

# Minimum intervention dentistry and the management of tooth wear in general practice

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## ABSTRACT

The incidence of tooth wear, or non-carious tooth surface loss (NCTSL), is increasing and oral rehabilitation of patients with non-carious tooth loss requires strategies that address all the factors relevant to the aetiology and pathogenesis of the condition. The multifactorial nature of tooth wear and the variability in its clinical presentation provides treatment challenges for the clinician and successful management must be more than just restoration. Management must include an appropriate mix of preventive and restorative strategies and an understanding that long-term restorative success is affected by the patient's oral environment, and how diet, lifestyle and medical status can modify this environment. Ultimately, the success of any restorative intervention is very dependent on the stability of the oral environment and the condition of the remaining tooth structure. Minimum intervention dentistry (MID) philosophies are ideally suited to tooth wear cases and an overall MID strategy involving diagnosis, recognition and control of predisposing factors, stabilization of the oral environment, remineralization and restoration of the tooth structure, and ongoing maintenance can be implemented. When restorative treatment is required, contemporary materials and techniques are available that can provide cost-effective and conservative restorative alternatives for patients unable to undergo the complex indirect restorative techniques that are both costly and time consuming to implement. These minimally invasive approaches are not only an economically viable solution, but can provide aesthetic and functional rehabilitation and maintain tooth structure as a precursor to more complex restorative options when required.

**Keywords:** Tooth wear, risk assessment, minimum intervention, oral environment, conservative restoration.

**Abbreviations and acronyms:** BEWE = Basic Erosive Wear Examination; MID = minimum intervention dentistry; NCTSL = non-carious tooth surface loss.

## INTRODUCTION

Caries and periodontal disease continue to be issues for the oral health profession, but there are also concerns over the substantial increase in yet another disease area, that of tooth wear or non-carious tooth surface loss (NCTSL). Although not specifically a micro-organism related disease, it is a non-reversible pathological condition which, if untreated, can cause substantial damage to the patient's dentition. The multifactorial nature of the disease, and the variability in its clinical presentation, provides a range of treatment challenges for the clinician. Unfortunately, while this is a preventable condition, its incidence is increasing in the population of all age groups around the world. Despite the overall trend towards improved oral health and reduced dental caries incidence over the last decades, epidemiological evidence is supporting the contention that tooth wear is increasing in severity and prevalence, not only amongst older

people who are living longer and retaining more teeth, but also amongst those in the early decades of their adult life.<sup>1–3</sup> This rising incidence of tooth wear has increased the demand on dental practitioners to provide a range of treatment options for the replacement of the lost tooth structure to cater for the range of individuals presenting with varying degrees of tooth wear.

Historically, treatments for the restorative management of tooth wear frequently involved the provision of multiple crowns and bridges to restore form and function and, as this was considered the definitive restorative treatment for the tooth surface loss, many still believe this is the best restorative intervention for patients with tooth wear.<sup>4–6</sup> Unfortunately, this approach can be quite destructive and in the cases of full oral rehabilitation it may involve the crowning of minimally affected or unaffected teeth, allegedly with the aim of protecting their surfaces from further tooth wear, but in fact causing more harm to the tooth

structure than the initial tooth wear.<sup>7</sup> In recent years there has been an increasing trend towards the restoration of severely worn and broken down dentitions using more conservative approaches with adhesive restorative materials.<sup>7-11</sup> These approaches aim to preserve as much remaining tooth structure as possible and provide a cost-effective management option for patients.

However, it is essential that any restorative treatment is only undertaken after careful diagnosis of the causative factors, stabilization of the oral environment and prevention of further tooth destruction, and where possible remineralization of the remaining tooth structure to enhance adhesive bonding.<sup>12,13</sup> Risk assessment, compliance and a commitment from both the oral health professional and patient underpin the overall success of the treatment. In the diagnosis and treatment planning phase it is important to understand and take into consideration the differences in the process of demineralization and tooth material loss in tooth wear cases compared to dental caries. While dental caries is a localized event with plaque producing relative weak acids which demineralize tooth tissue over a prolonged period of time, tooth erosion is predominantly linked with stronger extrinsic or intrinsic acids over relatively short periods of time and the tooth surface loss can be quite extensive.<sup>9-11</sup> Prevention of this acidic demineralization in the absence of plaque is very dependent on the ability of saliva to stabilize and buffer the acidic challenges in the mouth. Patients with reduced salivary flow or reduced salivary buffering capacity will be at greater risk, and frequently are those demonstrating signs of tooth erosion.<sup>12-16</sup>

Hyposalivation is a growing concern in dental practice and may be due to a multitude of factors including diet and lifestyle factors, medication side effects or underlying systemic conditions.<sup>17-20</sup> As our population ages, and individuals keep their teeth longer, we are faced with the ever increasing geriatric dentate population with a greater risk of hard tissue dental disease. Combine this with an increasing number of medications being provided to this older population and the overall hyposalivation and xerostomia concerns become more pronounced.<sup>21,22</sup> Consequently, the potential for irreversible tooth surface loss, other than by caries, becomes an important aspect of patient oral health management.

