Eur. J. Prosthodont. Rest. Dent., Vol.18, No. 3, pp 123-127
Printed in Great Britain

doi:10.1922/EJPRD_886Alani05

The Use of Implants for Anchorage in The Correction of Unilateral Crossbites

Aws Alani*, Karl Bishop†, Jeremy Knox‡ and Colin Gravenor§

Abstract - *The provision of orthodontic anchorage in the adult patient can be compromised due to reduced periodontal support, insufficient number of teeth and limited supra-gingival tooth tissue. Where tooth borne anchorage is unavailable for significant orthodontic movement implants represent a viable alternative. This paper describes the use of dental implants for orthodontic anchorage in a partially dentate patient with a severe unilateral cross-bite where orthognathic surgery was the only other realistic option. The implants were successfully engaged using a composite bridge and a modified quad helix appliance for correction of the malocclusion. Once orthodontics was completed the patient was restored using highly sintered ceramic crowns and bridges. This paper highlights the importance of the multi-disciplinary team and the close liaison between the restorative dentist, orthodontist and technician in treatment planning and provision.*

KEY WORDS: Orthodontics, Anchorage, Implants

INTRODUCTION

There is an increasing demand for adult orthodontic therapy[1]. However, this patient group has high expectations and are more likely to have a restored dentition, loss of periodontal support and edentulous spaces[2,3]. As a result, orthodontic anchorage using the natural dentition may be more difficult to control and utilize. In these circumstances, headgear can be used but adults may be unreliable wearers of this form of appliance[4]. As such, the older patient can present with significant treatment challenges particularly in the planning of multidisciplinary treatment.

Osseointegrated implants are now a routine consideration when restoring edentulous spaces[5,6]. The use of implants for orthodontic anchorage has also been described[7-14]. Used in this way, fixtures have been placed in areas of missing teeth, the palate, and in the retromolar pad region[15-17]. The use of palatal implants to aid rapid maxillary expansion has also been described as well as to increase the occlusal vertical dimension to allow the correction of a 'scissors bite' using conventional orthodontics[18-20].

This paper describes the use of definitive implants to reinforce anchorage in the joint restorative and orthodontic management of a unilateral cross-bite where the degree of malocclusion would have otherwise required an orthognathic intervention.

Case Report

A 40-year-old fit and healthy female presented complaining of poor and deteriorating aesthetics of her dentition. In particular, she was unhappy with the shape and colour of her teeth and the fact that they did not meet 'evenly'. On examination there was a heavily restored dentition with a large number of intra and extra-coronal restorations. The maxillary anterior teeth had tooth surface loss that appeared to have a major attritional component with approximately 30% reduction in crown height (Tooth Wear Index 3 (Smith & Knight 1984)) (Figure 1)[22].

A preliminary examination of the occlusion revealed that in the retruded contact position (RCP) the initial contact was bilateral between the maxillary and mandibular canines with a prominent slide to intercuspal position (ICP). The slide included both vertical and horizontal components with the latter involving a notable lateral movement to the right. In ICP the 22, 23, 24, 25 and 26 were in a lingual cross-bite, the 11, 21 and 22 were edge to edge whilst the 23 was in class I relationship (Figure 2, 3 & 4). Both the 12 and the 24 were tender to percussion. Initial radiographic examination revealed that the 24 had previously been endodontically treated and an associated post crown placed with no radiographic signs of endodontic treatment. The 12 had a short screw retained post in place. There was also a periapical radiolucency associated with this tooth with evidence of apical resorption (Figure 5).

Following a consultation on a multi-disciplinary clinic involving Restorative Dentistry, Orthodontics and Maxillofacial Surgery the following broad treatment options were discussed with the patient:

- A combined orthognathic and restorative approach to expand the maxilla, increase the occlusal vertical dimension (OVD) followed by restorative rehabilitation at this new position.
- A restorative approach only with an increase in OVD and restoration of the maxilla with the acceptance of the cross-bite.

* BDS, MFDS RCS, MSc
† BDS, MScD, DRD, MRD, FDSRCS, FDS (Rest Dent) RCS
‡ BDS , MScD , PhD , FDS RCS , MOrth RCS , FDS (Orth) RCS
§ Cert. Dent. Tech.

