

Dahl approach and its applications in dentistry: a systematic review

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Abstract:

Continuous development in the field of dentistry has given an enormous ways to relief patient's pain in a much more reliable way. Dahl approach based appliances is one of them. Unnecessary inter occlusal spaces can not only proves to be painful but can affect facial aesthetics of a person too. These inter occlusal spaces can occur due to a number of reasons like iatrogenic factors, faulty orthodontic treatment, some of the patients habits, syndromic, inappropriate or an occlusion unbalancing eruption of the part of dentition, teeth wear due to any cause etc. etc.. Use of Dahl approach to correct these undesired inter occlusal spaces have been in action from quite long time. The concept has been in continuous process of modifications in its design and material but the basic foundation is still the same. In this approach targeted teeth are allowed to erupt while hindering the eruption of opposite balancing teeth. The appliance can be designed as either removable or fixed type by using direct composite resins. This systematic review revolves around different aspects of Dahl approach and its importance and possible complications occurring in the field of dentistry.

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I. Introduction:

Wear and tear are the two important component considered in the life expectancy of any product. Human teeth are not an exception from this phenomenon. Tooth surface loss, whether physiological or pathological, has become a significant challenge for the dentists [1]. Teeth exhibit four main types of wear as attrition, erosion, abfraction and abrasion. A combination in one way or the other of these types is also very common. Both enamel and dentine can be affected by tooth wear and the wear can be pathological or physiological too [2].

Although tooth wear is not a micro-organism related disease but if left untreated it can cause substantial amount of damage to the patient's dentition [3]. According to the Adult Dental Health Survey conducted in 1998, some kind of dental wear is present on dentine of anterior teeth of almost two thirds of the adults. Similarly, 11% of adults had extensive involvement of dentine in moderate wear and 1% had severe wear. On the other hand the Child Dental Health Survey held in 1993 showed that for the kids aged 14 years, 32% had evidence of erosion involving the palatal surfaces of permanent upper anterior teeth [4]. These stats show that the tooth wear is a significant problem not only in adults but the kids too.

The teeth most commonly affected by wear are the anterior ones, compromising the appearance and even confidence of the patients. A very recognizable result of teeth wear is a reduction in inter occlusal space [5]. By using Dahl concept we can avoid the loss of inter occlusal space by two means. First mean for obtaining this space is by the intrusion of anterior teeth in contact with the appliance and secondly the eruption of the separated posterior teeth [6, 7]. Although restorations may be indicated but the prevention and monitoring continue to be the crucial techniques in preserving the life expectancy of teeth [8]. Like any other medical ailment, the foundation of a dental treatment lies on making a firm diagnosis. Using Dahl approach for a desired treatment plan in mind but forgetting the alternate possible consequences that might occur can give some undesired results. In this systematic review we were discussing that how Dahl approach has help in many of the dental procedures assuring a better quality of life for the patient.

A thorough electronic search of the internet specifically the Google Scholar and Pubmed was made in order to find the relevant articles for this systematic review. The keywords used are "Dahl approach", "Teeth Wear", "Dahl appliance", "Dahl concept in dentistry" and the related synonyms of these key terms.

Inclusion Criteria:

The inclusion criteria were the papers published from 2000 to 2021. The chosen language for the selected papers was English. All the papers considered for this systematic review were clinical studies or literature reviews elaborating the importance of Dahl approach in dentistry. Both observational studies

(prospective cohort studies, retrospective cohort studies, case control studies, and cross sectional studies) and experimental studies (randomized and non-randomized controlled trials, non-controlled clinical trials, and case series) were included for the review. The publications which have a higher significance rank in the hierarchical pyramid were selected.

Exclusion Criteria:

Exclusion criteria for this paper were the publications with Dahl approach in other fields of medicine apart from dentistry. Papers older than the year 2000 or written in a language other than English were also not selected.

