

Exploring orthodontic options in complex adult cases

Shivani Patel¹

A 40-year-old male at the start of treatment presented with a mild class III incisor relationship on a skeletal I dental base with average vertical facial proportions.

There was severe crowding in the upper arch and mild crowding in the lower arch. He had a reduced overjet and increased overbite with bimaxillary retroclination. The treatment took exactly two years.

The molar relationship was class III on the right and class I on the left side. The case was complicated, with retained upper right and left deciduous canine teeth, along with unerupted and impacted upper right and left canine teeth.

Treatment carried out was with bilateral closed surgical exposure of the upper right and left canine teeth, combined with upper and lower preadjusted Edgewise appliance therapy.

Preoperative assessment

The patient complained of having baby teeth that were now mobile and also made his smile immature. He was now applying for the chief executive officer post in his firm and wanted to be taken seriously, and for his smile to look mature and fit his face and age.

He was undecided and came to see us initially four years ago and was re-exploring his orthodontic options again.

Relevant medical history suggested the patient was fit and healthy.

Extraoral assessment

Skeletal assessment

- Skeletal I pattern
- Average vertical skeletal relations
- No asymmetries.

Soft tissue assessment

Lips

- Lips were incompetent at rest
- The soft tissue profile looked good. It was felt that the patient was bimaxillary retroclined, which meant his upper and lower lips were set back and less supported.

Nose

- Average nasolabial angle.

Tongue

- Nothing abnormal detected.

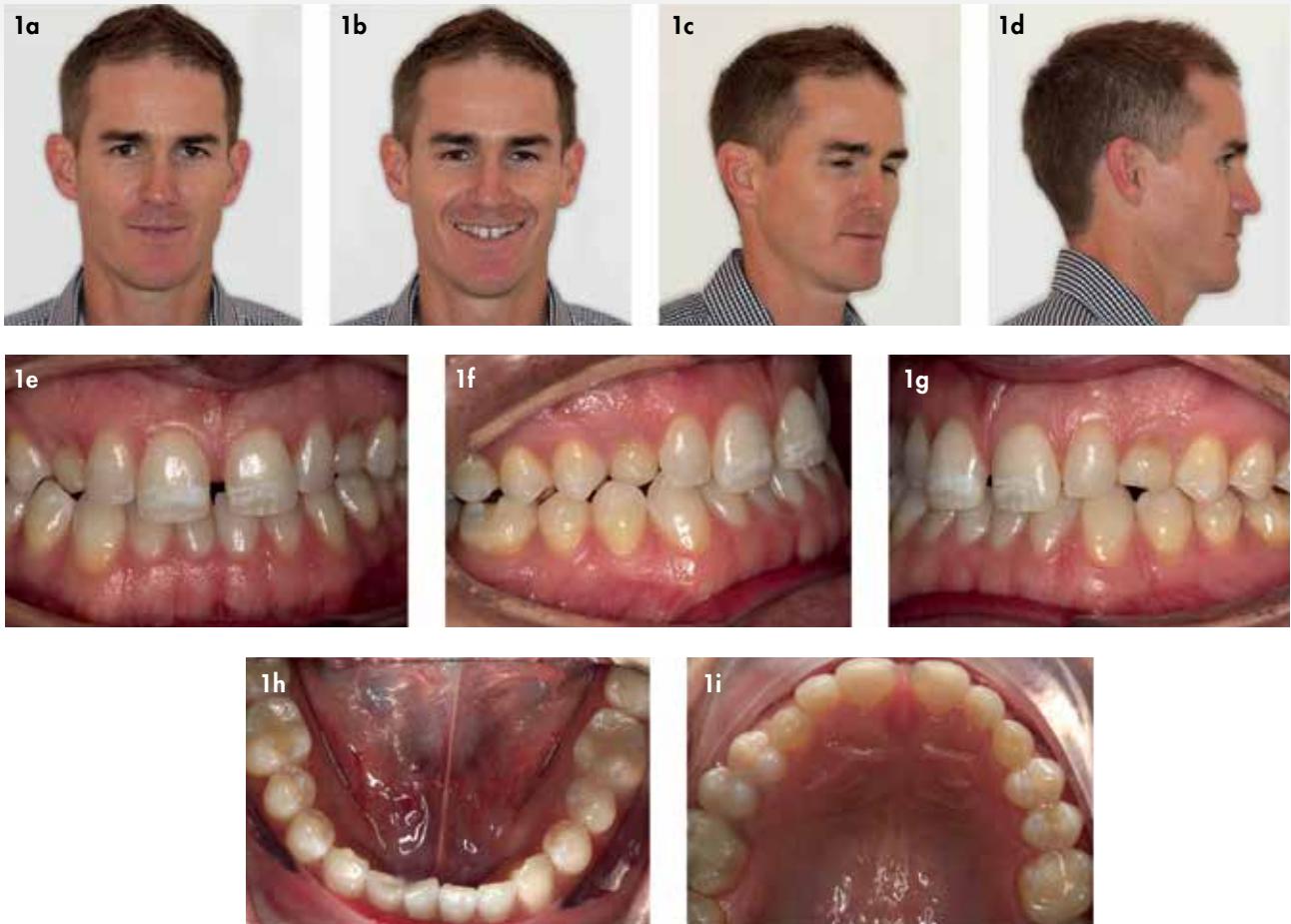
Speech

- Nothing abnormal detected.

Temporomandibular (TMJ) assessment

- Nothing abnormal was detected
- Maximum mouth opening: 42mm.

¹ Shivani Patel BDS (Hons), MFDS RCSP (Glas), MSc (Lond), IMOrth RCPS(Glas), FDS(Orth) RCS(Eng) FICD(Hons), Consultant Orthodontist, London, UK.



Figures 1A-I: Preoperative photographs

Intraoral assessment

Oral hygiene and dental health

- Oral hygiene was good
- Restorations present on some posterior teeth. All sound and with no other pathology detected.

Soft tissue assessment

- Gingiva and mucosa were healthy.

Unerupted teeth

- All teeth had erupted apart from UR3 and UL3.

Arch alignment and space assessment

Maxillary arch

- Upper labial segment was severely crowded and retroclined
- The upper right and left deciduous canine teeth were retained and mobile. Mobility grade II
- The buccal segments showed mild crowding, primarily confined to the first premolars
- Median diastema of 2.5mm with a low frenal attachment.

Mandibular arch

- The lower labial segment was mildly crowded and retroclined
- The buccal segments were well aligned.

