PBPC
ISSN 2674-9432
Qualis A3 CAPES 2021-2024
DOI - Crossref
Latindex
Indexado no Google Acadêmico

PERIODONTAL OUTCOMES ASSOCIATED WITH CLEAR ALIGNER THERAPY IN ORTHODONTICS: CURRENT EVIDENCE AND CLINICAL IMPLICATIONS

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https://doi.org/10.36557/2674-9432.2026v5n2p406-426
Artigo recebido em 6 de Fevereiro e publicado em 6 de Abril de 2026

LITERATURE REVIEW

ABSTRACT

Clear aligner therapy has become increasingly popular in contemporary orthodontics, especially among adult patients seeking esthetic and comfortable treatment alternatives. Beyond esthetic and biomechanical aspects, its potential influence on periodontal health has attracted growing scientific interest. This review aimed to analyze the current evidence regarding periodontal outcomes associated with clear aligner therapy in orthodontics and to discuss its clinical implications compared with conventional fixed appliances. A narrative literature review was performed based on recent systematic reviews, meta-analyses, randomized controlled trials, and evidence-based reviews addressing periodontal parameters during orthodontic treatment. Current evidence suggests that clear aligners are generally associated with more favorable periodontal conditions, particularly regarding plaque control, gingival inflammation, bleeding on probing, and probing depth, when compared with fixed appliances. However, these advantages appear to be modest and are strongly influenced by confounding variables such as oral hygiene compliance, patient motivation, professional periodontal maintenance, and treatment complexity. In periodontally compromised patients, orthodontic treatment may be performed safely after periodontal stabilization, provided that interdisciplinary planning and close periodontal monitoring are maintained. Although available evidence supports the periodontal benefits of clear aligners in selected clinical situations, further high-quality longitudinal and randomized studies are needed to better define their long-term periodontal effects and clinical relevance.

Keywords: Clear aligners; Orthodontics; Periodontal health; Gingival inflammation; Dental plaque; Oral hygiene.

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1 INTRODUCTION

Orthodontic treatment has undergone substantial transformation in recent decades, particularly with the increasing use of clear aligner therapy as an alternative to conventional fixed appliances. Initially indicated for mild to moderate malocclusions, clear aligners have progressively expanded their scope of application and are now widely used in adult orthodontic patients due to their esthetic appeal, removability, and comfort (WEIR, 2017; WANG *et al*., 2025).

The growing demand for orthodontic treatment among adults has also increased the relevance of periodontal considerations during treatment. Adult patients often present pre-existing periodontal challenges, including reduced periodontal support, gingival recession, mucogingival defects, and a previous history of periodontitis. In this context, orthodontic treatment should no longer be viewed solely from a biomechanical or occlusal perspective, but also as a procedure capable of affecting periodontal tissues positively or negatively depending on case selection, treatment planning, and maintenance (WANG *et al*., 2020; JEPSEN; SCULEAN; JEPSEN, 2023).

Conventional fixed appliances are known to create plaque-retentive areas that may compromise oral hygiene and increase the risk of gingival inflammation and periodontal deterioration. By contrast, clear aligners are removable and may facilitate better plaque control and periodontal maintenance, although their actual periodontal superiority remains under debate (CREGO-RUIZ; JORBA-GARCÍA, 2023; DI SPIRITO *et al*., 2023).

Given the growing body of evidence and the increasing interdisciplinary interaction between Orthodontics and Periodontics, understanding the periodontal implications of clear aligner therapy has become clinically relevant. Therefore, this review aimed to analyze the current evidence regarding periodontal outcomes associated with clear aligner conventional fixed appliances.

2 METHODOLOGICAL APPROACHES OF THE REVIEW

This study consists of a narrative literature review with critical synthesis of the evidence. The bibliographic basis was composed of systematic reviews, umbrella reviews, meta-analyses, randomized controlled trials, and evidence-based reviews addressing periodontal health during orthodontic treatment, especially in patients

treated with clear aligners and conventional fixed appliances.

The selected literature included studies focused on periodontal parameters such as plaque index (PI), gingival index (GI), bleeding on probing (BOP), probing depth (PD/PPD), gingival recession, clinical attachment level (CAL), and oral hygiene-related outcomes. Additional references were included to support the discussion on periodontal phenotype, complications, tissue response, and interdisciplinary treatment planning.

