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Non-Cervical Carious Lesions: An Overview

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Abstract
Non-carious tooth surface loss is common in clinical dentistry. It encompasses four main processes: attrition, abrasion, erosion and abfraction. These processes progressively remove enamel, dentin, or cementum without the presence of bacteria. Collectively, they can cause pain, sensitivity, functional impairment, and aesthetic concerns.This review defines each condition, explains pathophysiology and clinical features, and covers diagnosis, management, and prevention from clinical and patient-education perspectives.

Introduction

Non-carious tooth surface loss (often termed “tooth wear” or “wasting”) is common in clinical dentistry. It encompasses four main processes: attrition (tooth-to-tooth wear), abrasion (wear from external objects), erosion (chemical dissolution by acids), and abfraction (stress-induced cervical lesions)(1). These processes progressively remove enamel, dentin, or cementum without the presence of bacteria. Collectively, they can cause pain, sensitivity, functional impairment, and aesthetic concerns(2,3). In older adults, for example, tooth wear is often advanced, and affected teeth become shorter and flatter with exposed yellowish dentin. Dentists should identify wear early, distinguish its causes, and plan management to preserve dentition and patient comfort. This review defines each condition, explains pathophysiology and clinical features, and covers diagnosis, management, and prevention from clinical and patient-education perspectives(4,5).

Attrition

Attrition is the mechanical wear of teeth from tooth-to-tooth contact, typically during chewing or parafunctional habits. It is considered a physiological process of ageing, but excessive attrition can occur with *bruxism* (habitual grinding) or malocclusion. For example, nocturnal bruxism (sleep grinding) is believed to exaggerate the attrition process.

Enamel and dentin resist normal chewing stresses, but repeated heavy contact (especially lateral forces) causes microfractures and abrasion of enamel rods. Over time, enamel is worn down to expose underlying dentin, which wears more rapidly. If attrition is severe, it can reduce the occlusal vertical dimension and strain the pulp or periodontal attachment(6).

Attrition appears as flattened and polished surfaces on incisal edges or cusp tips. Wear facets often match opposing teeth. Affected teeth look shorter and have a “dull, frosty” appearance; the exposed dentin may

look yellow or brown. In advanced cases, cusps and ridges may be gone, and the bite plane is level. Patients often report *sensitivity* when dentin is exposed.

A careful history is vital. Ask about clenching/grinding (patients may mention jaw pain or partner's reports). Wear severity can be graded with indices (e.g. the Basic Erosive Wear Examination, BEWE, can be adapted for general wear). Radiographs and study models help assess vertical loss(7).

The primary goal is to eliminate excessive force and prevent progression. Behavioural interventions include stress management and sleep hygiene, since anxiety/clenching often worsens bruxism. A nightguard should be fabricated for confirmed bruxers; it protects teeth by distributing forces and should be prescribed even prophylactically. If attrition has altered the bite, an occlusal adjustment by selective grinding or orthodontics may be needed(8).

Restoratively, severely worn teeth often benefit from minimally invasive buildups. Direct composite resins can rebuild cusps/incisors, restoring form and protecting dentin. Composites are favoured for being simple, cost-effective, and conservative. In older patients or extensive wear, ceramic onlays or crowns may be indicated, but only after addressing habits; otherwise, restorations will fail.

In addition to a nightguard, patients should be educated about reducing risk factors. Address parafunctional habits: avoid chewing hard objects, open-bite behaviours, and nail-biting. Teach gentle chewing and encourage regular dental check-ups to catch wear early(9,10).

Abrasion

Abrasion is the loss of tooth substance by the mechanical action of external objects, most often toothbrushing with abrasive agents. Overly vigorous brushing, especially with a hard-bristled brush or abrasive toothpaste, causes cervical wear. Other causes include abrasive foods, pipe smoking, toothpicks, or habits like holding items between teeth. Abrasion is often preventable and localised.

Repeated friction against enamel chips away the tooth structure. At the gumline, repeated brushing can create a sharp notch(11). On root surfaces, abrasion can rapidly destroy cementum and dentin since these are softer. Over time, exposed dentin may sclerose, forming a smear layer, which can temporarily mask sensitivity.

Abrasion lesions typically appear as V-shaped or wedge-shaped indentations at the cervical area of teeth, often on the buccal side(2,12). These notches have smooth, polished surfaces. Hypersensitivity is variable, and early lesions may not hurt because of the smear layer, but as the abrasion deepens, it can cause sharp tooth pain to cold/air. Lesions have well-defined margins without decay(2,13).

The pattern and patient history are key. Inquire about brushing technique: vigorous horizontal scrubbing with a hard brush is a clue. Examine the notches: abrasion is usually unilateral or limited to teeth that are frequently brushed. Unlike erosion, abrasion does not produce generalised enamel loss, and there is no cupping or etching pattern. Radiographs are seldom needed unless caries must be excluded. Tooth wear indices (like Smith & Knight TWI) can quantify severity, but practical grading is often clinical(14).

The first step is to identify and eliminate the cause. Switch the patient to a soft-bristled toothbrush and non-abrasive fluoride toothpaste.

