

# The aetiology and management of labial and vertical migration of maxillary incisors: 'Do you catch my drift?'

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## IN BRIEF

- Understand the aetiology of migration of the incisors.
- Understand the importance of disease stabilisation to prevent further aesthetic and functional compromise.
- Understand the differing management strategies and their relative benefits and costs.

Labial and vertical migration of maxillary incisors is a common complaint seen in general and specialist practices alike. Tooth movement in the aesthetic zone may cause significant concern to the patient, and a challenging management case for the dental team. This paper describes the aetiology, stabilisation and management of such cases.

## INTRODUCTION

Unwanted tooth movement is a significant event for patients, especially if it occurs in the anterior region of the mouth. Migrated anterior teeth can have a profound aesthetic impact, often causing embarrassment for the patient and potentially affecting their wellbeing and social functioning<sup>1</sup> (Fig. 1). The prevalence of tooth migration has been reported to be between 30%<sup>2</sup> to 56%<sup>3</sup> with anterior teeth being most commonly affected. Patients are mostly concerned about a progressively worsening diastema (Fig. 2) in the upper jaw or complain of a distorted smile. It has been reported that such tooth migration alone has been the reason for patients to seek periodontal treatment in 9%<sup>4</sup> to 37%<sup>5</sup> of cases.

This article will review the aetiological factors associated with such movement and aims to present the reader with a variety of treatment modalities available to manage these cases.

## AETIOLOGY

### Why don't more teeth move?

Tooth position is maintained by a complex interplay of forces involving the hard and soft tissues. Any factor that disturbs this equilibrium can result in tooth movement, which may be unwanted, creating an aesthetic or functional problem. Soft tissue forces exerted on teeth include pressure from the tongue, lips, cheeks and periodontal soft tissues. Such

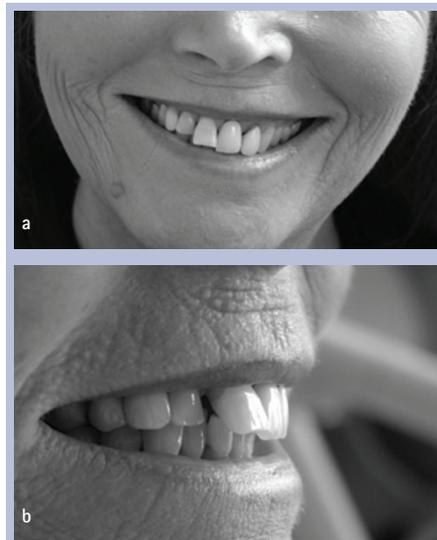


Fig. 1 Unwanted tooth movement can have considerable aesthetic consequences. Front (a) and lateral (b, c) views

pressures differ in both magnitude and direction, and may work alongside or in opposition to each other. Magnitude of the forces differs - for example, the forces exerted by the tongue are far greater than the opposing ones generated by the lips and cheeks.<sup>6</sup> Furthermore, the duration of the exerted force is thought to play a more significant role.<sup>7</sup>

In addition to influence of the soft tissues, the positions of adjacent and opposing teeth are also important in maintaining tooth position. Contacts with adjacent teeth help to maintain the mesio-distal position of a tooth. This has been highlighted in studies which have investigated tooth movement following tooth loss.<sup>8</sup> Intermittent forces generated during occlusal contacts also have a role in maintaining tooth position.<sup>2</sup> Finally, the supporting periodontal tissues perhaps play the most critical role in preventing tooth migration in health.

### Tippling the balance

Tooth movement occurs when the forces



Fig. 2 Twenty-four-year-old female presenting with spontaneous diastema formation in an apparently otherwise healthy dentition. Further clinical (a) and radiographic examination (b) reveals generalised aggressive periodontitis

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acting upon the tooth exceed the adaptive capacity of its supporting structures. Maxillary incisors can undergo a variety of unwanted movements, including rotation, extrusion, bucco-lingual and mesio-distal migration or a combination of these (Fig. 3). Limited evidence suggests that labial migration and diastema formation are the most common.<sup>9</sup> Given the elaborate mechanisms involved in maintaining tooth position, it is not surprising that alteration of any of these factors can have a potentially deleterious effect. Often, such tooth movement is a result of the influence of multiple factors, highlighting its complexity and the importance of thorough patient, mouth and tooth assessment. These are summarised in Table 1.

