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ADMINISTRATIVE INFORMATION

Support - Any financial support.
Review Stage at time of this submission - Data analysis.
Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 27 July 2025 and was last updated on 27 July 2025.

INTRODUCTION

Review question / Objective To evaluate the current evidence on the shape, position, and dimensions of attachments used in clear aligner therapy, and to assess their impact on tooth movement efficiency, control, and clinical outcomes.

Rationale Clear aligner therapy has gained significant popularity as an esthetic and comfortable alternative to conventional fixed appliances. However, achieving precise and predictable tooth movements with aligners often requires the use of attachments composite shapes bonded to teeth that enhance aligner retention and force delivery. Despite their widespread use, there is no clear consensus regarding the optimal shape, position, or dimensions of these attachments to achieve specific orthodontic movements. Variability in design protocols and limited comparative evidence may affect treatment efficiency and outcomes. A systematic evaluation of the available literature is necessary to provide

clinicians with evidence-based guidelines for the effective use of attachments in clear aligner therapy.

Condition being studied This systematic review focuses on orthodontic tooth movement using clear aligner therapy. Specifically, it investigates how the design features of attachments including their shape, position, and dimensions influence the effectiveness and predictability of tooth movements such as extrusion, rotation, and root control.

METHODS

Search strategy
Mesh terms :
1-Orthodontic appliances, removable
2-Tooth movement technique
3-Designs, orthodontic appliance
4-Composite resins
5-Denture precion attachments
6-Dental bonding
7- Orthodontics

Electronic databases: Pubmed, Scopus, Cochrane Library, Science direct.

Participant or population Orthodontic patients treated with clear aligners therapy.

Intervention Use of specific attachment designs (shape, position, and/or dimension).

Comparator Different shapes (conventionnal, optimized), position (vertical, horizontal, buccal, lingual)....

Study designs to be included Retrospective studies, randomized control studies, cohorte study.

Eligibility criteria Inclusion criteria: Human studies, english language, published since 2014, studies that examine the shape, the size, the position of the attachments
Exclusion criteria: finite element studies, case reports, systematic reviews and meta-analysis.

Information sources Pubmed, Cochrane library, scopus, we have also contacted one author to send us the full text article.

Main outcome(s) This systematic review highlights the critical role of attachment morphology, position, and dimensions in enhancing the clinical efficacy of clear aligner therapy. Various attachment designs — including vertical rectangular, horizontal ellipsoid, beveled, and optimized shapes — demonstrate differential effectiveness depending on the type of tooth movement. Optimized attachments show superior performance for rotating premolars and lateral incisors, while conventional vertical attachments are more effective for mesio-distal angulation and incisor extrusion. Horizontal attachments are best suited for torque movements. The review also identifies significant variability in the predictability and accuracy of different movements, with central incisor extrusion being the most accurate and mandibular canine extrusion the least. Attachment design further influences treatment duration and the likelihood of undesirable outcomes such as open gingival embrasures. In cases requiring complex movements like molar distalization or anterior open bite closure, rectangular vertical attachments applied strategically can reduce side effects such as tipping and anchorage loss.

Quality assessment / Risk of bias analysis Cochrane risk of bias tool for randomized clinical trials, minors risk of bias assessment : a tool for assessing risk of bias in non randomised studies.

Strategy of data synthesis PRISMA protocole.

Subgroup analysis Subgroup analyses were planned and conducted to explore potential sources of heterogeneity and to assess whether specific factors influenced the effectiveness of attachments in achieving desired tooth movements. The following subgroups were examined when data were available:

Attachment Design

- Optimized vs conventional attachments
- Vertical vs horizontal orientation
- Rectangular vs ellipsoid vs beveled shapes

Type of Tooth Movement

- Rotation (e.g., premolars, lateral incisors)
- Torque (e.g., maxillary incisors)
- Extrusion (e.g., central vs canine teeth)
- Bodily distalization (e.g., upper molars)
- Closure of anterior open bite

Tooth Type and Location

- Incisors vs canines vs premolars vs molars
- Maxillary vs mandibular arch

Patient-Specific Factors

- Age group (adolescent vs adult patients)
- Degree of initial crowding or malocclusion severity
- Extraction vs non-extraction treatment plans

Treatment Variables

- Presence vs absence of auxiliary devices (e.g., elastics, power ridges)
- Overcorrection protocols applied vs not applied
- Use of attachments with or without overcorrection planning.

Sensitivity analysis Sensitivity analyses will be performed to assess the robustness of the findings by:

- Excluding studies with a high risk of bias or unclear methodological quality
- Comparing results based on study design (e.g., randomized controlled trials vs retrospective studies)
- Evaluating the impact of sample size variation across studies
- Assessing the influence of attachment type categorization (e.g., grouping optimized vs conventional designs)
- Reanalyzing outcomes after excluding studies with incomplete data or missing treatment duration.

Language restriction English.

Country(ies) involved Morocco.

Keywords Orthodontic appliances, removable, clear aligners, attachments.

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