

## Dental Attrition- Aetiology, Diagnosis and Treatment Planning: A Review

Dr. Radhika Jain, Dr. Mithra N. Hegde

---

**Abstract:** *Tooth wear and its rehabilitation is a much discussed and studied subject in dentistry. The increased life expectancy may be one of the factors that it has become more ubiquitous. Often patients with tooth wear report to the dental clinic requiring extensive restorative treatment. Wear can be the result of attrition, abrasion, erosion or abfraction. The clinical presentation may vary and can be quite confusing. A proper diagnosis of the aetiology is essential for management of worn dentition as these factors must be eliminated before initiating restorative treatment. Attrition is the result of tooth-tooth grinding due to functional and parafunctional habits. It appears as wear facets on the occlusal surfaces of teeth which in due course can lead to considerable loss of tooth structure and loss of vertical dimension. This review article focuses on dental attrition as the aetiology of tooth wear, the signs and symptoms which help in diagnosis of attrition and the guidelines for treatment planning. A literature search was done using PubMed and Google Scholar with the key words: 'dental attrition', 'tooth loss', 'occlusal wear'. The articles excluded were reviews, case reports and references in which wear had meaning other than loss of tooth tissue. Observer agreements were analysed and disputes were resolved with debate and discussion.*

**Keywords:** *dental attrition, tooth wear, treatment planning.*

---

Key Messages (Provide appropriate messages of about 35-50 words to be printed in centre box):

Tooth wear is a worldwide phenomenon. It could be due to attrition, abrasion, erosion or abfraction. The management of attrited teeth is a challenging endeavour as it requires replacing lost tooth structure but restoring the vertical dimension as well. A multidisciplinary approach is essential in the management of these cases.

### I. Introduction

Tooth wear has been a topic of discussion in dentistry with several epidemiological studies conducted and several articles published relating to the management and rehabilitation of worn dentition.<sup>1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16</sup> Although some degree of tooth surface loss is considered acceptable, an extensively mutilated dentition is a potential threat to the development of functional problems. It is essential to determine the aetiology of abnormal wear to prevent further pathologic changes and to establish the protocol for management. The rehabilitation involves recognising the need for treatment, the procedures to be followed, choice of material and the occlusal concepts to be adopted.

### II. Material and methods

A literature search was done using PubMed with the key words 'tooth' and 'wear' together. The limitation of publication year was decided to be from 1950 until 2012.

#### Inclusion and exclusion of papers:

From the above database, studies with the subject 'wear of human tooth tissue' and 'treatment planning of tooth wear' were selected. The references were added on the basis of abstracts by two independent readers and the search was not limited to randomised control trials. Those research papers were not included in which wear meant to be something other than tooth wear. Original papers were obtained for those articles whose abstracts were not available. Articles other than in English language were not included in the review.

The next step involved including those studies which had studied the association between tooth wear and: a) occlusal factors, b) parafunctional habits and related disorders, c) treatment planning.

Finally, only studies giving outcome data on dental attrition were included in our review. Observer agreements were analysed and disputes were resolved with debate and discussion.

Thus out of 895 articles screened, 81 were included in the review.

#### Types of tooth surface loss

Tooth wear can be physiologic, occurring as a normal ageing process.<sup>17</sup> This process accelerated by several endogenous and exogenous factors is termed pathologic. Depending upon the cause, four types of surface loss have been identified; attrition, abrasion, erosion and abfraction.<sup>18,19,20,21,22,23,24,25,26,27</sup> These can be

further categorised into; mechanical loss which includes attrition and abrasion, chemical loss which includes erosion and finally abfraction which comes under biomechanical loss.<sup>19</sup>

Attrition is the loss of tooth substance occurring as a result of mechanical wear between the opposing surfaces of teeth during masticatory and parafunctional movements.<sup>30,31,32,33</sup> It is most often seen on the occlusal surfaces of posterior teeth, the incisal edges of anterior teeth. It is due to mechanical wear that the contact points on the proximal surfaces turn into contact areas which can lead to a reduction in the dental arch.<sup>34</sup>

Abrasion denotes mechanical wear of teeth due to causes other than tooth- to- tooth contact.<sup>29,36,71</sup> It occurs due to friction between teeth and exogenous agents like a hard toothbrush, abrasive toothpaste, intensive horizontal brushing motion, etc.<sup>35,72</sup>