### Periodontal disease

Unsurprisingly, periodontitis is the most influential factor relating to the unwanted movement of teeth. Studies investigating maxillary incisor tooth migration among patients with periodontitis found a significant association with the degree of bone loss present.<sup>3,9,10</sup> Teeth with 50-75% bone loss had an 80% incidence of migration, compared to only 33% for those with bone loss of less than a quarter of the root length.<sup>3</sup> It is logical to conclude that a reduction of the bone and periodontal ligament attachment of a tooth will result in less resistance to any forces placed upon it, hence a greater likelihood of migration (Fig. 4).

It is not only the bone which can influence tooth migration, but also the periodontal soft tissues. Periodontitis is an inflammatory disease and this process results in greater vascular permeability and potentially higher fluid pressure within the affected gingival tissues. Observations that teeth migrate away from the area exhibiting the greatest periodontal destruction have been ascribed to this process.<sup>2</sup> Although this may seem theoretically plausible, it is unlikely that it plays a significant role. Inflammation of the periodontal tissues is an extremely common finding, yet tooth migration is seen to a far lesser extent. It is more likely that tooth movement away from the deepest part of a periodontal pocket is linked to the reduced periodontal attachment on that aspect of the tooth. The tooth will be more susceptible to the 'pull' from the remaining ligament fibres and less able to withstand any occlusal forces due to its compromised support. Tooth migration is also seen in patients exhibiting proliferation of the gingival tissues, such as those taking phenytoin, cyclosporin and calcium channel blockers. In such circumstances, the gingivae become more fibrotic, hence are able to exert pressure upon the teeth. Animal studies have shown that the associated loss of gingival architecture accompanying periodontitis

might also predispose to tooth migration; this is thought to be primarily linked with a reduction in the transeptal fibres linking adjacent teeth.<sup>11</sup> The fibroblasts in such fibres are thought to contract in response to forces placed upon the tooth, helping to resist its movement away from the force.<sup>2</sup>

### Occlusal trauma

Occlusal factors also have an important role in the migration of maxillary incisors. Occlusal trauma (both primary and secondary) results in increased mobility of teeth with either normal or reduced periodontal support, which can lead to tooth migration. During function, it is thought that a small component of occlusal force is transmitted anteriorly, as the mandible is rotating on a hinge. Proximal contacts are thought to help resist this force and when they are lost, teeth become more susceptible to mesial migration.<sup>12</sup> It has been suggested that patients who exhibit a protrusive pattern of mastication may also be at risk of developing anterior tooth migration.<sup>13</sup> Parafunctional activity such as bruxism and clenching could feasibly result in a greater likelihood of migration, although there is a lack of evidence proving this association.

### Class II incisor relationship

Skeletal and incisal relationships have also been linked to the unfavourable movement of anterior teeth. A higher incidence of maxillary incisor migration has been reported in patients with a Class II skeletal relationship.<sup>10</sup> Proclination of the lower incisors has also been linked with this finding in such patients, which may be a consideration in certain racial groups with a greater incidence of bimaxillary proclination.<sup>10</sup> It is plausible that soft tissue pressure may also play a role in patients with severe Class II skeletal relationships. In such situations, the lower lip may sit behind the upper incisors at rest exerting pressure on them, although this has not been proven. Lack of occlusal contact in intercuspal position on the maxillary incisors of such patients could exacerbate the vertical migration of these teeth, as there is no force from the opposing dentition to counteract this movement. It has also been suggested that a Class II div 2 incisor relationship may predispose to this condition due to the deep overbite and long, steep anterior guidance, placing greater outward force on the maxillary incisors.<sup>14</sup>

'Posterior bite collapse' is a term used to describe a loss of occlusal vertical dimension (OVD) initially ascribed to the extraction of first molars, which results in migration of anterior teeth<sup>15</sup> (Fig. 5). Various causes have been proposed including loss of arch

**Table 1** Reasons for unwanted tooth movement

Periodontal disease
Occlusal trauma
Class II incisor relationship
Iatrogenic: <ul style="list-style-type: none"> <li>• Inadequate restorations</li> <li>• Orthodontic relapse</li> </ul>
Habits



