Submitted: Jun 16, 2025 | Accepted: Sep 23, 2025
Vol. 8/No. 2/July-December, 2025 Case Report

# Restoring Esthetics and Function in Worn Anterior Teeth Using Dahl Principle – A Case Series

**Karthickraj S M[1], Farhan Durrani[2], Amar Bhochhibhoya[3], Ramanarayana Boyapati [4]**

[1]Reader, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.

[2]Professor, Department of Periodontology, Faculty of Dental Science, Institute of Medical Science, Banaras Hindu University, Varanasi, India.

[3]Assistant Professor, Department of Prosthodontics, Maharajgunj Medical Campus, Institute of Medicine, Tribhuvan University.

[4]Professor, Department of Periodontology, Sibar Institute of Dental Sciences, Guntur, Andhra Pradesh

## ABSTRACT

Tooth wear due to pathological attrition and erosion is a growing concern in adult patients, often leading to rapid loss of tooth structure without sufficient time for natural reparative processes. Restorative management in such cases requires careful consideration of etiological factors, including bruxism, dietary habits, saliva composition, and gastric regurgitation. This case series presents the use of a cemented Dahl appliance as a conservative and effective method for gaining interocclusal space to restore lost anterior tooth structure. Three patients exhibiting varying degrees of anterior tooth wear and occlusal changes were treated using the Dahl principle, employing a fixed anterior bite platform worn for six months. This appliance facilitated space creation through relative intrusion of anterior teeth and passive eruption of posteriors, enabling definitive restorations using porcelain veneers and crowns. Clinical outcomes were assessed over a two-year follow-up period based on parameters such as plaque and gingival indices, pulp vitality, hypersensitivity, occlusal re-establishment, secondary caries, and mechanical complications. All patients successfully regained posterior occlusion and showed stable gingival and periodontal health. Minor veneer debonding and staining were observed but managed without significant impact on esthetics or function. No cases exhibited hypersensitivity, pulp changes, or occlusal discomfort. The cemented Dahl appliance proved to be a predictable, minimally invasive alternative to more extensive orthodontic or prosthodontic interventions, offering a safe and esthetically favourable solution for patients requiring anterior tooth rehabilitation.

**Keywords:** Anterior attrition, Dahl appliance, Occlusal vertical dimension, Porcelain veneers, Restorative dentistry, Tooth wear

## INTRODUCTION

Pathological attrition in the adult dentition can progress rapidly, leading to significant and often irreversible loss of tooth structure if not identified and managed early.[1] Numerous factors have to be considered in controlling the wear of the teeth. Some of these are bruxing habits, dietary habits, saliva and gastric regurgitation.[2] These factors have to be countered in the prevention of tooth loss. To avoid further tooth loss and increase the space lost, orthodontic intrusion can be considered.[3] Still patients avoid the extra treatment cost, time required during the orthodontic treatment. In order to ease this process, Dahl and Krogstad devised an appliance increasing the occlusal vertical dimension (OVD).[4] The space required

*Conflict of Interest: None*

***Corresponding Author**

*Karthickraj S M, Reader, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.*
*Phone No.: 09840094540*
*E-mail: karthickrajsm.sdc@saveetha.com*

for restoring the lost tooth structure was created by this alternative approach described by Dahl.[5] The original platform was devised to disocclude the posterior teeth with subsequent reestablishment of the posterior occlusion by a combination of intrusion of the anterior teeth and supraeruption of the posterior teeth.[5,6] This could be achieved within a period of 6-12 months of time.[7] The Dahl technique is a conservative and safe method to increase occlusal vertical dimension, with no evidence of inducing temporomandibular disorders, and it is suitable for patients across a wide age range.[8] The original Dahl appliance was a removable one covering the palatal surface of the upper anterior teeth. The modification of cemented one devised by Gough and Setchell[8] is used in this case series for increasing the interocclusal space.

## CASE REPORT

In this case series, three patients reported the loss of tooth structure and function in the anterior teeth to the Periodontics Unit. The study models and radiographs were taken accordingly. All the patients were discussed with the treatment plan and written consent was obtained. All patients underwent a basic screening for temporomandibular disorders (TMD) prior to appliance delivery and during follow-up. The evaluation included clinical palpation of the temporomandibular joints (TMJ) and masticatory muscles, assessment of mandibular range of motion, observation for joint sounds (clicking or crepitus), and inquiries about pain, discomfort, or functional limitations. Any signs of deviation or deflection during mouth opening, tenderness on palpation, or restricted movement were noted. The following treatment plan was devised: Fabrication of Cemented Dahl appliance and wearing it for six months followed by assessment of the space obtained for crowns and veneers.

