

Review Article

Retention Strategies in Orthodontic Patients with Reduced Periodontal Support

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ABSTRACT

Orthodontic treatment in patients with reduced periodontal support presents unique challenges due to the increased risk of relapse, tooth mobility, and potential deterioration of periodontal health. This narrative review synthesizes evidence from peer-reviewed journal articles published on retention strategies tailored to such patients. The objectives are to examine the types of retainers used, their effects on periodontal parameters, factors influencing retainer longevity and failure, and strategies to optimize outcomes in periodontally compromised individuals. Fixed retainers, particularly bonded lingual wires, are commonly employed for their efficacy in maintaining alignment, though they may accumulate more plaque and calculus compared to removable options. Studies indicate that while fixed retainers are generally compatible with periodontal health, careful patient selection, supportive periodontal therapy, and appropriate retainer design are crucial to minimize adverse effects. CAD/CAM-fabricated retainers show promise in reducing gingival inflammation and improving hygiene. Adjunctive procedures like circumferential supracrestal fibrotomy may enhance stability. Long-term retention protocols, including dual retention and regular monitoring, are recommended to prevent relapse and maintain periodontal stability. Overall, multidisciplinary approaches integrating orthodontic and periodontal care yield improved functional and aesthetic results, with no irreversible deterioration of periodontal health when managed appropriately. However, high-quality prospective studies are needed to refine these strategies.

Keywords: Orthodontic retention, Periodontal disease, Fixed retainers, Periodontal health, Tooth mobility, Relapse prevention

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Introduction

Orthodontic treatment aims to achieve optimal dental alignment, occlusion, and aesthetics, but maintaining these outcomes post-treatment is critical to prevent relapse. Relapse refers to the tendency of teeth to return to their pre-treatment positions due to factors such as periodontal fiber reorganization, occlusal forces, and soft tissue pressures [1, 2]. In patients with reduced periodontal support—often resulting from chronic periodontitis characterized by alveolar bone loss, attachment loss, and increased tooth mobility—the risk

of relapse is amplified [3–6]. These patients frequently present with secondary malocclusions, such as pathological tooth migration, flaring, spacing, or extrusion, which complicate retention planning [7–10]. Historically, retention has been an integral phase of orthodontic therapy, with early emphasis on lifelong protocols to counteract natural aging processes and periodontal changes [11, 12]. In periodontally compromised patients, the challenge is twofold: ensuring stability of the corrected alignment while preserving or enhancing periodontal health. Reduced bone support diminishes the anchorage capacity of

teeth, heightens susceptibility to occlusal trauma, and increases the potential for further bone loss if improper forces are applied during or after treatment [13, 14]. Moreover, retainers can influence plaque accumulation, gingival inflammation, and calculus formation, potentially exacerbating periodontal issues if not managed [15–18].

Recent literature highlights advancements in retention strategies, including the use of fixed bonded retainers, removable appliances, and adjunctive techniques like fiber-reinforced composites or CAD/CAM designs [19–22]. These approaches must be tailored to account for the patient's periodontal status, with pre-orthodontic periodontal stabilization being a prerequisite [23–26]. Supportive periodontal therapy (SPT), including regular professional cleanings and oral hygiene education, is essential throughout retention to mitigate risks [3, 27–29].

The objectives of this review are to: (1) provide background on the interplay between orthodontic retention and periodontal health in patients with reduced support; (2) evaluate various retention strategies, their efficacy, and impact on periodontal parameters; (3) discuss factors affecting retainer longevity and failure rates; and (4) outline recommendations for multidisciplinary management to optimize long-term outcomes. By synthesizing evidence from recent peer-reviewed studies, this review aims to guide clinicians in selecting evidence-based retention protocols that balance stability, periodontal integrity, and patient satisfaction.

