8]. Aesthetic concerns have increased patients' search for treatments with aesthetic aligners in orthodontics[9]. The literature suggests advantages in the combined use of these aligners with orthognathic surgery, such as better aesthetic acceptance by the patient, better adaptation to speech during treatment, and a reduction in discomfort in soft tissues relative to the use of lingual or fixed appliances. labials and better occlusal adaptation[9, 10].

Although interest in orthodontic treatment with aligners has increased and the natural order has increased in terms of its use in surgical cases, few studies have associated these two methods in the current literature[8]. Therefore, the growing demand for this type of orthodontic treatment highlights the need for studies with good methodological quality to evaluate the effectiveness of treatment in cases combined with orthognathic surgery. The main objective of the present study was to evaluate the

effectiveness of using aesthetic aligners compared with traditional orthodontic appliances in ortho-surgical patients. The secondary objectives evaluated were quality of life, stability, facial edema, periodontal parameters, and treatment time.

2. Methods

2.1. Protocol and Registration

The present study is a systematic and qualitative literature review conducted according to the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[11]and registered in PROSPERO with the registration code CRD42024549983.

2.2. PICOS Question

The PICOS acronym strategy (patient, problem or population, intervention, comparison, outcomes, study design) was used.

Population: Patients who were undergoing orthodontic treatment and orthognathic surgery.

Intervention: Use of clear aligners for pre- and postsurgical orthodontic treatment.

Comparison: Use of conventional orthodontic appliances pre- and post-surgery.

Outcome: Occlusal stability and quality of life.

Study Types: Clinical trials.

Thus, this review aims to answer the following question: Do clear aligners have more advantages than conventional orthodontic appliances do in terms of occlusal stability and quality of life after orthognathic surgery? The expected outcome is that clear aligners will be as effective as conventional braces and will offer advantages in terms of quality of life and clinical parameters.

2.3. Eligibility

For this review, original articles from clinical trials, randomized or not, that compared the use of clear orthodontic aligners with the use of conventional appliances in patients undergoing orthognathic surgery were included. Articles with other study designs were excluded.

2.4. Search strategy

The search strategy was implemented in the following databases: PubMed Bireme, Embase, Cochrane Central, Web of Science, and BVS (Virtual Health Library). The search was conducted in May 2024 without any restrictions on language or publication date. A search of the first 100 references on Google Scholar (gray literature) and a manual search of the references of the included articles were also conducted to identify studies that could have remained undetected during the primary search.

The terms used were found in Mesh and Entree (terms such as “Orthognathic Surgeries” and “Removable Orthodontic Appliances OR Clear Aligners”). A detailed search strategy for each database is provided in the supplementary file, which can be obtained from the corresponding author.

At the end of the search, the articles were exported to the Rayyan app[12] to start the removal of duplicates and screening (the title and abstract were read for the first exclusion of articles that did not fit the inclusion criteria) through a comprehensive and rigorous evaluation, which was conducted blindly and independently by two reviewers (ACRP and RSA). At the end of this phase, the full texts of the studies that met the inclusion criteria were read. Cases where there was a conflict in selection were resolved by consensus.

2.5. Data Extraction

Data of interest from selected articles were extracted independently by two authors (ECN and VMC), and disagreements were resolved by consensus. The outcomes sought in the articles were those established by the review objectives.

A summary (Table 1) was used to compare the data of the selected articles on the basis of the following topics: year of publication, which indicates the recency of the study; country, which reveals regional characteristics that might influence the patient's facial pattern; sample size, which provides data for group comparison; and average age and sex, which reveal subgroup characteristics to assess heterogeneity and risk of bias, potentially affecting patient perceptions of the evaluated criteria. Additionally, the evaluation times indicate whether validated parameters from the literature were used, and the results serve as the primary tool for comparison and addressing the research objective.

