References

1. Nyman S, Ericsson I. The capacity of reduced periodontal tissues to support fixed bridgework. J Clin Periodontol 1982;9:409–414.
2. Wennström J, Ekestubbe A, Grondahl K, Karlsson S, Lindhe J. Oral rehabilitation with implant-supported FPD in periodontitis-susceptible subjects. A 5-year prospective study. Clin Periodontol 2004;31:713–724.
3. Claffey N, Polyzois I, Ziaka P. An overview of non-surgical and surgical therapy. Periodontol 2000 2004;36:35–44.
4. DeSanctis M, Murphy KG. The role of resective periodontal surgery in the treatment of furcation defects. Periodontol 2000 2000;22:154–168.
5. Svärdström G, Wennström JL. Periodontal treatment decisions for molars: An analysis of influencing factors and long-term outcome. J Periodontol 2000;71:579–585.
6. Cortellini P, Tonetti MS. Long-term tooth survival following regenerative treatment of intra-bony defects. J Periodontol 2004;75:672–678.
7. Heden G, Wennström JL. Five-year follow-up of regenerative periodontal therapy with enamel matrix derivative at sites with angular bone defects. J Periodontol 2006;77:295–301.
8. Sanz M, Giovannoli JL. Focus on furcation defects: Guided tissue regeneration. Periodontol 2000 2000;22:169–189.
9. Murphy KG, Gunsolley JC. Guided tissue regeneration for the treatment of periodontal intrabony and furcation defects. A systematic review. Ann Periodontol 2003;8:266–302.
10. Needleman IG, Worthington HV, Giedrys-Leeper E, Tucker RJ. Guided tissue regeneration for periodontal infra-bony defects. Cochrane Database Syst Rev 2006;(2):CD001724.
11. Esposito M, Grusovin MG, Coulthard P, Worthington HV. The efficacy of various bone augmentation procedures for dental implants: A Cochrane systematic review of randomized controlled clinical trials. Int J Oral Maxillofac Implants 2006;21:696–710.
12. Wennström JL, Tomasi C. Periodontal infection control: Current clinical concepts. Endodontic Topics 2006;13:3–12.
13. Taylor BA, Tofler GH, Carey HMR, et al. Full-mouth tooth extraction lowers systemic inflammatory and thrombotic markers of cardio vascular risk. J Dent Res 2006;85:74–78.

Tooth Wear and Occlusion: Friends or Foes?

Nico H.J. Creugers
Professor and Chair
Department of Oral Function and Prosthetic Dentistry
College of Dental Science
Radboud University Nijmegen Medical Centre
Nijmegen, The Netherlands
Fax: +31 24 36541971
E-mail: n.creugers@dent.umcn.nl

Arie van't Spijker
PhD Student, Department of Oral Function and Prosthetic Dentistry
College of Dental Science, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

It is believed that extensive tooth wear is a potential threat to the functional dentition. From a prosthodontic point of view, attrition is of particular concern because it interacts directly with a central issue: occlusion. In a 1976 paper, attrition was considered to be part of a normal aging process in which depositioning of secondary dentin, alveolar growth, and muscle adaptation compensate for the loss of tooth substance.[1] The authors state that "attrition, whatever its extent, can never be excessive." Nevertheless, attrition may affect dental occlusion, and it is still disputed whether a changing occlusion should be ignored. It has been advised by some authors that tooth wear should be diagnosed early and treated quickly.[2] Others advise careful monitoring above early treatment because the progress of tooth wear can fluctuate.[3]

The interrelationship between occlusion and (the management of) tooth wear has been considered in the dental literature in 2 ways. First, it has been suggested that certain occlusal schemas may influence the development of tooth wear. Second, occlusal concepts may be considered useful to compass the treatment of worn teeth and dentitions. This paper aims to combine existing knowledge regarding the role of occlusal factors and concepts with (the management of) tooth wear, based on a systematic review by our research group on this topic.

Evidence of the Relationship Between Tooth Wear and Occlusion

The systematic review found 33 eligible articles describing the relationships between attrition and occlusal factors and/or oral (dys)function.[4]

Only a few studies reported correlations between attrition and occlusal parameters. Several studies reported no correlation between anterior attrition and absent posterior teeth, though 1 study found that lower numbers of teeth resulted in a higher tooth wear index of the remaining teeth. Associations between attrition and anterior (spatial) relationships were reported in several studies. As could be expected, anterior guidance seems to reduce the risk for posterior attrition, but increases the risk for anterior attrition. Whether the occurrence of anterior tooth wear is more or less a threat to the dentition or its function than posterior tooth wear remains a subjective issue.

Fig 1 *(left)* Frontal view of the dentition of a 27-year-old man exhibiting severe tooth wear, which was diagnosed as a combination of attrition (most likely due to bruxism) and erosion caused by gastroesophageal reflux disease. The patient complained of sensitive teeth, and large dentin surfaces were exposed. At the time of referral, the patient wore a removable splint that provided a convenient vertical dimension of occlusion.

Fig 2 *(right)* Occlusal view of the maxilla before restorative treatment

Fig 3 *(left)* Occlusal view of the mandible after restorative treatment. Maxillary and mandibular premolars and canines and maxillary incisors were restored with resin composite. A heavily filled hybrid resin composite with a nonabrasive filler was used occlusally. For buccal surfaces, a polishable anterior hybrid composite was applied. To maintain a durable vertical dimension of occlusion, gold uplays were adhesively cemented on the mandibular first molars. These restorations were opposed by enamel.

Fig 4 *(right)* Restorations after almost 5 years of function. The restored canine guidance is still present.

