

# Management of Localized Anterior Tooth Wear Using a Modified Sandwich Technique and the Dahl Concept: A Case Report

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## Clinical Relevance

A minimally invasive approach is proposed through the use of a modified sandwich technique combined with the Dahl concept to create interocclusal space and to eliminate the need for tooth structure removal of the affected dentition.

## SUMMARY

This case report illustrates a minimally invasive segmental rehabilitation of localized anterior tooth wear using a modification of the sandwich technique, a combination of indirect palatal composite veneers and direct labial composite restorations, at an increased occlusal vertical dimension (the Dahl concept).

## INTRODUCTION

The prevalence of tooth wear in young adults has dramatically increased in the last few decades.<sup>1</sup> Poor

eating habits, parafunctional activities, and underlying medical conditions are risk factors for the development of tooth wear of nonbacteriological origin; this wear includes abrasion, erosion, attrition, and abfraction.<sup>2</sup> These etiological factors have resulted in loss of tooth structure, which can have biological, functional, and esthetic implications.

Traditionally, structurally compromised, worn-down dentition should receive multiple full-coverage crowns. However, this approach is expensive and technically challenging and requires much long-term maintenance care. Additionally, the vital tooth preparation for indirect restoration can involve significant removal of the compromised tooth structure and increases the risk of root canal treatment.<sup>3</sup> Therefore, the additive approach should be adopted in management of localized tooth wear. The lost tissues should be replaced using an adhesive material to preserve the remaining tooth structure.<sup>4</sup> Vailati and Belser<sup>5</sup> have introduced the anterior clinical erosive classification (ACE) based on their clinical observation of localized anterior tooth wear. This classification not only helps in assessing the severity of tooth structure loss but also provides a guide suggesting the type of restorations that the clinician

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should use to restore the affected teeth. The severity of tooth wear is graded in six levels (class I-class VI), based on the amount of dentin exposure on the palatal surface and the length of the remaining clinical crown height of the anterior teeth. Their recommendation was to manage the localized anterior tooth wear (Class IV and above) using sandwich-approach restorations, in which the worn-down surfaces are restored using a combination of indirect palatal composite veneers and labial porcelain veneers (Figure 1).

One of the main restorative challenges of localized tooth wear is lack of interocclusal space. Therefore, the Dahl concept has been recommended to create space for definitive restorations.<sup>6</sup> It is defined as “axial tooth movement observed when a localized appliance or restoration was placed in supra-occlusion and full arch occlusal re-establishment contact occurred over a period of time.”<sup>7</sup> Dahl and others<sup>6</sup> were the first to introduce this concept for the management of localized worn dentition. They used a removable partial cobalt-chromium bite plane prosthesis to create interocclusal space in a young patient with localized severe tooth wear. Sufficient space was created after a period of 8 months to restore the worn dentition. Since then, there have been more and more clinical studies reporting the application of the Dahl concept and the use of various Dahl appliances to create interocclusal space for tooth wear cases.<sup>7</sup> Occlusal re-establishment is defined as a physiological compensatory process

that occurs gradually in most patients to ensure that occlusal contacts are obtained and the efficacy of the masticatory system is maintained.<sup>7</sup> The physiological process involves intrusion of the teeth in contact with the prosthesis, which is cemented at an increased occlusal vertical dimension (OVD), eruption of the unopposed teeth, and an element of mandibular repositioning.<sup>8,9</sup> Most of the clinical studies have reported high success rates, ranging from 94% to 100%, of occlusal re-establishment in localized tooth-wear cases.<sup>8-10</sup>

The present clinical report describes occlusal therapy of localized anterior tooth wear using the Dahl concept. The Dahl restorations, a combination of indirect hybrid composite veneers on palatal surfaces and direct resin composites on the labial side (modified sandwich technique) were delivered to the patient at an increased (OVD).

## METHODS AND MATERIALS

### Case History

A 33-year-old female presented with a chief complaint of anxiety over her appearance due to tooth wear. On further questioning, she revealed that she had nocturnal bruxism and had been diagnosed with hyperemesis gravidarum during her two pregnancies. She denied any excessive consumption of acidic food or beverages. Her medical, dental, social, and family history was unremarkable. She has a high smile line with upper lip canted to the right side while smiling (Figure 2a). The intraoral examination revealed localized moderate-to-severe tooth wear on her maxillary and mandibular anterior teeth, with predominant attrition and erosion (Figure 2). Identical wear facets between maxillary and mandibular incisors were seen during left lateral excursion, suggesting a wear pattern related to parafunctional habits (Figure 3).