**Case A:**

A 58 years old female patient presented with the attrited upper and lower anterior teeth. On examination, cause for tooth wear was found to be pathological with bruxism habit. The patient had an edge-to-edge bite with the loss of occlusal vertical dimension (OVD), Angle's Class I molar relationship and midline diastema of three mm in the upper anterior teeth with the flattened papilla and loss of gingival scalloping. On the maxillary cast, a cobalt-chromium metal framework was waxed and cast to cover the palatal surfaces of the upper anterior teeth (typically canines to canines), extending slightly onto the incisal edges to establish a stable anterior contact. The thickness of the appliance was maintained at approximately 1.5–2 mm in the occlusal region to provide disocclusion for creating two mm of space in OVD. Following try-in and adjustment, the appliance was cemented using a glass ionomer luting cement to allow easy retrieval if needed, and to avoid excessive resin bonding that may interfere with later restorative procedures. Patients were instructed on appliance care and advised to wear it continuously for a period of 6 months, with periodic follow-up to monitor posterior occlusal re-establishment and space gain for definitive restorations (Figure 1). In the meantime, patient had to undergo implant placement for replacement of tooth # 16 and 25. After six months, the patient had desired OVD with adequate space for restoring the anterior teeth function and esthetics. The severe wear of the anterior teeth had disturbed eruption patterns of the anterior teeth. The eruption patterns were varied owing to the unequal wear of the teeth, leaving gingival asymmetry requiring crown lengthening for esthetic enhancement (Figure 2). Crown lengthening was performed to address gingival asymmetry and provide adequate clinical crown height for proper veneer retention. This further contributed to improved esthetic proportions and facilitated

optimal restorative contours. Surgical crown lengthening procedure was performed from canine to canine in both upper and lower arches. After the healing, the patient underwent the tooth preparation for porcelain veneer fabrication both in upper and lower arches (Figure 3). To reduce the risk of veneer fracture under occlusal loading, tooth preparations followed the manufacturer's recommendations, which emphasize minimal but adequate reduction. Specifically, labial reduction was limited to 0.3–0.5 mm, and incisal reduction was maintained at approximately one mm, with adequate lingual-incisal clearance. This protocol ensures sufficient material thickness in areas subject to functional stress while preserving enamel for optimal bonding. Studies have shown that such preparation designs significantly improve fracture resistance and longevity of lithium disilicate restorations. The elastomeric impression was made after retraction of gingiva to expose the preparatory margin and monolithic veneers (IPS emax; Ivoclar Vivadent AG) were fabricated. The final restoration was luted with self-adhesive resin cement (3M ESPE RELYX U200) (Figure 3[III]) and the patient was provided with a hard acrylic occlusal night guard to protect the restorations during bruxing episodes. The patient was followed up if there were any occlusal problems during masticatory function.

**Case B:**

A 41-year-old male patient had severe attrition of lower anterior teeth due to bruxism and deep bite of three mm was present (Figure 4). On examination, the patient had no loss of OVD but the space for the restoration was not sufficient. So, the patient was advised to wear the Dahl appliance for a period of six months to gain the interocclusal space for fabrication of restorations (Figure 4). Patient also had implant placement for the missing tooth #36 and #46. After the recommended time period of six months, the patient was evaluated to check if there was adequate interocclusal space required for the crown preparation and it was adequate. This patient also had required the crown lengthening procedure in the lower arch for increasing the crown structure. Crown lengthening was done from canine to canine in the lower arch by gingivectomy along with ostectomy (Figure 5). After the two weeks of healing, tooth preparation for veneers in the upper arch and crowns in the lower arch was done for functional and esthetic rehabilitation. The impressions were made and monolithic veneers and crowns (IPS Emax; Ivoclar Vivadent AG) were fabricated. Final restorations were cemented with self-adhesive luting cement (3M ESPE RELYX U200) (Figure 6). Hard acrylic occlusal guard was given to protect the restoration against the traumatic forces.