Table 1-Characteristics of the selected studies

Authors / Year / Country	Sample Size/ Gender / Age	Assessment time	Assessment instruments	Conclusions
Guntaka 2023 USA[13]	22 participants F=8 / M=14 IG=11 / AA 20.5 CG=11 / AA 20.9	T1 (1 week) T2 (3-4 weeks) T3 (5-7 weeks)	Facial edema. Through 3D images digitized and compared by software	The group using aligner experienced significantly less swelling in the first postoperative week, equaling the CG by the third week.
Liou et al. 2023 Taiwan [14]	33 participants F=13 / M=20 IG=19 / AA 20 CG= 14 / AA 21	T0 (before OGS) T1 (after OGS but before postoperative orthodontic therapy) T2 (after orthodontic therapy completion)	Clinical photographs of patients; intraoral photographs; high quality study models of the maxillary and mandibular arches; panoramic radiograph and cephalometrics; IOTN and PAR; and demographics	Results were similar between the clear aligner and fixed appliance groups after orthodontic therapy. IG exhibited more detailed immediate results after OGS than CG. Clear aligner therapy may be more effective than braces therapy.
Kankam 2019 USA[7]	33 participants F=17 / M=16 IG=13 / AA 20.8 CG=20 / AA 19.4	T0 (6 months after procedure) T1 (first appointment after OGS)	Facial edema. By superimposing pre- and post-surgery 3D images using software	Perioperative results and postoperative edema are not significantly affected by transparent aligner therapy. However, clear aligners do provide aesthetic benefits.
De Leyva et al. 2019 Spain[6]	28 participants F=16 / M=12 IG=14 / AA 26.5 CG=14 / AA 28.5	T0 (before OGS) T1 (1 month) T2 (end of treatment)	Quality of life. OQLQ, OHIP-14, Periodontal parameters: Bleeding on probing, Probing depth and Plaque index	Patients treated with aesthetic aligners after Surgery First showed better periodontal health and higher quality of life indices.

Mangat 2022 Canada [15]	60 participants F=28 / M=32 IG=30 / AA 21.4 CG=30 / AA 21.2	T1(before OGS) T2 (12 months after OGS)	Occlusal parameters. Cephalometrics landmarks	The degree of skeletal stability showed no difference, regardless of the type of appliance used, as well as surgical performance. Both techniques were considered efficient.
Moon et al. 2021 South Korea [16]	15 participants F=4 / M=11 IG=5 / CG=10 AA 22.6	T1 (2 days after procedure) T2 (6 months after procedure)	Occlusal parameters. Cephalometrics landmarks	With no statistical difference, both treatments were effective; however, the authors emphasize the need for more studies due to the limited sample size.
Robitaille 2016 Canada [17]	61 participants F=32 / M=19 IG=34 / AA 30.7 CG= 27 / AA 24.9	T1 (start of treatment) T2a (before surgery) T2b (surgery) T2 (after surgery) T3 (end of treatment)	Quality of occlusion and duration of treatment. Occlusal parameters. Cephalometrics landmarks and model scanning software.	The intervention group had a significantly shorter overall treatment duration but showed significantly inferior occlusal parameters compared to the control group.

Source: Adapted from Belém et al. (2021)[18]. **Abbreviations:** F=Female; M=Male; IG=Intervention Group; CG=Control Group; AA=Average Age; TN=Assessment time; OGS= Orthognathic surgery; IOTN (Index of Orthodontic Treatment Need); PAR=Peer Assessment Rating; OQLQ=Orthognathic Quality of Life Questionnaire; OHIP=Oral Health Impact Profile.

2.6. Evaluation of Levels of Evidence in Included Studies

The quality of the studies was assessed according to the Consolidated Standards of Reporting Trials (CONSORT) 2010[19] recommendations. Two independent reviewers (ACRP and ODF) evaluated the risk of bias and tabulated the data as proposed by Belém et al. and He et al.[18, 20]. The studies were analyzed across five domains: sample calculation, randomization, allocation concealment, blinding, and loss to follow-up.