Preference was given to studies with stronger methodological design, especially randomized clinical trials, systematic reviews, and meta-analyses published in recent years. The main characteristics of the included studies are summarized in **Table 1**.

Table 1 – Summary of included studies

Author (Year)	Study Design	Sample	Intervention	Periodontal Parameters	Main Findings
Crego-Ruiz & Jorba-García (2023)	Systematic review + meta-analysis	12 studies	CA vs FA	PI, GI, PD, recession	Slightly better periodontal indices with CA; no strong evidence of superiority
Di Spirito et al. (2023)	Umbrella review	4 SRs	CA vs FA	PI, GI, BOP, PPD	Small advantage for CA; clinically negligible differences
Partouche et al. (2022)	Integrative review	8 studies	CA vs FA	PI, GI, PD, BOP	Better periodontal control with CA; influenced by hygiene and compliance
Dipalma et al. (2025)	Systematic review	8 studies	CA vs FA	Inflammation, plaque	CA improved oral hygiene and

Author (Year)	Study Design	Sample	Intervention	Periodontal Parameters	Main Findings
					reduced inflammation
De Leyva et al. (2023)	RCT	28 patients	CA vs FA (post-surgical)	PI, BOP, PD	Significantly better periodontal outcomes with CA
Gehlot et al. (2022)	RCT	36 patients	Fixed orthodontics after periodontal stabilization	PI, GI, BOP, PD, CAL	No periodontal deterioration after orthodontic treatment
Wang et al. (2020)	Evidence-based review	8 studies	Ortho + PhMT	Bone, gingiva	Periodontal phenotype influences treatment safety
Jepsen et al. (2023)	Review	—	Orthodontics	Recession, complications	Orthodontics may cause periodontal complications if not controlled
Liu et al. (2023)	Review	—	Orthodontics	Gingival response	Gingivitis and recession linked to orthodontic treatment
Bumbar et al. (2024)	Review	—	Orthodontics	Periodontal health	Need for strict hygiene and monitoring

Author (Year)	Study Design	Sample	Intervention	Periodontal Parameters	Main Findings
Papageorgiou et al. (2020)	Meta-analysis	887 patients	CA vs FA	Clinical outcomes	CA less effective in occlusion, but not focused on periodontal harm
Wang et al. (2025)	Expert consensus	—	Aligners	Clinical management	Importance of case selection and clinical planning
Weir (2017)	Review	—	Aligners	General	Overview of aligner therapy and limitations

3 CLEAR ALIGNER THERAPY IN ORTHODONTICS: CURRENT CLINICAL CONTEXT

Clear aligner therapy has become one of the most visible developments in modern orthodontics. Its popularity has been driven by increased esthetic demands, the desire for more comfortable treatment options, and the digitalization of orthodontic planning. Unlike fixed appliances, aligners are removable thermoplastic devices designed to produce controlled tooth movement through sequential programmed activation (WEIR, 2017; WANG *et al*., 2025).

From a clinical perspective, clear aligners offer several practical advantages, including improved esthetics, easier maintenance of oral hygiene, and greater patient comfort. However, they also present limitations related to compliance, case complexity, predictability of certain movements, and dependence on patient adherence. Evidence suggests that although aligners may not always provide treatment outcomes equivalent to fixed appliances in more complex orthodontic cases, they remain a valid and increasingly adopted modality in contemporary orthodontics (PAPAGEORGIOU *et al*.,

2020).

Because the present review focuses on periodontal outcomes rather than solely orthodontic efficiency, it is essential to recognize that the periodontal response to treatment is influenced not only by the appliance itself, but also by the patient's oral hygiene, inflammatory status, phenotype, and periodontal history.

4 PERIODONTAL HEALTH AND ORTHODONTIC TREATMENT

The relationship between orthodontic treatment and periodontal health is complex and bidirectional. On one hand, orthodontic treatment may improve oral function, occlusal stability, and even facilitate periodontal rehabilitation in patients with pathologic tooth migration or malposition associated with periodontal disease. On the other hand, orthodontic appliances can create local conditions that favor plaque retention and inflammation, particularly if oral hygiene is inadequate (BUMBAR *et al*., 2024; LIU *et al*., 2023).