Erosion is the wearing of teeth due to chemical processes which may involve intrinsic or extrinsic acids. The rate of erosion is also affected by rate of salivary flow and salivary constituents. The palatal surface seems to be the most commonly.<sup>35, 37</sup>

Abfraction is the pathologic process of tooth loss in which repeated compression and flexure of teeth under occlusal loading will lead to fracture of thin enamel rods. It is mostly seen in the cervical region of teeth.<sup>28,38,39,40</sup>

It is important to distinguish between the different types of surface loss in order to understand the aetiology of tooth wear. It involves first differentiating whether the tooth loss is due to mechanical or chemical causes. The following features help in diagnosis:

The restoration wears at the same rate as the adjacent tooth structure in mechanical wear. Wear facets can be seen on occlusal surfaces, having sharp peripheries which can be articulated on diagnostic casts. Teeth are usually asymptomatic and patients may report parafunctional habits.<sup>18</sup>

The restorations stand out elevated as compared to tooth structure, called ‘amalgam islands’ in chemical wear. Occlusal surfaces show cupping with have rounded margins which cannot be articulated on diagnostic casts.<sup>41</sup> Patients may complain of hypersensitivity. The patterns of tooth wear in erosion can be varied.

Once the cause is narrowed down to mechanical wear, attrition and abrasion can be distinguished by the fact that abrasion usually appears as V- shaped notches on the facial surfaces of canines and premolars while attrition, as already stated, appears as well defined wear facets on the occlusal and incisal surfaces.

Dental attrition is one of the main causes of non-carious lesions which results in deterioration of natural dentition and consequent degradation of occlusion.

### **Aetiology of attrition**

Attrition of teeth is a normal physiological process.<sup>42</sup> However, several factors can cause excessive or pathological occlusal wear:<sup>43</sup>

**Congenital anomalies:** Developmental anomalies, especially, amelogenesis imperfecta and dentinogenesis imperfecta predispose teeth to rapid wear.<sup>44,69,73</sup> This is because the enamel is very thin or/and friable in amelogenesis imperfecta while in dentinogenesis imperfecta the attachment of the enamel and dentin is weak which results in easy separation.<sup>42</sup>

**Psychological factors and bruxism :** Traditionally, attrition of teeth was seen in the older age group as a sign of the natural ageing phenomenon. Studies state that it occurs mainly as a result of functional activity and is mostly seen with increasing age. As the diet consumed by our population is usually coarse and non- refined in nature, the concept attrition due to functional activity is all the more relevant to us.<sup>48</sup> However, numerous contradicting studies have reported it to be increasingly seen in the young adults and mostly linked to bruxing activity.<sup>49,50,51,52</sup> Bruxism is a parafunctional, non-productive habit of grinding or clutching the upper and lower teeth against each other & is destructive in nature. It is usually a response of an individual to increased stress and is associated with lowering the levels of stress- induced increase of nor-epinephrine turnover in brain. Stress as a lifestyle factor is increasingly seen as a predisposing influence towards bruxism.<sup>45,46</sup> Dental attrition has been found to be related to bruxism in most of the studies conducted and shown to have a rapid onset in bruxers.<sup>34,37,70</sup>

**Parafunctional habits:** Other habits, apart from bruxism, such as pen/pencil biting, pipe smoking and holding objects between teeth lead to accelerated wear of teeth.<sup>53</sup>

**Sex:** Dental attrition is more prevalently seen in males as compared to females. This could be due to the strong masseter muscle activity, greater muscle fibre mass and stronger ligaments.<sup>48,49,74</sup>

**Iatrogenic:** Occlusal prematurities due to a faulty restoration can be uncomfortable for the patient which can make him grind his teeth against each other. Also coarse porcelain restorations against natural teeth can expedite the rate of wear.<sup>35</sup>

### **Diagnosis:**

Diagnosis of the aetiology is not easy, not least because the patients may not recognise the signs and symptoms themselves.<sup>35</sup> The aetiology of attrition could be multifactorial characterised by craniofacial, musculoskeletal, stomatognathic interrelationships. The assessment includes an oral examination of the patient, dental and medical histories to determine conditions and medication that may affect the prognosis and management of attrition.<sup>54</sup>

