New Zealand **Dental Journal**
Scientific Journal of the New Zealand Dental Association

New Zealand Dental Assoc.

Peer-reviewed article, submitted July 2025, accepted September 2025 Handling editor: KC Li

A review of the epidemiological evidence on tooth wear

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Abstract

Background and objectives: Tooth wear is the gradual loss of tooth structure and can occur due to numerous aetiological factors. The aim of this review is to investigate current knowledge about the epidemiology of tooth wear and identify knowledge gaps.

Methods: A cohesive narrative review was conducted (non-systematic) to synthesise existing literature and highlight knowledge gaps relevant to a New Zealand audience.

Results: Global literature suggests that a significant number of individuals are impacted by tooth wear, yet there is a lack of epidemiological data on this condition specific to New Zealand. International studies have identified risk factors for tooth wear but often involve non-representative clinical samples.

Conclusions: Longitudinal studies and routine surveys of representative samples are needed to understand the prevalence, severity, aetiology, and patterns of tooth wear. Routine surveys of representative population samples should be carried out to monitor oral health within the population and such studies should include clinical assessment of tooth wear.

Introduction

Tooth wear is the irreversible loss of tooth structure, which occurs progressively throughout the life-course (Bartlett and O'Toole, 2019) and archaeological evidence shows it has affected humans since before recorded history (Kaidonis, 2008). Mild to moderate levels of tooth wear can be considered 'physiological,' and are associated with masticatory function and ageing (Smith and Robb, 1996). However, pathological tooth wear can result from a multitude of chemical and/or mechanical factors causing dentinal hypersensitivity, loss of pulp vitality, and, ultimately, tooth loss (Bartlett and O'Toole, 2021). Tooth wear in a young individual may be described as pathological if it is likely to progress to tooth loss over the life-course, whereas, an identical amount of tooth wear in an older individual may be seen as physiological (Kaidonis, 2008). A heavily worn dentition can impact dental aesthetics, oral health-related quality of life, and is often complex and costly to restore (Cunha-Cruz *et al.*, 2010; Mehta *et al.*, 2020).

There are three fundamental types of tooth wear: attrition, abrasion, and erosion (Bartlett and O'Toole, 2021). Attrition is tooth wear caused by tooth-to-tooth or tooth-to-restoration contact (Lee *et al.*, 2012). It occurs over time as part of normal ageing, but different rates can be seen between individuals (Bartlett and O'Toole, 2019). Abrasive tooth wear is caused by an exogenous source, independent of occlusion, for example: toothbrushes, toothpaste, biting objects, and coarse foods (Shellis and Addy, 2006; Wetselaar and Lobbezoo, 2016). Erosion differs from attrition and abrasion in that the process is chemical, rather than mechanical. It refers to the dissolution of tooth structure from exposure to chemical factors without bacterial action (Bartlett *et al.*, 1999). Most tooth wear cases involve more than one of these three main mechanisms (Shellis and Addy, 2006), and this can make the distinction between these three types of tooth wear clinically challenging. There is evidence that exposure of the oral cavity to acids reduces the integrity of enamel, making teeth more susceptible to mechanical wear through attrition and abrasion (Bartlett and O'Toole, 2021). This has resulted in the development of the term 'erosive tooth wear' emphasising that erosion is usually involved, even if signs of attrition and abrasion are more obvious clinically (Bartlett and O'Toole, 2019).

In some circumstances, tooth wear patterns can be related to certain causal factors (Kaidonis, 2008). A tooth wear pattern involving the palatal surfaces of the maxillary incisors, for example, has been observed in individuals with regurgitation issues and eating disorders, such as anorexia and bulimia (Hattab and Yassin, 2000; Kitasako *et al.*, 2015). Conversely, individuals that regularly hold or consume citrus fruits in a manner that brings them into contact with the front teeth may develop erosive wear patterns on the labial surfaces of the maxillary anterior teeth (Ganss and Lussi, 2014; Oginni and Olusile, 2002). Toothbrushing may cause tooth wear in the cervical region, particularly in canine and premolar teeth (Hattab and Yassin, 2000).