Overview of orthodontic retention in periodontally compromised patients

Orthodontic retention is essential for stabilizing tooth positions after active treatment, particularly in patients with reduced periodontal support where the periodontium is more vulnerable to changes [1, 30–32]. Generalized periodontitis, often presenting with attachment loss exceeding 5–6 mm and bone reduction, predisposes teeth to increased mobility and migration, necessitating robust retention to prevent relapse [7, 33]. Retention strategies are broadly categorized into fixed (bonded) and removable types, with fixed retainers preferred for their independence from patient compliance and suitability for lifelong use [2, 11, 34, 35].

In periodontally compromised patients, retention must address not only alignment stability but also periodontal health maintenance. Studies indicate that orthodontic treatment can be safely undertaken after periodontal stabilization, with potential benefits including improved bone insertion levels and facilitated oral hygiene [13, 23, 36]. However, the retention phase requires careful planning to avoid adverse effects such as gingival recession or further bone loss [14, 37–39]. For instance, in adult patients with chronic periodontitis, multidisciplinary approaches combining periodontal therapy, orthodontics, and prosthodontics have demonstrated long-term stability, with healthy periodontal tissues maintained over 10 years post-retention [33, 40, 41].

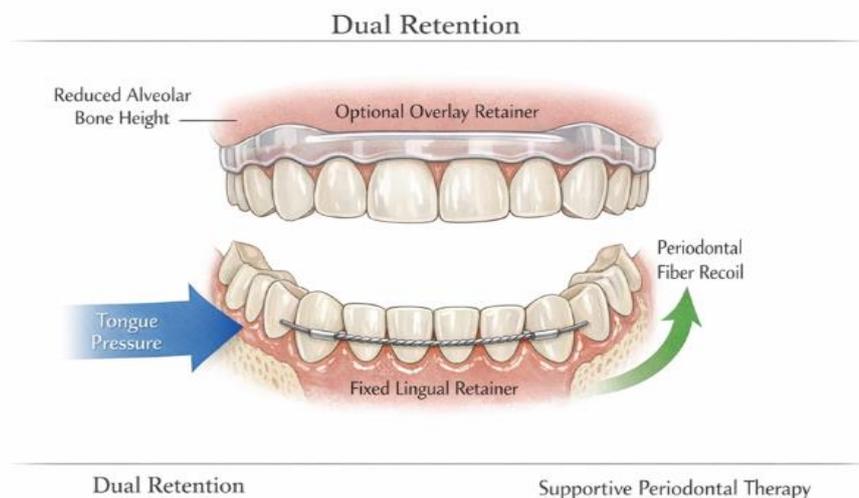


Figure 1. Schematic Overview of Retention Strategies in Patients With Reduced Periodontal Support

Key considerations include the stage and grade of periodontitis, as patients with stage III (grade B or C) exhibit higher retainer failure rates due to

compromised bone support [3]. Age is also a factor, with older patients showing greater satisfaction with outcomes, possibly due to lower expectations or

stabilized periodontal conditions [42]. Retention protocols should incorporate dual methods (e.g., fixed plus removable) for enhanced stability, especially in cases with severe initial irregularity [20, 40, 43].

Types of fixed retainers and their design variations

Fixed retainers, typically bonded to the lingual surfaces of anterior teeth, are the cornerstone of retention in periodontally compromised patients due to their efficacy in preventing relapse [2, 15]. Common designs include multistrand stainless steel wires (e.g., 0.0175-inch or 0.0215-inch), fiber-reinforced composites, and CAD/CAM nitinol wires [19, 20, 44, 45].

Multistrand wires, such as Bond-A-Braid or everStick ORTHO, offer flexibility and adaptability to tooth contours, reducing stress on the periodontium [46]. Comparative studies show that everStick ORTHO retainers yield better periodontal outcomes, with lower plaque index (PI) and gingival index (GI) scores at 6 months compared to other multistrand or braided wires [46, 47]. In contrast, glass-fiber reinforced retainers accumulate more plaque and calculus, potentially worsening periodontal health in susceptible patients [15].

