

## CLINICAL SECTION

# Canine transposition following trauma and loss of a central incisor: treatment options

**B. Lewis, P. Durning, W. McLaughlin and P. T. Nicholson**

Orthodontic Department, University Dental Hospital, Cardiff, UK

The aim of this article is to make clinicians aware of the possibility of canine transposition following loss of the upper central incisor. Using two case reports it considers the opportunities for rehabilitation of the occlusion, and discusses surgical, orthodontic and restorative considerations.

*Key words:* Transposition, maxillary canine, guidance theory

Received 28th January 2004; accepted 9th July 2004

## Introduction

Transposition can be defined as the interchanged position of two adjacent teeth.<sup>1</sup> This uncommon phenomenon occurs in 1 in 300 children.<sup>2</sup> It tends to occur at specific sites in both the maxilla and mandible, each causing a change in the natural order or sequence of the permanent teeth.

It has been reported that maxillary transpositions can be divided into five types, which relate to their distribution:<sup>2</sup>

- canine–first premolar 71%;
- canine–lateral incisor 20%;
- canine to first molar site 4%;
- lateral incisor–central incisor 3%;
- canine to central incisor site 2%.

The incidence of impaction of the permanent canine is approximately 2%,<sup>4</sup> of which approximately 80% are palatally placed. The etiology of this condition is usually reported as being due to genetics<sup>1</sup> or due to the guidance theory.<sup>5</sup> The canine develops high in the maxilla with a long path of eruption. The absence, malformation or malpositioning of the lateral incisor root is most often described as the reason for a lack of guidance for canine eruption, although some studies contradict this conclusion.<sup>6</sup>

Unusual transpositions can present challenges for treatment. Two such cases are presented where trauma to the upper anterior region resulted in the permanent canine becoming transposed with the lateral incisor, presenting interesting possibilities for orthodontic rehabilitation.

## Case report 1

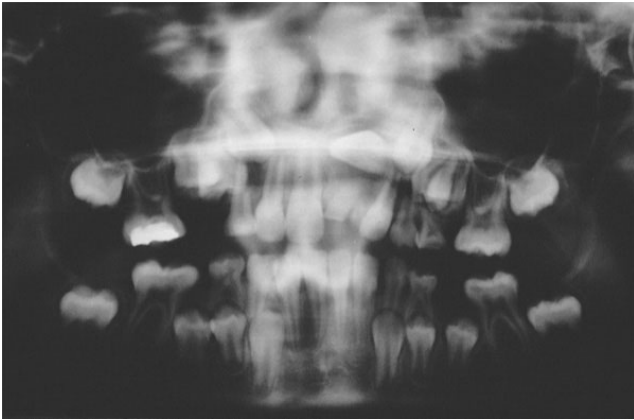
A 9-year-old female presented at a new patient orthodontic clinic. Clinical examination revealed a Class I skeletal base. The right buccal segment was Class I, and the left buccal segment Class II with a crossbite. The crowding was equivalent to a full unit in each quadrant. It was noted that the UL1 was unerupted. Radiographic examination showed the UL1 to be severely dilacerated (Figure 1), and caries in the LL6 and LR6.

A treatment plan was formulated:

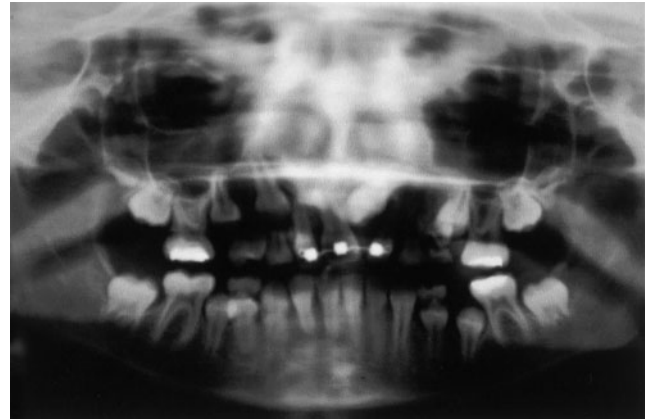
- Surgical removal UL1 with a sectional fixed appliance to close space. (The role of bracket prescriptions is described later.)
- Later, extraction in both right quadrants and full fixed appliance therapy.
- Restorative treatment of UL3 with a veneer to disguise it as the UL1.