There is limited New Zealand research on tooth wear (Taylor 1962, 1970, 1984; Houghton 1978; Kieser *et al.*, 2001a; Kieser *et al.*, 2001b; Ayers *et al.*, 2002; Buckley *et al.*, 2010; Lawrence, 2018; Berryman, 2024). This cohesive narrative review aims to critically evaluate and synthesize epidemiological and clinical evidence about tooth wear, highlighting knowledge gaps and focusing, where available, on New Zealand evidence.

Tooth wear epidemiology

It is difficult to determine the prevalence of tooth wear globally. Tooth wear prevalence and severity vary between countries, likely due to differences in diet, habits, and cultural practices (Schlueter and Luka, 2018; Bartlett and O'Toole, 2021). These studies also differ in research methods and sampling, making comparisons difficult (Schlueter and Luka, 2018). Most studies report tooth wear in terms of overall prevalence and/or general severity; however, tooth wear may manifest in distinct patterns of wear across different regions of the dentition (Kaidonis, 2008). Despite this, there have been few longitudinal epidemiological studies reporting on the occurrence and patterns of tooth wear through the life-course.

Estimates of the prevalence and severity of tooth wear vary according to the population studied and the measurement tool (or index) used. For example, one study of tooth wear investigated a population-based sample of Dutch adults aged 25-74 years (n=1125), with a clinician evaluating tooth wear among participants using a 5-point ordinal scale of severity. The prevalence of tooth wear was reported at 99%, with 13%, 80%, and 6% having mild, moderate, and severe tooth wear, respectively (Wetselaar *et al.*, 2016). In a cross-sectional study of 1007 people in England aged 18+ years using the Tooth Wear Index (TWI), 99% of the sample had tooth wear, while 5.1% had severely worn tooth surfaces. Men also had more tooth surfaces with severe wear than women (Smith and Robb, 1996).

A cross-sectional study of 2924 individuals in six Arab countries included participants between the ages of 18-35 years. This study used the Basic Erosive Wear Examination Index (BEWE) to measure tooth wear (Bartlett *et al.*, 2008). A BEWE score of three represented severe tooth wear. An overall prevalence of 41% severe tooth wear was reported (Awad *et al.*, 2019). Another cross-sectional study conducted in Japan that included 1108 adults aged 15-89 years used a modified version of the Tooth Wear Index by Smith and Knight (Smith and Knight, 1984) to measure erosive tooth wear (Kitasako *et al.*, 2015). In this study, 26% of Japanese adults had signs of erosive tooth wear. The mandibular anterior teeth were the most affected by tooth wear into dentine (Kitasako *et al.*, 2015). It is difficult compare the findings about the prevalence of tooth wear from these studies due to the variety of tooth wear indices used and the types of tooth wear evaluated.

Unlike other markers of ageing, tooth wear is irreversible due to the non-regenerative nature of teeth. Therefore, tooth wear severity would be expected to increase with age. A systematic review investigating the prevalence of tooth wear predicted that the percentage of severe tooth wear increases from 3% at age 20 to 17% at age 70 (Spijker *et al.*, 2009). Overall, it appears that tooth wear is common but severe tooth wear may be relatively rare, particularly in younger age groups (Spijker *et al.*, 2009; Wetselaar *et al.*, 2016). Multiple studies have reported tooth wear to be more prevalent and/or severe among males and older people than in females and younger people, respectively (Cunha-Cruz *et al.*, 2010; Spijker *et al.*, 2009; Wetselaar *et al.*, 2016). There has been a shift away from research of tooth wear in general, to a primary focus on erosive tooth wear (Johansson *et al.*, 2012). Most human tooth wear studies since the mid-1990s have analysed tooth wear in children and adolescents, rather than in adults (Johansson *et al.*, 2012; Spijker *et al.*, 2009).

As there is little original research about tooth wear in New Zealand, the epidemiology of this condition in the New Zealand population remains largely unknown. Tooth wear has been omitted from previous New Zealand Oral Health Surveys (Cutress *et al.*, 1979; Hunter *et al.*, 1992; Ministry of Health, 2010). In the Dunedin Study, intraoral scans of the study members' teeth (taken at age 45) are currently being investigated for tooth wear (Berryman, 2024).