Resin composites or glass ionomer cements bond to enamel/dentin and can fill cervical defects, improving contour and sealing the dentin. Teach patients daily oral hygiene with minimal trauma. Recommend soft brushes and low-abrasive toothpastes. For gingival recession exposing roots, cover exposed roots (e.g., with wax or RDA-neutral products) during demonstration, as root surfaces can abrade easily. If tobacco or other habit-related abrasion is involved, counsel cessation(15).

Erosion

Dental erosion is the chemical dissolution of tooth mineral by acids not of bacterial origin. It can be extrinsic (dietary acids from foods and drinks) or intrinsic (gastric acids from reflux or vomiting). Risk factors include frequent consumption of soft drinks, citrus juices, and sports drinks, as well as gastroesophageal reflux disease (GERD), bulimia nervosa, alcoholism, and medications that lower saliva(16). A major survey found 93% of common beverages have a pH <4, highlighting the prevalence of erosive drinks. Each acid attack softens enamel, and repeated exposure gradually removes it. Since erosion does not involve bacteria, it presents differently from caries or abrasion(17).

Acid demineralises enamel via a physicochemical process. Continued acid contact dissolves this layer, enlarging and linking enamel porosities until enamel falls away, exposing dentin. Dentin is even more acid-soluble, so once exposed, wear can accelerate. Intrinsic acids (gastric) contain HCl and are very potent; they often affect the palatal surfaces of upper anterior teeth ("perimylolysis") as seen in bulimia(18). Extrinsic acids (citric, phosphoric) more often affect occlusal or facial surfaces, depending on how liquid contacts the mouth. Saliva normally buffers acids and helps remineralise, but low saliva flow increases erosion risk(19).

Erosive lesions are smooth, cupped, and broad. Early signs include loss of enamel surface texture (smooth, glossy appearance). On flat surfaces (e.g. facial of incisors), erosion causes shallow scooping. On occlusals (especially lower molars or palatal of uppers), it can cause deep "cup" defects(20). Edges may look translucent, then opaque, and often have *sharp margins*. With progression, all enamel prismatic structure is lost; surfaces take on a shiny, "melted" look. Patients often complain of sensitivity to cold or sweet (dentin exposure) and shorter teeth. Diagnosis relies on history and exam. Ask about diet and GI symptoms. Also inquire about eating disorders or chronic vomiting. Examine enamel in all regions and differentiate from abrasion by pattern. Use indices such as BEWE: score each sextant 0–3 based on the most severe wear. Early erosion shows enamel loss without sharp notching(16).

Address the underlying cause first. For extrinsic acid, give dietary counselling: advise reducing or diluting acidic drinks (e.g., consume with meals, use a straw, avoid frequent sipping). For intrinsic acid, refer to the medical management of GERD or eating disorders. Advise patients to rinse with water or milk after acid exposure and wait 30–60 minutes before brushing to avoid abrading softened enamel(21).

Fluoride and other remineralising agents play a preventive role. Topical fluoride (especially stannous fluoride) can enhance acid resistance by forming fluorapatite and depositing a tin-rich protective layer. Daily use of a low-abrasion fluoride toothpaste and occasional professional fluoride varnish can help halt or slow erosion. Products containing calcium, phosphate, or casein can also aid remineralisation (e.g. casein phosphopeptides), though evidence is variable. Desensitising agents (e.g. 38% silver diamine fluoride) may reduce sensitivity from exposed dentin(22).

When structural damage is significant, restorations are considered. Treatment is always minimally invasive: composite resins or bonded veneers can rebuild lost contours and seal surfaces. Restoration not only improves esthetics and function; it also facilitates hygiene. Consistent with consensus, restorations are done *after* control of causative factors. The 2023 consensus emphasises prevention and simple restorations over extensive crowns for erosion lesions. Educate patients about the erosive process(23). Explain that acids are removing tooth mineral, even if it feels painless, until sensitivity appears. Dietary advice is crucial: encourage limiting sodas/juices, sipping through a straw, and consuming calcium-rich foods (milk, yoghurt) with meals to neutralise acid. Oral hygiene education includes using a soft brush

and fluoride toothpaste. Advise frequent sips of water, and after any vomiting episode, rinse with water or sodium bicarbonate solution before brushing(24).

Abfraction

Abfraction refers to the hypothesised loss of tooth structure at the cervical area due to biomechanical flexural forces. In this theory, oblique occlusal loads create tensile stress at the cementoenamel junction (CEJ), causing enamel and dentin to fracture away in a wedge shape. However, this concept is controversial. Recent reviews note that non-carious cervical lesions (NCCLs) are largely explained by abrasion and erosion, and that evidence linking occlusal stress to abfraction is inconclusive(25). In fact, one scoping review found only six studies on abfraction and concluded more research is needed, as the results neither confirm nor refute the stress-based theory. Practitioners should recognise that "abfraction" is still largely theoretical and that NCCLs likely have a *multifactorial* aetiology(26).