Initially the patient was not keen on embarking upon orthodontics or surgery and as such the restorative only approach was chosen as the most acceptable option.

Initial therapy involved the assessment of the 12 and the 24 for restorability and feasibility of root canal therapy. This revealed that the 12 and 24 had moderate long-term prognosis due to limited coronal tooth tissue and the need for root canal re-treatment. As such they were both root canal treated prior to the start of the definitive restorative treatment phase. A diet analysis was also undertaken but this revealed no significant erosive factors.

A diagnostic wax-up was carried out using duplicated articulated study models on a semi-adjustable articulator (Denar Mark II, Waterpik Technologies, Fort Collins, USA). This confirmed that to achieve the proposed aesthetic result then an increase in OVD was necessary and there would be a need for multiple extra-coronal restorations. It was also noted that at the final OVD sufficient inter-occlusal space was available to place implants to support a fixed restoration in the 25 and 26 positions (Figure 6).

Using a vacuum formed index constructed from a duplicate model of the proposed diagnostic wax-up and a temporary crown and bridge material (Luxatemp®, Zenith™/DMG, Hamburg, Germany) the proposed procedure was tried in the mouth. The patient was happy with this outcome.

Subsequently two implants (Nobel Biocare, Göteborg, Sweden) were placed in the 25 and 26 sites using a two stage procedure. After a healing period of 6 months, second stage surgery was performed to expose the fixtures. Between these stages the patient developed acute problems with the 24. As such it was decided to extract this tooth and temporarily restore the 24, 25, and 26 sites with an interim implant retained cantilever composite bridge at the original occlusal vertical dimension (Figures 7 & 8).

At this stage the patient reconsidered her earlier decision and decided that she would prefer to have the cross bite corrected but did not want any further surgery if possible. At a subsequent consultation on a multidisciplinary clinic it was decided that a hybrid quad helix appliance could be used to correct the cross-bite by using the implants in place on the left to reinforce anchorage and deliver the asymmetric expansion required.

A molar orthodontic band was fitted to the 16 and impression copings were placed on the fixtures on the left. These were picked up in using a polyether impression material in an impression tray. This model was articulated and a new implant retained interim bridge was constructed incorporating a Wilson orthodontic attachment system. This was achieved by laser welding the orthodontic attachment (3D Lingual Tube™, Rocky Mountain Orthodontics, Denver, Colorado) to a custom tag which was subsequently incorporated into the composite supra-structure of the bridge. The slot attachment on the bridge allowed a quad helix to be located and on the right hand side the quad was attached to the molar band. The anterior arm of the helix on the bridge side was initially extended onto the canine but was considered unnecessary and was later removed. This allowed the 22 space to be restored with an interim fibre-glass reinforced bridge (Stick Tech Ltd, Turku, Finland) (Figures 9 & 10).

The quad-helix was activated on two separate occasions 8 weeks apart. In total 10 mm of transverse expansion of the maxillary arch was achieved during a 4 month period. This resulted in movement of the 13, 14, 15, 16 into a more buccal relationship and an increase in the OVD. During this period the patient developed acute symptoms from the 12. At this point surgical endodontics was considered but a more predictable outcome was considered achievable prosthetically and the tooth extracted. The interim glass-fibre bridge was removed and a removable partial denture fitted to aid in the orthodontic retention of this new position (Figure 11). This position was maintained for three months with no problems reported by the patient.

The next phase of treatment involved rehabilitation to the new occlusal scheme using interim restorations (Luxatemp®, Zenith™/DMG, Hamburg, Germany) for three months. A new orthodontic retainer was also constructed. Again during this phase the patient reported no problems and was happy with the aesthetic result.

The definitive restorative phase involved the construction of zirconia all ceramic individual crowns on the 16, 15 and the 14. The maxillary lateral incisor spaces were restored using two, fixed–fixed all ceramic bridges with the 13, 11, 21 and 23 as abutments. A screw retained porcelain fused to metal cantilever bridge with a pontic at 24 was used to restore the implants (Figure 12). A Hawley type retainer was also constructed. The patient was then reviewed at regular intervals and at one year there was no change in occlusion or aesthetics.