A cross-sectional study in Dunedin, New Zealand involving 104 children aged 5-8 years which used a version of the TWI adapted for children reported that 82% of participants had at least one primary tooth with exposed dentine (Ayers *et al.*, 2002). The prevalence of tooth wear was similar in boys and girls. Severe tooth wear was less prevalent in children weaned after 12 months (14.3%), compared to those weaned earlier (29% $p<0.01$). No associations were found between tooth wear and dietary factors such as intake of fruit, yoghurt, pickled foods, fizzy drinks, or fruit-based drinks (Ayers *et al.*, 2002). This is one of the most recent studies on tooth wear in children in New Zealand.

A review on dental erosion was published by New Zealand authors in 2003 (Mahoney and Kilpatrick, 2003). This article described that the prevalence of erosion was difficult to determine because this condition can be challenging to isolate from other types of tooth wear and many different tooth wear indices had been used in previous studies. It also described potential aetiological factors for erosion including environmental factors, medications, lifestyle habits, acidic food and drinks, vomiting, eating disorders, regurgitation and gastro-oesophageal reflux, rumination, and salivary gland issues/dehydration (Mahoney and Kilpatrick, 2003).

A doctoral thesis from the University of Otago investigated tooth wear (among other dental conditions) in a sample of 41 New Zealand Māori adults with a mean age of 40 years. Within this group, tooth wear was mild overall (Lawrence, 2018). It is plausible that more severe tooth wear may have been observed in older participants and a larger sample size would have provided a more precise estimate.

Bioarchaeology

Severe tooth wear in pre-colonial Māori has been reported in bioarchaeological and anthropological research (Kieser *et al.*, 2001a; Kieser *et al.*, 2001b; Taylor, 1962). In pre-colonial Māori, most teeth lost throughout life were due to excessive tooth wear causing pulpal exposure and subsequent bacterial infiltration into the pulp chamber which resulted in infection and tooth loss (Kieser *et al.*, 2001b; Taylor, 1962). This likely occurred due to an abrasive diet and erosive tooth wear (Kieser *et al.*, 2001a). There is evidence that pre-colonial Māori consumed abrasive foods such as fern root, fish, shellfish, birds, rats, kumara grown in soil with gravel, and berries (Kieser *et al.*, 2001a; Kieser *et al.*, 2001b). Erosive tooth wear may have occurred due to extrinsic (*e.g.* dietary) or intrinsic (*e.g.* gastro-oesophageal reflux) sources of acid (Kieser *et al.*, 2001a). It has been hypothesised that strong facial muscles among pre-colonial Māori may have resulted in higher bite forces, contributing to the severe tooth wear seen (Kieser *et al.*, 2001b). Additional tooth wear research has been carried out at the University of Otago investigating tooth wear in bioarchaeological specimens from Wairau Bar, on the north coast of the NZ South Island (Buckley *et al.*, 2010). Among the adults at Wairau Bar, severe tooth wear extending to the root surfaces was found by old age (Buckley *et al.*, 2010).

Causes of tooth wear

Chemical factors

Dental erosion is a complex condition involving interactions between chemical, biological, and behavioural factors (Lussi and Jaeggi, 2008). The acids causing dental erosion can be classified as intrinsic or extrinsic (Loke *et al.*, 2016). Medical conditions including gastro-oesophageal reflux and eating disorders such as bulimia can cause intrinsic acid exposure to the dentition (Hattab and Yassin, 2000). Extrinsic acids that may cause erosion include acidic foods and beverages, medications, and exposure to acidic gases (Bartlett *et al.*, 1999; Hattab and Yassin, 2000; Mahoney and Kilpatrick, 2003).