Bolton Analysis

3(9mm) 2(6mm) 1(9mm)	1(9mm) 2(6mm) 3(9mm)
3(8mm) 2(6mm) 1(6mm)	1(6mm) 2(6mm) 3(8mm)

Total 83.33 (ideal ratio 77.2 +/- 1.65).

A Bolton discrepancy is evident. This is due to the upper lateral teeth being smaller than average

Occlusal relationships

- Incisor classification: class III
- Overjet: 1.5mm
- Overbite: increased, complete to tooth
- Centre line: coincident dentally and facially.



Figures 2A-C: Preoperative radiographs

Buccal segment relationship

Molars:

- Left: full unit class I
- Right: full unit class III.

Canines:

- Left: class I
- Right: class I.

Crossbites:

- Nil.

Displacements:

- Nil.

Other features to note:

- Mottling on the upper incisor edges
- History of childhood trauma.

Intercanine width

- Upper: 33mm
- Lower: 27mm.

Intermolar width

- Upper: 58mm
- Lower: 51mm.

Special investigations

1. Initial extra and intraoral photographs (Figures 1a-11)

2. Preoperative radiographs

- Views taken
- Dental panoramic tomogram
- Long cone periapicals
- Unerupted UR3 and UL3
- Absent teeth: none
- Pathology: none.

Other relevant radiographic findings:

roots of the upper right and left deciduous canine teeth have been resorbed.

3. Study models

Unfortunately, these were sent to the laboratory a few years ago for digitising and were misplaced/lost.

Summary of radiographic findings

An orthopantomogram (OPG) was taken of grade I quality to assess position, presence and pathology.

The OPG revealed normal TMJ and surrounding structures. Radiographic assessment revealed normal and healthy periodontal status; however, the upper canine teeth were impacted and the roots of the deciduous canines were resorbed.

It appears that both the upper canine teeth are aligned favourably close to their ideal axis in the arch and the apices are well positioned for potential movement into the arch.

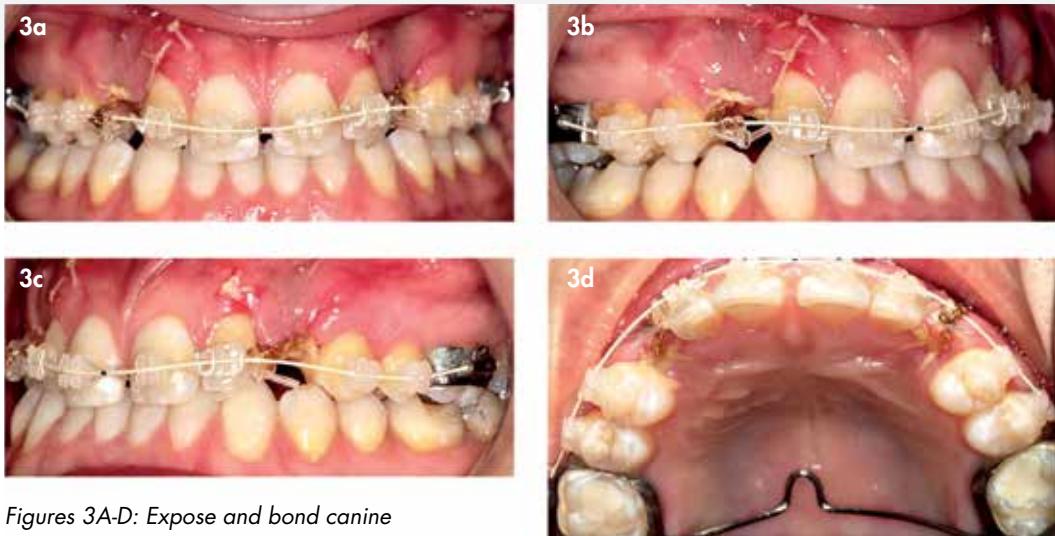
Horizontal parallax views were taken to localise the position of the teeth (Southall and Gravely, 1987). This was done with two long cone periapical views. Horizontal parallax views are more accurate; 83% of 3s were correctly located with horizontal parallax compared with 68% with vertical parallax (Armstrong et al, 2003).

When localising canines and determining the prognosis, there are a number of factors to consider:

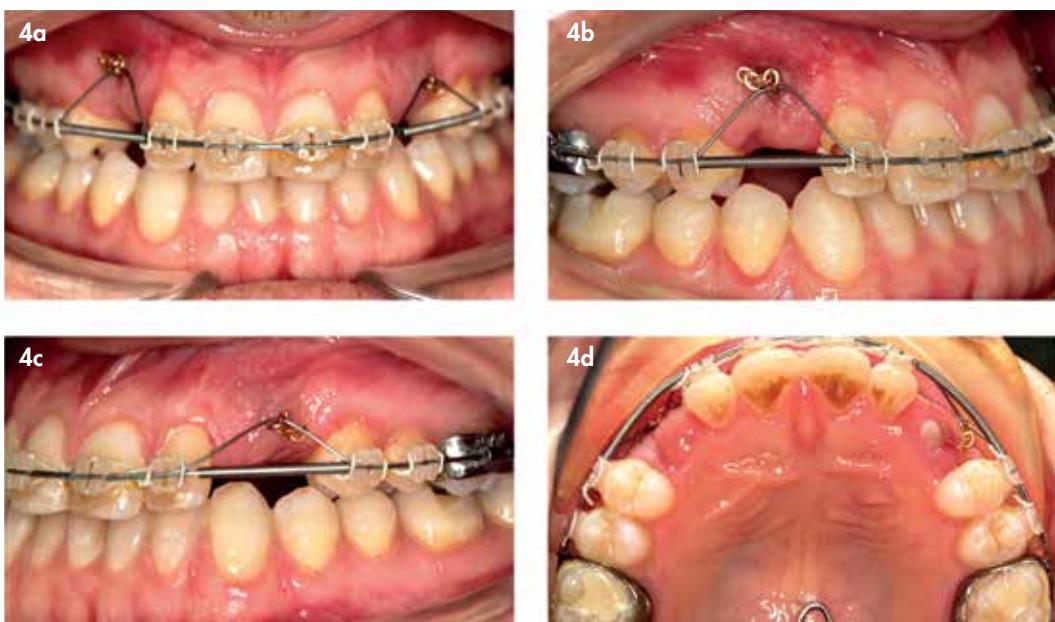
- The bucco-palatal position
- The position of the apex – very important
- Height of the crown to the occlusal plane
- Obliquity to the long axis
- Proximity to the midline.

Bearing all these factors in mind when assessing the radiographs, the UL3 is placed in the line of the arch as its crown shows no movement with respect to the lateral incisor tooth root between the two views.