DISCUSSION

A cross bite exists when the mandibular teeth lie more buccal to the maxillary antagonist in centric occlusion. The severity can vary from a single tooth to a whole quadrant. A cross-bite can lead to occlusal deviation, craniofacial asymmetry and temporomandibular joint dysfunction[22]. An association with abnormal speech patterns has also been documented[23]. In the case described in this paper, there was an obvious occlusal deviation which was not associated with any functional disturbance but was an aesthetic concern to the patient. It had also led to tooth surface loss.

Traditional techniques to correct a cross bite vary from the use of simple removable appliances to the surgical assisted expansion of the maxilla with post operative orthodontic appliance based treatment. The latter is often considered in adult patients where the likelihood of the palatal suture being fully fused is high or the severity of cross bite is such that the degree of movement required cannot be achieved by conventional orthodontics. Early correction of a cross-bite can prevent the need for more difficult treatment in adulthood where growth has ceased and the dentition is more likely to be heavily restored.

In the case described the patient initially declined any surgical or orthodontic intervention. As such the initial planning was based on a solely restorative approach to improve function and aesthetics. It was only after the placement of fixtures in the maxillary free end saddle area as part of the restorative rehabilitation was the option of an orthodontic correction of the cross bite considered acceptable by the patient. The presence of implants contra-lateral to the cross bite created an opportunity to improve anchorage for the cross bite correction.

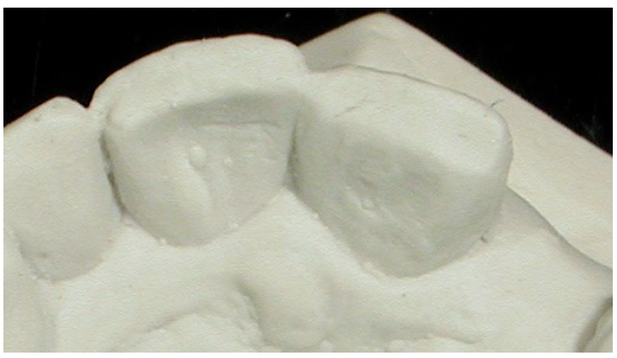

Figure 1. *Marked anterior toothwear of upper anterior teeth.*

Figure 2. *Right hand side slide into Intercuspal Position (ICP).*

Figure 3. *ICP*

Figure 4. *Lateral view illustrating extent of cross-bite on the right hand side.*

Figure 5. *Radiograph illustrating periapical radiolucency and apical resorption of 12.*

Figure 6. *Pre-operative wax up of projected outcome.*

Figure 7. *Post impant surgery with implant retained bridge present in 25 & 26 area.*

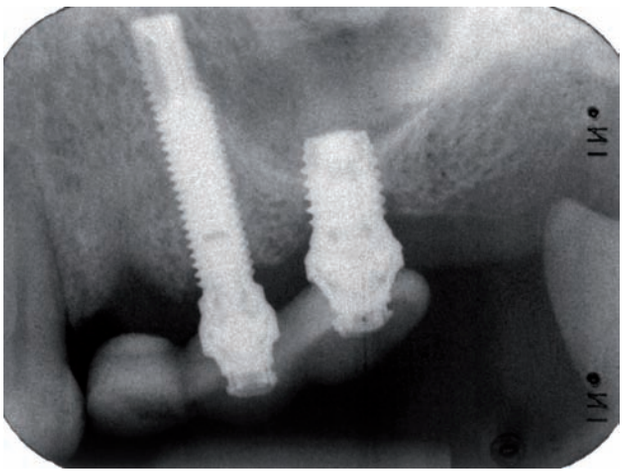

Figure 8. *Implants and temporary bridge in place prior to orthodontic movement.*

Figure 10. *Modified composite bridge in place incorporating the quad helix and molar band on the right hand side.*

Figure 9. *Pre-orthodontic view.*

Figure 11. *Post orthodontic view.*

Figure 12. *Cementation of definitive restorations.*

Anchorage is the resistance to movement on application of force to an object. In general terms the movement of multiple teeth across a substantial distance requires reliable and significant anchorage provision[24]. Historically this has taken the form of the resistance to movement of a group of teeth in the movement of other tooth units[24].