The clinical examination can be augmented by the use of intra-oral photographs, high density stone casts and radiographs. The stone casts help in occlusal and space analysis when mounted in a retruded contact position (RCP) on a semi-adjustable articulator. A horizontal space existing between RCP and ICP (intercuspal position) indicates space available between anterior teeth which could be useful for anterior restorations. They also help in easy assessment of tooth wear. Intraoral photographs help in identifying areas of pulpal and dentinal exposure and allow the analysis of smile line in relation to incisal edges. Radiographs help in assessing the remaining thickness of enamel and dentin, location of furcation and presence of periapical pathosis.<sup>35</sup>

There are different scales to quantify the severity and progression of wear. They use physical measurements such as crown height, the area of wear facet, depth of groove, etc.<sup>55</sup> Smith & Knight introduced the concept of measuring tooth wear irrespective of the cause. The Tooth Wear Index (TWI) produced by them evaluates the wear of all four surfaces of teeth regardless of how it occurred. The recent indices based on this index do not depend on clinical diagnosis and are more clinically relevant.<sup>56</sup>

The basic idea of diagnosis and management is identifying and eliminating etiological factors that lead to excessive wear of teeth.<sup>57</sup> This will preserve maximum tooth structure and enhance the prognosis of restorative treatment.

### **Treatment planning:**

In developing a treatment plan the dentist should consider the following factors:

- Whether the wear is localised or generalised
- Factors affecting the patient's speech, function and orofacial aesthetics.
- The behavioural, psychological, anatomical, developmental and physiological limitations of the patient<sup>27</sup>
- ❖ Observation and palliative strategies:

**Palliative strategies:** They include various methods to treat the etiological factors of attrition.

#### ▪ **Treatment of bruxism:**

Counselling by a trained psychologist is recommended for each case. Cognitive behavioural therapy is used to help the patients learn to better cope with the situations causing anxiety leading to bruxism.<sup>60,75</sup> Also meditation, yoga and deep breathing exercises are advised to better handle stressful situations. An occlusal splint made in hard acrylic resin is prescribed when most teeth are present to check bruxism. The splint should have a full occlusal coverage with multiple occlusal contacts on closure and correct anterior guidance.<sup>35,76,77,78</sup> Mandibular advancement devices might be used for treating bruxism. They are worn at night and as the name suggests, they hold the lower jaw forward and closed while sleeping. They are more painful to wear as compared to occlusal splints.<sup>61,79</sup> Habit breaking appliances can be given to the patients. Chemotherapeutic agents that are prescribed include muscle relaxants and non-steroidal anti-inflammatory drugs (NSAIDs) to relieve the symptoms.<sup>62,80</sup>

Occlusal prematurities should be corrected. Removable partial dentures are recommended for patients with missing anterior teeth and attrition of the anterior teeth present. Porcelain restorations which cause the wearing of opposing teeth can be polished properly which can reduce surface roughness. Malocclusion like Angle's class II division 2 and class III incisal malocclusion should be corrected by orthodontic treatment.<sup>35</sup>

- **Observation:** It is necessary to determine the rate of progression of wear.<sup>58</sup> The rationale being that wear is a slow process with patients seldom complaining of overt symptoms. Serial casts can be used for observations at 6-12 monthly intervals and comparing the recordings. It is possible to decide if any intervention is necessary based on the evaluation of rate. If the relevant objective and functional criteria are satisfactory regarding the patient's function, appearance and occlusal stability, the patient is only observed and monitored according to a recall schedule.<sup>59</sup>

#### ▪ **Rehabilitative techniques:**

**When is the need for restorative care?**

The control of primary dental diseases such as dental plaque, is imperative before restorative care. Also excessive occlusal loading as in cases of bruxism and clenching are detrimental to restorative materials. These factors should be addressed to before initiating restorative care.