### Restorative Treatment

During the treatment planning stage, pulp tests, including cold and electrical pulp testing, showed positive responses for all maxillary anterior teeth. An interocclusal record was taken in centric relation using extra-hard wax (Moyco Beauty Wax, Dentsply Sirona, Charlotte, NC, USA) and marked using temporary cement material (Temp-Bond, Kerr, Brea, CA, USA) (Figure 4a). A Lucia jig was used as a muscle deprogrammer and anterior stop (Figure 4b). The study casts were mounted on an arcon semi-adjustable articulator (Denar Mark II system, Whip Mix Corp., Louisville, KY, USA) using a facebow transfer (Denar Slidematic Facebow, Whip Mix Corp.). Diagnostic wax-up of the anterior teeth at an increased OVD of 2

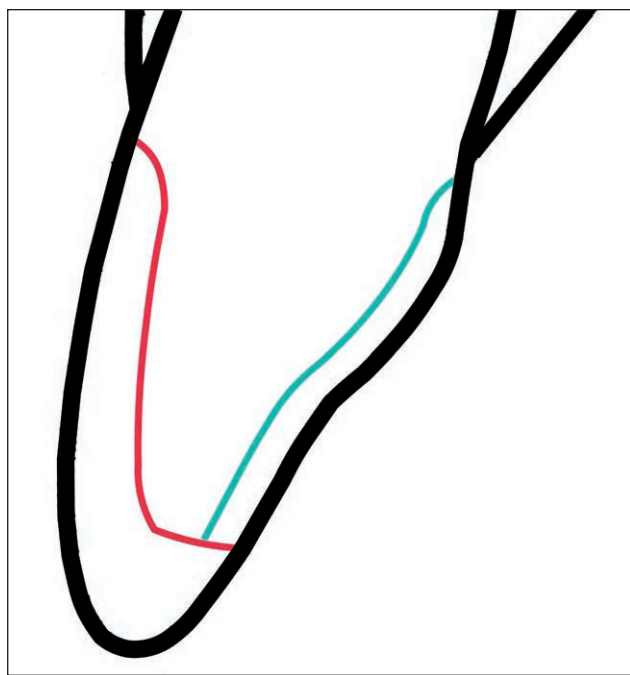


Figure 1. The sandwich approach using a combination of indirect palatal composite veneers and labial porcelain veneers.



Figure 2. Preoperative photographs: a) Smiling view; b) Erosion and attrition found in maxillary incisors; c) Accentuated translucency of the maxillary incisors; d) Maxillary occlusal view showing erosion of maxillary anterior teeth.

mm was performed (Figure 5). The patient was satisfied after seeing the trial mock-up of the treatment outcome (Figure 6). The increased OVD was established by evaluation of esthetics, occlusion, and phonetics during the mock-up visit.

Restorative treatment was conducted using a modified sandwich technique with minimal tooth preparation limited to removal of unsupported enamel. Sectional metal strips were placed between the teeth to separate them prior to the impression (Figure 7a). A definitive impression of the maxillary arch was taken using polyvinylsiloxane material (Aquasil, Dentsply)



Figure 3. The identical wear facets of the maxillary and mandibular incisors during left lateral excursion.

(Figure 7b). The veneers were fabricated using micro-ceramic indirect resin composite material (Ceramage, Shofu, Kyoto, Japan) because of its high inorganic content, which is indicated for use in areas subjected to greater masticatory loads (Figure 8). This indirect restorative material is a micro-ceramic polymer system with a composition of 73% zirconium silicate filler (PFS-progressive fine structured filler) supported by an inorganic polymer matrix containing urethane dimethacrylate and urethane diacrylate.