The provision of anchorage from the natural dentition is compromised when the size and number of tooth units present is inadequate or where the teeth are compromised to such a degree to exclude their suitability[3]. In the present case the quality of anchorage from the natural dentition was non-existent due to the missing teeth. Other than with implants, the restoration of the free end saddle on the left hand side could only have be achieved with a removable partial denture. The patient did not favour a removable prosthesis and its provision would have been difficult due to the reduced inter-occlusal space and the large edentulous span. The placement of implants allowed a fixed restoration to be constructed and also provided the potential for an improvement in the anchorage.

The placement of implants in adult patients to improve anchorage whilst facilitating post orthodontic restoration has been previously described. In posterior edentulous spaces they can facilitate the closure of diastemas and the reduction of overjets in class II malocclusions[25,26]. The use of implants temporarily restored at an increased occlusal vertical dimension to aid in the correction of a posterior cross-bite on the contra-lateral side has also been described[20]. In this case report, the increase in OVD allowed the teeth in cross bite on the contralateral side to be disengaged from the occlusion to facilitate conventional orthodontic treatment. The implants in this case did not play a direct role in anchorage for tooth movement but allowed an increase in OVD.

A case utilizing implants for the correction of 'collapsed occlusion' in a 48 year old adult by intruding teeth opposed by osseo-integrated implants has also been described[27]. Molar intrusion of 2.2mm was achieved over a period of 12 months, although the authors did comment that implant

stability (measured by resonance frequency analysis) did change over the first 4 months of movement[27].

In contrast to previous reports this case utilized implants for anchorage to facilitate a lateral expansion which once achieved also resulted in an increase in occlusal vertical dimension. This two-fold movement differs from previous reports where individual movements were largely achieved in one dimension or movements were possible due to the provision of a stable platform rather than direct engagement for anchorage[20,25,27].

Although the treatment objectives were achieved there were problems associated with the technique. For example, the quad helix was replaced twice and needed to be activated on two separate occasions. This was in part due to the large magnitude of tooth movement required which was unachievable without adjustment and replacement of the helix. Similarly as lateral movement was achieved restorations on natural teeth and implant supported provisional restorations needed maintenance and in some cases replacement as the occlusal scheme changed to the final position. The problems of repeated fracture of prostheses when using implants in orthodontic movement has been previously documented[27].

CONCLUSION

The case presented illustrates how implants provide new options for adult patients with both orthodontic and restorative problems. The placement of two implants in this case facilitated the correction of a severe malocclusion without the need for orthognathic surgical intervention. From a restorative aspect, implants provided a fixed solution to an edentulous space that would have been difficult to restore otherwise.

ADDRESS FOR CORRESPONDENCE

Aws Alani, Department of Restorative Dentistry,
Newcastle Dental Hospital, Newcastle, NE2 1YZ.
E-mail: awsalani@hotmail.com

MANUFACTURERS DETAILS

- Denar Mark II, Waterpik Technologies, Fort Collins, USA
- Luxatemp®, Zenith™/DMG, Hamburg, Germany
- Nobel Biocare, Göteborg, Sweden
- Stick Tech Ltd, Turku, Finland
- 3D Lingual Tube™, Rocky Mountain Orthodontics, Denver Colorado