CAD/CAM-fabricated retainers, like Memotain (0.014 × 0.014-inch nitinol), demonstrate superior performance in terms of reduced gingival inflammation and calculus accumulation [44, 48]. A 1-year follow-up study found Memotain retainers to have the lowest GI and calculus index values among dead-soft, multistrand, and connected pad designs [48]. Network meta-analyses confirm that CAD/CAM retainers maintain comparable stability to conventional types but with lower PI, suggesting they enhance hygiene in patients with reduced support [19, 49].

Rigid wires (e.g., 0.016 × 0.022-inch) and braided options (e.g., 8-strand rectangular) are effective for stability but may increase tooth mobility if not properly adapted [50]. In periodontitis patients, stainless steel lingual retainers are recommended over fiber-reinforced ones due to fewer periodontal complications [15]. Modified retainers, such as those with hygienic designs, are perceived by orthodontists and periodontists to accumulate more biofilm, potentially leading to periodontal changes [51, 52].

Overall, retainer selection should prioritize designs that minimize plaque retention, such as CAD/CAM or stainless steel multistrand, especially in patients with a history of poor hygiene or advanced periodontitis [3, 46, 53].

Impact of retainers on periodontal health parameters

The compatibility of orthodontic retainers with periodontal health represents a critical clinical

consideration, particularly in patients with reduced periodontal support. In such individuals, pre-existing attachment loss increases susceptibility to plaque-induced inflammation and disease progression, making long-term retention protocols especially relevant [2, 16]. Consequently, understanding the biological response of periodontal tissues to different retainer designs is essential for ensuring stability without compromising periodontal integrity.

Fixed retainers are generally regarded as periodontally safe when appropriately designed and maintained. Evidence from systematic reviews indicates that fixed retainers do not exert severe or irreversible detrimental effects on periodontal tissues in most patients [2, 15, 54]. Although their presence may complicate oral hygiene, especially in the lingual surfaces of anterior teeth, the overall periodontal response remains within clinically acceptable limits when adequate plaque control is achieved.

Comparative studies have shown that plaque and calculus accumulation tend to be greater around fixed retainers than removable appliances, with glass-fiber reinforced retainers demonstrating particularly high plaque retention potential [15]. Despite this increased biofilm accumulation, periodontal outcomes in patients with a history of periodontitis appear favorable when supportive periodontal therapy (SPT) is provided. In patients undergoing regular SPT, periodontal conditions remained stable following retainer bonding, with significant improvements observed in gingival bleeding indices and probing pocket depths after 12 months [3]. Furthermore, multiple longitudinal studies report no statistically significant deterioration in key periodontal parameters, including plaque index (PI), gingival index (GI), and bleeding on probing (BOP), across different types of fixed retainers over observation periods ranging from one to two years [44, 55].

Tooth mobility is another important periodontal parameter influenced by orthodontic treatment and retention. Increased mobility is frequently observed following active orthodontic therapy due to transient bone remodeling and periodontal ligament reorganization. However, studies consistently demonstrate that mobility decreases after retainer placement and returns to physiological levels regardless of the wire dimension or material used, including wires ranging from 0.0150-inch to 0.0215-inch [50]. In a controlled clinical investigation, all retainer types effectively reduced post-treatment mobility within a few weeks, with no significant differences observed between wire groups [50]. In terms of hard tissue response, long-term radiographic

evaluations reveal cervical alveolar bone recovery after orthodontic treatment, with no evidence of irreversible bone loss, even in cases involving bimaxillary protrusion managed with tooth extractions [37]. Although adverse periodontal effects associated with retainers are uncommon, they have been reported in specific clinical contexts. Gingival recession and unintended torque changes are more frequently associated with direct-bonded fixed retainers, potentially due to excessive bonding resin, wire

deformation, or prolonged mechanical forces [56, 57]. Case series have described less common but clinically significant complications, sometimes referred to as the “dark side” of fixed retention, including the development of crossbites, open bites, or unwanted tooth movements in long-term retainer wearers. These complications are often associated with mandibular canine regions and may coincide with localized periodontal deterioration [57].