Shade selection was performed prior to any treatment (Figure 9a). The maxillary teeth were then isolated using a rubber dam (Figure 9b). The palatal veneers were sandblasted with 50  $\mu$ m aluminum oxide particles for 10 seconds, at a distance of 10mm using two pressure bars, followed by a steam clean to remove debris. The fitting surfaces of the veneers were then treated using a silane coupling agent (Ultradent, South Jordan, UT, USA) and application of an adhesive system (Scotchbond Universal Adhesive, 3M Oral Care, St Paul, MN, USA) without curing. The palatal enamel and dentin were etched for 15 seconds using 37% phosphoric acid, followed by application of the adhesive system (Scotchbond Universal Adhesive, 3M Oral Care), which was applied for 20 seconds without curing. Subsequently, the palatal veneers were cemented using preheated resin composites (ENA



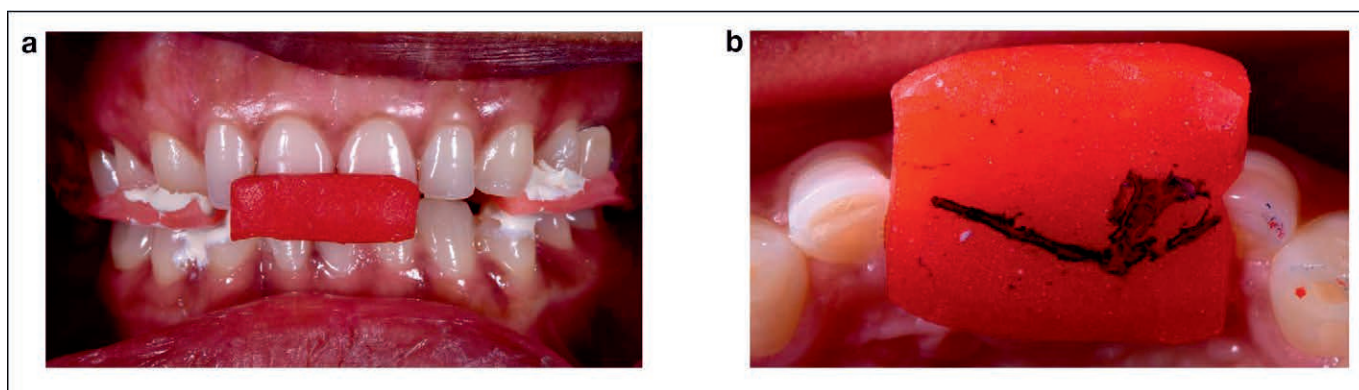


Figure 4. The interocclusal record: a) Interocclusal record taken at centric relation; b) Lucia jig.

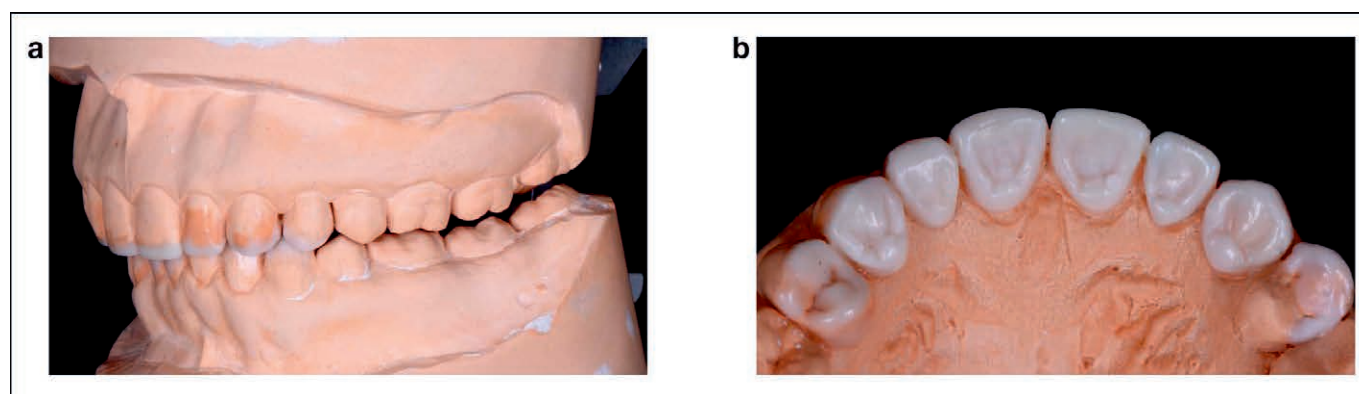


Figure 5. The diagnostic wax-up: a) The diagnostic wax-up at an increased occlusal vertical dimension; b) Diagnostic wax-up of maxillary palatal surface.