The indications for restorative treatment are:

- **Biological:**
    - Irregular tooth surfaces due to tooth substance loss leading to plaque retention.
    - Presence of pulpal exposure
    - Weakening of tooth structure due to loss of tooth tissue.
  - **Functional:**
    - Dentoalveolar compensation does not occur and occlusal wear leads to reduced masticatory efficiency.
  - **Aesthetic:**
    - The appearance post tooth substance loss is unacceptable to the patient.<sup>35</sup>
- The factors to be assessed in a patient before restorative treatment are periodontic, endodontic, coronal, occlusal, functional, aesthetic.
- **Periodontal assessment:**

Uncontrolled periodontal disease is a contraindication for restorative care as periodontal breakdown may lead to questionable prognosis of the restoration. The gingival and periodontal health should be assessed using standard indices and dental plaque should be controlled before initiating treatment. Also, reduced bone support may lead to unwanted tooth movement. In cases of short clinical crown, surgical crown lengthening might be required.<sup>63</sup>
  - **Endodontic assessment:**

The pulpal and periapical status should be ascertained using clinical tests and radiographs. All treatment should be completed before restorative procedures as performing endodontic treatment after rehabilitative procedures may jeopardise the strength of the restorations.<sup>35</sup>
  - **Coronal assessment:**

This may involve creation of retentive features on the occlusal surface of posterior teeth for restorations.<sup>35</sup>
  - **Occlusal assessment:**

The vertical dimension at occlusion is determined and adjusted according to the requirement of rehabilitative procedure.
  - **Functional assessment:**

Whether the loss of teeth will increase the wear of remaining dentition is still debatable. The anterior teeth can experience unfavourable masticatory stress in the absence of posterior support.<sup>35</sup> However, many authors disagree with the view.<sup>47</sup>
  - **Aesthetic assessment:**

This is mainly related to the anterior teeth. The assessment includes severity of tooth loss, location of gingival margin and lip line.<sup>35</sup>
- **Evaluation of Vertical Dimension at Occlusion:**

Shortening of the clinical crown due to wear can result in changes in the vertical dimension of occlusion(OVD). However dentoalveolar compensation might cause the OVD to remain constant or increase.<sup>64</sup>

A reliable method to determine physiologic VDO, however, is the use of trial restorations. A removable splint made of heat polymerised resin is placed and observed periodically for 6-8 weeks. It is not entirely reliable as patient compliance is doubtful. Fixed provisional restorations are placed for another 2-3 months subsequent to which final restorations are planned.<sup>42</sup>

In planning of final restorations, space is required for the restorative materials in the maximum intercuspal position(MIP). Space available makes the restoration straightforward. If, anyhow, the space is not available, the next step is to assess whether the wear is localised or generalised.<sup>59</sup>

  - **Anterior wear:** There are several techniques used to create interocclusal space for localised toothwear:
  - Dahl appliance works on the principle of selective intrusion of worn teeth and their counterparts, with continuous eruption of unaffected teeth. An anterior cobalt-chromium removable splint, resin bonded cast or composite palatal onlay/build-up or temporary crowns can be used. This method is used for localised wear only and has withstood scrutiny over a long term.<sup>65,81</sup>