**Fig. 3** Central incisor exhibiting labial migration and rotation. (a) Right lateral view. (b) Occlusal view

integrity from spaced teeth, caries, poor restorations, tooth loss and tooth wear.<sup>15</sup> Such factors are thought to result in anterior positioning of the mandible which negatively affects a mutually protected occlusion, resulting in greater occlusal contact on the anterior teeth. Interestingly, in a case series discussing this phenomenon, all patients also had periodontal disease of varying severity.<sup>15</sup>

## IATROGENIC FACTORS

### Restorative treatments

Iatrogenic factors may also contribute to unwanted movement. Restorative treatment of poor design and technical quality can account for the majority of these situations. Restorations which introduce a posterior interference may result in a 'hit and slide' situation, whereby contact on the interference during closing pushes the mandible anteriorly resulting in heavy contact on the incisor teeth. Alternatively, failure to restore

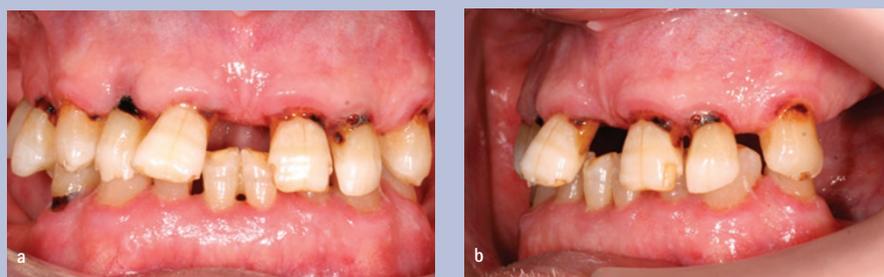


**Fig. 4** Labial migration of the upper left central incisor and vertical migration of upper left lateral incisor. (a) Frontal view. (b) Right lateral view. Note draining sinus associated with the upper left central incisor, indicative of a perio–endo lesion. (c) Periapical radiograph showing the true extend of periodontal disease resulting in primary periodontal and secondary endodontic lesion

proximal contacts with a restoration may result in loss of arch integrity altering the distribution of occlusal forces or permitting tooth migration which causes an interference. If the palatal aspect of a restoration placed on an anterior tooth is over contoured, this can result in excessive force being placed upon it during dynamic movements, potentially resulting in labial migration.

### Orthodontic relapse

In patients without periodontal disease, the



**Fig. 5** Occlusal overload of the anterior segment due to reduced support of posterior occluding units. Front (a) and left lateral (b) views

**Table 2** Effect of occlusal factors on unwanted tooth migration

Occlusal Factor	Reason it causes anterior tooth movement	Management
Bulky restorations on anterior teeth	Changes guidance on anterior teeth resulting in non-axial loading	Assess guidance, consider recontouring or replacing restoration (± provisional restorations)
Class II malocclusions	Teeth severely proclined, cannot be axially loaded	Orthodontics
Loss of posterior support	Increased demands on anterior teeth	Restoration of missing posterior unit(s) or restoration to a shortened dental arch.
Posterior occlusal interferences	Deflection causes large lateral forces anteriorly	Consider occlusal adjustment (after trial upon duplicate, mounted models)
Anterior occlusal interferences	Teeth that have moved may now be in a position where they face further loading	Consider recontouring the tooth/ removing some enamel to lighten the occlusal contact
Parafunction	Increased loading for prolonged periods of time	Indefinite splint therapy
Habits (thumb sucking, woodwind instrument players)	Direct application of extrinsic forces to teeth may have an orthodontic effect. If a habit is active for >50% of the time, drifting of teeth may occur.	Habit cessation should be encouraged if at all possible. If not possible (for example, woodwind instrument players), reduction of extrinsic forces to <50% of time maybe sufficient.

most common cause for unwanted tooth movement is relapse after orthodontic treatment. The incidence of orthodontic relapse has been reported to be 10%–67%.<sup>16,17</sup> Although not confined to the maxillary incisors, movement in these teeth is often first noticed by patients. This is often a result of non-compliance with wearing removable retainers.