II. Results:

An electronic search on Google scholar about the Dahl approach in dentistry yielded 17,001 results. After applying the inclusion and exclusion criteria the search results remained 562. Key terms on Pubmed yielded 20 results. The researches meeting the required criteria were selected and reviewed for this study.

With the advancing age people are becoming more conscious about their oral health and aesthetics. This is why the profession of dentistry has to be in continuous development to meet the higher expectations and needs of people. When some of the teeth undergo structural loss, an imbalance in inter occlusal space is evident. This is the dento alveolar compensations required for maintaining the proper efficacy of the masticatory apparatus. The dento alveolar compensation is achieved by continued tooth eruption, growth in alveolar bone and deposition at apical cementum. These results in a significant reduction of interocclusal space. Many techniques were employed including restorative or surgical interventions to maintain the appropriate inter occlusal space. The technique offered by Dahl is one of them. This technique employs a conservative approach for controlling incisal guidance and making space on palatal aspect for the restorative material [9-11]. This phenomenon of re-establishing the occlusion has been also known by other names like 'minor axial tooth movement', 'relative axial tooth movement', 'fixed orthodontic intrusion appliances', 'localized inter-occlusal space creation', and 'partial bite raising appliance' etc.

Previous studies:

In 1975, a removable cobalt chromium partial bite raising appliance was introduced by Dahl et al. The purpose of this appliance was to create sufficient inter occlusal space in a patient with localized maxillary anterior tooth wear. The study yields a 100% result in achieving the desired inter occlusal space in 20 cases [12]. Dahl gets the credits of this appliance as he gave the idea despite of the fact that he did not had access to appropriate adhesive materials or the modern techniques. Later on the design and materials for the construction of this set up was revolutionized dramatically. A large number of materials were practiced for this appliance as long as the main approach given by Dahl was followed. Another study by Anderson in 1962 uses restoration in supra occlusion to describe the idea of experimental malocclusion. His subjects were five human beings who wear a removable metal cap with approximately 0.5mm thickness on occlusal surface of the right lower first permanent molar [13].

Later on Dahl and Krogstad published studies based on the implant supported cephalometry that concluded that the axial movement of the teeth creates inter occlusal space rather than the change in inclination of teeth [12]. Some relapse in the vertical dimension of occlusion was noted during the first six months which remains static after this period. The anterior teeth in contact with cobalt chromium appliance showed intrusion along with the eruption of separated posterior teeth. This gave the required results of an increase in inter occlusal space. Recently in 2021 Rostam et al published a clinical study for a resin bonded fixed partial dental prostheses using Dahl concept. The results showed that after 12 weeks occlusal forces were established [10].

Manufacturing of the Dahl appliance:

Dahl appliance can be either cemented to the teeth or can also be made into a removable one. Conventional appliances operating on the basis of Dahl appliance are associated with not only the patient discomfort but undesirable appearance too [14]. To overcome these disadvantages a direct resin based composite build up Dahl appliance is used [15]. This not only provides the necessary inter occlusal space, but also offers a permanent aesthetic treatment for worn out teeth [6]. It also eliminates the poor compliance showed by the patients for other removable appliances.

Since the advent of Dahl appliance, the design and materials for it has gone through a number of changes. The original cobalt-chromium used for this appliance can be replaced by any other material as long as the principle of Dahl is being followed. Anterior crowns are designed with labial aspects following the natural esthetics in a way as similar to the natural teeth as possible [16]. The palatal aspects of such crowns in case of Dahl appliance is altered to an appropriate thickness in order to facilitate the increase in inter occlusal space. The lack in occlusal contact of posterior teeth will allow them to maintain a new occlusion by over erupting.

The design of the appliance would be in direct favor of the patient for not only his treatment but the level of his ease and comfort too [9].