Orthodontic tooth movement can influence both hard and soft periodontal tissues. Gingivitis, gingival enlargement, gingival recession, mucogingival defects, and inflammatory periodontal changes are among the clinical findings most commonly discussed in the literature (LIU *et al*., 2023; JEPSEN; SCULEAN; JEPSEN, 2023). These effects are not necessarily inherent to orthodontic treatment itself, but are often mediated by local biofilm accumulation, inadequate hygiene, traumatic mechanics, or failure to respect biological limits.

Importantly, orthodontic treatment in periodontally compromised patients is not contraindicated per se. When preceded by periodontal stabilization and followed by adequate maintenance, orthodontic treatment may be performed safely and may even contribute to improved periodontal architecture and function (GEHLOT *et al*., 2022). Therefore, periodontal health should be regarded as a central determinant of treatment planning in orthodontics, especially in adults.

The main periodontal parameters commonly evaluated in orthodontic studies are presented in **Table 2**.

Table 2 – Main periodontal parameters evaluated in orthodontic studies

Parameter	Description	Clinical Relevance
Plaque Index (PI)	Measures biofilm accumulation	Indicator of hygiene quality
Gingival Index (GI)	Measures gingival inflammation	Early sign of periodontal disease
Bleeding on Probing (BOP)	Bleeding after probing	Indicator of active inflammation
Probing Depth (PD/PPD)	Depth of gingival sulcus/pocket	Indicates periodontal condition
Clinical Attachment Level (CAL)	Loss of attachment	Reflects disease progression
Gingival recession	Apical migration of gingiva	Aesthetic and functional impact

5 PERIODONTAL OUTCOMES ASSOCIATED WITH CLEAR ALIGNER THERAPY

5.1 Plaque accumulation and oral hygiene

One of the main arguments in favor of clear aligner therapy is its potential to facilitate oral hygiene. Because aligners can be removed during tooth brushing and flossing, they may reduce the plaque-retentive burden commonly associated with brackets, wires, elastomeric ligatures, and fixed attachments.

Current evidence supports this assumption to some extent. In a systematic review and meta-analysis, CREGO-RUIZ and JORBA-GARCÍA (2023) found that clear aligners tended to be associated with slightly better periodontal health indices than fixed appliances, with statistically significant differences favoring aligners for plaque index in the mid-term. Similarly, DI SPIRITO *et al*. (2023) found that differences in plaque index, gingival index, and bleeding on probing often favored aligners, especially in the short and medium term.

PARTOUCHE *et al*. (2022), in an integrative review, also reported better

periodontal control in patients treated with clear aligners, especially regarding plaque accumulation. However, the authors emphasized that appliance type alone does not fully determine periodontal outcomes; patient motivation, hygiene instruction, and professional follow-up remain decisive.

Thus, while clear aligners appear to offer a mechanical advantage for plaque control, their clinical benefit depends substantially on patient behavior and adherence.

5.2 Gingival inflammation and bleeding on probing

Gingival inflammation is one of the earliest and most clinically relevant indicators of periodontal response during orthodontic treatment. Inflammatory changes are commonly associated with increased plaque retention and can manifest as gingival enlargement, erythema, edema, and bleeding on probing.

Available evidence suggests that patients treated with clear aligners may present lower levels of gingival inflammation compared with those treated with fixed appliances. In the systematic review by DIPALMA *et al*. (2025), clear aligners were associated with reduced plaque accumulation and inflammatory periodontal changes, whereas fixed appliances were more frequently linked to worsened periodontal inflammatory conditions.

This finding is supported by the randomized controlled trial conducted by DE LEYVA *et al*. (2023), in which patients treated with Invisalign after orthognathic surgery demonstrated significantly better periodontal outcomes than those treated with fixed appliances, including lower bleeding on probing and better plaque control. Although this study involved a postsurgical orthodontic population, it provides valuable clinical evidence that removable aligner systems may support healthier gingival conditions under monitored treatment.

Overall, the literature indicates that gingival health tends to be more favorably maintained in aligner-treated patients, particularly when oral hygiene compliance is adequate.

5.3 Probing depth and periodontal clinical parameters

Probing depth is a clinically relevant periodontal parameter that reflects inflammatory and structural changes in the gingival sulcus or periodontal pocket. Several studies included in recent reviews have investigated probing depth during orthodontic treatment with clear aligners and fixed appliances.

CREGO-RUIZ and JORBA-GARCÍA (2023) reported statistically significant long-term differences favoring clear aligners in pocket probing depth, suggesting a modest periodontal advantage. Likewise, DI SPIRITO *et al*. (2023) observed differences in probing depth that tended to favor aligners, although the clinical relevance of these differences was considered limited.