### Habits

Habits have long been associated with development of an anterior open bite; however, they may also result in maxillary tooth migration. Such factors might include nail biting, lip and tongue habits, pipe smoking, thumb sucking and playing wind instruments, although the evidence is scarce.<sup>2</sup>

To summarise it is evident that a number of causative factors exist for migration of anterior teeth, yet the presence of periodontal destruction appears to have an underlying presence in the vast majority of cases. Data relating to incidence of anterior tooth migration in the literature come from cohorts exhibiting periodontal destruction.<sup>3,9,10</sup> Given that the other

factors discussed above are commonly seen in patients who do not exhibit such migration, it could be concluded that periodontal destruction is the common denominator in such unwanted tooth movement. Clinical examination paying particular attention to the factors discussed above is essential in determining an accurate diagnosis of the underlying causes hence providing effective treatment.

### MANAGEMENT

As with any presenting complaint, thorough history-taking, clinical and radiographic examination and sensibility testing of affected teeth is paramount. Patients presenting with maxillary anterior tooth movement may have one or more of the following concerns:

- None
- Concerned that teeth have moved, unaffected by aesthetics
- Aesthetic concerns
- Functional concerns.

In a patient with no functional or aesthetic concerns, reassurance and management of

the underlying cause may suffice. However, increased mobility or movement of a tooth can be of great distress to a patient: doing nothing may not be an option. Primary disease must be controlled or the outcome of all interventions may be compromised. As described previously, the migration process is often multifactorial and all aspects of aetiology should be addressed. Once the primary aetiology has been stabilised, the patient may be happy to wear a vacuum formed splint (for example an Essix removable orthodontic retainer) at night as a retainer to ensure no further movement of the teeth. This may suffice for some, but if the migration has progressed into moderate or severe levels many will require rectification of the situation with a combination of orthodontic, restorative or surgical treatment.