**Case C:**

A 37-year-old female patient reported with erosion of the maxillary anterior teeth. A brief review of history revealed that the patient's primary concern was improving the esthetics and also had gastric regurgitation with the wear of the teeth corresponding to it. She was advised to seek medical consultation and management regarding the gastric regurgitation. She had improvement in the gastric disturbance after medical consultation. On examination, the patient's periodontal condition was healthy with good oral hygiene and an edge-to-edge bite in the anteriors with no overjet (Figure 7). The patient was advised to wear the Dahl appliance for six months to create the palatal space for the fabrication of crowns (Figure 7). After the waiting period of six months, the patient was checked for whether adequate interocclusal space was present for crown preparation. Crown lengthening procedure was not required for this patient as there was no esthetic problem. After the gain of adequate palatal restorative space, crown preparation was done for only maxillary

anterior teeth. The mandibular anterior teeth did not require crowns as there was not much tooth wear. It required only composite restorations for the wear in the mandibular anterior teeth. The final restorations were placed and checked for any occlusal disturbances (Figure 8). Patient was provided with a hard acrylic guard for protection against the occlusal disturbances.

The following parameters were assessed in these patients for determining the success and survival of the restoration:

Restorations were clinically assessed and evaluated performance in terms of plaque index, gingival bleeding index, recessions, secondary caries, hypersensitivity, changes in pulp vitality, staining, re-establishment of posterior occlusion and mechanical accidents; fractures and debonding.

All three cases were assessed from restoring till two years of follow-up and the results are as follows:

Case C had a score of two for both indices at all the follow-ups and case B had a score of two for plaque index at all follow-ups with a lesser score of one for gingival index. Gingiva was healthy with a score of zero in case A. All three cases did not show any incidence of recession at all point of follow-ups. Case B and case C had signs of mild gingival erythema with no obvious bleeding on probing. It resolved significantly after the maintenance of oral hygiene.

Secondary caries was not observed in all these three cases. There was no incidence of hypersensitivity and pulp vitality changes observed in all these cases. Extrinsic stains were seen in case A and B at all follow-ups and no stains were seen in Case C at all follow-ups.

Re-establishment of posterior occlusion was seen complete in cases A and B in the six months follow-up after restoring the teeth. In Case C, there was less contact in the posteriors during the restorative period and six months' follow-up but it got re-established at the end of 12 months' follow-up. Fractures were not observed in all these cases. Case A and C showed episodes of veneer debonding between the 6 and 12 months of follow ups after restoration. In Case A, three veneers were debonded during that period and one of the veneers had to be replaced for the patient. Case C had only two veneers debonded. No patients demonstrated signs or symptoms of TMD before or after treatment with the Dahl appliance.

**Scoring Evaluation sheet**

| Parameter | Case A | Case B | Case C |
|---|---|---|---|
| Plaque Index (PI) | 0 | 2 | 2 |
| Gingival Index (GI) | 0 | 1 | 2 |
| Gingival Recession | 0 | 0 | 0 |
| Secondary Caries | 0 | 0 | 0 |
| Pulp Vitality Response | 0 | 0 | 0 |
| Hypersensitivity | 0 | 0 | 0 |
| Extrinsic Staining | 2 | 2 | 0 |
| Posterior Occlusion Re-establishment | 0 (by 6 months) | 0 (by 6 months) | 1 (by 12 months) |
| Mechanical Fractures | 0 | 0 | 0 |
| Restoration Debonding | 2 (≥3 veneers, 1 replaced) | 0 | 1 (2 veneers debonded) |

**Summary:**

| Parameter | Case A | Case B | Case C |
|---|---|---|---|
| Preoperative Findings | Severe attrition and loss of anterior guidance, deep bite, generalized wear of anteriors | Generalized lower anterior attrition, reduced restorative space, mild malalignment | Palatal erosion of maxillary anteriors, edge-to-edge bite, history of gastric regurgitation |
| Treatment Rendered | Dahl appliance to regain interocclusal space, crown lengthening (anterior), IPS e.max veneers | Dahl appliance, crown lengthening in mandibular anteriors, full-coverage crowns and veneers | Dahl appliance for space gain, composite buildup in mandibular anteriors, crowns in maxillary anteriors |
| Final Restorative Outcome | Monolithic veneers placed with improved anterior guidance, restored OVD, symmetry achieved | Esthetic anterior restorations with crowns and veneers, space successfully restored | Functional crowns in upper anteriors, minimal composite touch-up in lowers, esthetics well restored |
| Gingival/Periodontal Health | Symmetrical gingival contours post-crown lengthening, no signs of inflammation | Healthy gingiva, minor erythema resolved with hygiene, no recession observed | Healthy gingiva maintained throughout, no esthetic crown lengthening required |
| Posterior Occlusion Re-establishment | Re-established by 6 months follow-up with full function | Re-established by 6 months, no occlusal discomfort reported | Delayed re-establishment, achieved by 12 months post-restoration |
| Complications/ Challenges | Veneer debonding in three units (1 replaced), minor extrinsic staining managed by finishing | No complications reported, excellent compliance and hygiene | Two veneer debondings observed between 6–12 months, minor initial disocclusion |
| Overall Functional & Esthetic Result | Excellent esthetic enhancement with restored anterior guidance and harmony | Balanced function and esthetics, proper anterior-posterior coupling | Natural esthetic appearance with stable occlusion and no signs of recurrence |