Regurgitation of stomach acid

Regurgitation of stomach acid in individuals with eating disorders, gastro-oesophageal reflux disease, chronic alcoholism, voluntary rumination, and hiatus hernia's can contribute to dental erosion (Smith *et al.*, 1997). The relationship between eating disorders and dental erosion has been investigated in two systematic reviews and meta-analyses, both of which found that those with self-induced vomiting had a greater risk of dental erosion compared to controls (Hermont *et al.*, 2014; Kisely *et al.*, 2015). Participants with eating disorders had a greater risk of dental erosion compared to those without (OR=12.4, 95%CI=4.1-37.5), and those with self-induced vomiting also had a greater risk of dental erosion compared to those without (OR=19.6, 95%CI=5.6-68.8) (Hermont *et al.*, 2014). Eating disorders/purging behaviours seem to increase the risk of dental erosion but more high-quality evidence is needed to confirm a causal relationship. Another systematic review and meta-analysis reported similar findings (Kisely *et al.*, 2015). This study assessed dental erosion in participants diagnosed with eating disorders, compared to a control group. Participants were stratified into three subcategories: frequent self-induced vomiting, infrequent/absent self-induced vomiting, or combined/uncertain. Participants with an eating disorder had five times the odds of dental erosion compared to controls (OR=5.0, 95%CI=3.31-7.58). Those with self-induced vomiting had the highest odds of dental erosion out of the three eating disorder subcategories (OR=7.32, 95%CI=3.92-13.67). This study also concluded that more good quality research about this topic is needed (Kisely *et al.*, 2015).

A tooth wear pattern involving anterior palatal and occlusal wear is a common clinical presentation seen in individuals with vomit-induced erosive tooth wear (Rangé *et al.*, 2021). It has also been speculated that individuals with eating disorders might consume acidic sports drinks, if attempting to lose weight via intense physical activity, which may increase their risk of erosive tooth wear (Lo Russo *et al.*, 2008). These individuals may also have a high intake of caffeinated and/or carbonated drinks to improve energy levels and supress their appetite (Kisely *et al.*, 2015; Lo Russo *et al.*, 2008).

Salivary hypofunction

Saliva aids in diluting, buffering, and neutralizing acids (Carvalho *et al.*, 2015). Therefore, low salivary flow or a decreased buffering capacity may increase the risk of erosion. This is particularly concerning for individuals with medical conditions such as Sjögren's syndrome, those who take medications that reduce salivary flow, and/or individuals who have undergone head and neck radiation for cancer treatments (Loke *et al.*, 2016). When the salivary flow rate decreases, there is less mineral content available and the bicarbonate buffering system is less effective. Additionally, the swallowing rate decreases, so the processes of clearing and diluting acids are also impaired (Loke *et al.*, 2016).

Food and beverages

Regular consumption of acidic foods and beverages can cause erosive tooth wear (Salas *et al.*, 2015). A meta-analysis and meta-regression suggested that the following dietary factors were associated with an increased risk of erosion in children and adolescents: carbonated drinks (OR=1.61, 95%CI 1.29-2.01), acidic snacks/sweets (OR=2.24, 95%CI 1.16-4.34), and fruit juices (OR=1.20, 95%CI 1.02-1.42). Conversely, milk and yoghurt had a protective effect with odds ratios of (OR=0.96, 95%CI 0.92-0.99) and (OR=0.87, 95%CI 0.77-0.98) respectively (Salas *et al.*, 2015). A systematic review on dental erosion in adolescents reported that the main factors were the erosive potential of carbonated drinks and the erosive effects of consuming acidic drinks at bed-time (Chan *et al.*, 2020). However, there was conflicting evidence when many other potential risk factors for erosion were assessed including the consumption of sports/energy drinks, fruit juice, tea, citrus fruits, vitamin C tablets, vinegar, and pickles (Chan *et al.*, 2020). It should be noted that most studies included in this systematic review were cross-sectional studies (five cohort studies, three case-control studies, and 44 cross-sectional studies). It has been suggested that a vegetarian diet may be a risk factor for erosive tooth wear because individuals who are vegetarian may consume more acidic fruits and vegetables (Marshall, 2021). Some studies have supported this hypothesis, while others have found no association between a vegetarian diet and erosion (Buzalaf *et al.*, 2018; Marshall, 2021).