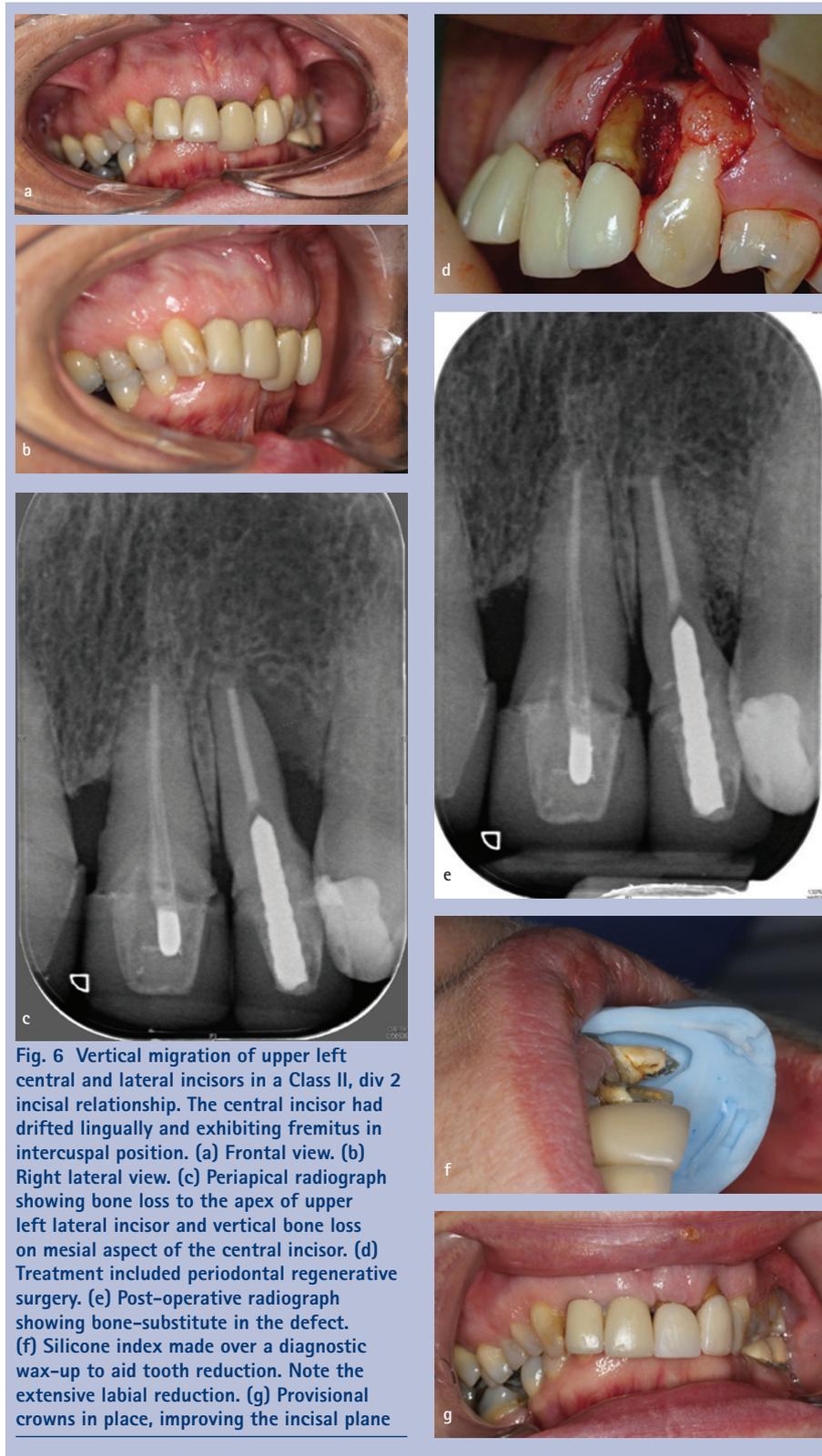
## STABILISATION OF PRIMARY DISEASE

### Periodontal disease

Patients with periodontitis should be enrolled into a standard programme of periodontal therapy.<sup>18</sup> This should begin with oral hygiene instruction and non-surgical debridement. The patient should then be placed into a regimen of supportive periodontal therapy. This should be risk-based, those in higher risk being seen more often, every 2-3 months.<sup>19</sup> Patients should have all the necessary oral health advice reiterated and residual pockets with bleeding upon probing should be debrided. The onus should be placed upon patients to take responsibility for oral disease, and if they cannot maintain adequate levels of oral hygiene they should be informed that their treatment options thereafter are limited.

When primary disease is stabilised deep residual pockets may persist. Surgical therapy may be considered in pockets greater than 7 mm for which routine instrumentation proves difficult or impossible. In certain cases the clinician may elect to use guided tissue regeneration with or without some form of root surface preparation.

There have been reports of spontaneous improvement in tooth position following non-surgical and surgical periodontal therapy.<sup>20-23</sup> Gaumet<sup>24</sup> confirmed that spontaneous closure does occur and the gap completely closes in 78% of cases when the diastema is less than 1 mm; however, when the gap measures more than 1 mm, the success rate drops. In another study, 52% of midline diastemas closed completely following surgical treatment. This may only be attainable again with diastemas less than 1 mm.<sup>24</sup> When a surgical approach is chosen, it should be considered that it may result in 'gappy smiles', papilla loss or vertical



**Fig. 6** Vertical migration of upper left central and lateral incisors in a Class II, div 2 incisal relationship. The central incisor had drifted lingually and exhibiting fremitus in intercuspal position. (a) Frontal view. (b) Right lateral view. (c) Periapical radiograph showing bone loss to the apex of upper left lateral incisor and vertical bone loss on mesial aspect of the central incisor. (d) Treatment included periodontal regenerative surgery. (e) Post-operative radiograph showing bone-substitute in the defect. (f) Silicone index made over a diagnostic wax-up to aid tooth reduction. Note the extensive labial reduction. (g) Provisional crowns in place, improving the incisal plane

irregularity of the gingival margin, further compromising anterior aesthetics.

If the unwanted tooth movement is related to drug-induced gingival overgrowth, non-surgical therapy and gingivectomy may be considered in combination. The patient's general medical practitioner should be consulted about the possibility of changing medications. This alone may be

sufficient to allow spontaneous correction of drifting.<sup>21</sup>

## OCCUSAL CONSIDERATIONS

There are circumstances where occlusal factors may be significantly influential in the progression of migration. These are summarised in Table 2 and highlight the importance of careful history taking and



**Fig. 7 Enamel reduction and use of direct composite veneer. (a) Pre-operative view. (b) Post-operative view**



**Fig. 8 Orthodontic management of tooth migration. Frontal (a) and right lateral (b) show the extent of migration before treatment. Photos courtesy of Dr David Waring, King of Orthodontics**

examination of the patient. This should include mounted study models on a semi-adjustable articulator with facebow transfer where appropriate.