There are some basic prerequisites that are to be followed for every Dahl based appliance [4]. Proper thickness of the material is the first and foremost step in manufacturing this appliance. The thickness should be in direct relation to the inter-occlusal space required. There should be no mucosal borne component and the thickness of the material should be placed on the incisal or occlusal component of the teeth with respect to the inter-occlusal space required. These contacts are also to be stable and should be designed in such a way that occlusal forces are focused along the long axis of the teeth [17, 18]. The appliance should also not hinder the movement of other discluded teeth. Moreover the appliance should have to be acceptable to the patient in not only that it is not hindering in his speech or offering a hurdle in his esthetics. Maintenance and routine reviews of the appliance is also required provided the mutual cooperation and communication between the patient and the doctor is ensured.

Indications:

The appliance based on Dahl concept can be indicated in a variety of cases. Patients with tooth wear due to any pathological or physiological process can be a very good candidate for this appliance[5]. Dental wear can be because of four main types as abrasion, attrition, erosion and abfraction. Abrasion is generated by food and foreign body contact (e.g., teeth brushing, nail biting habit), which can even destroy the attrition wear patterns which are due to tooth to tooth contact that forms acquired wear facets on new enamel. Bruxism is the classical cause of attrition and is more common in older people [19]. Erosion of the hydroxyapatite crystals of enamel caused by acid-based leaching and dissolving due to any sort of chemicals may override prior enamel defects [20]. Children and young people are most commonly affected by this condition and it's a rapidly progressive ailment, can lead towards tooth loss too. Dahl approach has a major influence in treatment of dental erosion [21]. Most children or adolescents prefer to use this technique in treating dental erosion as compared to other appliances [22, 23].

Abfraction is yet another pathological cause for tooth wear caused by biomechanical loading forces that cause bending and failure of enamel and dentin at a location remote from the loading[24]. These four reasons of teeth wear can further be due to a large number of other factors like diet, eating habits, poor or inappropriate measures of oral hygiene, bruxism, xerostomia, gastro-esophageal reflux disease (GERD), bulimia, vomiting as well as other medications or even some of the dietary supplements.

Apart from using Dahl appliance merely for tooth wear suspects, it can also be employed for patients with physiological or iatrogenic over eruption as seen in inappropriate restorations or crowns etc. Similarly some orthodontic patients can also show lack of inter occlusal space due to either adult or faulty orthodontic treatments. Dahl concept has also many other important applications in the field of orthodontics [25]. Orthodontists uses this approach to cover inter occlusal defects or spacing prior to or during the treatment phase with any other appliance.

Complications of Dahl approach in dentistry:

As with any other product, Dahl based appliances also exhibits some complications[26]. These complications can easily be avoided and does not limit the further usage of the appliance. First and foremost complication that can arise is due to faulty manufacturing of the appliance. Dahl appliance can be of no use if the treatment planning lacks proper diagnosis and estimation of required inter occlusal space. Other complications can arise due to fracture, surface roughness, change in color of surface or the margins, gingival health and most importantly pain or discomfort to the patient. No Temporomandibular joint dysfunction (TMJD) symptoms or even root resorption has been reported in literature due to Dahl appliance as compared to other orthodontic appliances[27, 28]. The literature also has not enough data to support the occurrence of apical resorption due to this appliance.

Transient periodontal tenderness can occur after immediate insertion of the appliance. This also alarmed the dentist in checking the periodontal health of the patient before making this treatment plan. Patient should also be warned about the initial discomfort in chewing and speaking[29]. Proper hygiene measures should be adopted by the patient to avoid any sort of periodontal related discomfort. Check and balance of posterior teeth is also necessary to assure the reduction in inter occlusal space as the function of the appliance. Teeth with wear if not properly diagnosed for their pulp health or dentine sensitivity can also further complicate the prognosis of the treatment. Many studies have not reported any kind of pulpal symptoms due to Dahl approach for gaining inter occlusal space[30, 31]. Minor discomforts can be treated without any surgical interventions. The only pulpal damage that might be observed is while removing the cemented Dahl appliance. This iatrogenic pulpal exposure can be avoided with dentist's experience and dexterity. But as like any other appliance or treatment plan, it is important to weigh out all the benefits and complications. All of the

complications offered by Dahl approach are avoidable and hence proper benefits from the Dahl based appliances can be gained.