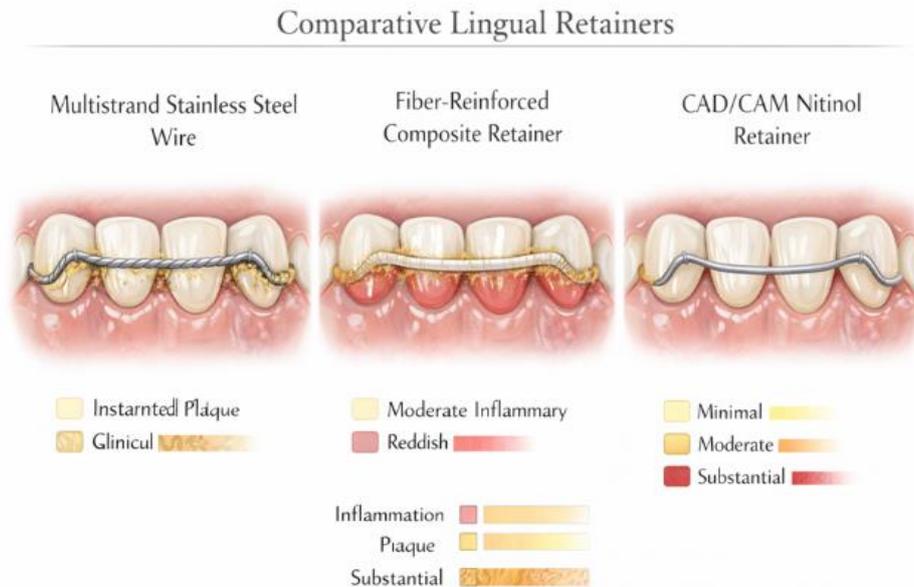


Figure 2. Periodontal Tissue Response to Different Fixed Retainer Designs

Patient-reported outcomes generally suggest that individuals are able to maintain satisfactory oral hygiene with fixed retainers, particularly when proper instruction is provided. However, subgroup analyses indicate that smokers experience higher levels of gingival bleeding, while female patients report a greater prevalence of gingival recession, suggesting that behavioral and biological factors may influence periodontal responses during retention [42]. Additionally, fixed retainers in the mandibular arch have been associated with lower treatment satisfaction, primarily due to perceived difficulties in maintaining oral hygiene, although objective periodontal parameters remain largely stable [42]. Overall, the available evidence underscores the importance of supportive periodontal therapy and continuous oral hygiene reinforcement in mitigating potential risks associated with fixed retainers. Studies consistently demonstrate that when patients receive regular periodontal monitoring and individualized hygiene instruction, periodontal health parameters remain stable over time [3, 23]. Thus, fixed retainers can be considered compatible with periodontal health,

even in patients with reduced periodontal support, provided that appropriate maintenance strategies are implemented and long-term follow-up is ensured.

Bonding techniques and factors influencing retainer longevity

The longevity of orthodontic retainers is influenced by multiple technical and patient-related factors, among which the bonding technique plays a central role. Direct and indirect bonding methods have been widely compared with respect to retainer survival, clinical performance, and biological outcomes. While the bonding approach appears to affect technical handling and chairside efficiency, current evidence suggests that it does not substantially influence periodontal health outcomes [56].

Long-term randomized clinical trials indicate comparable survival outcomes between direct and indirect bonding techniques. In a five-year follow-up randomized controlled trial evaluating mandibular fixed retainers, no statistically significant differences were observed between the two bonding methods in terms of failure rates, with both approaches

demonstrating cumulative failure rates of approximately 54% [56]. Inter canine width stability was also similar between groups, suggesting that the choice of bonding technique does not affect post-treatment alignment stability. Consistent with these findings, reported survival rates of fixed retainers range between 46% and 52% over observation periods of two to five years, and neither patient age nor gender has been identified as a significant prognostic factor for retainer failure [55, 56].