Occupational risk factors

Professional wine tasters are at risk of erosive tooth wear (George *et al.*, 2014; Mulic *et al.*, 2011). The pH of wine is between 3.0 to 4.0 (Mulic *et al.*, 2011). During wine tasting, wine is swirled and then held in the mouth for 15-60 seconds prior to swallowing. This increases contact of the beverage with tooth surfaces, which further increases the risk of erosive tooth wear (Loke *et al.*, 2016). Industrial occupations such as battery manufacturing may be associated with erosive tooth wear due to exposure to acidic fumes (Wiegand and Attin, 2007). However, this is unlikely to be a significant cause of dental erosion in developed countries due to the enforcement of health and safety regulations (Wiegand and Attin, 2007).

Active/sporting lifestyle

Exercise-induced dehydration among athletes could decrease salivary flow and therefore, increase the risk of erosive tooth wear (Attin *et al.*, 2021). Other factors that may also increase the risk of erosive tooth wear in athletes include vomiting due to intense exertion, or as a mechanism of weight control and the consumption of acidic sports drinks (Attin *et al.*, 2021; Lussi and Jaeggi, 2008). A systematic review on dental erosion in athletes reported that almost half of the athletes had signs of erosive tooth wear (Nijakowski *et al.*, 2022). They concluded that regular physical activity is associated with a greater risk of dental erosion, especially if sports drinks are consumed regularly (Nijakowski *et al.*, 2022). Many of the athletes in the studies included were competitive swimmers, suggesting that if swimmers are routinely training in pools with a low pH this may cause erosive tooth wear (Attin *et al.*, 2021; Lussi and Jaeggi, 2008).

Drug use

Multiple studies have reported that methamphetamine users exhibit severe tooth wear (Hamamoto and Rhodus, 2009; Rommel *et al.*, 2016; Teoh *et al.*, 2019). Chronic methamphetamine use has been linked to bruxism, a reduced salivary flow rate, and a decreased salivary buffering capacity (Rommel *et al.*, 2016; Teoh *et al.*, 2019). Salivary changes, in conjunction with high consumption of carbonated beverages due to xerostomia symptoms, contribute to the increased risk of dental caries and erosive tooth wear among these individuals (Hamamoto and Rhodus, 2009; Rommel *et al.*, 2016). Attrition and erosion are common dental findings among cocaine users via mechanisms similar to methamphetamine (Teoh *et al.*, 2019).

Mechanical factors

Bruxism

Awake and sleep bruxism are the two types of bruxism described in the literature. Some studies have reported that sleep bruxism can cause tooth wear (Abe *et al.*, 2009; Lavigne *et al.*, 1996), while others have reported contradictory findings (Lavigne *et al.*, 2008; Baba *et al.*, 2004). More high-quality longitudinal data is needed to investigate the relationship between awake and sleep bruxism and tooth wear (Abe *et al.*, 2009; Lavigne *et al.*, 2008; Martins *et al.*, 2022; Hilgenberg-Sydney *et al.*, 2022).

Psychosocial factors such as stress, anxiety, mood, distress, nervousness, and ‘feeling blue’ may be associated with sleep bruxism (Goldstein *et al.*, 2021). Substances such as alcohol, smoking, and caffeine have also been associated with sleep bruxism (Goldstein *et al.*, 2021). Gastroesophageal reflux could be a potential risk factor for bruxism because acidification of the oesophagus might stimulate tooth grinding (Ohmure *et al.*, 2011). It has also been reported that antidepressant medications such as selective serotonin reuptake inhibitors (SSRI’s) can cause bruxism (Garrett and Hawley, 2018). However, due to the lack of high-quality evidence in this area, further research is needed to confirm this association (Massahud *et al.*, 2022; Melo *et al.*, 2018).

Parafunctional habits

Habits such as nail-biting, pen-biting, and pipe smoking have been reported to cause abrasive tooth wear (Lee *et al.*, 2012; Wetselaar *et al.*, 2016). However, the evidence for this is primarily based on case reports and bioarchaeological specimens. Bioarchaeological research analysing human skulls has reported evidence of pipe smoking causing specific tooth wear patterns, specifically involving wear of the canine, incisor, and premolar teeth (Ubelaker, 1996; Cybulski, 1988, Handler and Lange, 1978).