## DIAGNOSIS AND RISK ASSESSMENT

Thorough patient risk assessment is essential and requires that all predisposing factors are considered and risks minimized. There are many diagnostic templates and risk assessment protocols available to assist in this process,<sup>23-25</sup> but it is important to be aware

that no two individuals will be the same and consideration must be given to specific circumstances. A careful step-by-step evaluation of diet and lifestyle factors must be undertaken and all predisposing and causative factors identified. Frequently, individuals focus on the presence of sugars and carbohydrates in the diet with the focus on caries and development of a cariogenic biofilm, but it is essential to also assess acid intake and frequency of exposure. Lifestyle factors which may lead to dehydration and reduction in saliva, and inadequate hydration are frequently encountered in patients and assessment of hyposalivation and xerostomia are essential in the examination and assessment process.<sup>26</sup> Individuals will also have widely differing medical and dental histories and this must be taken into consideration when assessing the individual and deciding on the interventions for management of the tooth wear.<sup>27</sup> As such it is important to accept that there is no single 'off the shelf' treatment modality suitable for all patients, but similar strategies of management can be employed.

It is essential to not only recognize the presence of tooth wear, but more importantly to determine the activity status of the process. Many patients will present with tooth surface loss and, while for the sake of record taking it can be classified as showing patterns of erosion, abrasion, attrition or abfraction, it is rarely related to one single factor but rather the result of many or all of these processes. There is often no knowledge of how or when this tooth surface loss commenced and over what period of time it occurred. Determining if the tooth wear is a result of past destruction and is now stabilized, or if it is currently still actively occurring, becomes central to determining intervention and management strategies. Most patients will demonstrate a range of factors contributing to their overall wear, and while many long-standing concepts of 'tooth brush abrasion' or 'bruxism' have been suggested as causing tooth wear, these are often only part of the problem and there is frequently an underlying erosive process which accelerates the process beyond the normal physiological range.<sup>28</sup>

While there are a number of proposed tooth wear indices and scoring criteria published,<sup>29-33</sup> there is currently no real consensus on an ideal method of recording and evaluating tooth wear, so it falls on the individual operator to make their own clinical decision on when and how to evaluate, record and determine management options. The concept of the Basic Erosive Wear Examination (BEWE)<sup>30</sup> was suggested as a simple tool for use in general practice and provides a simple structure for identifying and recording the visible evidence of tooth wear. The most severely affected tooth surface in each sextant is recorded with a four-level score (0 = no erosive tooth wear, 1 = initial loss of surface texture, 2 = distinct defect, with

hard tissue loss <50% of the surface area, 3 = hard tissue loss ≥50% of the surface area) and the cumulative score classified and matched to risk levels which guide the management of the condition. While this scoring system is extremely useful in collecting data for scientific and clinical use, and encourages clinicians to pay more attention to the presence of tooth wear, it does not establish the presenting activity of the wear process. Clinical charting and recording of the overall presenting appearance of the teeth does not differentiate between currently active tooth wear and historical, now stabilized tooth wear.

However, there are a number of clinical indicators which may provide a guide for determining the activity of tooth wear and these should be carefully assessed prior to the commencement of any restorative treatment. Visual clues such as decreased surface lustre on enamel and dentine may be an indicator of acid dissolution of the tooth surface, similar to tooth etching. Gentle air drying of the tooth surface may show a lack of reflectivity and possibly indicate a reduction in surface mineralization. In active erosion cases, exposed dentine is often quite sensitive due to dissolution of any protective smear layer and the opening of dentine tubules, thereby allowing tubule fluid flow and sensitivity to stimulus. Patients with active tooth erosion often complain of tooth sensitivity, particularly after consuming certain acidic foods or beverages, and this should be taken as a clear indicator of a shift in oral balance from remineralization to demineralization and removing the surface protection on dentine.<sup>34–36</sup> The presence of calculus, particularly on the lingual of the lower incisors teeth, should always be assessed in patients with tooth wear as the absence of calculus may be an indicator of unsaturated saliva with insufficient ability to mineralize. The formation of calculus is a mineralizing event and will not occur when there is a balance towards demineralization in the mouth. The evaluation of salivary flow, viscosity, pH and buffering capacity becomes critical in these cases, not just for the clinician, but for the patient to assist them in developing an understanding of the risks present.<sup>37,38</sup> Placement of restorations in an oral environment where there are uncontrolled risks and active disease will undoubtedly lead to early restoration failure. To ensure predictable long-term success of any restorative intervention, it is critical that the tooth substrate it attaches to is sound and it resides in a stable and healthy oral environment.