In patients with a history of periodontitis, additional biological factors have been shown to influence retainer longevity. High calculus accumulation, quantified as a calculus index (CI) of ≥ 1 at 12 months post-bonding, has been identified as a strong predictor of retainer failure [3]. Moreover, patients diagnosed with stage III periodontitis exhibit a substantially increased risk of failure, with hazard ratios indicating a 5.4-fold higher likelihood of retainer loss compared with patients presenting with less severe disease [3]. These findings highlight the importance of periodontal status and maintenance in determining long-term retainer survival.

Retainer design and material composition also contribute significantly to longevity. Multistrand stainless steel retainers and digitally fabricated CAD/CAM retainers demonstrate comparable survival rates, suggesting that modern digital designs do not inherently reduce failure risk [20, 43]. In contrast, fiber-reinforced composite retainers, despite providing favorable initial rigidity and esthetics, tend to exhibit earlier failure, potentially due to material fatigue, bonding interface degradation, or susceptibility to fracture under functional loads [20, 43].

Several technical and biological pitfalls have been associated with fixed retention. Common modes of failure include composite detachments, wire fractures, and partial debonding, which may remain unnoticed by patients and lead to unintended tooth movement or occlusal changes [11, 57]. Poor adaptation of the retainer wire to the lingual tooth surface can generate unwanted forces, increasing the risk of both mechanical failure and localized periodontal complications [57]. Direct bonding techniques, in particular, may be more prone to subtle posttreatment changes due to operator variability, reinforcing the need for regular clinical monitoring following retainer placement [56]. Importantly, in periodontitis patients, retainer longevity is significantly improved when supportive periodontal therapy is maintained and calculus accumulation is minimized, underscoring the synergistic role of periodontal care in orthodontic retention [3].

Comparison of fixed and removable retainers

The choice between fixed and removable retainers remains a topic of clinical debate, especially in patients with compromised periodontal support. Fixed retainers are generally considered superior in maintaining long-term alignment stability, particularly in the mandibular anterior region, where relapse risk is highest [1, 16]. However, removable retainers offer advantages in terms of oral hygiene access and patient comfort, which may be particularly relevant for periodontal maintenance.

Evidence synthesized in Cochrane systematic reviews suggests that fixed retainers are more effective than removable retainers in reducing orthodontic relapse, as measured by Little's Irregularity Index (LII) [1]. Although statistically significant differences have been reported, the magnitude of relapse reduction is often less than 1 mm and may therefore be of limited clinical relevance. Fixed retainers, however, are associated with higher rates of appliance-related discomfort and technical failure compared with part-time removable retainers [1]. In contrast, full-time removable retainers have been associated with improved periodontal outcomes, including reduced gingival bleeding, but demonstrate a higher risk of non-compliance and appliance failure [1].

In patients with reduced periodontal support, fixed retainers are generally preferred to ensure continuous stabilization of the mandibular anterior teeth, where even minor relapse may have functional and esthetic consequences [23, 58]. In such cases, a combined or dual retention strategy—consisting of a fixed retainer supplemented by a removable overlay—has been proposed to balance stability and periodontal hygiene [23, 58]. Comparative studies evaluating different fixed retainer designs, such as round twisted wires versus rectangular braided wires, report no significant differences in periodontal parameters or survival rates over two-year follow-up periods, with overall first-time failure risks approaching 52% [55].

Removable retainers, including clear thermoplastic appliances and Hawley retainers, have demonstrated alignment stability comparable to that of fixed retainers in general orthodontic populations, while being associated with lower rates of discomfort and technical complications [1]. Nevertheless, in patients with a history of periodontitis, fixed retainers combined with regular supportive periodontal therapy have been shown to maintain periodontal health effectively without inducing significant orthodontic relapse [3, 33]. Collectively, these findings support an individualized approach to retainer selection, in which periodontal status, patient compliance, and

maintenance capability are carefully balanced to optimize both stability and long-term oral health.