The randomized trial by DE LEYVA *et al*. (2023) also found significantly better probing depth values in the aligner group. Together, these findings suggest that clear aligners may contribute to more stable periodontal conditions over time, especially in environments where plaque control is critical.

Nevertheless, caution is warranted. Current evidence does not support the assumption that clear aligners are universally superior in all periodontal aspects. Rather, they appear to offer a modest but clinically relevant advantage under appropriate hygiene and maintenance conditions.

5.4 Gingival recession and mucogingival considerations

Gingival recession is a frequent concern in orthodontic treatment, particularly in adults, in patients with thin periodontal phenotype, and in cases involving buccal tooth movement beyond alveolar housing. This issue is especially relevant in interdisciplinary orthodontic-periodontal treatment planning.

CREGO-RUIZ and JORBA-GARCÍA (2023) included gingival recession among the outcomes assessed in their review and did not find sufficient evidence to support a major difference between clear aligners and fixed appliances in this parameter. This suggests that gingival recession may depend less on the type of appliance itself and more on factors such as periodontal phenotype, tooth movement direction, alveolar bone thickness, and biological limits.

Reviews by WANG *et al*. (2020) and JEPSEN; SCULEAN; JEPSEN (2023) reinforce this interpretation. These authors emphasized that orthodontic movement in patients

with thin periodontal phenotype may predispose to dehiscence, fenestration, and gingival recession if treatment is not carefully planned. Therefore, the prevention of mucogingival complications requires a phenotype-based and biologically informed approach rather than merely choosing one orthodontic appliance over another.

6 CLEAR ALIGNERS VERSUS FIXED APPLIANCES: WHAT DOES THE EVICENCE SHOW?

The comparison between clear aligners and fixed appliances is central to understanding the periodontal implications of contemporary orthodontic treatment.

The current body of evidence generally suggests a slight periodontal advantage for clear aligners, especially in relation to:

- plaque control;
- gingival inflammation;
- bleeding on probing;
- probing depth.

However, the magnitude of these benefits should not be overstated. According to DI SPIRITO *et al*. (2023), although some statistically significant differences favor aligners, many of them may be of limited clinical relevance. This is a key point: while aligners may facilitate a healthier periodontal environment, they do not guarantee periodontal success independently.

Likewise, CREGO-RUIZ and JORBA-GARCÍA (2023) concluded that the available evidence was still insufficient to definitively establish that aligners maintain better periodontal health than fixed appliances throughout orthodontic treatment. In the same direction, PARTOUCHE *et al*. (2022) suggested that although better periodontal outcomes are frequently observed in aligner-treated patients, confounding factors remain substantial.

Therefore, the most evidence-based interpretation is that clear aligners may favor periodontal maintenance, but their superiority appears to be context-dependent and modest, rather than absolute. A comparative summary of the main periodontal findings is presented in **Table 3**.

Table 3 – Comparison between clear aligners and fixed appliances

Parameter	Clear Aligners (CA)	Fixed Appliances (FA)
Plaque accumulation	Lower	Higher
Oral hygiene	Easier (removable)	More difficult
Gingival inflammation	Reduced	Increased
Bleeding on probing (BOP)	Lower	Higher
Probing depth (PD)	Slightly lower	Slightly higher
Gingival recession	Similar (depends on phenotype)	Similar
Patient compliance	High dependency	Less dependent
Biofilm retention	Lower	Higher
Clinical control	Depends on compliance	More controlled by clinician
Esthetics	High	Low

7 PERIODONTALLY COMPROMISED PATIENTS AND INTERDISCIPLINARY IMPLICATIONS

One of the most clinically relevant aspects of this topic concerns patients with previous or ongoing periodontal compromise. These individuals often require orthodontic treatment for correction of pathologic tooth migration, occlusal trauma, spacing, extrusion, or alignment after periodontal therapy.

Evidence suggests that orthodontic treatment may be safely performed in periodontally compromised adults once inflammation is controlled and periodontal stability is achieved. In a randomized controlled trial, GEHLOT *et al*. (2022) demonstrated that orthodontic treatment after periodontal stabilization did not produce detrimental effects on periodontal health and may even contribute to additional benefits when combined with periodontal therapy.