The UR3 has its crown slightly towards the palatal aspect. Both of these teeth would be accessible buccally for the



Figures 3A-D: Expose and bond canine



Figures 4A-D: Piggyback mechanics

approached of expose and bond.

There is no evidence on any of the X-rays of any cyst formation or root resorption; however, this is a 2D X-ray of a 3D person. Twelve per cent of cases of impacted 3s cause root resorption of the lateral incisor teeth (Ericson and Kurol, 1987).

Computed tomography (CT) scans demonstrated that 48% of lateral incisor teeth demonstrate a degree of resorption. (Ericson and Kurol, 2000). Risk factors for the root resorption of lateral incisor teeth are:

- Female
- Under 14 years of age

- Horizontally impacted canine teeth
- Canine crown medial to the midline of the lateral incisor (Ericson and Kurol, 1988).

It was not deemed necessary in this case to take a routine CT scan and expose the patient to unnecessary radiation.

Aetiology of presenting malocclusion – dentoalveolar

- Severe crowding in the upper arch and mild crowding in the lower arches due to dentoalveolar disproportion
- Failure of resorption of the deciduous canine
- Pathology impeding the canine eruption – alveolar bone/fibrous tissue/cyst



Figures 5A-E: Transpalatal arch removed

- Lateral incisor teeth are slightly small – guidance theory
- Genetics?

Aims of treatment

Facial

- Improve facial profile (up righting the upper and lower anterior teeth giving better soft tissue support).

Dental

- Maintain good oral hygiene and general dental condition
- Create sufficient space for the alignment of the upper canine teeth
- Relief of crowding and align the arches
- Correct the molar relationship
- Correct the overbite and overjet
- Retain.

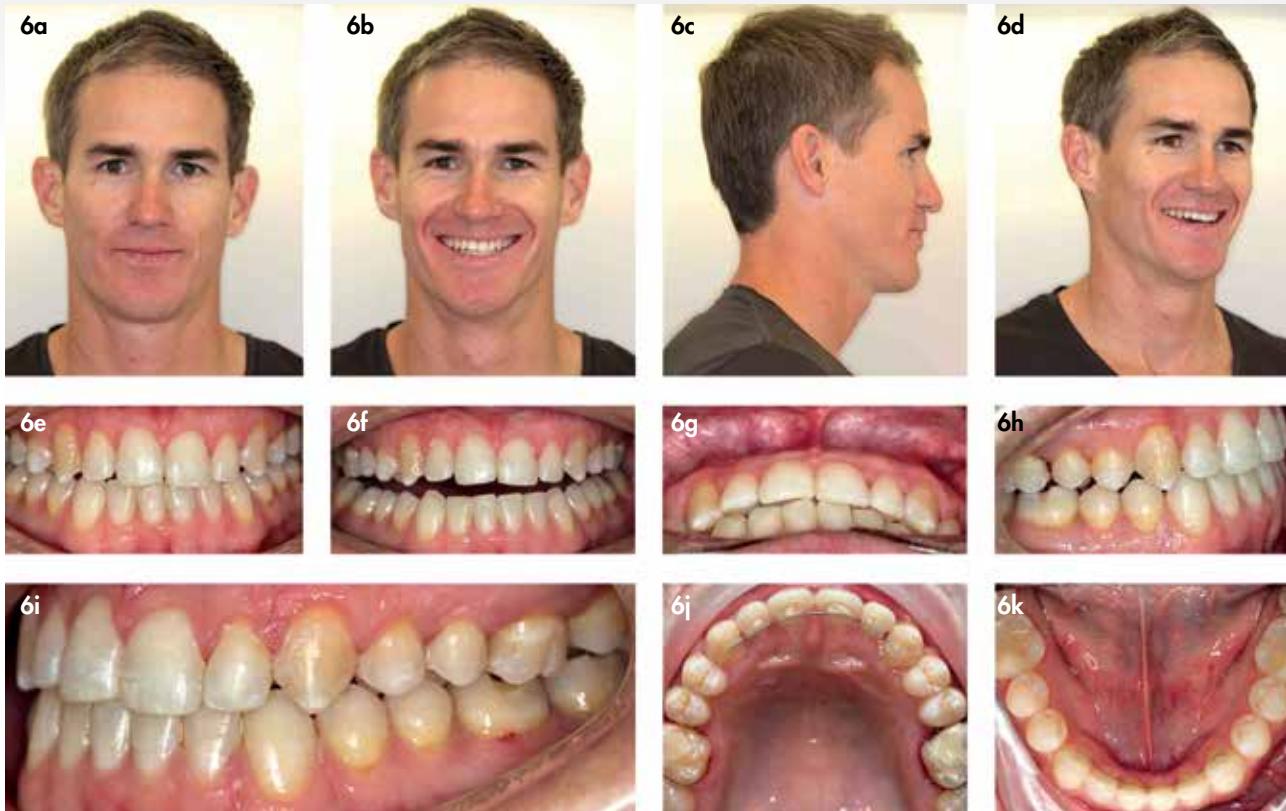
Treatment plan

1. Stabilisation and prevention

This involved a comprehensive check-up and bitewings, along with two sessions of oral hygiene sessions to reverse the mild gingivitis and prepare the patient for high standards of oral hygiene required during orthodontic therapy.

2. Orthodontic options

- i) No active treatment
- ii) Surgical exposure of the canine teeth and traction with fixed appliances – comprehensive care
 - Extractions patterns: ULC and URC
 - Expose and bond: UL3 and UR3
 - Transpalatal arch for additional vertical anchorage
 - Placement of upper and lower buccal fixed braces and align the exposed upper 3s.
- iii) Surgical extraction of the impacted canine teeth, orthodontics and replacement with implants/resin bonded bridges-orthodontics with limited objectives. Under general anaesthesia, surgically extract the upper canine teeth. The upper deciduous canines are also very mobile and, hence, would be lost in the process. Placement of fixed appliances to align the teeth, improve the overjet and overbite, and create sufficient space for the future restoration of the canine teeth with implants or resin bonded bridges.
- iv) Extraction of the deciduous canines, impacted canines and close the extraction spaces with fixed appliances. Camouflage the upper first premolar teeth to look like canines – orthodontics with limited objectives



Figures 6A-K: Debond

v) Transalveolar transplant and surgical repositioning.

3. Indefinite retention

Upper and lower vacuum formed retainers to be worn initially full time, then, after one year, part time at night for an indefinite period of time.

Bonded upper and lower lingual retainers from the UR3 to UL3 and LR3 to LL3 using 0.0175" braided stainless steel (co-axial).

