

Tooth Wear Solutions for Success

Techniques & Materials for dealing with worn teeth

Notes to accompany the practical course for
General Dental Practitioners at Exeter

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Overview

Tooth Surface Loss (Tooth Wear) is an increasing problem and needs to be identified early to enable preventative measures to be put in place. TSL includes all forms of loss of tooth material not due to disease of bacterial origin (ie. caries) and is usually considered to be:

- Attrition
- Abrasion
- Erosion
- Fractures
- Developmental defects

Dentistry should also be added to the list as we as a profession often cut bits off teeth!

Always look for it at patient examination using loupes (eg 3x magnification), bright light and dry teeth. Establish a diagnosis then formulate a plan. The TSL can be monitored using photographs, study models, indices or charts. Check these are dated. The general plan is to apply prevention, monitor and avoid restorative treatment where possible. Active intervention should be non-invasive where possible to prevent further tooth loss.

Principles of management:

1. Determine if there is tooth wear
2. Determine the cause(s)
3. Apply prevention and immediate therapy if necessary
4. Monitor the rate of loss (should be low if aetiological factor eliminated)
5. Intervene with restorative procedures only if necessary to restore aesthetics and/or function. Minimal intervention where possible. Identify the Turner type of TSL: 1/2/3
6. Monitor and maintain

The aim of immediate therapy:

- Relieve sensitivity, cover sharp edges
- Identify aetiological factors, form diagnosis, start prevention of further loss
- Protect remaining tooth structure

Examples include:

Diet analysis and counselling, tooth brushing advice, to control or reduce the effects of aetiological factors.

Prescribe a sodium fluoride mouth rinse to be use daily to help with sensitivity, consider desensitising tooth paste and gels (ToothMoose, GC).

Construct a close fitting soft occlusal splint

Consult with general medical practitioner in cases of suspected gastrointestinal disease.

Photographs and impressions for monitoring

Reassessment

After initial therapy a period of time should lapse to allow for assessment of the patients response to the initial therapy. Review symptoms. Monitor rate of loss.

At this stage the patient's views and expectations should be considered and treatment plan finalised.

Consider treatment options: minimal or traditional (preparation). Consider materials and longevity. Consider the occlusion and how to manage it.

There is increasing support of the view that once diagnosed, progression of tooth wear is slow, if preventive advice has been successfully implemented. Restorative intervention may not be necessary.

Monitoring

This is an essential component of management. Evidence of monitoring should be included in patient records for medico-legal purposes and to protect against claims of 'supervised neglect'.

Take baseline measurements at initial examination, including charting

Monitor rate of progression using:

study models (high density stone), intra-oral photographs, putty index sectioned across area of wear.

All records should be named and dated.

These methods are crude but they are all we have available at present in general practice. In time, digital scanners may enable more accurate monitoring.

Basic Erosive Wear Examination(D Bartlett, BDJ 2010; 208: 207-209)

A recently proposed screening tool devised by a group of clinicians from UK, Switzerland and Germany. Based on similar concepts to the BPE. A simple scoring system which gives an indication of the severity of wear, allows screening, recording and monitoring.

Clinical sequence when using BEWE:

1. Diagnose presence of tooth wear(excluding trauma, developmental defects)
2. Examine all teeth and all surfaces for wear
3. Identify in each quadrant the most severely affected tooth with wear
4. Record cumulative BEWE score

Results are recorded in patient notes in grid style, similar to BPE.

Cumulative score is matched to a list of interventions which can assist in management

Criteria for grading wear:

Score	Features
0	No erosive tooth wear
1	Initial loss of surface texture
2	Distinct defect, hard tissue loss<50% of surface area
3	Hard tissue loss >50% of surface area

The concept of the BEWE is still in the early stages and is not yet widely adopted in clinical practice.

Long Term Management

The treatment options are;

1. Review and monitoring - Provided the patient has no significant, aesthetic, functional, occlusal or sensitivity problems then close monitoring is acceptable.

Restorative treatment – based on aesthetic, functional, occlusal requirements. Aim to add to teeth, do not cut more off, protecting and conserving the remaining tooth structure.

Anterior teeth often require veneering, usually composite, which can be palatal to establish the anterior occlusion, move the mandible posteriorly towards RCP, rather like a Lucia jig, or to prevent further palatal erosion. Labial veneers are used to provide aesthetic restoration but can also prevent further erosion. These can be ceramic or composite. Use minimal preparation if possible to maintain enamel.

Posterior teeth usually require occlusal protection against further attrition, erosion or fracture and so consider the occlusal gold overlay with 1mm thick gold. Think of the occlusal surface only of a gold crown bonded onto the tooth with Panavia. This could be an indirect composite but requires 2mm thickness. For missing cusps consider composite direct or indirect to replace what is missing. These techniques require the use of adhesive bonding, good moisture control and up-to-date techniques and materials.