HRI, Micerium, SYNCA, Le Gardeur, QC, Canada) and light cured for 20 seconds. The resin composites for cementation were warmed for 15 minutes at 54°C using a composite heating conditioner (ENA Heat, Micerium, SYNCA). As a result, the increase in OVD could be obtained in a predictable way following the planned occlusion with the prescribed anterior guidance. In order to ensure preservation of remaining tooth structure, a modified sandwich technique was adopted. The labial surfaces of the indirect palatal

veneers were then cut back and acted as palatal shells for labial resin composite buildup (Filtek Z350 XT, 3M Oral Care) (Figure 10). This is a nanofilled resin composite containing bisphenol-A-diglycidylether methacrylate, urethane dimethacrylates, triethylene glycoldimethacrylate, ethoxylated bisphenol-A-glycol dimethacrylate resins, silica and zirconia fillers, and aggregated zirconia/ silica cluster fillers. After the restorations were completed, white stone bur polishing discs (Sof-Lex, 3M Oral Care) and polishing pastes (ENA Shiny, SYNCA) were used for finishing and polishing (Figure 11).

All of the maxillary anterior restorations were placed at an increased OVD using the Dahl concept. Postoperative instructions were given to the patient, the possibility of discomfort and difficulty in chewing were discussed, and a temporary soft diet regime was advised (Figure 12). The patient was scheduled for a 3-month follow-up appointment. Occlusal analysis exhibited complete occlusal re-establishment, with Shimstock foil (Bausch Arti-Fol, Bausch, Nashua, NH, USA) holding between all the posterior teeth (Figure 13).



Figure 6. Trial mock-up.

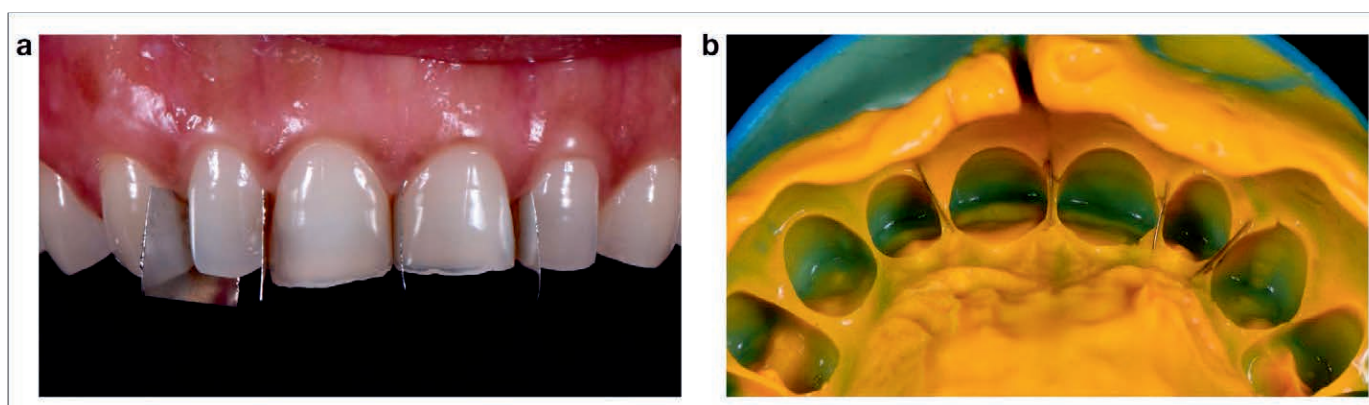


Figure 7. Definitive impression: a) Sectional metal strips were placed in between the teeth; b) The definitive impression was taken using dual-impression technique.

