

Iatrogenic effects of orthodontics

Intraoral damage

In the first of her two-part series on the risks of orthodontic treatment, Shivani Patel highlights the intraoral problems that can occur in treatment and ways to prevent them

Although orthodontic treatment has recognised benefits, including improvements in dental health, orthodontic appliances, function, appearance and self-esteem, orthodontic appliances can cause harm. The decision whether to proceed with orthodontics requires comparison of the potential risks with the potential benefits.¹

Some patients are more at risk than others and they need to be identified early and managed appropriately to avoid adverse sequelae. The GDP's contribution is crucial, even if he or she does not fit orthodontic appliances, in helping to ensure that braces are properly maintained by reinforcing oral hygiene and preventive measures. The GDP may also help in an emergency if a wire or bracket is causing soft-tissue damage.²

Only when the patient is informed about the reason for treatment and the risks involved, can he or she then make a fully-informed choice and consent to go ahead.

The first part of this paper highlights the potential intraoral hazards and suggests how they may be avoided or minimised. The types of deleterious damage to the individual patient as a result of orthodontic treatment are listed below and are in reference to the most comprehensive classification compiled by NJ McGuinness.³

1) Teeth

Crown decalcification (Figure 1) can



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INTRAORAL EFFECTS	
Teeth	Crowns: Decalcification Enamel trauma Surface wear
	Roots: Resorption
	Pulp: Pulpitis
Periodontium	Gingivitis Periodontitis Burns
Soft tissues	Direct Trauma: Ulceration Headgear trauma
	Allergy/sensitivity
	Cytotoxicity
	Damage from appliances (removable and fixed)

be caused by the production of acid by products of plaque metabolism. This requires four elements to occur: plaque, substrate, susceptible tooth surface and time.

Decalcification is often related to the length of treatment, with upper canines and laterals, lower premolars and canines most likely to be affected.⁴ Gorelick et al showed that 50% of patients in fixed appliance treatment were found to have at least one white spot lesion after treatment.⁵ Another study also showed a positive correlation between oral hygiene and caries incidence in patients wearing fixed appliances.⁶ Decalcification is often related to the length of treatment.

Treatment and prevention: white spot lesions can resolve spontaneously and the majority will resolve in three months postoperation. Acid pumice

EXTRAORAL EFFECTS	
TMJ	TMJD
Soft tissues	Headgear induced trauma Burns Allergies
Systemic effects	Allergy/sensitivity Cytotoxicity Bacterial endocarditis Cross-infection Risks from radiation
Other effects	Psychological Failed treatment Unwanted effects from treatment

abrasion using 18% hydrochloric acid has been advocated by Croll and Cavanagh (1986) as a method of reducing the visibility of effects of demineralisation.

Avoid putting fluoride varnish on dematerialised lesions following removal of appliances as this may arrest the lesion, but will also leave a mark. Prevention involves appropriate patient selection. Orthodontic treatment should not be provided for patients with poor oral hygiene.

The orthodontist and their own GDP/hygienist should monitor every patient during treatment carefully. Once provided with an appliance, each patient should receive an education programme from the orthodontist that includes:

- Oral hygiene instructions
- Dietary advice
- Topical fluoride - daily mouthwash (0.05% fluoride) has shown to reduce white spot lesions and has better compliance than weekly mouthwash.⁷

Risks can also be reduced by modifying appliance designs, such as:



Figure 1: Extensive demineralisation in a patient who was in fixed appliance treatment



Figures 2a and 2b: Wear of the upper canine tip by lower canine bracket



Figure 3: Wear of the upper incisor teeth due to the presence of lower ceramic brackets



Figure 4: Upper standard occlusal X-ray showing root resorption

- Use of well-fitting bands
- Smaller brackets
- Removal of flash from around the brackets