## STABILIZATION AND REMINERALIZATION

Active tooth erosion will produce a demineralized tooth surface which will not provide a reliable or predictable bond with adhesive restorative materials. A severely compromised tooth surface may in fact be

more prone to cohesive failure of the tooth rather than adhesive failure at the restoration tooth interface. Predictable adhesion with acid etch composite resin, glass-ionomer cements and resin-reinforced glass-ionomer cements can only be achieved when an adequately mineralized enamel surface is present. To ensure the maximum benefits from all adhesive restorative materials it is essential that the oral environment is stabilized, risk factors reduced, and the tooth surface remineralized to the best possible condition prior to repair.<sup>9,33</sup> Strategies for remineralization should include reduction of acids and underlying risk factors where possible, and the inclusion of various remineralization agents. Fluoride has been accepted as an effective agent for enhancing remineralization and reducing demineralization, but it must be remembered that its action is very dependent on the availability of sufficient calcium. Most current remineralization strategies include recommending the use of calcium and phosphate enhanced remineralization products.<sup>39–43</sup> It must be remembered that bioavailability of calcium, phosphate and fluoride ions is critical, as is the presence of saliva, in enabling adequate remineralization of the tooth surface.<sup>43</sup> The absence of saliva will reduce the potential benefits of remineralizing agents and consideration may need to be given to the inclusion of a saliva substitute or hydrating agent to enhance the remineralization potential.<sup>12</sup> It is also clear that patient motivation and compliance have a substantial impact on success and the patient must be made aware of the importance of this preparation phase prior to restoration. The time taken for stabilization of the oral environment and remineralization of the tooth structure will vary from individual to individual, and the clinician can assess the appropriate time to commence restorative treatment based on the various clinical signs and symptoms previously discussed. Most important is the recognition of patient compliance and an understanding that maintenance of oral health is paramount in the longevity of any restorative procedure.

Once the clinician is satisfied with the level of disease stability and tooth surface remineralization, the technical task of rehabilitating a severely worn dentition can proceed. The range of restorative materials available enables the selection of a number of different approaches and the restorative strategies chosen will be very operator and individual patient dependent. While complex reconstructions with ceramics, crowns, bridges and implants may be considered the best or 'ideal' option, many patients are unable to afford the cost associated with this extensive work and consequently many patients request less costly options. Restoration and rehabilitation of worn dentitions using direct and semi-direct tooth coloured adhesive restoratives have been shown to be a very successful and conservative option for many cases,

and these less invasive treatments when implemented following on from the initial stabilization phase may be used to evaluate long-term patient compliance prior to undertaking more complex and costly indirect procedures.<sup>4,5,8,9,11,13,44</sup>

## CONSERVATIVE RESTORATIVE OPTIONS

There are currently available a range of materials and techniques which enable cost-effective and conservative alternatives to the restorative management of patients with tooth wear at an earlier stage. Options exist for the use of direct adhesive restorative materials to address the immediate functional and aesthetic concerns of the patient and minimize further damage.<sup>7,9-11,44</sup> In a well stabilized oral environment these treatments provide an intermediate restorative option aiming toward the long-term occlusal and functional rehabilitation of the worn dentition. Indeed it has been suggested that there may be a tendency in dental practice to place more full crowns than may be necessary, and that the numerous advances that have become available to make conservative dentistry easier and more attractive for dentists and patients.<sup>45</sup> Contrary to popular belief among dentists, conservative restorations can demonstrate good service longevity, and practitioners need to be aware that conservative restorative dentistry can benefit patients and still be profitable for dental practices.

There is also evidence emerging that when patients are adequately informed, most prefer more conservative options using adhesive tooth coloured restorations rather than the destructive options required for ceramic restorations.<sup>46</sup> In addition, patients do not perceive porcelain restorations to be necessarily more aesthetic than resin composite restorations.<sup>46</sup>

The concept of pragmatic aesthetics has been suggested as an appropriate approach for many patients in which the aesthetics of the patient's anterior dentition has been improved from the original appearance, but may not be perceived as 'dental perfection'.<sup>7,47</sup> In other words, the appearance of the teeth has been made as good as it can be without causing any significant damage to tooth structure or a need for destructive periodontal surgery.<sup>7</sup> This conservative and pragmatic approach provides a very appropriate option for patients and provides a mechanism of restoratively managing tooth wear that is conservative, predictable, and usually aesthetically acceptable to patients, and is also safe with minimal long-term pulpal or structural complications being reported.<sup>2</sup>

Long-term success is dependent on initial patient risk assessment and the ability to stabilize and remineralize, and ultimately the level of patient compliance. Careful case selection with appropriate pre-restorative preparation involving diagnostic

records, diagnostic wax-ups and an understanding of the limitations of the materials being used can lead to very successful outcomes. Frequently there is loss of vertical height and no available space for placement of restorative materials and it becomes necessary to increase the tooth height, thereby increasing the occluding vertical dimension. Frequently the determination of the increase in vertical height is determined by the aesthetic result required and the final anatomical shape of the anterior teeth. In the majority of cases this increase in opening is well tolerated by the patient, but may take some days to fully feel comfortable with the increased size of the teeth relative to the previously worn dentition.