Under general anesthesia the UL1 was surgically removed. Fixed appliance treatment using standard edgewise brackets was used locally on UR21 and UL2 (Figure 2a–c). After 1 year, the prognosis for space closure was poor: new radiographs showed that the UL3 was erupting between the UR1 and UL2 (Figure 3). Caries was still noted in the LR6 with large restorations in UL6, UR6 and LL6, and third molars were absent. The localized fixed appliance was therefore removed and the situation monitored (Figure 4a–i).

After 15 months new records were taken. The GDP was asked to extract the UR4 and LR4. Following this



**Figure 1** Pretreatment DPT showing dilacerated UL1



**Figure 3** DPT showing UL3 transposed with UL2

full upper and lower fixed appliances were used. On completion of fixed therapy a retainer was used for 1 year (Figure 5a–h). Finally, the patient was seen by their GDP for a veneer on the UL3 to disguise it as UL1. Following a review appointment the patient was then discharged from orthodontic care (Figure 6a–h).

## Case report 2

An 8-year-old female first presented to a pediatric consultant clinic with failed eruption of UL12. Clinical examination showed that the buccal segment classification was Class II ½ unit on the left and Class II full unit on the right. The patient had an overjet of 8 mm and minimal overbite. Lower labial crowding was also noted. Radiographic examination showed that the UL1 had a dilacerated root and the UL3 was transposed with the UL2 (Figure 7a,b).

After consulting with the orthodontic and oral and maxillofacial surgeons a treatment plan was formulated:

- surgical removal of dilacerated UL1;
- upper removable appliance to distalize UR1;
- allow UL3 to erupt into the position of UL1;
- restorative treatment to disguise the UL3 as UL1.

Under general anesthesia the dilacerated UL1 was surgically removed. The patient was then treated with an upper removable appliance to move the mesially drifting UR1 distally. Following regular review appointments it was noted that both the UL3 and UR3 had not moved over the last year. The decision was made to extract a premolar in the upper right quadrant, and surgically expose the UL3 and UR3. A bracket was attached to UL3 and a gold chain was used to aid this movement in conjunction with fixed appliance therapy. As the UL3 was transposed with the UL2, the UL3 was moved into the UL1 position (Figure 8a–o).