REFERENCES

1. Khan RS, Horrocks EN. A study of adult orthodontic patients and their treatment. *Br J Orthod*. 1991; **18**:183-94.
2. Nattrass C, Sandy JR. Adult orthodontics-a review. *Br J Orthod*. 1995; **22**:331-7.
3. Scott P, Fleming P, DiBiase A. An update in adult orthodontics. *Dent Update*. 2007; **34**:427-8, 431-4, 436.
4. Stratford NM. Assessment of the adult patient for orthodontic treatment in general dental practice. *Dent Update*. 1996; **23**:116-18.
5. Brånemark PI, Hansson BO, Adell R, Breine U, Lindström J, Hallén O, Ohman A. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. *Scand J Plast Reconstr Surg Suppl*. 1977; **16**:1-132.
6. Odman J, Lekholm U, Jemt T, Thilander B. Osseointegrated implants as orthodontic anchorage in the treatment of partially edentulous adult patients. *Eur J Orthod*. 1994; **16**:187-201.
7. Gray JB, Steen ME, King GJ, Clark AE.Studies on the efficacy of implants as orthodontic anchorage. *Am J Orthod*. 1983; **83**:311-7.
8. Roberts WE. Rigid endosseous anchorage and tricalcium phosphate (TCP)-coated implants. *CDA J*. 1984; **12**:158-61.
9. Smalley WM, Shapiro PA, Hohl TH, Kokich VG, Brånemark PI. Osseointegrated titanium implants for maxillofacial protraction in monkeys. *Am J Orthod Dentofacial Orthop*. 1988; **94**:285-95.
10. Turley PK, Kean C, Schur J, Stefanac J, Gray J, Hennes J, Poon LC. Orthodontic force application to titanium endosseous implants. *Angle Orthod*. 1988; **58**:151-62.
11. Roberts WE, Helm FR, Marshall KJ, Gongloff RK. Rigid endosseous implants for orthodontic and orthopedic anchorage. *Angle Orthod*. 1989; **59**:247-56.
12. Higuchi KW, Slack JM. The use of titanium fixtures for intraoral anchorage to facilitate orthodontic tooth movement. *Int J Oral Maxillofac Implants*. 1991; **6**:338-44.
13. Parr JA, Garetto LP, Wohlford ME, Arbuckle GR, Roberts WE. Sutural expansion using rigidly integrated endosseous implants: an experimental study in rabbits. *Angle Orthod*. 1997; **67**:283-90.
14. Akin-Nergiz N, Nergiz I, Schulz A, Arpak N, Niedermeier W. Reactions of peri-implant tissues to continuous loading of Osseointegrated implants. *Am J Orthod Dentofacial Orthop*. 1998; **114**:292-8.
15. Schweizer CM, Schlegel KA, Rudzki-Janson I. Endosseous dental implants in orthodontic therapy. *Int Dent J*. 1996; **46**:61-8.
16. Wehrbein H, Merz BR, Diedrich P, Glatzmaier J. The use of palatal implants for orthodontic anchorage. Design and clinical application of the orthosystem. *Clin Oral Implants Res*. 1996; **7**:410-6.
17. Kokich VG. Managing complex orthodontic problems: the use of implants for anchorage. *Semin Orthod*. 1996; **2**:153-60.
18. Parr JA, Garetto LP, Wohlford ME, Arbuckle GR, Roberts WE. Sutural expansion using rigidly integrated endosseous implants: an experimental study in rabbits. *Angle Orthod*. 1997; **67**:283-90.
19. Harzer W, Schneider M, Gedrange T. Rapid maxillary expansion with palatal anchorage of the hyrax expansion screw--pilot study with case presentation. *J Orofac Orthop*. 2004; **65**:419-24.
20. Wilson GB, Kidner G, Hemmings K. The use of implants at an increased vertical dimension of occlusion to correct a scissor bite: a case report. *Eur J Prosthodont Restor Dent*. 2008; **16**:67-72.
21. Smith B G N, Knight J K. An index for measuring the wear and tear of teeth. *Br Dent J* 1984; **156**: 435-438.
22. Lipp MJ. Temporomandibular symptoms and occlusion: a review of the literature & the concept. *N Y State Dent J*. 1990 ;**56**:58-66.
23. Valiente Zaldívar C, Bravo Rodríguez J, Figueredo Pérez E. Dental malocclusion and its relation to speech disorders. 1 *Rev Cubana Estomatol*. 1987; **24**:135-40.
24. Roberts-Harry D, Sandy J. Orthodontics. Part 9: anchorage control and distal movement. *Br Dent J*. 2004 **13**; 196:255-63.
25. Valeron JF, Velazquez JF. Implants in the orthodontic and prosthetic rehabilitation of an adult patient: A case report. *Int J Oral Maxillofac Implants*. 1996; **11**:534-538.
26. Drago CJ. Use of osseointegrated implants in adult orthodontic treatment: a clinical report. *J Prosthet Dent*. 1999; **82**:504-9.
27. Kato S, Kato M. Intrusion of molars with implants as anchorage: a report of two cases. *Clin Implant Dent Relat Res*. 2006; **8**:100-6.