Retention regime: full-time wear for 12 months, followed by nocturnal wear for 12 months, and then long-term wear of the upper retainer for a minimum of four nights a week.

4. Frenectomy

5. Restorative phase

Whitening and bonding to mask the mottling on the upper central incisor teeth.

Consent and treatment

Standard benefits and risks pertaining to orthodontic treatment were discussed with the patient, including those related to poor oral hygiene, caries, periodontal issues, root resorption, loss of vitality, ankylosis and TMJ dysfunction TM disorders.

More specific to this case was the risk of ankylosis of the upper canines, the risk of a second surgical procedure to remove the ankylosed canines, and additional costs possibly involved to restore the spaces created by the missing canine teeth, along with possible formation of postoperative black triangles, which is highly likely in adults.

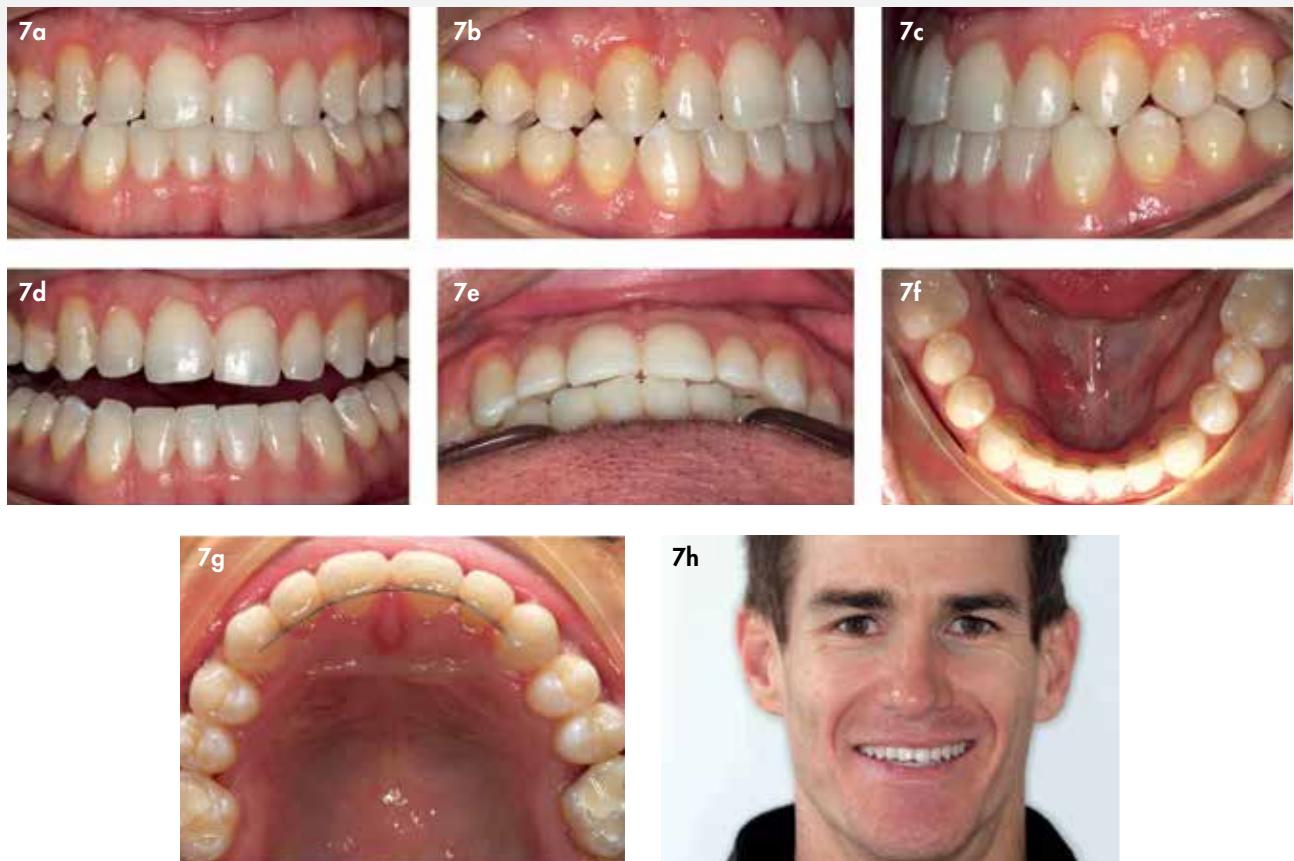
The treatment option selected was extraction of the Cs, surgical expose and bond of the upper 3s and orthodontic traction – comprehensive care.

The patient, as front-face worker, was keen for lingual braces, extractions of the 3s and Cs and placement of two implants. After three reviews to ensure we got the right ethical plan for this patient, the above option was chosen, which was one-third of the cost of the patient's ideal plan.

Fixed appliance design

Orthodontic traction is required to pull an unerupted tooth toward the line of the arch. This can be done with removable appliances or fixed appliances. In this instance, as it involved an adult patient, we deemed it predictable and acceptable to align the upper canine teeth with buccal fixed appliances.

- Bracket prescription and variation



Figures 7A-H: Three-month review

- Placement of upper and lower preadjusted Edgewise fixed appliances
- Upper ceramic and lower metal (due to the deep bite)
- MBT prescription brackets using $0.022'' \times 0.028''$ slot size. An MBT bracket of $+7^\circ$ was used to give sufficient labial root torque. The upper canine teeth are in the line of the arch and hence root torquing shouldn't be much of an issue.

The lower incisor MBT brackets have a -6° torque, which in this case is not ideal, as the teeth are already retroclined and up righting them would have been better achieved with -1° from an Andrews or Roth bracket.

Aligning the canine teeth

The upper fixed appliances were placed before the procedure on exposure and bond was carried out so that sufficient space could be created before traction was applied.

Up-righting the retroclined anterior teeth and closing off the diastema created enough space.

Traction was initially applied using zing string. This was renewed every two weeks.

Then we used piggy back mechanics using $0.019 \times 0.025''$ SS as a base arch/stabilising wire and using $0.014''$ nickel titanium as an initial aligning arch wire running on top of the base arch wire, and ligated with ligatures to reduce the amount of friction.