- Use of glass ionomer cement to bond⁸
- Bonding rather than banding teeth
- Use of ligatures rather than elastomers (plaque retentive)
- Fluoride impregnated into modules and power chain has shown a 50% reduction decalcification over 18 months.⁹

Crown surface wear. Metal brackets placed on lower 3s can some times lead to the wear of the tips of the uppers 3s during canine retraction¹⁰ (Figure 2a and 2b). Swartz (1988) suggested that ceramic brackets on the lower incisors in deep bite cases could abrade the incisal edges of the upper incisors¹¹ (Figure 3). During the debonding of ceramic brackets there is an increased risk of enamel damage as is the use of debonding burs during the removal of excess composite. It has also been seen that the careless use of band seaters can lead to the enamel fractures. The prevention measures that could be put in place are:

- Careful bracket positioning so that brackets do not clash with teeth from the opposing arch
- Avoiding the use of ceramic brackets on the lower teeth in deep bite cases
- Careful debonding of all brackets especially ceramic brackets and brackets placed on restored teeth
- Use of tungsten carbide burs in a slow handpiece to remove excess composite.

Root resorption is a common idiopathic problem that occurs during fixed appliance orthodontic treatment (Figure 4). It is a major concern as it is unpredictable and irreversible. Kennedy et al have suggested that root resorption particularly affects upper and lower incisors and the distal roots of lower 6s.¹² The mean loss (usually apically) is between 1-2mm. Brezniak and Wasserstein (1993) have identified four main types of root resorption: physiological, inflammatory, replacement, and idiopathic.¹³

They also give a good account in their papers about the risk factors, which can be divided into:

a) Biological factors

- Susceptibility: Individual difference in tissue response
- Genetics: No definite conclusion on its effects
- Systemic factors: Increased doses of corticosteroids, increased alcohol causing vitamin D hydroxylation and certain endocrine diseases such as hypothyroidism and hypopituitarism can cause root resorption, though these factors are rarely seen in orthodontic patients

- Nutrition: This is not a major factor but studies on animals have shown that malnutrition can be a cause
- Gender: The female to male ratio for susceptibility of risk is 4:1
- Age: The vascularity of the alveolar bone decreases and the density increases with age and this can be a causative factor. Hence susceptibility can increase with age.
- Race: Higher incidence in caucasian and hispanic people than Asians
- Previously traumatised teeth: There is an increased risk with root resorption in teeth that have previously experienced root resorption
- Transplanted teeth: These are less susceptible to risk, especially if the transplant is without complications
- Endodontically treated teeth: These teeth are not necessarily at an increased risk as long as the root treatment is sound
- Alveolar bone density: Controversial reports state that increased bone density can affect movement but not related to resorption
- Tooth shape: Short, blunt, bent, dilacerated and pipette-shaped roots are more susceptible.¹⁴ Diminutive and peg-shaped laterals are less susceptible.
- Malocclusion: Any malocclusion that increases the load on teeth above physiological threshold can cause root resorption
- Habits: digit sucking and nail biting during treatment can cause jiggling forces, which may lead to root resorption.

b) Mechanical factors

Fixed appliances, use of rectangular wires, Class II traction, increased distance moved by teeth, intrusion of teeth, excessive palatal expansion and super elastic wires have all shown to increase the risk of developing root resorption.

Prevention techniques for root resorption include:

- Taking a thorough dental history and carrying out a good dental examination to identify any risk factors
- Radiologically looking for any preoperative signs such as root shapes, previous trauma, root treated teeth
- Stopping any habits that will have an impact on treatment
- Using light forces
- Minimising treatment length
- Reconsidering treatment aims when resorption is apparent.