III. Conclusion:

Multifactorial etiology of tooth wear cannot be denied. However, eliminating the possible cause along with the protection of teeth is the main concern. This imposes a great deal of challenges for the dentist. The loss of inter occlusal space due to wear of anterior teeth is one of the dilemma. With the advent of Dahl concept worn teeth had got an essential appliance for their treatment. The literature supports this approach for dental treatments with achievement of desired objectives in 94% to even 100% of the cases[32]. The appliance is built in such a way to compensate for not only the reduced inter occlusal space but the affected teeth too. In a nutshell a Dahl appliance when cemented to the teeth allows over eruption of the posterior teeth along with the anterior teeth to be intruded at the same time.

Although this technique for management of worn teeth has shown a confident and successful result from a variety of clinical situations, but still it requires further research. The complications that are shown till date due to this appliance were minor in nature with no unwanted long-term sequel. However it should be kept in mind that a larger aspect of the success of this appliance depends upon proper selection and the compliance of the patient. A close collaboration between the patient and the health care provider team will ensure the ongoing success and benefit of the appliance.

Reverences:

- [1]. White, D., et al., Adult Dental Health Survey 2009: common oral health conditions and their impact on the population. *British dental journal*, 2012. **213**(11): p. 567-572.
- [2]. Loomans, B., et al., Severe tooth wear: European consensus statement on management guidelines. *J Adhes Dent*, 2017. **19**(2): p. 111-119.
- [3]. Meyers, I., Minimum intervention dentistry and the management of tooth wear in general practice. *Australian dental journal*, 2013. **58**: p. 60-65.
- [4]. Poyser, N., et al., The Dahl Concept: past, present and future. *British Dental Journal*, 2005. **198**(11): p. 669-676.
- [5]. Milosevic, A. and G. Burnside, The survival of direct composite restorations in the management of severe tooth wear including attrition and erosion: A prospective 8-year study. *Journal of dentistry*, 2016. **44**: p. 13-19.
- [6]. Magne, P., M. Magne, and U.C. Belsler, Adhesive restorations, centric relation, and the Dahl principle: minimally invasive approaches to localized anterior tooth erosion. *European Journal of Esthetic Dentistry*, 2007. **2**(3).
- [7]. Djemal, S., K. Bavisha, and G. Gilmour, Management of a supra-erupted premolar: A case report. *Dental update*, 2004. **31**(4): p. 220-222.
- [8]. Condon, M. and K. Eaton, An investigation into how general dental practitioners in leeds manage complex tooth wear cases. *British dental journal*, 2020. **228**(5): p. 366-370.
- [9]. Mzrahi, B., The Dahl principle: creating space and improving the biomechanical prognosis of anterior crowns. *Quintessence international*, 2006. **37**(4).
- [10]. Idris, R.I., Y. Shoji, and T.W. Lim, Occlusal force and occlusal contact reestablishment with resin-bonded fixed partial dental prostheses using the Dahl concept: A clinical study. *The Journal of prosthetic dentistry*, 2021.
- [11]. Milosevic, A., Direct placement composite: The treatment modality of choice to restore the worn or eroded dentition in primary dental care. *Primary dental journal*, 2016. **5**(3): p. 25-29.
- [12]. Dahl, B.L. and O. Krogstad, The effect of a partial bite raising splint on the occlusal face height: An x-ray cephalometric study in human adults. *Acta odontologica scandinavica*, 1982. **40**(1): p. 17-24.