### SPLINTING

Periodontal splinting *per se* is not directly concerned with the management of migrated teeth but may be considered a part of post treatment retention. In the unrestored mouth, simple wire retention is adequate but where multiple indirect restorations are present or require replacement these may be preferably linked. This may improve comfort, spread masticatory load and improve aesthetics.<sup>6</sup> Care must be taken to design the occlusal form with consideration of a mutually protective occlusal scheme. Cross-arch splinting should be considered as shortened splinted teeth may be prone to 'block' movement if support is insufficient.<sup>25</sup>

### DEFINITIVE TREATMENT

Once a diagnosis has been made, the aetiology identified and the underlying cause stabilised, the patient is left with the often unsightly appearance of spaced, overerupted, tilted or rotated incisor teeth. Often this is more an aesthetic concern than a functional one, and the following management decisions need to be considered:

- Restorative camouflage
- Orthodontics
- Extract and replace with:
- Removable dental prosthesis
- Fixed dental prosthesis
- Implant-retained fixed or removable prosthesis
- Restorative camouflage.

This involves modification of the affected teeth to give more favourable aesthetics using direct or indirect restorations (Fig. 6). The ability to camouflage the tooth is dependent upon the extent of displacement. If the root emergence is outside the prosthodontic envelope, it is unlikely that any amount of reshaping will permit adequate aesthetics. This is often a very difficult situation and patient expectations must be managed from the beginning. A diagnostic wax-up is recommended in advance to allow the clinician to visualise the extent of reduction and modification necessary. It also supports the consent process. Extensive preparation of the drifted tooth/teeth may be necessary (Fig. 6f). Consideration must be given to elective endodontic treatment if there is a risk of iatrogenic pulpal damage during re-contouring.

When it is necessary to remove enamel in the recontouring process, the resulting exposure of underlying dentine may be unsightly. Tooth whitening is the least invasive option

but additional tooth removal may be necessary to accommodate a restoration on the labial surface if whitening does not meet with patient expectations. Restoration of the palatal surface may be required if the body of the tooth lies outside the prosthodontic envelope. Composite resin may be used as a minimally invasive material for recontouring, direct veneers and to close diastemata. This can achieve the desired outcome (Fig. 7) but consideration may be given to all ceramic or metal ceramic indirect restorations. If the tooth/teeth are already restored with partial or full-coverage indirect restorations, replacement is the only camouflage option. The patient, however, must be warned of the risk that the underlying core may not be suitable for a new indirect restoration.

### ORTHODONTICS

Orthodontics is a good, non-destructive option in the stabilised patient<sup>26</sup> (Fig. 8). There is evidence to suggest that adults have better oral hygiene and if the periodontium is stabilised and healthy then orthodontics will not result in further bone loss.<sup>26–28</sup> Thus, pre-existing periodontal breakdown is not a contraindication. In addition, orthodontics may be used to help reduce pocket depth through selective intrusion; however, certain precautions should be taken:<sup>29</sup>

- Check-ups need to be frequent to ensure no plaque accumulation<sup>30</sup>
- Close communication between GDP/periodontist and orthodontist is advisable
- Anchorage must be stable and allow plaque control. Miniscrews, miniplates or implants may be considered as anchorage devices
- Appliances should be simple, bonds over bands, ss ligatures over elastics
- Removal of appliances must be considered if oral hygiene deteriorates
- Long term retention is essential with flexible spiral wire for a minimum of 12 months.

In cases of significant bone loss permanent retention is essential to prevent relapse.<sup>31</sup> The wire should be bonded in a significantly coronal position to facilitate oral hygiene with interspace and interdental brushes.