This reinforces the importance of interdisciplinary planning. The orthodontist must

not evaluate appliance selection in isolation; instead, treatment should be based on:

- periodontal diagnosis;
- phenotype evaluation;
- inflammation control;
- oral hygiene capability;
- long-term maintenance feasibility.

In this context, clear aligners may offer practical advantages in selected patients, especially those with reduced periodontal support or higher susceptibility to plaque-induced inflammation. However, their indication should remain individualized and not merely preference based.

8 CLINICAL IMPLICATIONS

From a clinical standpoint, the current evidence suggests several important implications.

First, clear aligners may represent a useful alternative for adult orthodontic patients in whom periodontal maintenance is a priority. Their removability appears to facilitate better oral hygiene and may reduce inflammatory periodontal burden when compared with fixed appliances.

Second, the type of appliance should not be interpreted as the sole determinant of periodontal outcomes. Even in aligner-treated patients, poor compliance, inadequate hygiene, or absence of periodontal monitoring may lead to unfavorable results.

Third, periodontal phenotype assessment should be integrated into orthodontic treatment planning. Patients with thin phenotype, reduced bone support, gingival recession risk, or previous periodontitis may require modified biomechanics, preventive periodontal procedures, or closer interdisciplinary follow-up (WANG *et al.*, 2020; JEPSEN; SCULEAN; JEPSEN, 2023).

Finally, the clinician should understand that the periodontal advantage of clear aligners appears to be real but not absolute. Their success depends on an individualized, biologically respectful, and prevention-oriented treatment approach. The main clinical implications are summarized in **Table 4**.

Table 4 – Clinical implications of clear aligner therapy in periodontal patients

Clinical Aspect	**Implication**
Oral hygiene	Aligners facilitate better hygiene control
Periodontal maintenance	Easier in aligner patients
Adult patients	Aligners may be preferable in selected periodontal-risk cases
Periodontal phenotype	Thin phenotype requires careful planning
Compliance	Critical for success with aligners
Biofilm control	Improved with removable appliances
Interdisciplinary approach	Essential between orthodontist and periodontist
Treatment planning	Must consider periodontal status
Risk of complications	Reduced but not eliminated
Long-term stability	Depends on maintenance and hygiene

9 DISCUSSIONS

The present review analyzed the available evidence regarding periodontal outcomes associated with clear aligner therapy in orthodontics and compared these findings with those reported for conventional fixed appliances. Overall, the current literature suggests that clear aligners may provide a more favorable periodontal environment during orthodontic treatment, particularly in terms of plaque accumulation, gingival inflammation, bleeding on probing, and probing depth. However, the interpretation of these findings requires caution, as the observed advantages are

generally modest and often influenced by patient-related and treatment-related variables.

One of the most consistent findings across the reviewed literature is the relationship between appliance design and oral hygiene. Because clear aligners are removable, they allow patients to perform conventional brushing and interdental cleaning more effectively than fixed appliances. This characteristic likely explains the lower plaque accumulation and reduced gingival inflammation frequently observed in aligner-treated patients. Systematic reviews and meta-analyses have repeatedly shown a trend favoring aligners for periodontal maintenance, especially in short- and medium-term evaluations (CREGO-RUIZ; JORBA-GARCÍA, 2023; DI SPIRITO *et al*., 2023). Nevertheless, some of these differences, although statistically significant, may not always translate into substantial clinical superiority.

This distinction between statistical significance and clinical relevance is particularly important. Reviews such as those by DI SPIRITO *et al*. (2023) and CREGO-RUIZ and JORBA-GARCÍA (2023) indicate that while clear aligners may offer measurable periodontal benefits, these improvements are not necessarily dramatic enough to justify a universal assumption of superiority over fixed appliances. In other words, aligners may facilitate periodontal preservation, but they do not eliminate the need for strict oral hygiene, regular professional maintenance, and appropriate case selection.

Another important aspect highlighted in the literature is the role of patient compliance. Unlike fixed appliances, the effectiveness of clear aligner therapy depends heavily on patient adherence, both in terms of wearing time and appliance hygiene. This creates a paradox: although aligners may theoretically favor better periodontal health, their clinical success depends more strongly on patient behavior. A poorly compliant aligner patient may present periodontal outcomes equal to or worse than those observed in fixed appliance therapy. Therefore, the periodontal advantage of aligners should be interpreted not as an intrinsic property of the appliance alone, but as a result of the interaction between appliance design and patient behavior.