Alternatively, the required space for the restoration of worn anterior teeth can be achieved by placement of a Dahl Appliance.<sup>48-51</sup> This concept for achieving the necessary space was put forward by Dahl in the 1970s,<sup>52</sup> although the original work examining the effect of placing a supra-occluding restoration on a posterior tooth was originally described by Anderson in 1962.<sup>53</sup> Dahl used a removable appliance limited to the palatal aspects of maxillary anterior teeth affected by NCTSL (the so-called Dahl Appliance), causing disclusion of the posterior teeth and reported that the posterior teeth subsequently regained occlusal contacts. These regained occlusal contacts were attributed to a combination of intrusion of the anterior teeth and eruption of the posterior teeth. However, mandibular condylar repositioning to a more superior and retruded position could also be considered to account for some of the changes reported.<sup>7</sup> It has also been suggested that with cases of localized anterior tooth wear, restoring the anatomical form of the anterior teeth and leaving the posterior teeth discluded is in essence mimicking the placement of a Dahl Appliance and the subsequent eruption of the unaffected posterior teeth enables equilibration of the occlusion without any further restorative work.<sup>9</sup>

The restorative procedures used to restore the anterior teeth with direct placement tooth coloured restorative materials are many and varied. The use of preformed templates and silicone putty keys for the reconstruction of lost tooth structure is well established.<sup>54,55</sup> These techniques enable the reconstruction of the palatal and incisal surfaces of the teeth to match the diagnostic wax-up and thereby reduce the need for major occlusal adjustments. These techniques can be extended to the use of a transparent polyvinyl siloxane template constructed from the diagnostic wax-up to rapidly reproduce the full anatomical structure of the tooth with direct placement of restorative materials into the mouth.<sup>56</sup> This technique can be used to rapidly reproduce the anatomical structure of the anterior teeth with direct restorative materials in the mouth, and provides benefits for patients and clinicians by reducing



treatment time and providing a cost and time effective technique for the placement of multiple direct restorations.<sup>9</sup> The restoration of posterior teeth can then proceed using direct or indirect procedures, depending on the amount of tooth wear present in the posterior segments. Frequently indirect restorations are indicated due to the large surface area that is required to be replaced and the difficulty in obtaining adequate interproximal contacts. While chairside CAD/CAM milling of composite resin inlays is a viable option,<sup>57</sup> a number of extra-oral chairside techniques have been described using fast setting stone, or hard die silicone, to produce a replica of the worn teeth such that indirect composite resin inlays can be constructed for cementation at a lower overall cost to the patient.<sup>10,58–60</sup>

## LONGEVITY AND MAINTENANCE

The success and longevity of composite resin reconstructions as a treatment option for rehabilitation of the worn dentition has been discussed by a number of authors.<sup>61–65</sup> Long-term follow-up studies show that the main complications are repairable and retrievable with no loss of tooth vitality or need for loss of further teeth.<sup>63</sup> It has been reported that chipping or partial debonding may appear in teeth with no, or minimal, enamel at the margins of the worn surfaces, but the majority of problems are restorable.<sup>7</sup> Further studies have shown that despite concerns regarding materials strength and resistance to occlusal load, the main reasons for failure in the long-term are secondary caries, related to the individual caries risk,<sup>64</sup> and specific materials selection has little or no significant effect on survival time.<sup>65</sup> Patients can have many years of aesthetic and functional success following conservative restorative approaches to the management of tooth wear, and due to the minimally invasive nature of the treatment it allows all other complex treatment options to be considered at a later date. Maintenance and routine reviews of the restorations are required, and provided a mutual and collaborative care regime involving both the patient and the oral health care team is adhered to, then ongoing success and benefit is assured.

It is inevitable that MID restorative techniques will continue to evolve with the development of more bio-compatible restorative materials to help address the ever increasing challenges encountered with debilitated dentitions and severely worn dentitions. However, the key to long-term success is managing the oral environment and minimizing the ongoing risk of tooth wear while maintaining as much natural tooth structure as possible.

## DISCLOSURE

The author has no conflicts of interest to declare.

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