- [13]. Anderson, D.J., Tooth movement in experimental malocclusion. *Archives of Oral Biology*, 1962. **7**(1): p. 7-15.
- [14]. Lempel, E., et al., Adhesive management of anterior tooth wear in combination with the Dahl concept. 27-months observational case-series. *OPERATIVE DENTISTRY*, 2021.
- [15]. Golobic, M. and N. Funduk, Direct Resin-Based Composite Dahl Appliance: A Case Report. *International Journal of Prosthodontics*, 2008. **21**(1).
- [16]. Ahmed, K.E. and S. Murbay, Survival rates of anterior composites in managing tooth wear: systematic review. *Journal of oral rehabilitation*, 2016. **43**(2): p. 145-153.
- [17]. Kashyap, R., et al., Modified Dahl's Appliance: A Clinical Report. *Journal of Advanced Oral Research*, 2012. **3**(1): p. 10-14.
- [18]. Aljawad, A. and J.S. Rees, Retrospective Study of the Survival and Patient Satisfaction with Composite Dahl Restorations in the Management of Localised Anterior Tooth Wear. *The European journal of prosthodontics and restorative dentistry*, 2016. **24**(4): p. 222-229.
- [19]. Rees, J. and S. Somi, A guide to the clinical management of attrition. *British dental journal*, 2018. **224**(5): p. 319-323.
- [20]. Sperber, G.H., Dental wear: attrition, erosion, and abrasion—a palaeo-odontological approach. *Dentistry journal*, 2017. **5**(2): p. 19.
- [21]. Tunkiwala, A. and R. Chitguppi, Conservative, Functional, and Esthetic Rehabilitation of Severe Palatal Erosion (Class IV) Using Modified Dahl Approach. *Compendium*, 2017. **38**(5).
- [22]. Johansson, A.-K., et al., Dental erosion and its growing importance in clinical practice: from past to present. *International journal of dentistry*, 2012. **2012**.
- [23]. Sleep, A., The Dahl technique—teenager thrilled with makeover. *Oral Health*, 2021.
- [24]. Sarode, G.S. and S.C. Sarode, Abrfraction: A review. *Journal of oral and maxillofacial pathology: JOMFP*, 2013. **17**(2): p. 222.
- [25]. Faus-Matoses, V., et al., Orthodontics and veneers to restore the anterior guidance. A minimally invasive approach. *Journal of clinical and experimental dentistry*, 2017. **9**(11): p. e1375.
- [26]. Coulter, J. and G. McCracken, Complications in managing tooth wear; exploring a potential pitfall of using the dahl approach—a case study. *Dental Update*, 2018. **45**(4): p. 320-326.
- [27]. Wong, T.L. and M.G. Botelho, Restorative management of severe localized tooth wear using a supraoccluding appliance: a 5-year follow-up. *Case reports in dentistry*, 2018. **2018**.

- [28]. Seligman, D.A. and A.G. Pullinger, Analysis of occlusal variables, dental attrition, and age for distinguishing healthy controls from female patients with intracapsular temporomandibular disorders. *The Journal of prosthetic dentistry*, 2000. **83**(1): p. 76-82.
- [29]. Burke, F.T., Information for patients undergoing treatment for toothwear with resin composite restorations placed at an increased occlusal vertical dimension. *Dental update*, 2014. **41**(1): p. 28-39.
- [30]. Hemmings, K.W., U.R. Darbar, and S. Vaughan, Tooth wear treated with direct composite restorations at an increased vertical dimension: results at 30 months. *The Journal of prosthetic dentistry*, 2000. **83**(3): p. 287-293.
- [31]. Gow, A.M. and K.W. Hemmings, The treatment of localised anterior tooth wear with indirect Artglass restorations at an increased occlusal vertical dimension. Results after two years. *The European journal of prosthodontics and restorative dentistry*, 2002. **10**(3): p. 101-105.
- [32]. Bilgee, J., et al., ADULT ORTHODONTICS WITH DAHL TECHNIQUE FOR BETTERFUNCTION AND AESTHETICS. *Innovation*, 2018. **12**(4): p. 40-44.

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