Adjunctive procedures and multidisciplinary approaches

Adjunctive procedures play a supportive role in enhancing orthodontic retention, particularly in patients with compromised periodontal conditions where relapse risk is inherently higher. These interventions are primarily aimed at modifying the biological and mechanical factors that contribute to post-treatment tooth movement, thereby improving long-term stability.

Circumferential supracrestal fibrotomy has been proposed as an effective adjunctive procedure to reduce relapse following orthodontic alignment, especially in the mandibular anterior region. By severing the supracrestal gingival fibers responsible for elastic recoil, this procedure has been shown to significantly decrease post-treatment irregularity. Clinical evidence indicates a mean reduction in Little's Irregularity Index (LII) of approximately 2.3 mm in patients undergoing fibrotomy, suggesting a meaningful improvement in alignment stability compared with conventional retention alone [16]. Other adjunctive techniques, such as interproximal enamel reduction and pericision, have also been suggested as potential strategies to minimize relapse by redistributing contact points and reducing tooth-size

discrepancies. However, the supporting evidence for these approaches remains limited and inconsistent, and their routine use cannot yet be strongly recommended [1, 16].

Given the complex needs of periodontally compromised patients, a multidisciplinary treatment approach is widely regarded as essential for achieving predictable and sustainable outcomes. Close collaboration between periodontists, orthodontists, and prosthodontists allows for comprehensive treatment planning that addresses both biological limitations and functional requirements [7, 33]. Periodontal stabilization typically precedes orthodontic intervention and may involve non-surgical scaling and root planing, periodontal flap surgery, or regenerative procedures such as guided tissue regeneration to control inflammation and improve tissue support before the application of orthodontic forces [23, 58].

During orthodontic treatment, biomechanical strategies must be adapted to the reduced periodontal support. Light and controlled forces are emphasized to minimize the risk of further attachment loss, while temporary anchorage devices may be employed to enhance control of tooth movement and reduce reliance on compromised dentition for anchorage [23, 58]. These measures allow for precise tooth positioning while respecting the altered center of resistance associated with periodontal bone loss.

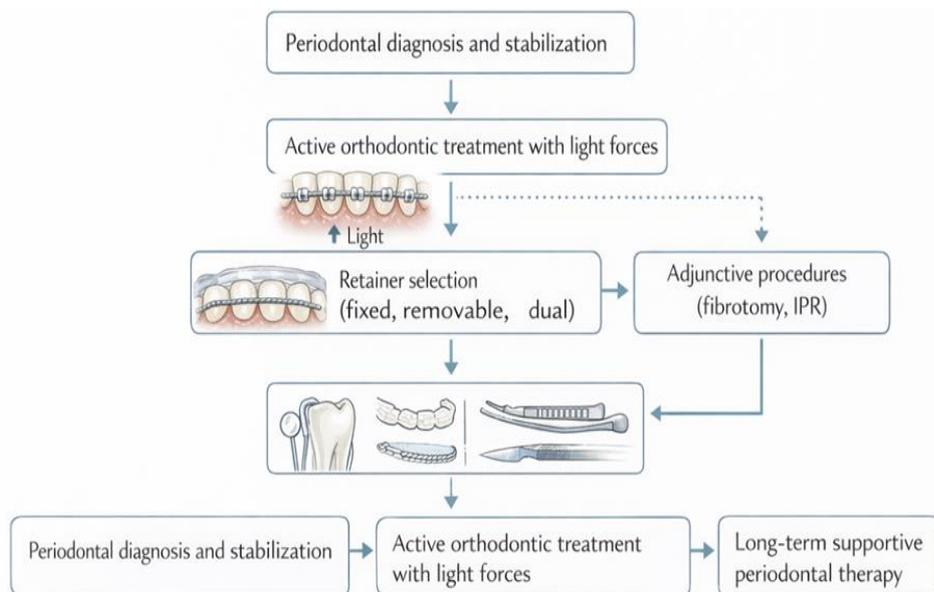


Figure 3. Multidisciplinary Workflow for Orthodontic Retention in Periodontally Compromised Patients

Following active orthodontic therapy, prosthodontic rehabilitation may be integrated into the overall treatment plan to restore function and occlusion. Dental implants, fixed prostheses, or other restorative

solutions are often coordinated with retention strategies to ensure long-term stability of both natural teeth and prosthetic components [33]. In this context, retention appliances must be carefully designed to accommodate

restorative elements without inducing unwanted forces or compromising periodontal health.