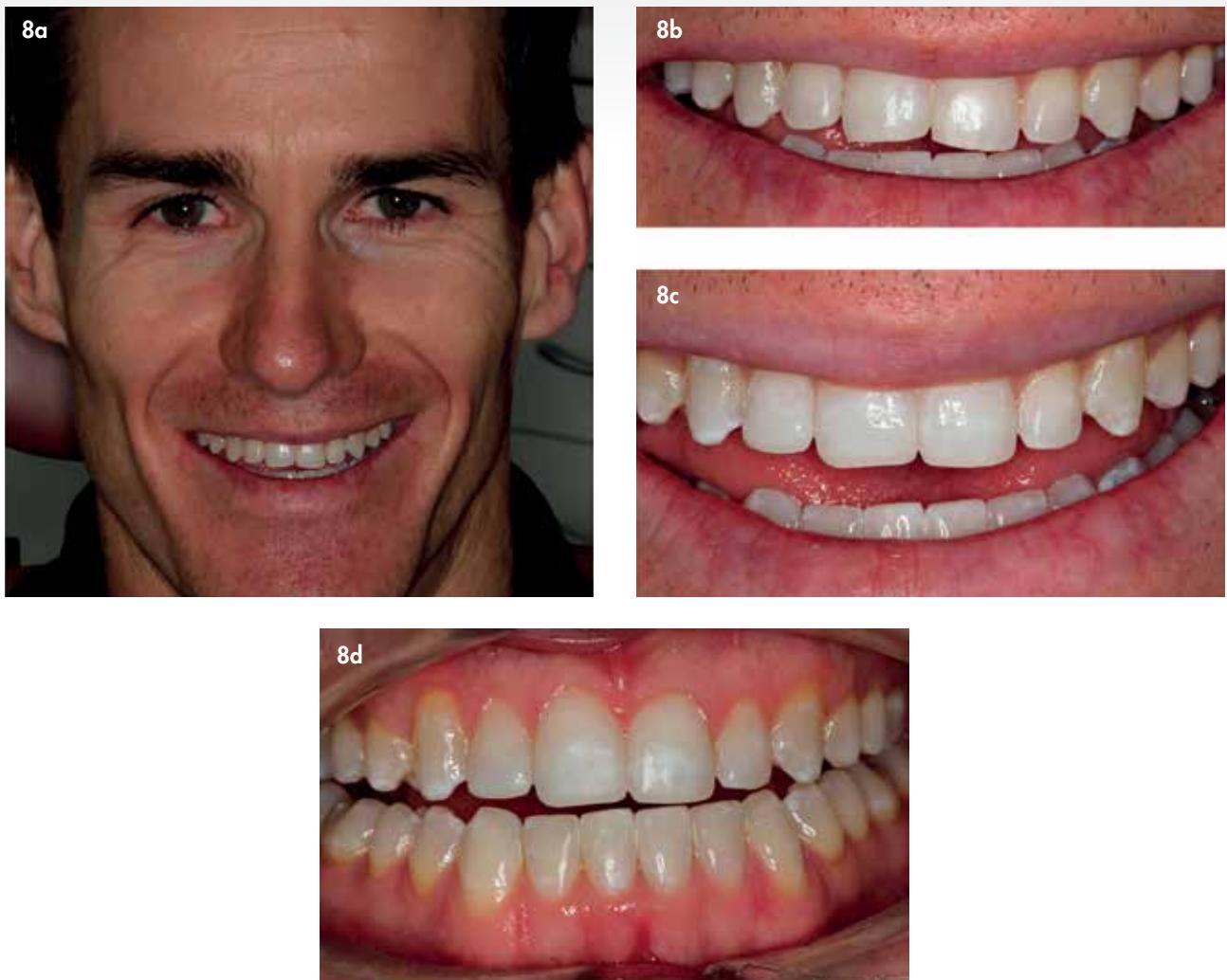
After six months of aligning, we took a progress OPG X-ray to look for movement of the canine teeth and rule out any ankylosis.

Anchorage

A transpalatal arch (TPA) was constructed with 0.9mm stainless steel wires soldered to slightly oversized bands on the upper first molar teeth. The TPA has several clinical applications, but, in this instance, was used to provided vertical anchorage when extruding the canines into the line of the arch (Wise et al, 1994).

Surgical procedure (surgeon's account)

Extraction of the Cs and closed exposure and a gold chain was bonded under sedation. The patient did not want a



Figures 8A-D: Before and after bonding

general anaesthetic and, due to the favourable position of the teeth, sedation was a viable option.

The first stage of this procedure is to achieve effective anaesthesia. Local anaesthetic with adrenaline was injected both palatally and buccally as an infiltration.

A full thickness palatal mucoperiosteal flap must be raised. The incision needed to extend to at least two teeth either side of impacted canine. Often the canine is partially visible, or there is a bulbosity of bone under which the canine lies.

Once the position is identified, overlying bone around the crown of the canine is removed to expose the tip of the tooth up to the cemento-enamel junction. Finally, any follicular tissue is curetted away.

The next step is to bond the chain to the canine. The surgical field was kept completely moisture free during the

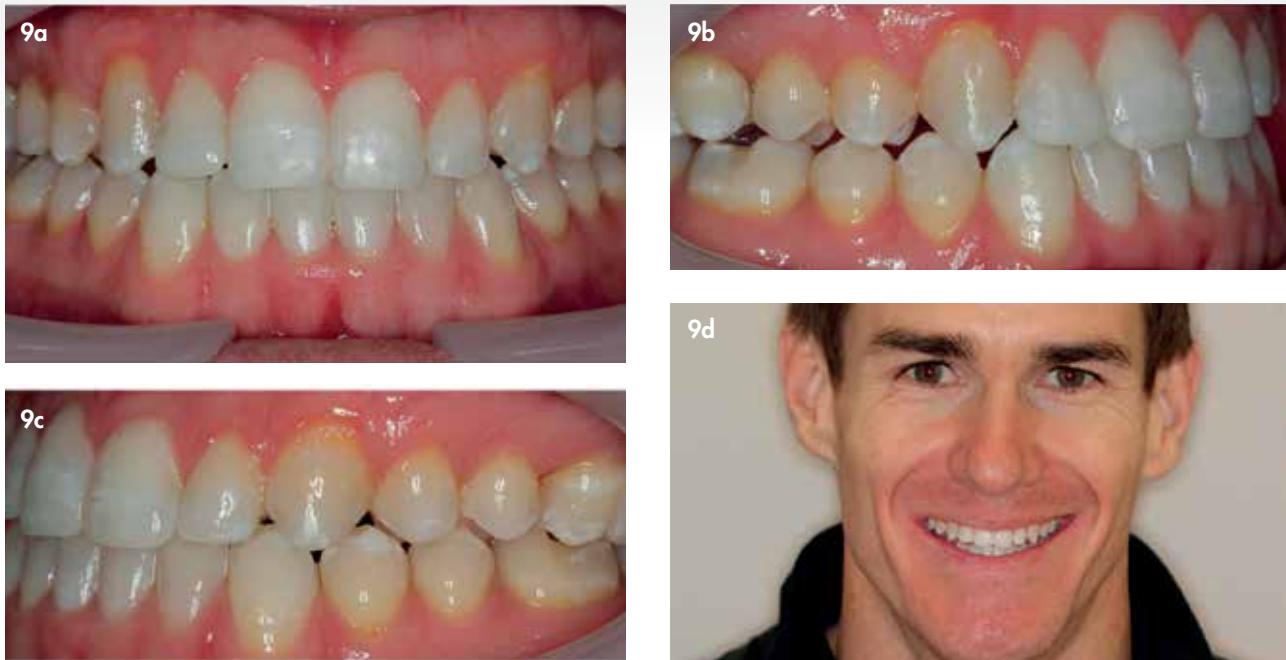
bonding process; local anaesthetic and highspeed suction can help achieve haemostasis and a favourable bonding environment.