Complications may arise during adult orthodontics when a patient has an extensively restored dentition. Bond strengths to metal ceramic crowns are reduced. Roughening of ceramic surfaces may be necessary to increase the micro-mechanical retention. Consideration may be given to removal of such crowns and replacement with long-term composite provisional restorations. The cost and time requirements of these additional steps may preclude their

Table 3a Removable partial denture	
Advantages	Disadvantages
Excellent aesthetics possible	Less favourably accepted in younger patients
Cost-effective	Higher biological price and may thus compromise disease control elsewhere
Simple	May not be worn
Many be viewed as a transitional prosthesis if further tooth loss is likely	
Sensible immediate option to allow hard and soft tissue recontouring after extraction	
Replaces both tooth and gum	
Diastema may be included and prosthetic tooth may be more favourably inclined and positioned to harmonise with existing dentition	

Table 3b Fixed partial denture	
Advantages	Disadvantages
Fixed solution preferable for patients	Abutment teeth may be too compromised to support pontic
Good aesthetics may be possible	Aesthetic mesio-distal positioning of the prosthetic tooth may not be possible
Psychologically advantageous	Adequate replacement of lost soft tissue not always possible
May require minimal tooth removal if adhesive design	Not appropriate in cases of bi maxillary proclination or when generalised spacing present
Good solution to allow restoration to a shortened dental arch precluding the need for a partial prosthesis	Mechanically limited to smaller spans
Pink porcelain possible to replace missing soft tissue	Pink porcelain may compromise aesthetics further
Quick solution: may only require two visits	May compromise periodontal and/or pulpal health of abutment teeth
	More costly

Table 3c Dental implants	
Advantages	Disadvantages
Fixed solution with no damage to adjacent teeth often regarded as optimal	Dependent upon available bone
Screw-retained removable designs accommodate future loss of teeth and future implant placement	May necessitate grafting or guided tissue regeneration
No collateral damage to adjacent teeth either through preparation or plaque retention	Surgical procedure involved
Excellent aesthetics possible	Long time between initiation of care and restoration
	Precise timing between extraction and fixture placement essential
	May be challenging to achieve optimal aesthetics
	Dependent upon pink porcelain to replace soft tissues
	Higher risk of peri-implant disease in patients with active or historical periodontal disease
	Specific contra indications/caution must be acknowledged including bleeding disorders, history of radiotherapy
	May necessitate elective loss of other compromised teeth for strategic long term planning
	Most costly



**Fig. 9** Extraction and replacement with a natural immediate bridge. (a) Fibre-reinforced composite in place immediately post-extraction. (b) Extracted tooth is bonded to the fibre. (c) Post-operative view

use. If teeth are linked with conventional or adhesive bridges these will invariably need to be removed and temporised to allow tooth movement. Temporary pontics may be attached to the arch wire during orthodontics.

Orthodontic therapy may also be considered for patients planned for implants. Extrusion of compromised teeth may increase alveolar bone volume and negate the need for grafting. Furthermore the total time for sufficient extrusion may be comparable or shorter compared to augmentation techniques.<sup>32</sup>

### EXTRACTION AND REPLACEMENT

If the tooth is significantly displaced or periodontally damaged to the extent that restoration or orthodontics are not possible, extraction is the only solution. Replacement options are dentures, bridgework or an implant-supported fixed or removable prosthesis (Fig. 9). Prosthodontic rehabilitation may be very challenging. Clinicians should be aware of the very specific risks and benefits of each option (Table 3). In reality, should extraction be indicated it is likely the patient will need an immediate denture in the first instance, followed by a definitive restoration once healing has completed.

### CONCLUSION

Historically the prognosis of migrated teeth

was considered to be poor and the affected teeth were extracted. This continued until 1933 when Hirschfeld<sup>33</sup> showed that these teeth can be maintained for a relatively long time if the patients are placed on a periodontal maintenance regimen. In modern-day dentistry, where extraction is often considered a last resort by patients and clinicians alike, restorative, orthodontic and surgical options exist to manage such a problem. The indolent and multifactorial nature of unwanted migration of anterior teeth predisposes to late diagnosis resulting in the need for more complex treatment. It does, however, remain clear there are many risk factors that can be identified and addressed. Practitioners should be aware of these and thus the need for early intervention. Treatment must be aimed at controlling aetiological factors before managing the cosmetic demands and expectations of the patient. Definitive treatment options are varied with unique risks and benefits, all of which must be discussed as part of the consent process. Whatever the final treatment plan, the improvement in aesthetics and function can have a significant impact upon patient wellbeing.

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