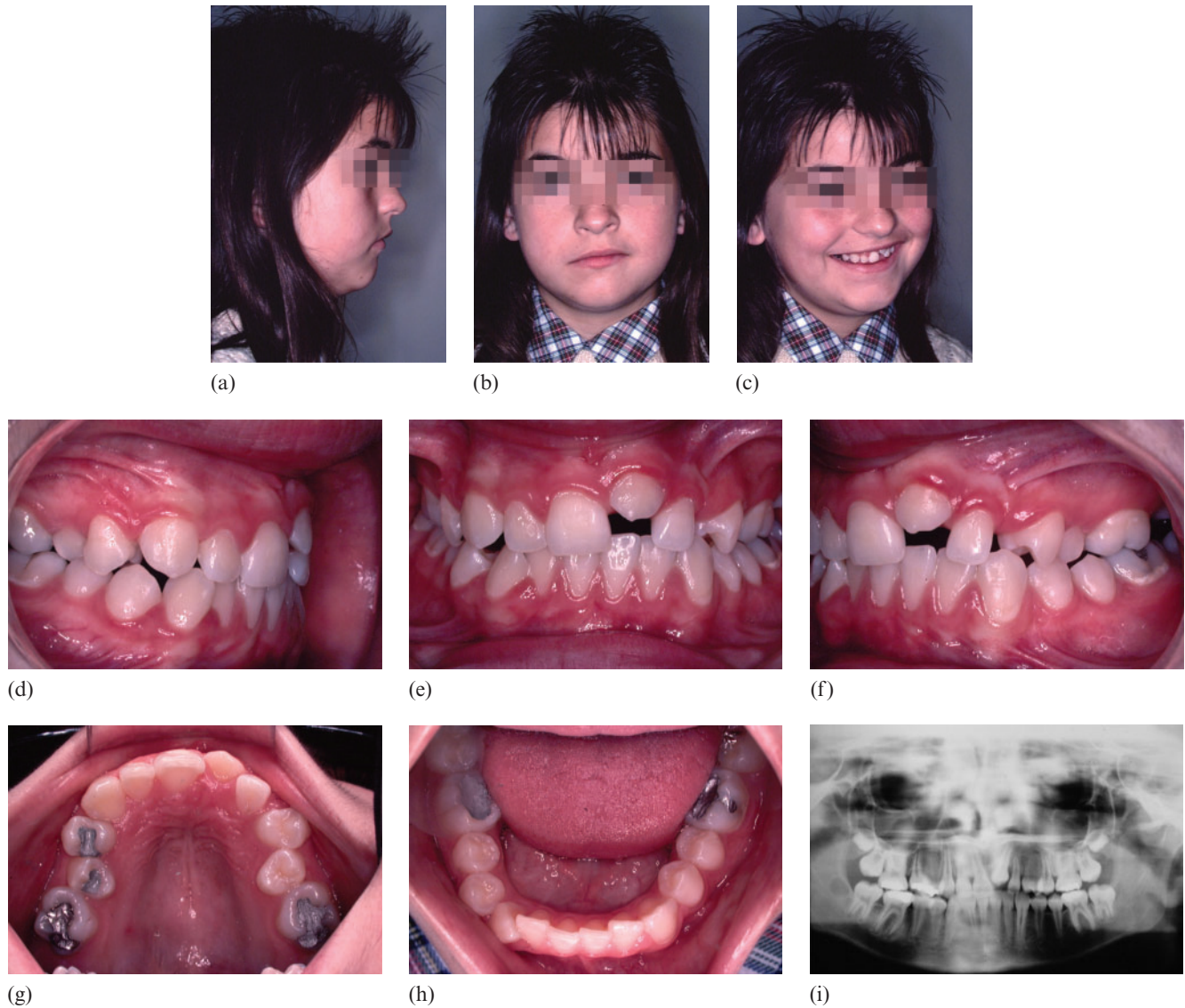
On completion of the fixed treatment the UL3 was restored with a veneer to disguise it as the UL1 (Figure 9a–j).

## Discussion

If the guidance theory of eruption of the permanent canine is to be believed, several anomalies of the lateral incisor tooth may contribute to ectopic positioning of the adjacent tooth. Missing, microdont lateral incisors or cases in which the lateral incisor root is positioned differently, for example, in Class II division II



**Figure 2** (a–c) Sectional fixed appliance to close space following surgical removal of dilacerated UL1



**Figure 4** (a-i) Records following removal of the sectional fixed appliance to allow the situation to be monitored

malocclusions, may fail to provide adequate guidance for the permanent canine.

It is therefore possible that, given the absence of a central incisor, the lateral incisor may become more mesially positioned than expected or even alter its angulation. This phenomenon may predispose the permanent canine to lose guidance during eruption and become mesially positioned. The transposed canine has the potential following alignment to act as a replacement for the central incisor.