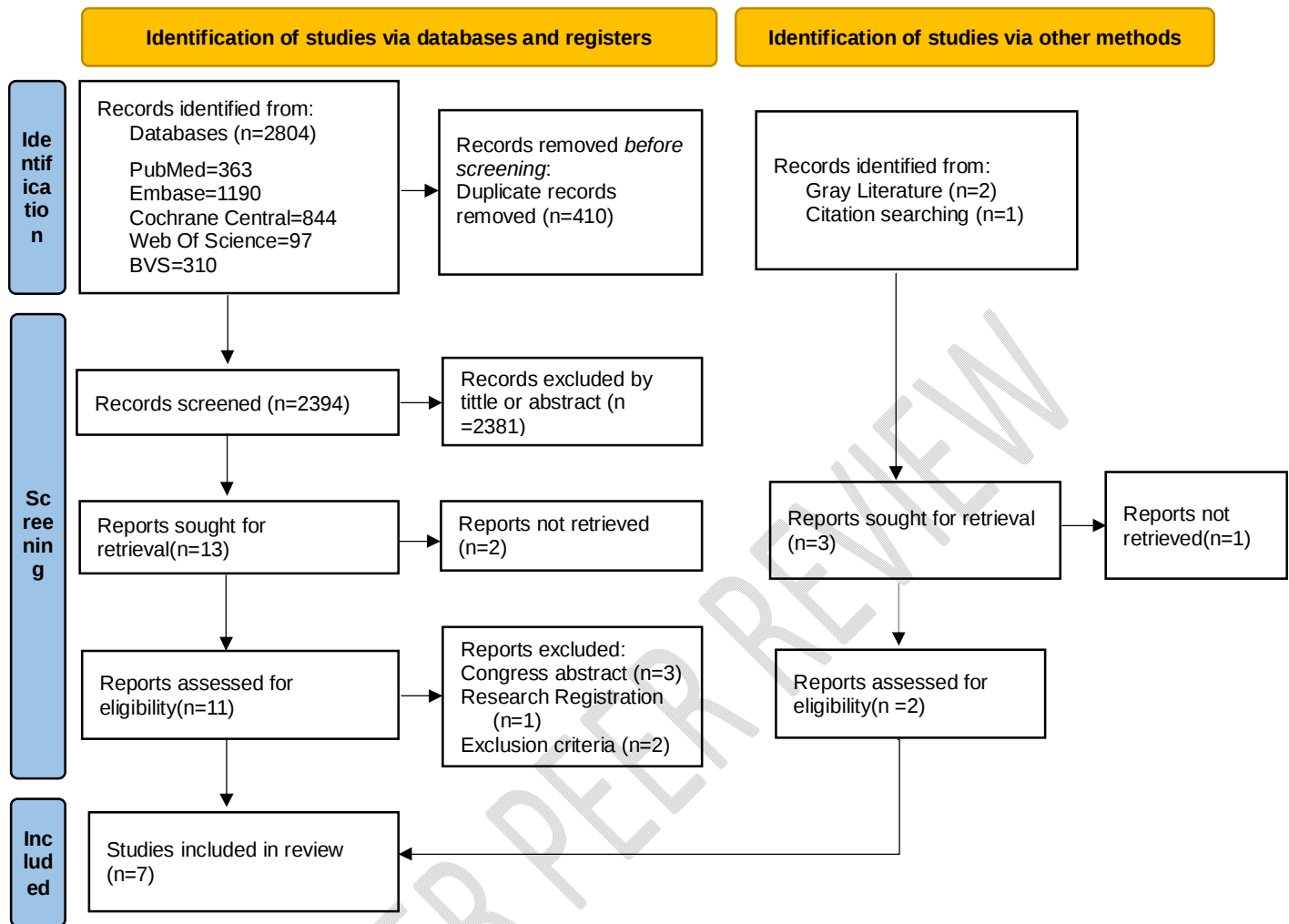
A study received an "A" if the evaluated criterion was met or explained by the author, a "B" if it was mentioned but incompletely or not explained, and a "C" if the domain was not mentioned[20]. The study received a high level of evidence "I" if it had at most one "B" evaluation across the five criteria, a medium level of evidence "II" if it had more than one "B" evaluation but only one "C" evaluation, and a low level of evidence "III" if it received more "C" evaluations (adapted from Belém et al.)[18].

3. Results

3.1. Systematic Review

The initial search identified a total of 2804 indexed articles using the selected terms within the mentioned databases. A total of 410 studies were excluded due to duplication. After screening the titles and abstracts, 2381 studies were excluded because they did not meet the desired criteria. Of the 13 remaining studies for full-text reading, 2 were not found, and 6 articles were excluded for not meeting the defined criteria. An additional 2 articles were added through gray literature and manual searches[15, 17]. In total, 7 articles[6, 7, 13–17] were included in this systematic review, comprising 252 patients, with 126 using aesthetic aligners and 126 using conventional fixed appliances. Six of the articles were in English, and one was in French[17] with publication dates ranging from 2016 to 2023. The article selection process is illustrated in Figure 1.

Figure I - PRISMA flowchart showing the selection of articles



Adapted from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71[21].

3.2. Results of the evaluated outcomes

3.2.1. Efficiency

Among the 7 studies evaluated, 6 concluded that aesthetic aligners are as effective as conventional orthodontic appliances[6, 7, 13–16].

3.2.2. Quality of life

Only De Leyva et al.[6]assessed the quality of life via two questionnaires, the OHIP-14 (Oral Health Impact Profile)[22]and the OQLQ-22 (Orthognathic Quality of Life Questionnaire)[23].The study demonstrated that patients treated with aligners had a significantly greater quality of life than patients treated with conventional devices did, although both groups improved.