Either a single or two-staged etch and bond technique can be used.

We applied composite to the orthodontic bracket and bond to the exposed canine surface. The chain should be attached closer to the canine tip than the cementoenamel junction.

Once secure, a hole is pierced for the chain into the palatal tissue with a 15 blade, and thread the chain through the tissue. Suture the palatal flap into place with resorbable sutures and attach the chain to archwire (if present) or into the buccal sulcus so it is free from the occlusion using non-resorbable sutures.

Analgesics and warm saline rinse postoperatively was



Figures 9A-D: One-year review

recommended. A two-week review to monitor healing was advised. Following successful healing the patient is ready for continuation of orthodontic treatment and traction.

Retention regime

Bonded upper and lower lingual retainers from the UR3 to UL3 and LR3 to LL3 using 0.0175" braided stainless steel (co-axial). An upper bonded retainer was essential to prevent the diastema from opening up.

Full-time wear of the VFRs for 12 months, followed by nocturnal wear for 12 months, then long-term wear of the upper retainer for a minimum of four nights a week.

Frenectomy

This was carried out under local anaesthesia by the oral surgeon. The ideal time for the frenectomy is once the teeth are aligned, the diastema is completely closed, hence when healing occurs with the teeth together inevitably the post-surgical scar stabilises the teeth in their correct position, instead of creating obstacles to final space closure. The key to success is the removal of the interdental fibrous tissue.

The diastema will recur no matter how carefully the space is managed initially. The critical area keeping the teeth in contact is missing, so a bonded fixed retainer is essential (Edward, 1993).

Whitening process

Custom trays were made for day whitening using 6% Pola following upper and lower alginate impressions. The technician also made a wax up on a duplicate model for the upper four incisors. SO whitened for a period of 15 days to achieve a B1 status.

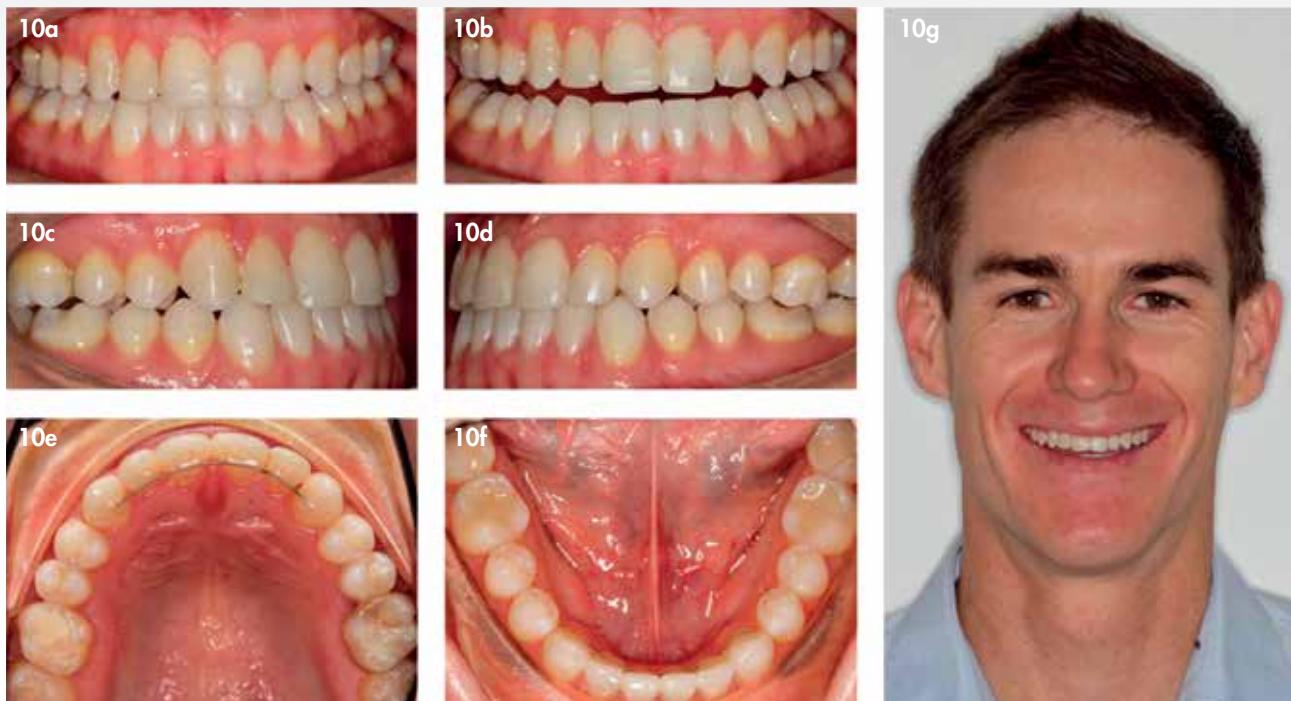
After four weeks post whitening, we commenced the bonding phase. Studies have shown the residual oxygen within enamel and dentine prevent optimal resin infiltration and complete resin polymerisation if the adhesive procedures are performed too soon after bleaching. Delayed bonding also allows for the whitening shade to settle at a hue that the patient can maintain in the long term without having to continually whiten.

Bonding

A silicone stent, with incisal and palatal shelves were fabricated to aid the process. A shade between Vita A1 and B1 was measured.

Rubber dam was applied and a chamfer was created of 0.5mm to 1.0mm buccally. Air abrasion with 27 micromillimetre aluminium oxide particles was used to remove the pellicle layer, aprismatic enamel and topi cal stains.

Phosphoric acid (35%) was placed, washed and rinsed. Next, a layer of single bottle etch and rinse bonding agent



Figures 10A-G: Two-year review

(Optibond Solo) was applied and air thinned to evaporate the solvent, then cured for 20 seconds.