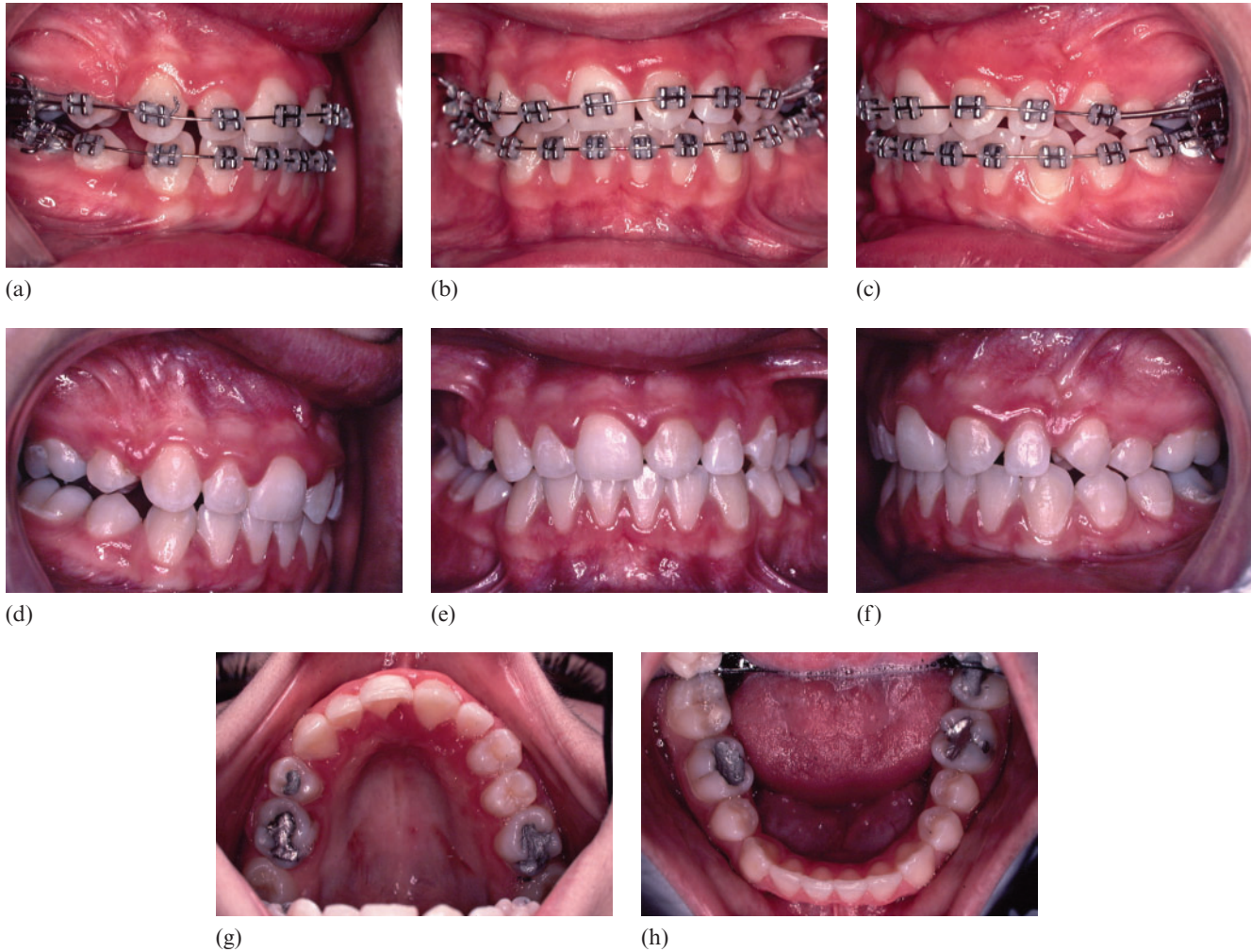
#### *Surgical management*

The most appropriate method of surgical orthodontic management of these teeth is a closed surgical exposure technique.<sup>7</sup>

A flap should be reflected from the crest of the alveolus, the crown identified and a bonded orthodontic attachment with a gold chain attached fixed to this tooth. Care should be taken when this attachment is placed as once the flap is replaced teeth that are very superficial labially can be prone to exposure of the attachment ulcerating through the unattached gingivae labially. This often results in a poor gingival form. If the crown of the canine is superficial labially, thought should be given to placing this attachment on the palatal surface of the crown, which may require reflection of a palatal flap.

A further option is the open surgical procedure. It involves removal of overlying gingivae and bone, and the formation of granulation tissue by placement of a





**Figure 5** (a–c) Mid-orthodontic treatment. (d–h) Post-orthodontic treatment

pack, such as zinc oxide eugenol or gauze with Whiteheads varnish. This is useful if the canine is superficial, but there is a danger that the gingivae may cover the tooth again.

#### *Orthodontic management*

The timing of orthodontic treatment is dependent on each individual case, but a good rule of thumb is to create space for the tooth, and prepare the arch by leveling and aligning prior to surgical exposure. However, some clinicians would undertake exposure prior to commencement of orthodontic treatment as this is the 'rate limiting step' and early intervention would expedite the treatment.