Adhesion

1. Enamel Bonding

Preserve enamel for bonding to. It makes a difference. Wrap over teeth as far as possible, utilize tooth undercuts. Restore before all the enamel is lost.

Always clean the enamel surface to increase bond strength 10x. Composite bonding to enamel following etching with 30-40% phosphoric acid for 20-30s. The different levels of enamel solubility between enamel prism centres and periphery provides a rough surface into which the resin penetrates. Remove of surface enamel initially (0.1mm) greatly improves bond strengths. Bevelling of the cavosurface margin will increase the bonding area, expose prism ends to improve etching, remove the surface contaminated enamel, improve aesthetics. This is not carried out on occlusal surfaces.

The subsequent application of dentine primers does not adversely affect the enamel bond.

2. Dentine Bonding

Dentine bonding is essential to provide a seal in the bulk of the cavity, to eliminate gaps where bacteria may survive, and resist polymerisation contraction. It is particularly important where there is no enamel at the margin such as in a deep proximal box or in most cervical cavities. Dentine Bonding Agents (DBA) have been categorised into “generations”. This in itself is unimportant but it provides a framework to observe the development over the years.

Fourth Generation eg Optibond FL

Technically provides the best bond, also good for Immediate Dentine Sealing (IDS). The dentine and enamel are etched using the same phosphoric acid. Then wash to remove all the debris, smear layer and inorganic debris. Now try to remove water but do not dry the dentine – dry enamel is good but moist dentine is essential - difficult clinically!

With the fourth generation systems (etch then prime then bonding resin) there is a risk of post-op sensitivity due to overdrying dentine and poor resin penetration of the dentine resulting in microscopic leakage, often called nanoleakage.

Fifth Generation

One bottle bonding systems applied after etching, results apparently not quite so good as 4th generation, but the marketplace prefers the simplicity of it, e.g. Dentsply Prime & Bond, Coltene One-coat Bond. So we now have an etch (for enamel and dentine together) then the single application of primer and bond together. Sounds easy? Convenient and gives secure bonding, well-proven. The difficulties are still:

- Etching enamel for 25s, the outer dentine for 15s and deep dentine for 5s.
- Washing away the etchant and demineralised products then drying the enamel but not the dentine
- Keeping the dentine free from contamination, mainly blood and saliva, while bonding
- Controlling polymerisation contraction stresses with in the composite resin

Sixth Generation

More recent developments has been the self-etching adhesives to simplify the stages even further. These components cannot be stored in a single bottle any more so they need to be mixed before use. Some of the well-proven brands such as Clearfil SE requires two bottles but Prompt L-Pop has a novel blister pack with automixing.

Seventh generation

The most recent development has been the incorporation of both components into a single bottle with i-bond *Heraus-Kulzer* as the first. There is a lack of strong evidence to support 6th generation systems and even less for the 7th generation. Given that today's

composites can last over 10 years is it wise to bond them in with adhesive systems that have no long-term proven records? The 4th generation offer the best proven longevity provided the instructions are obeyed but 5th seen as overall best due to convenience and good bonding. 6th/7th may offer similar bond strengths and be easier to use but there are risks.

One concern with the self-etching, self-priming systems is that the enamel etching is less efficient (van Meerbeek et al 2001) and the enamel needs to be specially prepared by cleaning and rubbing in the self-etching adhesive. Does all this defeat the object of a "one-stage bond"?

There are also concerns about the reprecipitation of etched-out minerals and that the products of the demineralised enamel and dentine, and smear layer components (including bacteria and debris) remain. The quality and integrity of the hybrid layer has been questioned but the biggest concern to the clinical dentist may be that the highly acidic adhesive may inhibit polymerisation, means that GIC cannot be used in the same cavity, and also creates a risk of causing soft tissue burns.

In conclusion, the self-etching adhesives are quick and easy to use but there are concerns with them and there is "insufficient long-term research". 4th G is best, followed by 5th G, then 6th G.

Intervention Treatment Summary:

Where damage is to anterior teeth only:



Eg. dietary erosion to labial –

- do you need incisal extension?

- composite mock-up?

- try freehand composite veneers

- consider indirect composite or ceramic veneers (try to avoid further tooth reduction)

- Dahl if required to regain OVD

gastric erosion to palatal

- palatal composite veneers, direct or indirect

- Dahl to regain OVD

incisal wear only, eg attrition or attrition/erosion

- freehand incisal composite, often Dahl type.

Where damage is to posterior teeth only, eg. ruminants:

- Composite to replace what is missing, Dahl if necessary

- Metal overlay



Where damage is to all teeth:

Use combination of above, usually Dahl type to regain OVD



Where lack of teeth present consider partial denture plus overdenture abutments on the very worn teeth.