***Figure 1I:*** *Preoperative image of the Case A showing the loss of tooth structure; II, III: Cemented Dahl appliance in place*

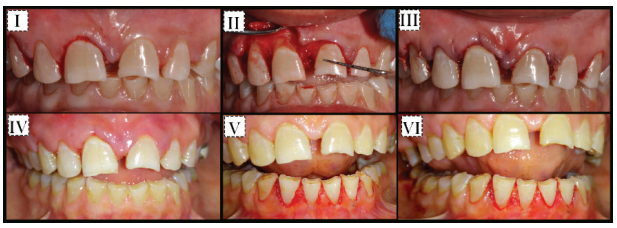


***Figure 2:*** *Esthetic management of maxillary and mandibular gingival contours of Case A*

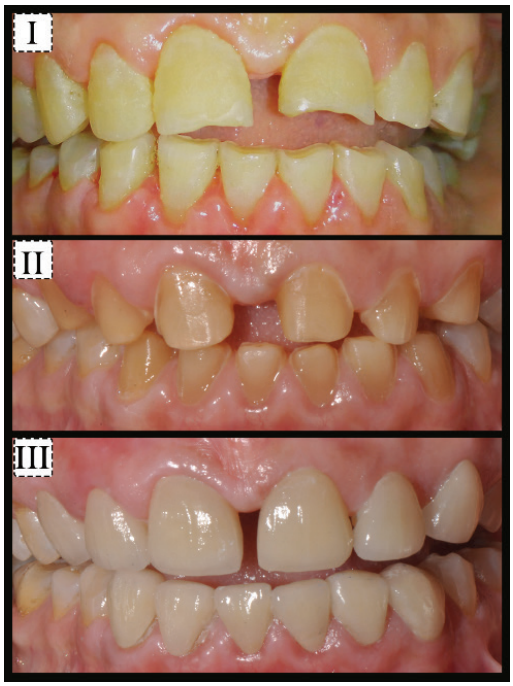


***Figure 3I:*** *Postoperative healing after the correction of gingival contour; II: minimal tooth preparation done for the restoration; III: final restoration in place for Case A*


***Figure 4I, II****: Case B showing the worn anterior teeth;* ***III*** *– Cemented Dahl appliance in place*


***Figure 5I, II, III****: correction of gingival esthetics in mandibular arch of Case B*


***Figure 6I:*** *Postoperative healing after the correction of gingival contour of Case B;* ***II*** *– minimal tooth preparation done for the restoration;* ***III & IV*** *– final restoration in place for Case B*


***Figure 7I:*** *Case C showing the erosion of the maxillary anterior teeth;* ***II & III*** *– Cemented Dahl appliance in place*


***Figure 8 I, II & III*** *– Post Dahl appliance removal of Case C;* ***IV*** *– minimal tooth preparation;* ***V, VI*** *&* ***VII*** *– final restoration in place*