- Straight wire orthodontics: Intrusion of attrited teeth and their counterparts or proclination of anterior teeth is done to create space.
- Tooth preparation at existing intercuspal position to create space.
- Occlusal adjustment: To move the occlusion from the existing ICP to a more retruded position, usually the RCP; to create horizontal difference which would provide the space available for the restorations.<sup>35</sup>
- Generalised wear: In cases of wear where the OVD has reduced, it is generally recommended to be maintained if the patient is well adapted to the occlusion and there are no functional problems. However if the decreased OVD creates space problems or aesthetic considerations, there should be no hesitation in increasing the OVD. This should be cautiously done in patients with signs and symptoms of temporomandibular disorders(TMD). They are first treated by reversible methods to reduce the signs and symptoms of TMD and only then prosthetic rehabilitation is started.<sup>59,66</sup>
- ✓ A classification given by Turner and Missirlian helps in determining the treatment protocols in different cases. In patients with excessive wear along with loss of VDO all teeth of one arch should be prepared in a single sitting which makes the increase in VDO less abrupt and allows better control of aesthetics. In other cases where VDO is not lost and space for restorative material is available, the crown length would be shortened because of dentoalveolar compensation and so gingivoplasty might be necessary. In patients with limited space available between teeth but without loss of VDO, vertical space can be created by means of orthodontic treatment, restorative repositioning and surgical repositioning of segments.<sup>35</sup>
- Removable prosthodontic strategies: In countries where removable means of treatment are preferred due to economic considerations, extracting all the teeth and going for a complete denture is a popular choice. However, this leads to residual ridge resorption. The progression can be decreased by using single teeth or roots as overdenture abutments. Maintenance of good oral hygiene is important in the long term success of the restoration.<sup>59</sup>
- **Restorative Materials**  
An ideal restorative material should be as wear resistant as the opposing structure, tooth or restorative material; should have a high flexural strength, be economical and should be repairable in the mouth<sup>35</sup>  
Different materials are used for different situations. To prevent wear of opposing natural dentition, metal occlusal surface and of high noble content, such as gold alloys are preferred. In cases of heavy bruxers, under consideration is not only the wear of the restoration itself and the opposing dentition but also strength to withstand the heavy load applied. Metal and metal-ceramic conditions seem to be the safest choices in such cases.<sup>67</sup>
- ❖ Adhesive strategies: Composite restorations can be used as a less invasive option for the treatment of worn dentition. However, the efficacy of such treatment options is not clinically evident. According to a study, the restorative method was concluded to be conservative, easily maintainable with a short to medium term survival.<sup>68</sup>
- ❖ Maintenance phase: Regular follow up of treated cases is necessary as there is lack of knowledge regarding long term results. Cases should be reviewed annually and new study casts and photographs taken to assess. Clinical and radiographic examination of abutments should be performed to check for caries, wear facets and failed retention. Risk of cementation failure is present due to differential wear, bruxism and short clinical crowns.

### III. Conclusion

Tooth wear is a physiologic process. It can be termed pathologic when it affects the function of teeth or the aesthetic appearance. However, there are no universally accepted guidelines delineating the two entities. Dental attrition is a type of tooth surface loss caused by mechanical wear. It is increasingly being seen in young adults, especially adolescents. The stressful life lead in current times could be an associated factor. Early diagnosis is necessary to bring about timely intervention in the form of preventive and restorative methods. The decision to treat should be guided by the patient's needs, the severity of wear and the potential for progression.

### References

- [1]. Bartlett DW. The role of erosion in tooth wear: aetiology, prevention and management. *Int Dent J* 2005;55:277–284.
- [2]. Arnadottir IB, Holbrook WP, Eggertsson H, Gudmundsdottir H, Jonsson SH, Gudlaugsson JO et al. Prevalence of dental erosion in children: a national survey. *Comm Dent Oral Epidemiol* 2010;38:521–526.
- [3]. Turner KA, Missirlian DM. Restoration of the extremely worn dentition. *J Prosthet Dent* 1984;52:467–474.
- [4]. Johansson A, Johansson A, Omar R, Carlsson G. Rehabilitation of the worn dentition. *J Oral Rehabil* 2008;35:548–566
- [5]. Chekhani UN, Mikeli AA, Huettig FK. All-ceramic prosthetic rehabilitation of worn dentition: Use of a distal cantilever. Two-year follow-up. *Dent Res J* 2013;10(1):126-31.