Regarding functional parameters in relation to attrition, only 1 study addressed "normal" function. Several reports dealt with temporomandibular disorders or bruxism, thus addressing dysfunction. Of these, most addressed the question of whether functional or dysfunctional parameters may be cause for attrition. Bruxism was identified as an associative factor in dental attrition in most of the studies. However, since all reported associations were based on self-reported bruxism, they are lacking a sound methodologic basis.[5]

With respect to treatment of tooth wear, 1 prospective study reported less attrition in children wearing bite plates. Two retrospective studies examined the relationships between tooth wear and treatment history. Orthodontic treatment history was not associated with attrition, whereas extensive restorative treatment seemed to increase the risk for tooth wear. However, these studies did not compare true effects of one treatment to another; instead, they merely looked at tooth wear as a side effect of variable treatments in the past. No papers were identified investigating the threshold values of tooth wear at which interventions are indicated in subjects with attrition.

Overall, it was concluded that this analysis of the dental literature failed to find sound evidence supporting one superior occlusion-based treatment protocol over the others with respect to the management of attrition.

Clinical Considerations

Though evidential scientific support is lacking, one treatment strategy in cases of tooth wear seems to make sense. This strategy is based on providing reversible restorative oral rehabilitation and a thorough understanding of the etiology and development of occlusal anomalies over time.

The principle of reversibility is important because the worn dentition is usually the result of a slow process of occlusal breakdown, which allows most patients to adapt gradually to this situation until a level of unacceptability is reached. In contrast, restoration of occlusal morphology is a sudden action that hinders careful evaluation of the patient's ability to readapt to changed oral conditions.

Understanding the development (genesis) of worn dentition helps the practitioner guide the process of restoring occlusal balance to a level of acceptable function and esthetics. The wear-path to a collapsed bite may vary. Local tooth wear (eg, loss of canine guidance) may develop into regional wear, which may subsequently lead to displacement of the anterior dentoalveolar complex or condilar displacement. More general wear may only cause absent occlusal morphology, but can also lead to loss of vertical dimension of occlusion or complete breakdown of occlusal support. If the practitioner is able to reconstruct the

sequence of this process, or in other words, to produce an accurate "virtual movie" of the process, the backward transcription of this "movie" will provide the steps necessary for the reconstruction process. This strategy has been followed in the case displayed in Figs 1 to 4.

Acknowledgment

The authors would like to thank Dr Joost Roeters for the use of the clinical case presented in this paper.

References

1. Berry DC, Poole DFG. Attrition: Posible mechanisms of compensation. J Oral Rehabil 1976;3:201–206.
2. Dawson PE. Functional Occlusion: From TMJ to Smile Design. St Louis: Mosby, 2007.
3. Smith BG, Robb ND. The prevalence of tooth wear in 1007 dental patients. J Oral Rehabil 1996;23:232–239.
4. van't Spijker A, Kreulen CM, Creugers NHJ. Attrition, occlusion, (dys)function and intervention: A systematic review. Clin Oral Implants Res 2007 (in press).
5. Lavigne, GJ, Rompre PH, Montplaisir JY. Sleep bruxism: Validity in diagnosed research criteria in a controlled polysomnographic study. J Dent Res 1996;75:546–552.

Overdenture Therapy and Worst-Case Scenarios: Alternative Management Strategies

Francesco Bassi, MD, DDS
Biological Science and Human Oncology, Prosthodontic Section
School of Dentistry
University of Turin, Italy
E-mail: f.bassi@onw.it

The characteristics of the general population are going to change: according to an epidemiologic projection, in the year 2025 more than 20% of the population in Europe, Japan, and Canada will be over 65 years of age; furthermore, the incidence of complete edentulism will severely increase after 75 year of age.[1] Often, elderly patients have great difficulty adapting to new situations (eg, learning new neuromuscular reflexes for active retention with complete dentures). From an economic point of view, financial power is often decreased after retirement, rendering many of our rehabilitations unacceptable.

It is important to treat completely edentulous patients in a gradual and inexpensive manner. Patients must be able to adapt psychologically and functionally to the new situation. One option to achieve such a result is overdenture treatment on natural teeth. Overdentures have been successfully used for many years and are still considered as a useful treatment modality.[2]

The Glossary of Prosthodontic Terms defines an overdenture as "Any (complete or partial) removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and/or dental implants; a dental prosthesis that covers and is partially supported by natural teeth, natural tooth roots, and/or dental implants—called also *overlay denture*, *overlay prosthesis*, *superimposed prosthesis*."

The advantages of overdentures can be classified as follows:

- *Psychologic:* Self-image is maintained or even improved (when esthetics are poor before treatment); functional satisfaction is related to number, position, and condition of teeth; some teeth are still preserved.[3]
- *Functional:* Periodontal receptors and denture stability and retention allow occlusal force discrimination to be maintained; masticatory performance and electromyographic activity remain similar to the dentate population[4]; retention of only 2 roots is sufficient to obtain good results.[5]
- *Biologic:* Resorption of the alveolar ridge, which is worsened in complete denture wearers, is extremely diminished; settling and relining of the dentures is reduced.[6]

The possible complications and failures can be classified as follows:

- *Tooth decay:* Incidence between 6% and 35%; can be controlled by covering the abutments with cast copings, use of bonding agents, thorough oral hygiene, and fluoride and chlorhexidine protection.[7]
- *Gingivitis:* Incidence between 4% and 13% around the retained roots; can be controlled as reported by Butz-Jorgensen[8]; overlaid roots can be maintained via excellent home care and professional assistance.
- *Endodontic failure:* Ettinger and Qian[9] showed a 12.1% rate of endodontic failure in a 23-year longitudinal study; most common causes were periapical lesions developed on endodontically treated teeth (37%) and vital teeth (19.8%).
- *Vertical root fracture:* Represents 30.9% of overdenture abutment failures and occurs more frequently in the maxilla when opposed by natural teeth.[9]