Pulp. Ninety percent of orthodontic patients will experience pulpitis in the first month and rarely will this lead to loss of vitality.¹⁵



Figure 5: Surgical over expansion showing gingival recession around the central incisors



Figure 6: Severe loss of alveolar bone and gingival recession



Figure 7: Typical malocclusion following severe periodontal disease



Figure 8: Ulceration caused due to long distal end wire

2) Periodontium

Gingivitis. Nearly all patients will experience gingivitis during their treatment. This can be due to:

- Poor oral hygiene
- Increased bacterial counts due to presence of appliances
- Bands around teeth that cause a microbial shift (increased anaerobes)
- Elastomeric modules
- Composite flash
- Poor cleaning around bonded retainers

- Excessive proclination/expansion (Figure 5)
- Individual variation.¹⁶

However, Zachrisson's study (1972) and clinical experience shows that these effects are transient and resolve once the appliances are removed.¹⁷ Adolescents are also seen to be affected more than adults, but there are generally no long-term periodontal problems related to orthodontic treatment.

Preventive methods include:

- Thorough preoperative screening and good patient selection
- Good oral hygiene programmes and motivation
- Basic periodontal examination (BPE) and probing in patients previously affected by periodontal disease
- Regular hygiene visits.

Periodontitis. Orthodontic treatment does not cause periodontitis and generally has no long-term effects on the periodontium.¹⁸ This is supported by Zachrisson (1976) who showed in his studies that 10% of orthodontic patients had significant attachment loss (1-2mm) compared with controls, but 50% had no loss.

Other periodontal problems that can also, but rarely, be seen during treatment are:

- Gingival recession (Figure 6)
- Localised juvenile periodontitis
- Rapidly progressing periodontitis
- Periodontal disease associated with systemic disease like diabetes.

Research has suggested that patients affected by periodontal disease should not be treated until their condition is stabilised.¹⁹ Patients with compromised periodontal health frequently have:

- An increased overjet
- Spaced dentition
- Extruded teeth
- Malalignment (Figure 7).

Orthodontic treatment is not contraindicated in this group, provided the disease is controlled and the patient is sufficiently motivated and dexterous to maintain excellent oral hygiene during treatment. These teeth are easy to move as their centre of resistance has shifted along with reduced periodontal support. As a result, these teeth will need permanent retention postoperation, as chances of relapse is higher. During treatment these patients need three monthly screenings and need to be seen regularly by their periodontist and hygienist.

Burns. Careless use of acid-etch and electro-thermal bonders can lead to minor burns of the gingivae.

3) Soft tissues

Mucosal trauma is very common²⁰ in orthodontic treatment and can be caused by:

- Ulceration by distal ends/long span of wires (Figure 8)
- Displacement of headgear whiskers
- Ulceration from brackets
- Burns from acid-etch
- Thermal burns from hot instruments
- Clumsy instrumentation.

Prevention techniques include:

- Careful instrumentation
- Cutting distal ends short
- Using bumper sleeve on long spans of wire
- Providing patients with wax
- Safety straps on headgear.

Cytotoxicity. Various studies that have been carried out show bonding agents, elastics, arch wires, bands and brackets do not have any toxic effects.

Allergies/sensitivity. Ten percent of the population is allergic to nickel. This is 10 times higher in females due to constant contact to jewellery. Five to 12 times the nickel concentration would be required in the mouth to have an effect compared with the skin. This could be due to the protective nature of salivary glycoproteins, the difference in permeability between skin and mucosa. Patients allergic to latex can develop a type I (risk of anaphylaxis) or type IV sensitivity in response to gloves, elastomers and intraoral elastics.

Preventive means include:

- Taking a good medical history
- Patch testing if necessary
- Avoiding elastomers - use self ligation brackets/ligatures
- Using latex-free gloves
- Ceramic brackets/gold brackets can be used in patients with a nickel allergy.

It is important for all readers to appreciate that a high proportion of patients are considering or undergoing orthodontic treatment. It is also important to understand the potential risks of wearing an orthodontic appliance.

To ask a question or comment on this article, or for a full list of references, please send an email to andy.myall@fmc.co.uk

In the next issue of *Orthodontic Practice*, Shivani looks at the external risks of orthodontics