- [6]. Goyal MK, Goyal S, Hegde V, Balkrishana D, Narayana AI. Recreating an esthetically and functionally acceptable dentition: a multidisciplinary approach. *Int J Periodontics Restorative Dent*. 2013;33(4):527-32.
- [7]. Wong AT, Nguyen CT. Rehabilitation of a patient with an elusive medical history and loss of occlusal vertical dimension. *J Can Dent Assoc* 2013;79:d35.
- [8]. Gargari M, Ceruso FM, Prete V, Pujia A. Prosthetic-restorative approach for the restoration of tooth wear. Vdo increase, rehabilitation of anatomy and function and aesthetic restoration of anterior teeth. Case report. *Oral Implantol* 2012;5(2-3):70-4.
- [9]. Agrawal M, Sankeshwari B, Pattanshetti CV. Use of zirconia to restore severely worn dentition: a case report. *Case Rep Dent* 2012;2012:324597.
- [10]. Hatami M, Sabouhi M, Samanipoor S, Badrian H. Prosthodontic rehabilitation of the patient with severely worn dentition: a case report. *Case Rep Dent* 2012;2012:961826.
- [11]. Gopi Chander N, Venkat R. An appraisal on increasing the occlusal vertical dimension in full occlusal rehabilitation and its outcome. *J Indian Prosthodont Soc* 2011;11(2):77-81.
- [12]. Freitas AC Jr, Silva AM, Lima Verde MA, Jorge de Aguiar JR. Oral rehabilitation of severely worn dentition using an overlay for immediate re-establishment of occlusal vertical dimension. *Gerodontology* 2012;29(1):75-80.
- [13]. Fradeani M, Barducci G, Bacherini L, Brennan M. Esthetic rehabilitation of a severely worn dentition with minimally invasive prosthetic procedures (MIPP). *Int J Periodontics Restorative Dent* 2012;32(2):135-47.
- [14]. Moslehifard E, Nikzad S, Geraminpanah F, Mahboub F. Full-mouth rehabilitation of a patient with severely worn dentition and uneven occlusal plane: a clinical report. *J Prosthodont* 2012;21(1):56-64.
- [15]. Weston JF. Conservative full-mouth reconstruction of a worn dentition utilizing digital impression technology and modern ceramic materials. *Compend Contin Educ Dent* 2011;32(7):44-6,48,50-1.
- [16]. Mumcu E, Geckili O, Bilhan H, Kayserili T. Management of the severely worn dentition with different prosthetic rehabilitation methods: a case series. *Gen Dent* 2011;59(2):e41-5.
- [17]. Lambrechts P, Braem M, Vuylsteke-Wauters M, Vanherle G. Quantitative in vivo wear of human enamel. *J Dent Res* 1989;68(12):1752-4.
- [18]. Verrett RG. Analyzing the etiology of an extremely worn dentition. *J Prosthodont* 2001;10(4):224-33.
- [19]. M Kelleher, K Bishop. Tooth surface loss: an overview. *Br Dent J* 1999;186:61-66.
- [20]. Wood I, Jawad Z, Paisley C, Brunton P. Non-carious cervical tooth surface loss: A literature review. *J Dent* 2008;36(10):759-766.
- [21]. Imfeld T, ten Gate JM. Dental erosion, summary. *Eur J Oral Sci* 1996;104(2):241-244.
- [22]. ZeroDT. Etiology of dental erosion – extrinsic factors. *Eur J Oral Sci* 1996;104(2): 162-177.
- [23]. C R Dugmore, W P Rock. Verifiable CPD Paper: A multifactorial analysis of factors associated with dental erosion. *Br Dent J* 2004;196:283-286.
- [24]. Dahl BL, Carsson GE, Ekfeldt A. Occlusal wear of teeth and restorative materials: A review of classification, etiology, mechanisms of wear, and some aspects of restorative procedures. *Acta Odontol Scand* 1993;51(5):299-311.
- [25]. Imfeld T. Dental erosion. Definition, classification and links. *Eur J Oral Sci* 1996;104(2):151-155.
- [27]. David Bartlett, Chris Dugmore. Pathological or physiological erosion—is there a relationship to age? *Clin Oral Investig* 2008;12(1): 27-31.