Long-term supportive periodontal therapy remains a cornerstone of successful retention in periodontally compromised patients. Maintenance protocols typically include individualized recall intervals, frequent clinical and radiographic monitoring, and reinforcement of oral hygiene measures tailored to the presence of retainers and restorative appliances [23, 58]. By addressing the unique biological and mechanical challenges of these patients through adjunctive procedures and coordinated multidisciplinary care, long-term orthodontic stability can be achieved while preserving periodontal health.

Results and Discussion

The retention phase in orthodontic treatment for patients with reduced periodontal support is pivotal, as it not only aims to preserve the achieved alignment but also to safeguard the compromised periodontium from further deterioration. The synthesis of recent literature underscores that while orthodontic intervention in periodontally affected individuals is feasible and beneficial, the choice of retention strategy must be judicious, considering factors such as periodontal status, patient compliance, and long-term monitoring [1, 2]. Fixed retainers emerge as a preferred modality due to their superior stability and reduced reliance on patient adherence, yet their potential to impede oral hygiene necessitates tailored designs and adjunctive periodontal care [11, 14].

One key theme is the compatibility of fixed retainers with periodontal health. Systematic reviews consistently report that fixed retainers do not induce significant adverse periodontal effects when patients undergo regular supportive therapy [11, 14, 16]. For instance, in periodontitis patients, fixed retainers maintained stable probing depths and bleeding indices over 12 months, with failure risks mitigated by low calculus accumulation [16]. However, variations in retainer design influence outcomes; CAD/CAM-fabricated nickel-titanium retainers demonstrate lower plaque and gingival indices compared to conventional multistrand or fiber-reinforced options, attributed to their smooth surfaces and precise adaptation [30, 33, 37]. Network meta-analyses further support this, ranking CAD/CAM retainers highest for periodontal friendliness while maintaining equivalent stability [30]. In contrast, traditional braided or glass-fiber retainers may promote biofilm accumulation, potentially exacerbating inflammation in susceptible patients [13, 15]. These findings suggest that in cases of reduced periodontal support, prioritizing hygienic

designs could reduce the incidence of gingival recession or attachment loss, which are more prevalent in poorly adapted retainers [20].

Retainer longevity and failure rates are critical considerations, particularly in periodontally compromised cohorts where bone loss may compromise bond strength [16, 24, 27]. Retrospective studies indicate survival rates of approximately 50% over 5 years for mandibular fixed retainers, with no significant differences between direct and indirect bonding techniques [27]. However, in periodontitis patients, stage III disease and elevated calculus indices at follow-up are strong predictors of failure, increasing hazard ratios substantially [16]. Comparative trials reveal similar failure rates across retainer types, such as round twisted versus rectangular braided wires, with periodontal health remaining unaffected over 2 years [24]. Short-term prospective studies echo this, showing no disparities in survival between Memotain (CAD/CAM) and five-stranded retainers, though both preserved periodontal parameters [33]. These data imply that while failures are inevitable—often due to detachment or fracture—multidisciplinary protocols incorporating pre-retention periodontal stabilization and ongoing SPT can enhance durability [2, 3].