Occlusal/incisal TSL can be divided into 3 types (Turner Classification):

Type 1 TSL has occlusal/incisal loss of height, normal freeway space and loss of OVD so usually Dahl composites to regain height and maintain, or definitive restorations as the regained height. Put composite where the wear is. Usually on anterior teeth to restore aesthetics and function while preventing sensitivity and further TSL. Get the bonding right (wrap-over) and occlusion correct and they should last with annual repairs.

Type 2 TSL have occlusal/incisal wear, may have loss of OVD, and are usually posturing anteriorly. Consider a provisional anterior jig (Lucia) or nowadays palatal veneers to establish occlusal towards RCP. Add composite to act as a Lucia jig while restoring aesthetics and function. Separate the posterior teeth to allow repositioning on the mandible back into CR. Restore the occlusal position, restore the vertical height and aesthetics once occlusion established in CR. Composite ideal as adjustable.

Type 3 TSL with occlusal/incisal loss of height, normal freeway space but no loss of OVD, due to alveolar compensation. Dahl inadvisable so consider crown lengthening by surgical manipulation of hard and soft tissues. Difficult! May need a full rehabilitation in CR.

Metal adhesive onlays

The principles and materials employed in adhesive bridges can be used with single tooth restorations. General indications and contraindications for this type of restoration are listed below.

Indications

- Cuspal coverage for cracked tooth syndrome or protection
- Short or overtapered clinical crowns
- TSL - erosion/attrition

Contraindications

- Poor oral hygiene
- Subgingival margins
- Inability to gain moisture isolation
- Lack of enamel margins
- Parafunction



The principals of tooth preparation should allow good occlusal coverage with the replacement non-bondable restorations with composite or glass ionomer. The occlusal reduction should provide sufficient material for rigidity based on a clearance of 0.5 - 0.7 mm (unless placed in "high" for a "Dahl" effect). The onlay is extended 0.5 - 1.0 mm below the occlusal reduction, except for the area of the contact point. At the contact point, the extension should stop above this area by sufficient distance to allow the technician to separate the die and gain access to the margin for waxing. This extension serves to provide a bracing action if used for "cracked tooth syndrome", and provides a positive seating for cementation.

The marginal finish should be clear for the technician and can either be a rounded shoulder or chamfer of about 0.3-0.5 mm reduction. This margin should be in enamel. Onlay may be constructed in either gold or "resin-bonded" bridge metal and should be sandblasted prior to bonding.

Occlusion - Occlusal positions and movements

Terminology of positions

- Intercuspal position (ICP), also called centric occlusion (CO). ICP is where the teeth have maximum contact.
- Centric Relation (CR) is anywhere on the curve while the condyles are fully seated in the fossa. It is a series of positions with condyles seated at different OVDs.
- Retruded contact position (RCP) is one point in CR where the teeth first meet.

Other tooth contact positions (incisal edge-to-edge position and lateral positions) are encountered during physiological movements such as mastication, and also during pathological movements, eg. bruxism.

Movements

There are two particular mandibular movements to consider:

1. In the vertical plane, opening and closing, from maximum opening to tooth contact involving hinge and translation movements of the condyle.
2. Movements made while the teeth maintain contact:
 - a slide from RCP into ICP
 - lateral excursions, left and right
 - anterior protrusive movement into, and beyond, the edge-to-edge position

Anterior (protrusive), retrusive (from ICP to RCP) and lateral movements made while maintaining tooth contact are guided by the anterior anatomic determinants (the teeth) and the posterior anatomic determinants (the two TMJ's and adjacent tissues).

Articulation of casts requires good quality and accurate casts without voids on the occlusal surfaces and a facebow record. The clinician needs to select an occlusal position to articulate the upper and lower casts. If work is to be carried out using the patients existing intercuspal position (conformative approach) then the existing intercuspal position is used. Is an interocclusal record (IOR) required or is the interdigitation obvious to your technician?

If the interdigitation is not obvious then an interocclusal record is required to mount the casts in the correct intercuspal position. This will depend on the number and position of the remaining teeth as well as their occlusal form (how much tooth wear is there?). If a record is required then it should be recorded at the same vertical dimension at which the patient is to be restored.

In the case of study casts the articulation would be made at the patient's existing occlusal vertical height. So the occlusal record, taken in ICP, should be as close to zero

thickness as possible. This can be achieved with a thin layer of hard wax or a hard-setting polyvinylsiloxane occlusal registration material, such as Futar D Occlusion.

The IOR needs to be rigid enough to permit accurate location of the casts into it. Occlusal registration silicones are fast-set (1 minute), easy to use and do not require the use of wax, wax-knives and heat. The polyvinylsiloxane occlusal registration materials have also been shown to be suitable for RCP records. With the currently available materials which set to a rigid consistency the distortion is reduced, cast relocation is simple and they can be made at zero occlusal separation. If a wax is used then it should be of a hard-set variety (eg. Moyco hard wax).