### List of Materials Used

- Extra-hard wax (Moyco Beauty Wax, Dentsply Sirona, Charlotte, NC, USA)
- Arcon semi-adjustable articulator (Denar Mark II system, Whip Mix Corp., Louisville, KY, USA)
- Facebow (Denar Slidematic Facebow, Whip Mix Corp.)
- Polyvinylsiloxane (Aquasil, Dentsply)
- Ceramage indirect resin composite (Shofu, Kyoto, Japan)
- Silane coupling agent (Ultradent, South Jordan, UT, USA)
- Scotchbond Universal Adhesive (3M Oral Care, St Paul, MN, USA)
- ENA HRi, Micerium (SYNCA, Le Gardeur, QC, Canada)
- Filtek Z350 XT (3M Oral Care)
- Sof-Lex discs (3M Oral Care)
- ENA Shiny (SYNCA)
- Shimstock foil, Bausch Arti-Fol (Bausch, Nashua, NH, USA)



Figure 8. The indirect palatal hybrid composite veneers were fabricated.

### DISCUSSION

#### Potential Problems

Preservation of tooth structure should be the paramount aim in tooth wear management, especially for a young patient. Therefore, the traditional prosthodontic approach should be avoided to prevent any tooth preparation on the worn-down dentition. The recommended sandwich technique for restorations, using a combination of indirect resin composites on the palatal surfaces and porcelain veneers on the labial surfaces, have shown great potential for adoption as an additive approach for tooth wear management.<sup>11-13</sup> However, the modified sandwich technique described in the present clinical report illustrates a more conservative approach, without any tooth preparation, yet achieving an excellent esthetic and functional outcome. All resin composites have technical requirements that include moisture control, precise adhesive procedures, and superior dexterity. Additionally, a high level of maintenance care can be expected for resin composites because the restorations will undergo wear and mechanical complications, including fracture and discoloration over time. Therefore, the patient should be scheduled for regular follow-up visits (Figure 14).

There have been a few clinical studies reporting that biological complications rarely occur after application of the Dahl concept. Poyser and others<sup>7</sup> have reported a small number of long-term adverse effects including temporomandibular disorder, pulp symptoms, periodontal symptoms, and root resorption as consequences of Dahl restoration. A potential drawback of this technique might be partial occlusal re-establishment. However, most of the patients reported that they function perfectly well with the reduced number of occlusal contacts. Gulamali and others<sup>14</sup> found that 5 out of 26 (19%) localized anterior tooth wear



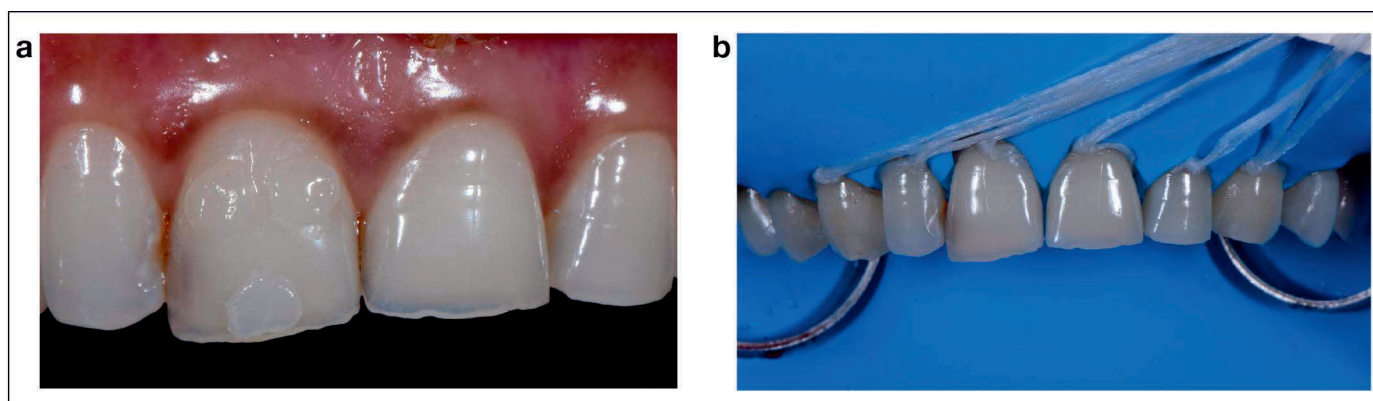


Figure 9. Before restorations: a) Shade selection; b) Rubber dam isolation.



Figure 10. Indirect palatal veneer cementation: a) Post-cementation of the palatal veneers. b) Palatal veneers cut back and used as palatal shells for buildup of labial resin composites; c) Layering resin composite technique applied.