Oral hygiene practices

Toothbrushing frequency, duration, force, and technique have been reported to contribute to tooth wear (Bartlett and Shah, 2006; Özgöz *et al.*, 2010). Some sources have suggested that the toothpaste, rather than the toothbrush, that contributes to abrasion because toothpastes contain abrasive particles (Addy and Hunter, 2003; Hunter *et al.*, 2002; Shellis and Addy, 2006). Papers supporting this idea have primarily cited one *in-vitro* study which inferred that use of a toothbrush alone would lead to minimal change in dentine wear (Absi *et al.*, 1992). Toothbrush bristle hardness, toothbrush tuft arrangement, and bristle design may contribute to exacerbate abrasive tooth wear (Bizhang *et al.*, 2016; Hamza *et al.*, 2021, 2022; Lippert *et al.*, 2017; Turssi *et al.*, 2019; Kumar *et al.*, 2014).

Abrasive foods

There is evidence of severe tooth wear in pre-industrial human populations, mainly attributed to the consumption of abrasive particles in the diet (Shellis and Addy, 2006). Abrasive tooth wear due to dietary sources has been identified in pre-colonial Māori skulls, with the description of specific tooth wear patterns associated with chewing fern root (Kieser *et al.*, 2001a). Pre-colonial Māori also consumed other abrasive foods such as fern root, fish, shellfish, birds, rats, kumara grown in soil with gravel, and berries (Kieser *et al.*, 2001a; Kieser *et al.*, 2001b). Most western diets now mainly consist of soft foods that are minimally abrasive. However, individuals who consume hard, fibrous diets (e.g. grit/bones or fibrous plants) may experience abrasive wear when chewing these foods (Forshaw, 2014).

Dental occlusion/malocclusion

Some dental malocclusions/anatomical factors (Class II malocclusions, deep bites, and brachyfacial anatomy) have been reported to cause tooth wear. However, the evidence supporting associations between these factors and tooth wear is weak and contradictory (Kiliaridis *et al.*, 1995; Young *et al.*, 1999; Janson *et al.*, 2010; Oltramari-Navarro *et al.*, 2010; Cunha-Cruz *et al.*, 2010). It remains unclear whether occlusal features can cause tooth wear (Almond *et al.*, 1999; Janson *et al.*, 2010; Mwangi *et al.*, 2009; Spijker *et al.*, 2007). In addition to features of static occlusion, functional occlusion should also be considered, including canine protected occlusions and group function. Despite this, there is limited and contradictory evidence about canine guidance, group function, and tooth wear in the literature (Johansson *et al.*, 1994; Tyagi *et al.*, 2022; Spijker *et al.*, 2015).

Dental restorative materials

Some dental restorative materials can cause wear of the opposing teeth. However, gold-based casting alloys are known to be both wear resistant and cause little wear to the opposing enamel (D'Arcangelo *et al.*, 2016). In an *in vitro* study, type III gold restorations caused less wear to human enamel compared to lithium disilicate glass ceramic (Lee *et al.*, 2014). A systematic review and meta-analysis of *in vitro* studies reported that feldspathic porcelain led to more enamel wear on the opposing tooth surfaces compared to monolithic zirconia, lithium disilicate, and human enamel (Aljomard *et al.*, 2022). The surface features (roughness, polish, glaze), hardness, and fracture toughness of dental ceramics can influence enamel wear. It is now accepted that polished ceramics cause less enamel wear than glazed ceramic surfaces (Aljomard *et al.*, 2022; Passos *et al.*, 2014; Sripetchdanond and Leevailoj, 2014).

Orthodontics and tooth wear

Ceramic orthodontic brackets are primarily made of aluminium oxide which has a greater hardness than enamel (Ghafari, 1992). Due to this, ceramic brackets can cause tooth wear and should not be placed in regions where they are in contact with the opposing teeth (Bishara and Fehr, 1997; Ghafari, 1992). Dental erosion is a potential issue with clear aligners (Nobrega *et al.*, 2024). Clear aligners can trap acidic substances against the tooth surfaces (if the aligner is not removed when consuming acidic drinks or during vomiting). Clear aligners also reduce contact of saliva with tooth surfaces, potentially reducing enamel remineralisation after an acidic exposure (Nobrega *et al.*, 2024).