3.2.3. Stability

Moon et al.[16] and Mangat et al.[15]did not find significant differences in stability when accessing skeletal landmarks. Liou et al. [14]found better results in the evaluation of the PAR (Peer Assessment Rating) index (used to assess the severity of malocclusion) in the clear aligner group. However, Robitaille[17]reported significantly lower results forthree of the eight criteria evaluated in the group that used aligners when assessing occlusal parameters.

3.2.4. Facial Edema

The two studies[7, 13]that evaluated this criterion reported similar results without significant differences between the groups.

3.2.5. Periodontal Parameters

Only De Leyva et al.[6]evaluated periodontal parameters. The intervention group had significantly better rates for all three criteria evaluated.

3.2.6. Duration of Treatment

De Leyva et al.[6]reported no significant difference in treatment time between the groups, with orthodontic treatment being carried out after surgery. Moon et al.[16]when evaluating the preoperative treatment time, also reported no significant difference between groups. Robitaille[17]evaluated the treatment

time and reported a significant reduction in the aligner group in terms of presurgical time and total time, although the difference was not significant in the postsurgical period. Liou et al. [14] present a longer treatment duration in the aligner group, but emphasize that the group wanted complex changes in appearance and dental alignment.

3.3. Classification of studies and justifications

The methodological quality of the selected studies was evaluated in the following domains: sample calculation, randomization, allocation concealment, blinding, and loss to follow-up. Each study was classified as having a level of evidence of I, II, or III. The extracted data is presented in a table for better visualization (Table 2).

Table 2-Assessment of the level of evidence and justifications of selected articles

Author/ Year	Sample Calculation	Randomization	Allocation Concealment	Blinding	Loss to Follow-up	LE
Guntaka et al., 2023[13]	C NM	C NM	C NM	Impossible	C NM	III
Liou et al., 2023 [14]	C NM	C NM	C NM	Impossible	A Adequate	III
Kankam et al., 2019[7]	C NM	C NM	C NM	Impossible	C NM	III
De Leyva et al., 2023[6]	A Adequate	A Software online	A Sealed opaque envelopes	Impossible	A No loss	II
Mangat, 2022[15]	C NM	C NM	C NM	Impossible	C NM	III
Moon et al., 2021[16]	C NM	C NM	C NM	Impossible	C NM	III
Robitaille, 2016[17]	B Unclear	C NM	C NM	Impossible	A Adequate	III

Source: Adapted from He et al. (2011)[20]; Belém et al. (2021)[18]. **Abbreviations:** LE=Level of Evidence; NM=Not Mentioned.

4. Discussion

As this is a recent and highly visible topic for both professionals and patients, clear aligners represent a fundamental point for current orthodontics. Its use in orthodontic practice is already well established, but its association with other procedures is still underexplored. The use of aligners in patients who have dentofacial deformities is of great interest because of the aesthetic concerns of these patients; therefore, this review aimed to evaluate whether clear aligners are as effective as conventional orthodontic appliances in the treatment of ortho-surgical patients.

Among the evaluated articles, the study with the best methodological quality[6] was considered adequate in terms of sample calculation, randomization, and allocation concealment criteria (a parameter rarely described in most articles), as each step was clearly detailed. The study did not present losses in the sample, which meant that this criterion was also well-evaluated. Blinding was not reported, but owing to the nature of the study and the type of treatment performed, this domain does not seem feasible. In this context, the ROB 2.0[24] tool considers that some study designs make blinding impossible, but even if the researcher has followed all other protocols, the potential for bias should not be ignored. Therefore, this study was classified as level II evidence. Another six studies[7, 13–17] were considered to have a low level of evidence (level III) because they did not present sample calculations, randomization, allocation concealment, or loss to follow-up. The work by Robitaille[17] cites the losses in each group in detail and mentions the sample calculation without details but fails to report whether there was randomization and allocation concealment, therefore being classified as having a low level of evidence (NE = III). Despite presenting follow-up losses, Liou et al. [14] did not present the other criteria, also being classified as low level of evidence (NE = III).

Furthermore, to avoid bias, an important criterion to consider is whether there was homogeneity of malocclusions at the beginning of treatment, and to estimate this risk, the clinical trial by Robitaille[17] carried out a test, which was not reported in the other studies. Despite this, Kankam et al.[7]reported that a sample was matched but did not perform specific tests to determine sample homogeneity.