- [28]. Kaifu Y, Kasai K, Townsend GC, Richards LC. Tooth wear and the "design" of the human dentition: a perspective from evolutionary medicine. *Am J Phys Anthropol* 2003;37:47-61.
- [29]. Grippo JO. Abfractions: a new classification of hard tissue lesions of teeth. *J Esthet Dent* 1991;3(1):14-9.
- [30]. Glossary of Prosthodontic Terms, ed 7. *J Prosthet Dent* 1999; 81:84.
- [31]. Lehman ML, Meyers ML. Relationship of dental caries and stress: concentrations in teeth as revealed by photoelastic tests. *J Dent Res* 1966;45:1706-14
- [32]. Shore NA. Temporomandibular joint dysfunction and occlusal equilibrium. 2<sup>nd</sup> ed. Philadelphia: Lippincott; 1976:11.
- [33]. Straub WJ. Malfunctions of the tongue. *Am J Ortho* 1960;40:404-20
- [34]. Kydd WL. Maximum forces exerted on the dentition by the perioral and lingual musculature. *J Am Dent Assoc* 1957;55:646-51.
- [35]. Murphy TR. Reduction of the dental arch by approximal attrition: a quantitative assessment. *Br Dent J* 1964;116:483-8.
- [36]. Chu FC, Yip HK, Newsome PR, Chow TW, Smales RJ. Restorative management of the worn dentition: I. Aetiology and diagnosis. *Dent Update* 2002;29(4):162-8.
- [37]. Grippo JO, Simring M, Schreiner S. Attrition, abrasion, corrosion and abfraction revisited. *J Am Dent Assoc* 2004;135:1109-18.
- [38]. Glossary of Prosthodontic Terms, ed 7. *J Prosthet Dent* 1999; 81:70.
- [39]. Lee WC, Eakle WS. Stress-induced cervical lesions: review of advances in the past 10 years. *J Prosthet Dent* 1996;75(5):487-94.
- [40]. McCoy G. On the longevity of teeth. *J Oral Implantol* 1983;11(2):248-67.
- [41]. Lee WC, Eakle WS. Possible role of tensile stress in the etiology of cervical erosive lesions of teeth. *J Prosthet Dent* 1984;52(3):374.
- [42]. Lussi A. Dental erosion clinical diagnosis and case history taking. *Eur J Oral Sci* 1996;104(2 ( Pt 2)):191-8.
- [43]. Turner KA. Restoration of the extremely worn dentition. *J Prosthet Dent* 1985;52:467-74.
- [44]. Krishna MG, Rao KS, Goyal K. Prosthodontic management of severely worn dentition: including review of literature related to physiology and pathology of increased vertical dimension of occlusion. *J Indian Prosthodont Soc* 2005;5(2):89-93.
- [45]. Schuyler CH. Factors in occlusion applicable to restorative dentistry. *J Prosthet Dent* 1953;3:722.
- [46]. Litonjua LA, Andreana S, Bush PJ, Cohen RE. Tooth wear: attrition, erosion, and abrasion. *Quintessence Int* 2003;34(6):435-46.
- [47]. Kaushik SK, Madan R, Gambhir A, Prasanth T. Aviation stress and dental attrition. *Ind J Aerospace Med* 2009;53(1):6-10
- [48]. van't Spijker A, Kreulen CM, Creugers NH. Attrition, occlusion, (dys)function, and intervention: a systematic review. *Clin Oral Implants Res* 2007;18(Suppl 3):117-26.
- [49]. Sangeeta Yadav. A Study on Prevalence of Dental Attrition and its Relation to Factors of Age, Gender and to the Signs of TMJ Dysfunction. *J Indian Prosthodont Soc* 2011;11(2):98–105.
- [50]. Seligman DA, Pullinger AG, Solberg WK. The prevalence of dental attrition and its association with factors of age, gender, occlusion and TMJ symptomatology. *J Dent Res* 1988;67:1323–33.
- [51]. Egermark-Ericksson I. Malocclusion and some functional recordings of the masticatory system in Swedish school children. *Swed Dent J* 1982;6:9–20.
- [52]. Richmond G, Rugh JD, Dolfi R, Wasilewsky JW. Survey of bruxism in an institutionalized mentally retarded population. *Am J Ment Defic* 1984;88:418–421.
- [53]. Clarke NG, Townsend GC, Carey SE. Bruxing patterns in man during sleep. *J Oral Rehabil* 1984;11:123–7.