If abfraction occurs, the mechanism is that lateral or eccentric forces bend the tooth slightly. The side under tension experiences microfractures in the cervical area. Anatomically, enamel is stiffer and dentin less so, so they flex differently; research models show stress concentrations at the CEJ under load. However, actual clinical evidence of pure stress-induced lesions is lacking(25,27). True abfraction lesions are described as sharp, wedge- or "V"-shaped notches at the CEJ on the buccal (cheek) surfaces. They often have crisp internal line angles. These lesions can be deep and crescent-shaped, with smooth walls. Unlike abrasion, abfractions are said to have sharper angles. Patients may experience severe sensitivity if dentin is exposed. However, because abfraction is a theory, diagnosing it clinically is challenging. Any deep NCCL could be called an abfraction by some authors, but others caution against the term if no clear occlusal stressor is evident(28).

Identify NCCLs (non-carious cervical lesions) by finding cervical defects without decay. Attempt to discern cause: a single deep V-notch on a tooth with heavy lateral force from occlusion might suggest stress; however, most cases involve multiple factors. Removal of calculus and plaque can help assess the true morphology(29). Clinicians often look for an "active" lesion by applying a sharp instrument; if a scratch on exposed dentin disappears, the lesion may still be eroding.

Whether or not abfraction is proven, treatment of deep cervical lesions is the same. As with other wear, reduce parafunctional forces. Adjust occlusion if uneven, provide an occlusal splint for bruxism, and consider occlusal adjustment or orthodontics to eliminate premature contacts. Advise gentle toothbrushing since vigorous brushing can worsen cervical defects(30).

Restoring NCCLs often alleviates sensitivity and prevents further wear. Resin-modified glass ionomer (RMGI) is commonly recommended as a first choice for cervical lesions due to its bonding and fluoride release. Composite resins are also used, often after placing an RMGI liner(28). Studies show restorations of NCCLs have higher failure rates due to tooth flexure. To maximise retention, use a conservative cavity design, an effective bonding protocol, and consider a flexible material. Microfilled or flowable composites (lower elastic modulus) may reduce stresses at the margin(31).

Even though abfraction's role is debated, if a patient has cervical wear, preventive advice overlaps with abrasion/erosion: correct brushing and diet. In mixed lesions (abrasion + abfraction), addressing both factors is important. Because NCCLs can progress, schedule regular check-ups. If a lesion is shallow (<1 mm), monitoring may suffice. For active or deep lesions, restoration plus control of all factors is indicated. In periodontics practice, note that scaling and root planing can contribute to NCCL-like defects;

performing restorations or sealants on exposed roots before or after periodontal therapy can help reduce post-scaling sensitivity(27).

Differential Diagnosis and Interrelations

Attrition, abrasion, erosion, and abfraction often coexist and interact. Attrition affects occlusal/incisal surfaces. Abrasion and abfraction produce cervical lesions; abrasion tends to produce more rounded grooves, abfraction sharper wedges. Erosion can affect any surface (lingual of anteriors in bulimia, occlusal of molars in GERD, facial surfaces in diet-related cases)(32).

Attrition yields flat facets. Abrasion creates V-shaped notches with hard margins. Erosive lesions are smooth, broad, often saucer-shaped, and may show cupping on occlusals. Abfractions are typically wedge-shaped at the CEJ with sharp line angles. Attrition aligns with heavy occlusal contacts or grinding(33). Abrasion often aligns with improper brushing. Erosion correlates with acid habits or medical history. Abfraction would correlate with uneven occlusion or bruxism not explained by other wear(27).

In practice, lesions are often *multifactorial*(32). For example, an acid-softened tooth is more vulnerable to abrasion or attrition. It's common to see NCCLs where erosion and abrasion have both acted. The term *"erosive tooth wear"* acknowledges this combination. Furthermore, studies show that bruxism may increase tooth wear in general(34).

Dentists should consider the overall occlusal scheme and habits. A patient with severe attrition (flattened teeth) likely also has worn contacts that predispose to NCCLs. The Crown-Root anatomy matters: exposed root surfaces (e.g. from periodontal recession) have no enamel, making abrasion and erosion much faster and more painful(35). The European consensus on tooth wear calls for a risk assessment (history, saliva testing, and indices) and a focus on preventive care. A new tool (EWAR) has been proposed for erosive wear risk assessment, illustrating the move toward systematic evaluation(36).

Conclusion

Attrition, abrasion, erosion, and abfraction are distinct but interrelated forms of tooth wear ("wasting") that affect dental hard tissues. A comprehensive approach is needed: dental professionals (periodontists, dentists, hygienists) must recognise each type's cause and clinical signs, differentiate them, and apply targeted management. Prevention and patient education are critical – for instance, teaching gentle brushing to avoid abrasion, dietary modifications to prevent erosion, and appliance therapy for attrition. Recent research underscores that tooth wear is often multifactorial, and occlusal factors like bruxism may exacerbate all forms of wear.

In practice, early detection allows less invasive intervention. When restorations are needed, minimally invasive composites or glass ionomers are preferred. Dentists should monitor progression with periodic photos or scanning, adjusting care as needed. By integrating clinical evidence from the literature with clear patient communication, practitioners can manage these "wasting diseases" effectively, preserving function and comfort.

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