If a significant number of teeth are missing it will be necessary to construct a wax rim on an acrylic baseplate for stability. This can be used along with wax or silicone to record the occlusal position (more likely to be RCP).

If teeth are out of occlusion due to an “open bite” or following tooth preparation then an IOR with a different thickness may be needed. You can simply apply more silicone registration material to those teeth.

If the intercuspal position (ICP) is non-existent (eg. where there has been extensive tooth wear) or unfavourable a decision may be made to study the dentition or restore the teeth in the retruded contact position (RCP). In this case you would need to record the RCP again using silicone or wax.

There are two steps to recording an RCP record, both of which can be difficult: getting the patient into the retruded contact position and then recording it

Determining the retruded contact position

With digital pressure on the mandible demonstrate the retruded contact position. Get the patient into the retruded arc of closure (centric relation) and allow the mandible to close gradually. The most widely used method is the Dawson technique. See the articles by Wise for details.

This technique is suitable for the easier cases where the patient does not resist the distal movement of the mandible too much. Where difficulty is encountered the teeth can be separated with a cotton wool roll, or tongue spatula, for at least 5 minutes. Then the manipulation is carried out as before.

When resistance is still present then an anterior acrylic jig is fabricated intra-orally by applying Palavit-G or Duralay to the vaselined palatal aspect of the upper incisors. This is usually called a Lucia jig after its inventor. The jig is shaped by hand to form an inclined plane while care is taken not to allow the exothermic reaction to cause discomfort to the patient.

If the patient still resists the distal manipulation of the mandible then an occlusal splint is fabricated in the laboratory and worn at night until the next appointment. A Michigan splint (stabilization splint) is ideal for this. It should not be removed on the day of the appointment until the RCP record has been obtained.

You can restore anterior teeth on upper palatal and lower incisal surfaces with composite to create a Lucia jig effect.

Key occlusal principles:

When restoring a dentition or providing a splint your aim should be to achieve:

1 contacts on all teeth in ICP (note initial contact on anterior teeth is slightly less than on posterior teeth to protect the anterior teeth in clenching)

2 anterior guidance, which will create posterior disclusion (ie separation of all posterior teeth during all movements away from CR/ICP)

3 Use canine guidance where possible to provide lateral guidance (part of the anterior guidance). If the canine is damaged, out of position, fragile etc then avoid canine guidance and use group function. This allows working side contacts to be present on posterior teeth during lateral excursions (buccal side of lower buccal cusps).

4 if all is well with the occlusion and ICP, then restore in ICP. So most cases where you judge the occlusion to be stable and acceptable, restore at existing height (ovd) and position (ICP) = conformative

5 if ICP is unacceptable, unavailable, unreproducible then you have to use CR. So restore in CR, or just anterior to it = reorganized.

Check **posterior** restorations for contacts:

keep centric stops,

never load non-functional cusps,

avoid non-working side interferences (NWSIs) which are:

LILB lingual incline of lower buccal cusps

BFIUP buccal facing incline of upper palatal cusps

Check **anterior** restorations for contacts:

keep light centric stops,

confirm anterior guidance:

protrusive contacts on all incisors equally

lateral guidance on canines (see 3 above)

Techniques

Useful instruments:

Impression putty or clear silicone (eg. *Affinity, Memosil, Elite Glass, RSVP*)

Clear trays, or clingfilm in a normal tray

PTFE tape

Putty knife (Coltene)

Composite heater, (eg Micerium)

Posterior teeth

Take alginates, facebow record, IOR in CR/RCP with increased separation (ovd)

Get diagnostic wax up and index it.

Methods to restore with composite resin:

1. use putty index from master with (a) cling film or (b) bonding resin as separator
2. dentine core made first then enamel placed using putty and cling
3. using a clear silicone matrix from master
4. free hand – cones then cusps method, or bulk and cut
5. indirect – get lab to make them
6. semi-indirect
 - diagnostic wax up
 - duplicate model
 - make clear index
 - prep the patient lightly
 - impression and pour
 - Put the clear index with enamel composite in it onto the model and cure to make one long composite sausage which is cut to form the individual restorations
 - Hollow out the restorations to make shells
 - On the patient, stick them on one by one with dentine composite indirect technique

Gold overlay best long-term, can be used after a period on composite to establish occlusal factors.

Anterior teeth:

Palatal putty index from master model

1. Build up in a single colour
2. Build up using layering
3. Freehand – good for lower anterior teeth.

Practice increasing the palatal surface on the upper canine so as to not to alter OVD but increase canine guidance. If you establish anterior guidance and posterior disclusion, then there cannot be posterior tooth wear.