- [54]. Rivera-Morales WC, Mohl ND. Restoration of the vertical dimension of occlusion in the severely worn dentition. *Dent Clin North Am* 1992;36(3):651-64.
- [55]. Dental practice parameters approved by the American Dental Association (ADA)
- [56]. Penny Fleur Bardsley. The evolution of tooth wear indices. *Clin Oral Investig* 2008;12(1):15–19.
- [57]. Smith BG, Knight JK. An index for measuring the wear of teeth. *Br Dent J* 1984;156:435–438.
- [58]. Johansson AK. On dental erosion and associated factors. *Swed Dent J Suppl* 2002;156:1-77.
- [59]. Carlsson GE, Johansson A, Lundqvist S. Occlusal wear. A follow-up study of 18 subjects with extensively worn dentitions. *Acta Odontol Scand* 1985;43(2):83-90.
- [60]. Johansson A, Johansson AK, Omar R, Carlsson GE. Rehabilitation of the worn dentition. *J Oral Rehabil* 2008;35(7):548-66.
- [61]. van der Meulen MJ, Lobbezoo F, Naeije M. Role of the psychologist in the treatment of bruxism. *Ned Tijdschr Tandheelkd* 2000;107(7):297-300.
- [62]. Landry ML, Rompré PH, Manzini C, Guitard F, de Grandmont P, Lavigne GJ. Reduction of sleep bruxism using a mandibular advancement device: an experimental controlled study. *Int J Prosthodont* 2006;19(6):549-56.
- [63]. Thompson BA, Blount BW, Krumholz TS. Treatment approaches to bruxism. *Am Fam Physician* 1994;49(7):1617-22.
- [64]. Brägger U, Lauchenaue D, Lang NP. Surgical lengthening of the clinical crown. *J Clin Periodontol* 1992;19(1):58-63.
- [65]. Berry DC, Poole DF. Attrition: possible mechanisms of compensation. *J Oral Rehabil* 1976;3(3):201-6.
- [66]. Dahl BL, Krogstad O, Karlsen K. An alternative treatment in cases with advanced localized attrition. *J Oral Rehabil* 1975;2(3):209-14.
- [67]. De Boever JA, Carlsson GE, Klineberg IJ. Need for occlusal therapy and prosthodontic treatment in the management of temporomandibular disorders. Part II: Tooth loss and prosthodontic treatment. *J Oral Rehabil* 2000;27(8):647-59.
- [68]. Yip KH, Smales RJ, Kaidonis JA. Differential wear of teeth and restorative materials : clinical implications. *Int J Prosthodont* 2004;17(3):350-6.
- [69]. Redman CD, Hemmings KW, Good JA. The survival and clinical performance of resin-based composite restorations used to treat localised anterior tooth wear. *Br Dent J* 2003;194(10):566-72.
- [70]. CCK Ho. Non-cariou tooth surface loss. *Australasian Dental Practice* 2007 May/ June.
- [71]. Tsiggos N, Tortopidis D, Hatzikyriakos A, Menexes G. Association between self-reported bruxism activity and occurrence of dental attrition, abfraction, and occlusal pits on natural teeth. *J Prosthet Dent* 2008 ;100(1):41-6
- [72]. Addy M, Shellis RP. Interaction between attrition, abrasion and erosion in tooth wear. *Monogr Oral Sci* 2006;20:17-31.
- [73]. Abrahamsen TC. The worn dentition- pathognomonic patterns of abrasion and erosion. *Int Dent J* 2005;55(4 Suppl 1):268-76.
- [74]. Atar, M, Körperich E J. Systemic disorders and their influence on the development of dental hard tissues: a literature review. *J Dent* 2010;38(4):296-306.
- [75]. Seligman D A, Pullinger AG, Solberg WK. The prevalence of dental attrition and its association with factors of age, gender, occlusion, and TMJ symptomatology. *J Dent Res* 1988;67(10):1323-33.
- [76]. Rollman GB, Gillespie JM. The role of psychosocial factors in temporomandibular disorders. *Curr Rev Pain*. 2000;4(1):71-81.
- [77]. Macedo CR, Silva AB, Machado MA, Saconato H, Prado GF. Occlusal splints for treating sleep bruxism (tooth grinding). *Cochrane Database Syst Rev* 2007;(4):CD005514.
- [78]. Re`J-P, Perez C, Darmouni L, Carlier JF, Orthlieb J-D. The occlusal splint therapy. *J Stomat Occ Med* 2009;2:82-86.
- [79]. Lobbezoo F, van der Zaag J, van Selms MK, Hamburger HL, Naeije M. Principles for the management of bruxism. *J Oral Rehabil*. 2008;35(7):509-23.
- [80]. Huynh N, Manzini C, Rompré PH, Lavigne GJ. Weighing the potential effectiveness of various treatments for sleep bruxism. *J Can Dent Assoc* 2007;73(8):727-30.
- [81]. Cohen SP, Mullings R, Abdi S. The pharmacologic treatment of muscle pain. *Anesthesiology*. 2004;101(2):495-526.
- [82]. Poyser NJ, Porter RW, Briggs PF, Chana HS, Kelleher MG. The Dahl Concept: past, present and future. *Br Dent J*. 2005;198(11):669-76.