Figure 11. Postoperative photographs: a) Smiling view; b) Labial view; c) Occlusal view.

patients exhibited partial occlusal re-establishment of their posterior teeth at 10-year follow-up and that all of them were asymptomatic. Overlay preparation or direct resin composites applied to the posterior teeth are suggested in case no occlusal re-establishment occurs after placement of the Dahl restorations.<sup>15</sup> In the present case, full occlusal re-establishment was achieved within 3 months, consistent with previous clinical studies that revealed 94% to 100% success rates of occlusal contact re-establishment in localized tooth wear cases within four to nine months.<sup>8-10</sup>

### Summary of Advantages and Disadvantages

In comparison with a traditional full-mouth rehabilitation, a simplified ultraconservative approach is suggested, using an occlusal therapy that combines

the Dahl technique and a modified sandwich technique to manage localized tooth wear in a safe, simple, cost effective, and minimally invasive way. The main advantage of the modified sandwich technique in the present case report is that there was no tooth preparation on the compromised tooth structure. Direct resin composites were used in place of the porcelain veneers previously suggested by Vailati and Belser,<sup>5</sup> which still require tooth preparation on the labial surfaces. The long-term survival rates of direct resin composites in tooth wear management have shown no statistically significant difference from full-coverage indirect restorations.<sup>16</sup> In addition, there have been several clinical studies that reported the successful placement of resin composite restorations to treat localized anterior tooth wear by using the Dahl concept.<sup>8,9,14</sup>

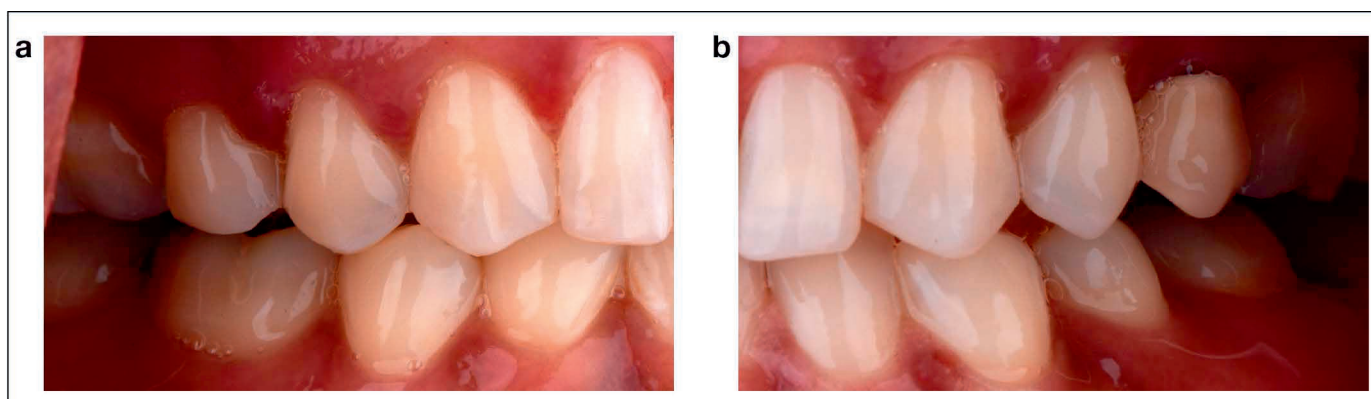


Figure 12. Immediate postoperative intraoral photographs: a) Right buccal view with no posterior occlusal contacts; b) Left buccal view with no posterior occlusal contacts.