Venus Pearl (Kulzer) was placed. Varying amounts of A1 and B1 using a layering technique, cured for 60 seconds, then again with glycerine applied and cured for another 60 seconds to cure the top oxidised layer.

The bite was adjusted and polished with sofflex discs and enhanced. A new upper Essix retainer was made following the placement of a bonded retainer immediately after my bonding.

Prognosis for stability

The stability of the corrected malocclusion was dependent on (Woloshyn et al, 1994):

- Age
- Viability of the canine-ankylosis is a possibility
- Good interdigitation of the buccal segments
- Good interincisal angle
- Availability of space
- Good root paralleling
- Dental health and periodontal status of the dentition
- Compliance with the proposed treatment and retention regime
- Prolonged retention to prevent late lower incisor crowding, diastema opening up.

Assessment of treatment outcome

- Preoperative peer assessment rating (PAR) score: 27
- Postoperative PAR score: 2
- Percentage reduction in PAR score: 93%.

Postoperative evaluation

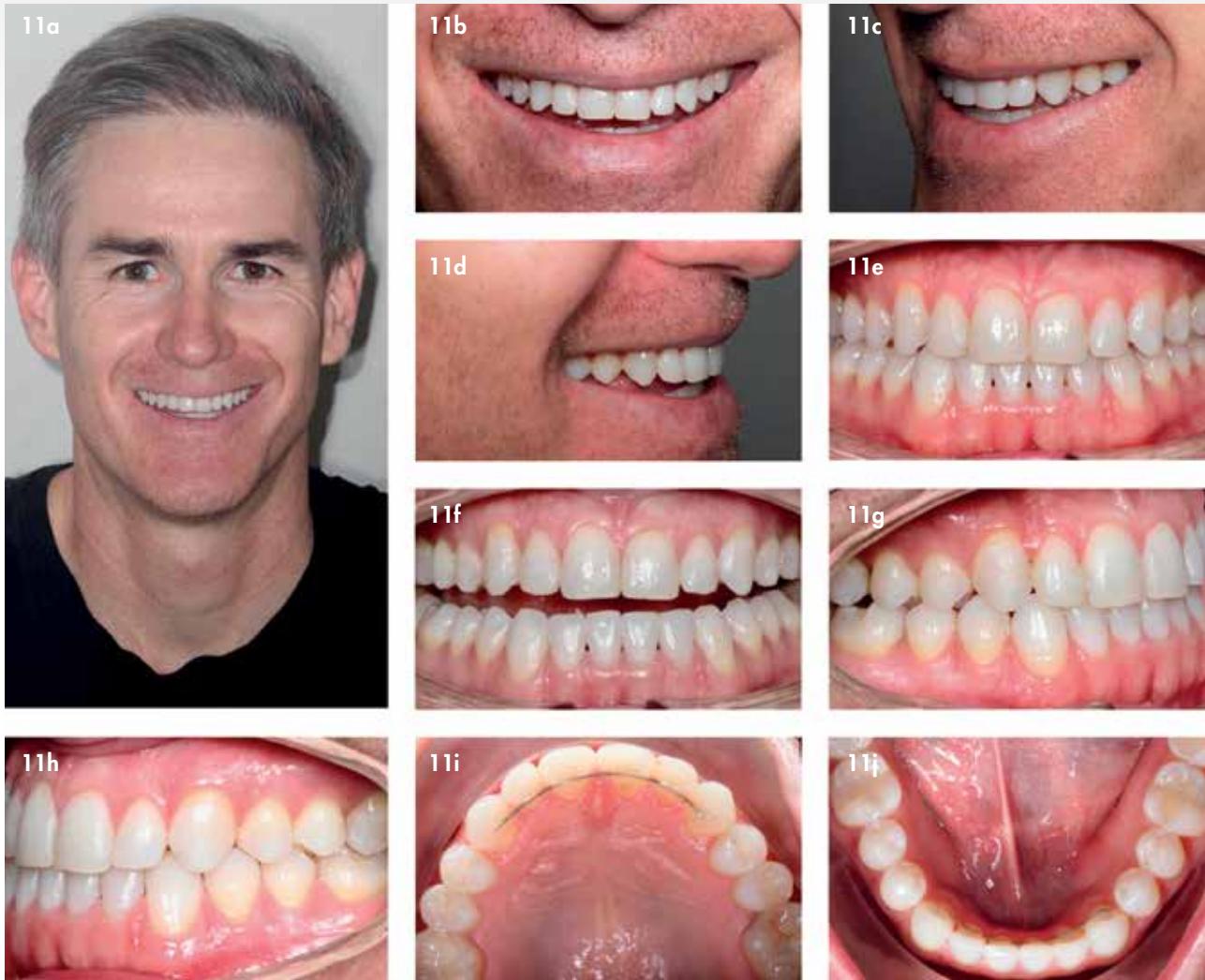
The patient has had a favourable improvement from his presenting malocclusion. He proved to be cooperative and treatment progressed well.

Occlusal features:

- Incisor relationship: class I
- Overjet (mm): 2 mm
- Overbite: average and complete to tooth
- Centrelines: dentally coincident and coincident with the facial midline
- Molar relationship right: class I
- Molar relationship left: class I
- Crossbites: none
- Displacements: none.

Functional occlusal features:

- Right and left canine guidance, no non-working side interferences
- Posterior disclusion on anterior guidance



Figures 11A-J: Three-year review

Intercanine width preoperative:

- Upper: 33mm
- Lower: 27mm.

Intercanine width postoperative:

- Upper: 37mm
- Lower: 28mm.

Intermolar width preoperative:

- Upper: 58mm
- Lower: 51mm.

Intermolar width postoperative:

- Upper: 59 mm
- Lower: 51 mm.

Difficulties encountered during treatment

Oral hygiene

Even though the patient's oral hygiene was satisfactory before

orthodontic treatment commenced, he struggled at times to maintain a high standard consistently throughout his orthodontics. This is evident from the photographs where the gingivae look inflamed, especially around the upper canine teeth.

We ensured that he saw the hygienist every three months, along with reinforcing the importance of good hygiene at each appointment and evaluating his methods of cleaning and stressing the importance of maintaining a good level, which would reduce the risk of dental decay, periodontal disease; and, also, unaesthetic gum margins, especially around the surgically exposed canine teeth.

Anterior tooth size

The Bolton discrepancy was discovered by Wayne A Bolton to determine the discrepancy between the upper and lower anterior teeth. The analysis helps determine the optimum inter arch relationship.