There are various techniques available to extrude the tooth. This includes the use of sectional arch wires, utilities and additional vertical anchorage devices, such as palatal arches and modified palatal arches. For

sectional arch wires it is advisable to use a rigid stainless steel arch wire in place before the exposure and following 2–3 weeks of post-operative healing orthodontic traction applied to the tooth. This can either be achieved by using an auxiliary nickel titanium wire overlaid on the stabilizing arch and linked into the chain of the orthodontic attachment on the unerupted tooth. Alternatively elastic thread from the base archwire to a link on the chain can be used. Whichever method is used, light forces should be utilized that do not apply reciprocal heavy forces to the potentially fragile apices of the central and lateral incisors.

Once the tooth is visible, the attachment should be replaced with a conventional bracket. This can only be undertaken once the FA point is properly available. Care should be taken in selecting the appropriate bracket. The ultimate positioning of the tooth for restorative rehabilitation needs to be considered at this time. Restorative treatment options include composite



**Figure 6** (a–h) Veneer to disguise UL3 as UL1

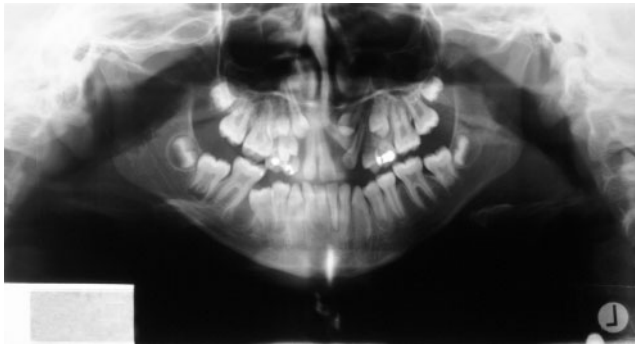
build-ups, composite veneers, porcelain veneers, and partial and full crowns. A porcelain veneer is often the restorative treatment of choice and the canine must be positioned to facilitate this procedure.

In orthodontic terms, the canine position in all planes of space must be considered.

*First order.* As the canine is thicker than the contralateral incisor tooth, and will be further compromised by the provision of a veneer, the overbite of the canine and whole labial segment requires consideration. To position the labial aspect of the canine slightly inset to the arch, but to also accommodate it to occlusal function, the overbite must be fully reduced. Given the contour of the labial surface

of the canine, a traditional canine bracket is most appropriate to provide overbite reduction and a small first order offset bend will detail the canine in this region.

*Second order.* The prescription of canine brackets in most pre-adjusted edgewise brackets are most variable in the maxillary canine value. The maxillary canine is approximately as wide as the central incisor, but the second order prescription of central incisor brackets is approximately  $5^\circ$ . Care must be taken in selecting a bracket for a canine replacing a central incisor as the most common bracket second order prescriptions for maxillary canines in pre-adjusted edgewise systems is  $10\text{--}13^\circ$ . This excess tip would mean the canine



(a)



(b)

**Figure 7** (a,b) Radiographs to show dilacerated UL1 and transposed UL3 with UL2

mesio-distal crown width being too great and may inhibit anterior space closure in the labial segment. A canine bracket with a low second order prescription would be recommended such as MBT ( $8^\circ$ ).

*Third order.* The prescription of torque in the central incisor bracket of most pre-adjusted edgewise appliances is  $7\text{--}12^\circ$  of palatal root torque. Conversely, most canine brackets have small degrees of buccal root torque. As

the central incisor and canine teeth will be simulating two central incisors, the torque prescription of the brackets should be considered. One useful solution is to select a canine bracket of similar second order value to the contralateral incisor and of a similar third order value if available (but generally in the opposite direction, as with Andrews SWA), then invert the bracket to retain the first and second order dimensions, but reverse the third order value.