Comparisons between fixed and removable retainers highlight trade-offs in stability versus hygiene. Systematic reviews of randomized trials demonstrate that bonded retainers provide better arch stability than vacuum-formed retainers (VFRs) in the lower arch, particularly in the initial 6 months and long-term, but VFRs and Hawley retainers may offer superior periodontal outcomes, with reduced gingival bleeding [4, 19, 42]. In periodontally affected patients, fixed retainers are often favored for anterior mandibular retention due to high relapse risks from pathological migration, yet combining them with removable appliances (dual retention) is advocated for comprehensive stability [1, 7]. Patient-reported measures reinforce this; individuals with fixed lingual retainers up to 10 years post-treatment report no impairment in oral hygiene or self-perceived periodontal health, though factors like smoking and gender influence experiences [20]. Nonetheless, removable options may be preferable in patients with poor compliance or advanced periodontitis, where hygiene maintenance is paramount [11, 19].

Adjunctive interventions represent an evolving area in retention optimization. Systematic evaluations indicate moderate evidence for procedures like circumferential supracrestal fibrotomy in reducing relapse, though effects on periodontal health remain understudied [7]. Pharmacological agents, such as raloxifene in experimental models, show promise in enhancing

retention by modulating bone metabolism, decreasing resorption and promoting formation [8]. However, clinical translation is limited, and human trials are warranted. Multidisciplinary approaches, integrating orthodontic, periodontal, and sometimes prosthodontic elements, yield superior outcomes; case reports illustrate successful management of severe periodontal defects through phased therapy, resulting in stable alignment and improved aesthetics without irreversible damage [3]. Orthodontists and periodontists' perspectives align on the need for modified retainer designs to minimize biofilm, though knowledge gaps persist regarding long-term impacts [15].

Limitations in the current evidence base merit discussion. Most studies are short-term (1-2 years), with few extending beyond 5 years, potentially underestimating chronic periodontal changes or late failures [27]. Heterogeneity in periodontal staging (e.g., using 2017 classifications) and outcome measures (e.g., PI, GI, LII) complicates meta-analyses [1, 11, 30]. Patient cohorts often exclude severe cases, limiting generalizability to advanced periodontitis [16]. Moreover, while systematic reviews provide high-level evidence, they rely on predominantly observational data, with randomized trials scarce for specific subpopulations [4, 7, 14]. Bias risks, such as selection and reporting, are noted in several reviews [1, 11]. Future research should prioritize prospective, long-term studies incorporating advanced imaging (e.g., CBCT for bone levels) and microbiological analyses to elucidate retainer-periodontium interactions [2].

In summary, retention strategies in periodontally compromised orthodontic patients must balance stability, hygiene, and patient factors. Fixed retainers, especially advanced designs, offer reliable outcomes when supported by SPT, but removable alternatives provide hygienic advantages. Adjunctive measures and interdisciplinary collaboration enhance efficacy, though evidence gaps persist.

Conclusion

In conclusion, this narrative review highlights that orthodontic retention in patients with reduced periodontal support can be effectively managed through tailored strategies that prioritize both alignment stability and periodontal integrity. Fixed retainers, particularly CAD/CAM variants, are efficacious and compatible with periodontal health, provided patients receive pre-treatment stabilization and ongoing supportive therapy [11, 14, 30, 33]. Removable retainers serve as viable alternatives or adjuncts, offering better hygiene but potentially inferior stability in high-risk cases [4, 19, 42]. Factors

influencing longevity include periodontal stage, calculus control, and design, with multidisciplinary approaches yielding optimal long-term results [2, 3, 16]. Overall, no evidence suggests irreversible periodontal deterioration from properly managed retention, affirming the safety of orthodontic intervention in this population [1, 20].

Future directions should focus on high-quality, long-term randomized controlled trials to compare retainer types in diverse periodontal severities, incorporating patient-centered outcomes and cost-effectiveness analyses [7, 27]. Exploration of innovative materials, such as bioactive composites or smart retainers with antimicrobial properties, could mitigate hygiene challenges [13, 15]. Additionally, integrating digital technologies like intraoral scanners for customized retainers and AI-driven monitoring may personalize protocols [30, 37]. Research on pharmacological adjuncts, building on preclinical findings, holds potential for relapse prevention [8]. Ultimately, standardized guidelines from professional bodies would aid clinicians in evidence-based decision-making for this growing patient demographic.

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