The findings of the present review also reinforce the importance of periodontal phenotype and biological limits of orthodontic movement. Gingival recession, dehiscence, fenestration, and mucogingival instability remain relevant concerns regardless of the appliance used. Evidence suggests that these complications are more

strongly associated with thin periodontal phenotype, pre-existing reduced alveolar support, and poorly planned buccal tooth movement than with the orthodontic appliance itself (WANG *et al*., 2020; JEPSEN; SCULEAN; JEPSEN, 2023). Thus, although clear aligners may offer advantages in biofilm control, they do not inherently prevent biologically driven periodontal complications. This highlights the need for individualized planning and interdisciplinary assessment before and during orthodontic treatment.

The discussion becomes even more clinically relevant in the context of periodontally compromised patients. The reviewed evidence indicates that orthodontic treatment can be safely performed in patients with a history of periodontitis or reduced periodontal support, provided that periodontal inflammation is controlled before treatment and maintenance is sustained throughout therapy. In such cases, clear aligners may offer practical benefits due to easier hygiene access and potentially lower inflammatory burden. However, the decision to use aligners should not be based solely on convenience or esthetics, but rather on a comprehensive evaluation of periodontal stability, compliance potential, treatment goals, and biomechanical feasibility (GEHLOT *et al*., 2022).

An additional point worth emphasizing is that most of the currently available evidence is derived from short-term or medium-term studies, with relatively few high-quality longitudinal trials. Moreover, heterogeneity among studies remains substantial, particularly regarding age groups, malocclusion severity, periodontal baseline conditions, oral hygiene instructions, follow-up duration, and aligner systems used. These methodological inconsistencies limit the ability to draw highly definitive conclusions and partly explain why the literature often points toward a “trend” rather than an unequivocal advantage.

From a broader perspective, the findings of this review support a more integrated orthodontic-periodontal model of care. Rather than viewing clear aligners simply as a more esthetic orthodontic option, clinicians should recognize their potential role within a periodontal preservation strategy, especially in adults and susceptible patients. However, appliance selection must always be subordinated to biological principles, periodontal risk assessment, and long-term maintenance planning.

In summary, the present evidence suggests that clear aligner therapy may offer periodontal advantages over fixed appliances, mainly by facilitating oral hygiene and

reducing inflammatory periodontal changes. Still, these benefits should be interpreted within a multifactorial framework in which patient compliance, periodontal phenotype, professional follow-up, and interdisciplinary planning remain decisive. Future well-designed randomized and longitudinal clinical studies are essential to clarify whether the periodontal advantages associated with aligners are sustained over time and whether they translate into clinically meaningful long-term benefits.

10 LIMITATIONS OF THE CURRENT EVIDENCE

Despite the growing number of studies on this topic, the current literature presents several limitations.

Many available studies are characterized by:

- heterogeneous designs;
- small sample sizes;
- short follow-up periods;
- differences in age, malocclusion severity, and treatment complexity.
- variable oral hygiene protocols;
- inconsistent periodontal assessment methods.

Furthermore, many studies compare treatment modalities in different clinical contexts, which may compromise external validity. In addition, patient compliance—one of the most decisive variables in aligner therapy—is often difficult to quantify and standardize.

These limitations help explain why current systematic reviews and meta-analyses often report only modest periodontal differences between aligners and fixed appliances, despite a consistent trend favoring aligners.

11 CONCLUSION

Based on the currently available evidence, clear aligner therapy in orthodontics appears to be associated with slightly more favorable periodontal outcomes than

conventional fixed appliances, particularly regarding plaque control, gingival inflammation, bleeding on probing, and probing depth. These advantages are likely related to the removable nature of aligners and the resulting facilitation of oral hygiene practices.

However, these benefits should not be interpreted as universal or independent of patient-related and clinical variables. The periodontal impact of orthodontic treatment is strongly influenced by oral hygiene compliance, periodontal phenotype, inflammation control, maintenance protocols, and interdisciplinary planning.

Therefore, clear aligners may represent a valuable option in patients for whom periodontal preservation is a clinical priority, especially in adults and periodontally susceptible individuals. Nevertheless, further high-quality longitudinal and randomized clinical studies are still necessary to better define the long-term periodontal implications of clear aligner therapy and to support more precise evidence-based recommendations.

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