#### *Other potential complicating factors*

The incisio-gingival height of the canine is often slightly longer than the central incisor. This can affect the comparable gingival heights of the canine and central incisor, and are aligned as described as above. In patients with an expressive smile, the differing gingival heights are quite unaesthetic. It is sometimes advisable to place the canine bracket slightly (1 mm) more gingival than normal to level the gingival heights. There will then of course be a requirement to grind 1mm off the incisal edge of the canine tooth. A further option would be to contour the gingival margin of the central incisor.

*Restorative Considerations.* When a canine is to be made to look like a central incisor there are a number of options for the final restorative material. These include:

- direct mesial and distal composite placement;
- indirect porcelain or composite veneer;
- porcelain bonded crown;
- other types of crowns, such as porcelain jacket or porcelain bonded to metal.

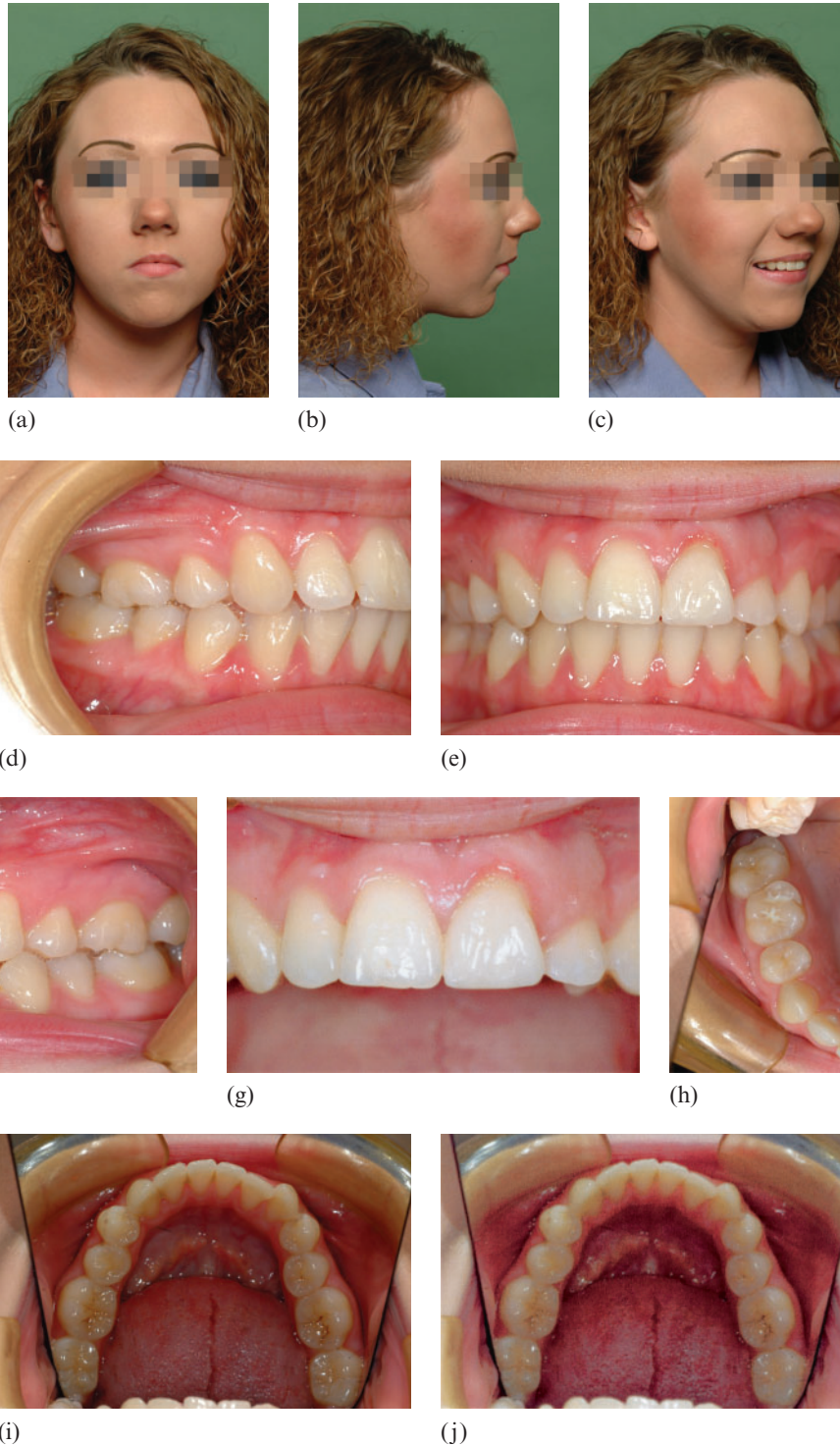
There are a number of problems that have to be considered when consideration is being made to camouflage a canine as a central incisor. These include:

- *The mesio-distal width of the canine.* This may be very similar or smaller than the central incisor, in which case any of the restorative options are possible. However, if the canine is considerably smaller than the remaining central incisor there will be a noticeable discrepancy at the gingival margin in regards to the emergence appearance. If the width of the canine is greater, then a crown is the only option to enable the tooth to be made smaller, although the emergence appearance will vary between the two anterior teeth.
- *The bucco-palatal width of the canine.* This is greater than the central incisor and may cause difficulties in





**Figure 8** (a-i) Pre-orthodontic treatment following surgical exposure of UR3 and UL3 with gold chain. Extraction of UR4. (j-o) Mid-orthodontic treatment showing traction on UL3 gold chain using elastic thread



**Figure 9** (a–j) Post-orthodontic treatment showing a veneer on the UL3 to disguise it as UL1. Lower arch irregularity and under torqued UL2 as patient was keen to complete treatment

protrusive excursion with all guidance being taken by the canine. If there were concerns regarding the guidance adjustments would have to be made to the canine's palatal aspect.

- *The hue (attribute of a color enabling an observer to classify it as red, blue etc.), value (graduation of tone from light to dark) and chroma (attribute of color enabling an observer to judge how much chromatic color*



it has) of the canine. In many cases this would be similar between the canine and central incisor, but where there are marked differences (and usually the canine is darker) it would not be possible to deal with the recontouring by direct addition of composite and by using even a veneer due to the 'shine through' of the natural tooth.

- *The buccal curvature of the canine.* In relation to the central incisor, is normally greater. This can necessitate increased bucco-palatal width of the final restoration in the mesial and distal aspects of the tooth to mimic the central incisor. This may result in a broad incisal edge that can make incising through food difficult.
- *The incisal tip of the canine.* This can be quite pronounced and, if so, it is beneficial to reduce it before the orthodontic phase of treatment is completed to reduce the extent of the incisal line angle build-up required on the tooth. This reduces the risks of fracture in this part of the final restoration.
- *The gingival margin.* As discussed above, problems can exist with regard to the gingival position. This may necessitate alterations in the position of the orthodontic bracket possibly combined with a gingivoplasty if there is excess tissue over the labial surface of the canine.

## Conclusion

Although not of relevance in planning rehabilitation, the clinician should be aware of the possibility of canine transposition following early loss of a central incisor. Timing is important. When early loss of the central incisor occurs before sufficient root development has taken place, this maybe the optimum time to consider the opportunities for rehabilitation of the occlusion.

## References

1. Peck S, Peck L, Kataja M. Mandibular lateral incisor-canine transposition, concomitant dental anomalies, and genetic control. *Angle Orthod* 1998; **68**: 455–66.
2. Peck S. Classification of maxillary tooth transpositions. *Am J Orthod Dentofac Orthop* 1995; **107**: 505–17.
3. Houston W, Stephens C, Tulley W. *A Textbook of Orthodontics*, 2nd edn. Oxford: Wright, 1992.
4. Ericson S, Kuroi J. Radiographic assessment of maxillary canine eruption in children with signs of eruption disturbance. *Eur J Orthod* 1986; **8**: 133–40.
5. Becker A, Zilberman Y, Tsur B. *et al.* Root length of lateral incisors adjacent to palatally displaced maxillary cuspids. *Angle Orthod* 1984; **54**: 219–25.
6. Brenchley Z, Oliver RG. Morphology of anterior teeth associated with displaced canines. *Br J Orthod* 1997; **24**: 41–5.
7. Howe G. *Minor Oral Surgery*, 3rd edn. London: Wright, 1996.