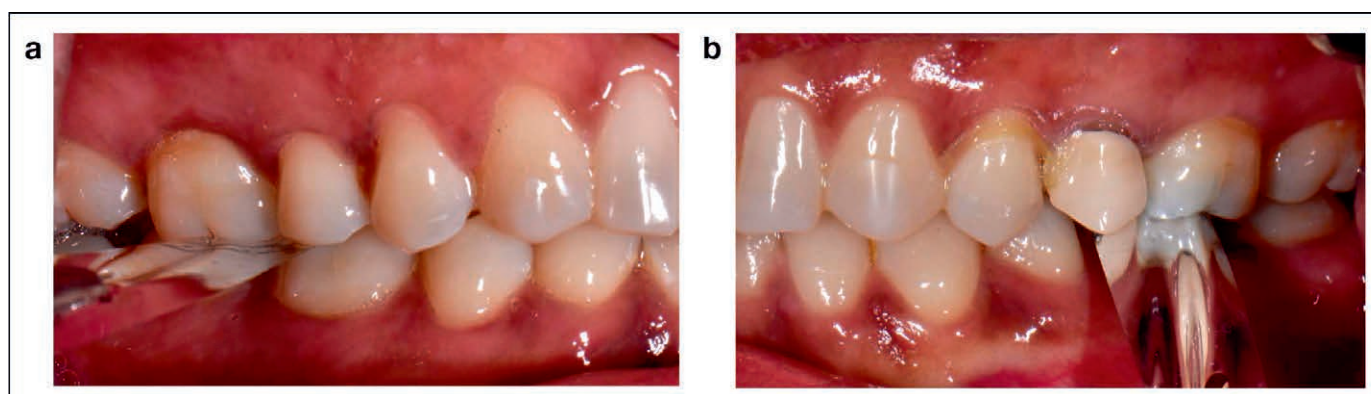


Figure 13. Intraoral photographs taken at 3-month follow-up appointment: a) Right buccal view with Shimstock foil hold; b) Left buccal view with Shimstock foil hold.

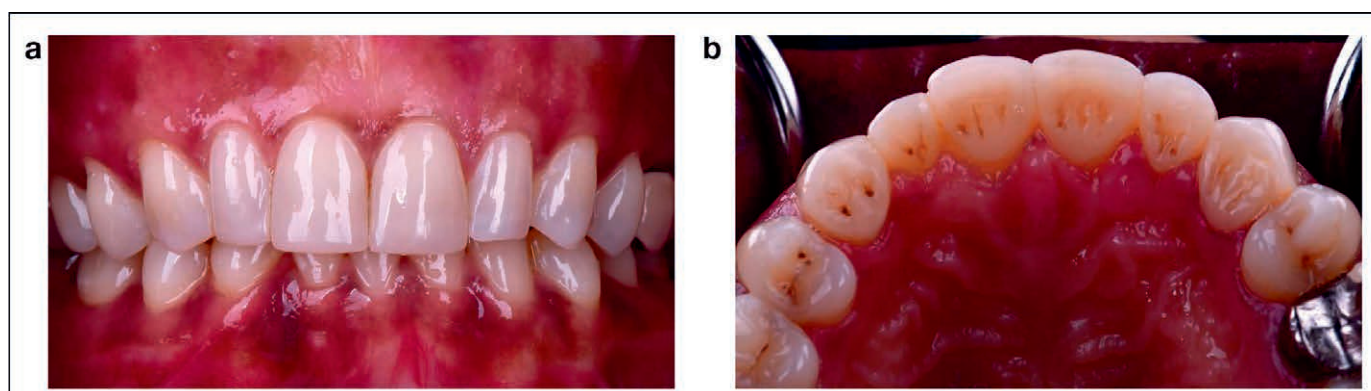


Figure 14. Intraoral photographs taken at 18-month follow-up appointment: a) Labial view; b) Occlusal view with evidence of wear on indirect resin composites.

Indirect hybrid composites provide high fracture resistance, natural color replication, outstanding polishability, as well as good plaque resistance.<sup>17</sup> The indirect technique itself offers many benefits compared to direct restorations in terms of better mechanical performance and a significant reduction in polymerization shrinkage.<sup>18</sup> Additional clinical

benefits include precise marginal integrity, ideal static and dynamic occlusal contacts, excellent anatomic morphology, and optimal esthetics.<sup>19</sup> The longevity of resin composites is probably their main disadvantage. However, Hemmings and others<sup>8</sup> reported that severe localized tooth wear managed using hybrid resin composites showed low failure rates after a mean



follow-up of 30 months. Bruxism is a risk factor strongly associated with mechanical complications in oral rehabilitation.<sup>20</sup> Resin composite restorations in bruxers demonstrated three to four times more substance loss than ceramics.<sup>20,21</sup> However, Willems and others<sup>22</sup> demonstrated that modern composite resin restorations have similar wear rates to human enamel. Therefore, the use of resin composite restorations to treat localized anterior tooth wear at an increased OVD is a viable treatment option that requires some degree of maintenance.

### Conflict of Interest

The authors have no financial interest in any of the companies or products mentioned in this article.

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