## DISCUSSION

To prevent the further attrition and erosion of the teeth from physiological manner(bruxism) and gastric regurgitation respectively, worn teeth had to be protected by restoring it with either crowns, laminates or composite restorations.[9] This series of case reports depicted that the Dahl appliance was used to disocclude the posterior teeth, causing the intrusion of anterior teeth and supra eruption of the posteriors. Numerous studies obtained the desired Occlusal Vertical Dimension (OVD) or the space for restoring the teeth with the Dahl appliance,[5,10,11] restoration was done with either direct or indirect restorations. The OVD desired for creating the effective anterior guidance plane in patients comforts them by removing the interferences in posterior and harmonizes the muscle activity.[11,12] Dahl principle was originally to provide the removable appliance to increase the OVD for a period of 6-14 months.[5] This was modified later on with a cemented appliance for almost the same time period.[8] In this case series, cemented appliances were provided for all the three patients for a similar time period based on the studies. [7,13] The appliance design originally involved a cobalt-chromium removable anterior partial bite platform and modified later on for the patient's convenience into more esthetically presentable materials. Cobalt–chromium alloy is the preferred material for long-term use of the Dahl appliance due to its superior mechanical strength, corrosion resistance, and clinical longevity. It offers a high elastic modulus, allowing for the fabrication of thin yet durable appliances capable of withstanding occlusal forces over extended periods. Clinical reports and case series have demonstrated the successful use of cobalt–chromium Dahl appliances for space creation without complications, with documented follow-up extending up to 13 years.[14] Direct composite restorations are replacing the metal appliance and followed by definitive restorations.[13] The composite restorations were avoided due to the regular requirement for maintenance due to chipping off and bonding failures. These shortcomings were overcome in this case report where the compliance of patients was good for the metal appliance and didn't complaint of any esthetic problem. Steep guidance plane should also be avoided when Dahl appliance is fabricated so as to avoid the deleterious non axial forces for the tooth. But still there is no evidence when to apply orthodontic forces against the Dahl appliance.[7] Dahl and krogstad[4] stated that the increase in the OVD was determined by the thickness of the appliance. Increase in OVD mainly was due to the stated axial movement of the anterior teeth and supra eruption of posterior teeth.[5,11] The amount of OVD gained with cemented Dahl appliance is still not clear but comparatively greater than the removable appliances. The objectives were clearly accomplished with this appliance without any failure. [7] In a case report

by Djemal et al,[15] Dahl concept was even used to intrude the supraerupted posterior teeth and harmonising the occlusion without creating any significant occlusal disturbances. In another case report by Lim,[16] he showed the application of Dahl concept in the hypodontia patient with the mixed dentition by increasing the interocclusal space before the permanent rehabilitation of the dentition.

The gingival contour also gets altered because of uneven eruption patterns in teeth which necessitates the esthetic crown lengthening procedure for producing the ideal gingival contour.[17,18] In all three cases, composite restorations were not found to be adequate to provide good esthetic and functional outcome for the patients' satisfaction. There were numerous studies to prove that the survival rate for bonded porcelain veneers to be more than 90% over 10 years of clinical service was better than the composite restorations.[19-22]

Plaque and gingival indices scores were not significantly higher, giving the similar results from the other studies that the restored teeth were free from deposits at all times.[21,23] Gingiva was found to be healthy with no attachment loss or recession at follow ups which were comparable to other studies. Since there was no incidence of secondary caries, hypersensitivity or pulpal problems, it could be confirmed with the reflection plaque and gingival indices scores that these weren't major issues with the porcelain veneer restorations. There were no other biological complications comparable to other studies. [21,24]

Re-establishment of posterior occlusion was not a problem for all three patients as they were not aware of any disocclusion and didn't complain of any chewing difficulties which correspond to other studies as well.[7,24] There was complete re-establishment of posterior occlusion in more than 60% of cases in these studies.[13,25] Episodes of debonding was a concern for case A patient but not a major issue for Case C patient. Extrinsic stains developed in two cases but still was not a major esthetic issue for the patients' satisfaction which was removed with minimal finishing. This level of patients' satisfaction could be concurred to the other studies as well.[19,21]

Despite its conservative nature, the cemented Dahl appliance has certain limitations. Patient adaptation to anterior disocclusion may cause temporary discomfort or speech difficulty.[26] Esthetic concerns with metal appliances may also arise, particularly in patients with high smile lines. Mechanical complications such as debonding have been reported, especially under parafunctional loading or inadequate bonding protocols.[27] Additionally, the appliance relies on physiological tooth movement, which varies between individuals and may lead to unpredictable occlusal outcomes.[28] Transient gingival inflammation or minor hygiene challenges around the appliance margins may also be observed. While evidence suggests minimal impact on temporomandibular joint function, long-term comparative studies between fixed and removable designs remain limited.[7]

## CONCLUSION

This case series demonstrates that the use of a cemented Dahl appliance is a conservative and effective approach for managing localized anterior tooth wear, facilitating space creation for restorative rehabilitation without surgical or orthodontic intervention. The appliance allowed re-establishment of posterior occlusion and provided sufficient interocclusal clearance for definitive restorations within a predictable time frame. Subsequent restorations using lithium disilicate veneers and crowns yielded favourable biological and mechanical outcomes over a two-year follow-up, with minimal complications and high patient satisfaction.

Proper case selection, adherence to minimally invasive preparation protocols, and supportive periodontal procedures such as crown lengthening, where indicated, contributed significantly to restorative success. These findings reinforce the clinical viability of the Dahl concept as a functional and esthetic solution for anterior tooth wear in adult patients.

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