Regarding the effectiveness of treatments, six of the studies evaluated[6, 7, 13–16]concluded that there are no significant differences between the use of aligners and conventional braces. Previous studies[2, 10, 25]corroborate this finding, presenting successful cases in which patients were treated with aligners during their ortho-surgical process.

According to De Leyva et al.[6] patients who used aesthetic aligners had better quality of life (QoL)than those who received conventional orthodontic treatment. However, this improvement was significant across the entire sample, as orthognathic surgery itself already enhances QoL indices, corroborating the findings of Tüz et al.[5]In their study, there was an improvement in the QoL index at all assessment times, with a statistically significant difference only in the third month after orthognathic surgery, regardless of the orthodontic device used.Tan et al.[26]reported a reduction in QoL immediately after surgery and a significant increase over 2 years post-surgery.

In terms of QoL during orthognathic surgery, the results of the group that used aesthetic aligners were significantly better than those of the group that used the conventional device. However, there were improvements in the entire sample, corroborating the findings of Vicente et al.[27], who used the B-OQLQ to evaluate the quality of life of patients requiring ortho-surgical treatment and reported significant improvements in quality of life after orthognathic surgery.

To evaluate the final stability of the occlusion, Liou et al.[14] evaluated the occlusion before and after orthodontic treatment with the PAR index, which assessed the misaligned parts of the patients' teeth, right and left buccal occlusion, overjet,

overbite and central line and found better results in the clear aligners group. The study by Robitaille's [17] revealed a statistically significant difference and suggested that aesthetic aligners require special attention. However, more recent studies with cephalometric analysis [15, 16, 28] revealed no significant difference in the final stability of the occlusion, indicating that both conventional devices and clear aligners yield excellent results. Furthermore, Miguel eGava [29] reported good results with the surgery-first approach, ensuring final occlusal stability, followed by conventional orthodontic treatment.

Regarding edema assessment, the results were similar across studies. The authors [7, 13, 30] did not find significant differences between the groups that received clear aligners and those that received conventional braces. Edema in the first week after surgery is a factor of clinical relevance, as explored by Douglas-de-Oliveira [31]; in some cases, clinical relevance may override the significant difference itself, so although Guntaka et al. [13] did not find a significant difference, they observed less edema in the first week in patients with aesthetic aligners, with both groups showing similar results by the third week.

Studies [6, 32] have shown that aesthetic aligners have greater benefits with respect to periodontal health. According to De Leyva et al. [6] conventional appliances make it difficult to brush and floss effectively, which, when combined with postoperative pain and swelling, induce plaque accumulation and worsen periodontal conditions. Reinforcing this information, Levrini et al. [32] compared the use of aesthetic aligners and conventional braces and detected a higher bacterial concentration in patients with conventional braces and an absence of pathogenic bacteria in patients who used aesthetic aligners.

The treatment time was similar across the groups [6, 16]. In the study by Liou et al. [14], the researchers evaluated patients who underwent surgery first and had a longer treatment duration in the aligner group due to the complexity of the patient's

treatment. However, Robitaille[17] was the only study that separately evaluated the preoperative and postoperative treatment times. In the preoperative phase, a significant reduction in time was observed for the intervention group, unlike the postoperative time, which did not significantly differ. Robitaille [17] also reported a significantly shorter total treatment time for the aligner group than for the conventional brace group, which is consistent with other findings[33, 34]. On the other hand, Miguel e Gava[29] obtained good results by performing the surgery before conventional orthodontic treatment, with a total duration of approximately 18 months. However, our authors emphasize that not all patients are psychologically prepared for this approach and point out the need for further studies on the technique.

This review was conducted without language or publication date restrictions, which has the advantage of including all relevant literature available. In addition, five criteria important for clinical decision-making by oral and maxillofacial surgeons and orthodontists were considered.

While the absence of randomization in several studies limits the strength of the conclusions, the consistency across multiple studies suggests that clear aligners are a promising alternative. It can be suggested that aesthetic aligners presented better outcomes in terms of occlusal and bone stability, edema, quality of life, periodontal parameters, and treatment time, suggesting strong external validation in this study.

Despite the relevance of the topic, few studies have been found in the literature, which is a limitation of this review. More randomized clinical trials with appropriate methodologies evaluating a greater variety of parameters are needed.

5. Conclusion

Although few articles on the subject were found, the evaluated studies suggest that clear aligners are viable and effective options for orthosurgical patients, offering

advantages in clinical parameters and quality of life and providing a basis for clinicians to consider them in treatment plans.

Declarations

Ethics approval statement

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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