Bolton analysis

3(9mm)	2(6mm)	1(9mm)	1(9mm)	2(6mm)	3(9mm)
3(8mm)	2(6mm)	1(6mm)	1(6mm)	2(6mm)	3(8mm)

Total 83.33 (ideal ratio 77.2 +/- 1.65)

There was a Bolton discrepancy that exceeded the 77.2% +/- 1.65, which showed that the upper lateral incisor teeth were only 6mm and smaller than the average upper lateral incisor tooth.

The patient did not initially want his lateral incisors bonded and sized up to the ideal size, which would have then allowed us to upright the upper anterior segment further, in turn creating sufficient space for the lower incisors to be uprighted, which would have aided further in the overbite correction.

Deep bite

In non-growing patient deep bites are difficult to correct. In this case we couldn't intrude the lower incisors, but had to rely on proclining them to open up the bite/improve it. However, the amount of proclination would be dependent on the space available from the upper anterior segment being uprighted.

In this case, without building up the lateral incisors to their ideal shape and size meant the full correction of the overbite was limited.

White spots

There was a history of trauma to the upper anterior teeth when the patient was growing up. The history was vague, as it occurred prior to the age of four years. This may have accounted for the light white spot lesions on his central incisor teeth. These can sometimes be difficult to fully mask.

Risk benefit

Benefits in orthodontic treatment are:

- Psychological
- Dental
- Functional.

The smile is an important component of the face and the malocclusion can affect self-esteem and social interaction. Correcting this young man's malocclusion has led to better psychological health and definitely self-confidence.

Some of the main risk factors in this case would be:

- Decalcification – however, we ensured we started treatment after good oral hygiene sessions and continued oral hygiene care
- Space opening after closure of the median diastema and also rotation of the canine teeth. Hence, prolonged fixed bonded retention is necessary.

If the canines had not been exposed and aligned, then the

patient would have been subjected to annual radiographs to assess the canines for the development of cysts or and adjacent lateral incisors for developing any root resorption from the impacted teeth.

The overall benefits of having the treatment outweighed the risks.

Conclusion

Adult orthodontic treatment has become increasingly popular over the years as patients become more discerning about the beauty of their smile.

The above patient is a typical young adult who desired, but did not receive, orthodontic treatment in his youth and now seeks it as he is financially independent and wants to improve the quality of his life. He was seeking comprehensive treatment and the maximum improvement that would be possible.

Despite all the alternative treatment options and risks laid out to him from the outset of treatment, he had taken his time over a few years to gain all the information regarding the complexity of his case and had finally decided the best option was to choose the comprehensive care. This was difficult and technically demanding and required great communication and planning among the multidisciplinary team involved.

References

- Armstrong C, Johnston C, Burden D, Stevenson M (2003) Localising ectopic canines- horizontal and vertical parallel. Eur J Orthod 25(6): 585-589
- Auroy P, Lecerf J (2010) Prosthetic restoration of the canine. J Dentofacial Anom Orthod 13: 112-132
- Becker A, Chaushu S (2000) Dental age in Canine ectopia. AJODO 117: 657-662
- Becker A, Chaushu S (2003) Success rate and duration of orthodontic treatment for adult patients with palatally impacted maxillary canine teeth. AJODO 124: 509-514
- Bishara S (1992) Impacted maxillary canines: A review. Am J Orthod, Dentofac 159-171
- Bishara SE (1998) Clinical management of impacted canines. Semin Orthod 4: 87-98
- Creuguer N, Kayser A, Hof M (1992) A seven and a half year survival study of resin bonded bridges. J dent Res 71: 1822-1825
- Edwards JG (1988) A long term prospective evaluation of the circumferential supracrestal fibrotomy in the alleviating orthodontic relapse. AJODO 93: 380-387
- Edward JG (1993) Soft tissue surgery to alleviate orthodontic relapse. Dent Clinic North America 37: 2015-225
- Ericson S, Kurol J (1987) Radiographic assessment of maxillary canines. AJODO 91: 483-492
- Ericson S, Kurol J (1988) Resorption of maxillary lateral incisors caused by ectopic eruption of canines. AJODO 94: 503-513

PATEL

- Ericson S, Kurol J (2000) Resorption of incisors after ectopic eruption of maxillary canines: a CT study. AO 70: 415-423
- Garcia A (2003) Ankylosis of impacted canines: a retrospective post-surgical study. IJO 11: 4
- Garcia R (2010) Missing maxillary canine: from diagnosis to treatment. JDAO 13: 55-74
- Hichen L, Rowland H, Williams A, Hollinghurst S, Ewings P, Clark S, Ireland A, Sandy J (2007) Cost effectiveness and patient satisfaction: Hawley and vacuumformed retainers. EJO 29: 372-378
- Houston WJB (1989) Incisor edge centroid relationships and overbite depth. EJO 11: 139-143
- Littlewood SJ, Millett DT, Doubleday B, Beam DR, Worthington HV (2004) Retention procedures for stabilising tooth position after treatment with orthodontic braces. Cochrane Database Systemic Review 29(1)
- Parkin N, Deery C, Smith A, Tinsley D, Sandler J, Benson P (2012) No difference in surgical outcomes between open and closed exposure of palatally displaced maxillary canines. Journal of Oral and Maxillofacial Surgery 70(9): 2026-2034
- Pearson MH, Robinson SN, Reed R (1997) Management of palatally impacted canines: the findings of a collaborative study. Eur J Ortho 19: 511-515
- Sinko K, Nemec S, Seemann R, Eder- Czembirek C (2016) Clinical Management of Impacted and Transmigrated Lower Canines. Journal of Oral and Maxillofacial Surgery 74(11): 2142
- Southall PJ, Gravely JF (1989) Vertical parallel radiology to localise an object in the anterior part of the maxilla. BJÖ 16: 79-83
- Thomas S, Turner S, Sandy J (1998) Autotransplantation of teeth: is there a role? British J Orthodo 25: 275-282
- Tofelof LN, Johnsson AC, Kjellberg H (2007) Evaluation of orthodontic treatment, retention and relapse in a 5 year follow up. Swed Dent J 31: 121-127
- Wise JB, Magness WB, Powers JM (1994) Maxillary molar vertical control with the use of transpalatal arches. Am J Orthod Dentofac Ortho 106: 403-407
- Woloshyn H, Artun J, Kennedy DB, Joondeph DR (1994) Pulpal and periodontal reactions to orthodontic alignment of palatally impacted canines. AO 64: 257-264

Reprinted with permission from Aesthetic Dentistry Today December 2019