New research directions in tooth wear epidemiology

There is limited longitudinal dental epidemiological literature reporting on the occurrence and patterns of tooth wear through the life-course. Most studies are based on cross-sectional data and report only on the prevalence of specific types of tooth wear. The analysis of tooth wear patterns at a population level could provide useful insight into common clinical presentations of tooth wear and the potential aetiological factors involved.

The management of tooth wear

The management of tooth wear can be complex and may require comprehensive treatment planning for more severe cases. Tooth wear can be monitored using study models, clinical photographs, and intraoral scan analysis (O'Toole *et al.*, 2023). Quantitative assessment of tooth wear from dental study models requires models to be scanned with a profilometer and the use of metrology software. Given that this process requires specialised equipment, it is only carried out in a research setting (O'Toole *et al.*, 2023). Intraoral scans can be useful to detect and monitor tooth wear and have been used in multiple studies (da Rosa Moreira Bastos *et al.*, 2021; Witecy *et al.*, 2021; Schlenz *et al.*, 2023). Depth and texture can be assessed using intraoral scans. Intraoral scans allow determination of colour and translucency but to a lesser extent than depth and texture (O'Toole *et al.*, 2023).

The superimposition of intraoral scan data is likely to become a useful clinical tool to monitor tooth wear progression. A purpose-built software called WearCompare has been developed to quantify erosive tooth wear using intraoral scans (O'Toole *et al.*, 2019). WearCompare is comparable to the previous gold-standard engineering software (Geomagic) in quantifying erosive tooth wear (O'Toole *et al.*, 2019). However, this study reported human errors occurred when superimposing the intraoral scans irrespective of which software was used. It is likely that advances in intraoral scan superimposition will allow more accurate quantification of loss of tooth structure in future (O'Toole *et al.*, 2019).

Tooth wear prevention can involve the removal or reduction of various aetiological factors, the use of fluoride to reduce erosive tooth wear, and the fabrication of custom-made occlusal splints for individuals with ongoing sleep bruxism (Lussi *et al.*, 2019; Mehta *et al.*, 2012). The type of fluoride is important with fluoride combined with titanium or stannous ions potentially providing greater protection than sodium or amine fluoride (Lussi *et al.*, 2019). A high fluoride concentration and/or regular application has also been recommended. However, this may not be suitable in children (Lussi *et al.*, 2019).

A recent New Zealand textbook focuses on the management of tooth wear. All documented cases are from New Zealand patients, demonstrating the range of presentations and varying aetiologies observed in practice (Shepperson, 2023). Direct composite restorations can be an ideal medium-term solution to restore worn teeth (Hansrani *et al.*, 2019). Restorative treatment should be as minimally invasive as possible and there should be a preference towards an additive, rather than subtractive, approach with the remaining tooth structure (Loomans *et al.*, 2017). Improvements in resin bonding and resin composite materials have led to a notable increase in the longevity of composite restorations. However, composite restorations may still experience small or bulk fractures and can become stained over time (Hansrani *et al.*, 2019). Direct composite restorations can also be used as a first-stage approach to re-establish the vertical dimension when this has been lost due to wear of the posterior dentition (Hansrani *et al.*, 2019). Indirect restorations such as crowns, onlays and/or veneers are other potential treatment options (Mehta *et al.*, 2012).

Conclusion

International literature indicates tooth wear is a common dental condition, but there is a lack of New Zealand epidemiological evidence on this condition. The risk factors for tooth wear have been described in international studies, but most are of non-representative clinical samples. There is a lack of epidemiological evidence from population-based representative samples and an almost complete lack of contemporary New Zealand epidemiological research on tooth wear. Longitudinal studies are needed to better-understand the prevalence, severity, aetiology, and patterns of tooth wear. Surveys of representative population samples should be conducted routinely to monitor population oral health, and such studies should include clinical assessment of tooth wear.

Author contributions

All authors contributed to conception and design of the work, data collection, analysis and interpretation, drafting and critical revision of the article, and final approval of the version to be published.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgements

The authors would like to express their gratitude to Dr Andrea Shepperson for her contribution in peer reviewing this article.

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