Mind the gap: A novel technique for space closure – a case report

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Abstract

Patients presenting with severe hypodontia can be challenging to manage. They often present with significant spaces within the dental arches and a lack of permanent teeth can make anchorage control difficult. This case report demonstrates a novel technique for diastema closure in a 14-year-old with severe hypodontia. The technique allows maintenance of root parallelism during space closure in cases with reduced anchorage support.

The treatment plan was agreed on a multidisciplinary hypodontia clinic and involved an upper sectional fixed orthodontic appliance to close a 7mm midline diastema aiding subsequent partial denture provision.

Treatment commenced by bonding upper primary canines and central incisors. However, attempting space closure on a 0.019” x 0.025” stainless steel archwire resulted in tipping of the incisor crowns. Two brackets were therefore placed on the labial surface of each central incisor (one incisal and one gingival). Subsequently two 0.019” x 0.025” stainless steel archwires and elastomeric chain were used for diastema closure. This 4-bracket system provided superior control allowing space closure by bodily tooth movement. Excellent root parallelism was achieved with this innovative technique.

Keywords:

Severe hypodontia; anchorage control; diastema closure; fixed appliances

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Introduction/background

Severe hypodontia is classified as the developmental absence of six or more permanent teeth, excluding the third molars (Hobkirk and Brook 1980). Although relatively rare, with an estimated prevalence of 0.1-0.2% in the general population (Polder et al. 2004; Worsaae et al. 2007) and 3.1% in the

hypodontia population (Khalaf et al. 2014), it can be very challenging to manage.

The aetiology of hypodontia is complex and multifactorial, with a likely combination of several genetic and environmental interactions (Graber 1978; Cobourne 2007). Severe hypodontia can present as an isolated anomaly in a non-syndomic patient but is often associated with syndromes or systemic conditions. Table one demonstrates some of the syndromes most commonly associated with hypodontia.

Hypodontia is often associated with characteristic dental features. Some of the common concerns and features encountered in these patients are outlined in Table 2.

Patients with hypodontia may present with significant spaces within the dental arches, often including a large midline diastema. Orthodontically, this can be difficult to manage in cases where a lack of permanent teeth complicates anchorage control. There are several possible techniques to improve anchorage control in these patients and in this case report we present a novel technique used for anchorage management and space closure of a 7mm midline diastema in a patient with severe hypodontia.

Case summary

A 14–year-old male was referred to …(removed for anonymity) multidisciplinary hypodontia clinic for comprehensive treatment planning. The patient was medically fit and healthy and his presenting concern was that he was unhappy with the appearance of his teeth. He presented with severe hypodontia of 20 teeth, a large 7mm midline diastema and 8 retained deciduous teeth.

The patient was seen by a team of specialists on the hypodontia clinic, and the treatment plan devised was an upper sectional fixed orthodontic appliance to close the midline diastema and subsequent provision of upper and lower partial dentures.

The patient's pre-treatment extra-oral photographs (Figures 1a and 1b) illustrate that when the patient smiled, he had significant spaces and a large midline diastema, which he was unhappy about.

[Figure 1 near here]

The pre-treatment intra-oral photographs (Figures 1c, 1d and 1e) demonstrate that the only permanent teeth erupted in the upper arch were the upper central incisors and the first permanent molars. The anterior view also illustrates that the patient does not have a prominent labial frenum.

A pre-treatment Dental Panoramic Tomograph (DPT) (Figure 2) confirmed the presence of severe hypodontia as well as two unerupted permanent teeth (the upper right canine and the lower right first premolar). It also showed there was no other physical obstruction which may have caused such a large midline diastema, such as a supernumerary tooth.

[Figure 2 near here]

Treatment

Treatment for this patient commenced with an upper sectional fixed appliance in which the upper central incisors and the upper deciduous canines were bonded. The precautions taken to control anchorage in this case were to bond the primary canine teeth as well as the central incisors, and also build up to a 0.019" x 0.025" SS archwire prior to commencing diastema closure.

During treatment, another DPT was taken to assess the position of the unerupted teeth (Figure 3a). However, the DPT demonstrated advanced resorption of the URC from the erupting UR3. The upper right primary canine eventually became mobile and the fixed appliance was no longer stable.

A subsequent long cone periapical (LCPA) radiograph (Figure 3b) taken of the upper central incisors once space closure had commenced illustrates how the central incisor crowns have tipped due to the lack of anchorage.

[Figure 3 near here]

A novel technique was utilised to encourage bodily space closure of the teeth. This involved the use of two brackets bonded to the labial surface of each central incisor, one more incisal and the other more gingival (Figures 3d and 3e). Two 0.019” x 0.025” SS archwires and elastomeric chain were subsequently used for diastema closure; this provided superior control allowing space closure by bodily tooth movement. The 4-bracket system increased the rigidity of the appliance and the presence of two archwires helped to control the coupling forces.

The technique used to ensure the brackets were parallel so as to not increase binding and hinder space closure were to initially bond the two incisal brackets, ensuring the 0.019” x 0.025” SS archwire was passive when the brackets were light cured. The same technique was then applied to the two gingival brackets. It is important to highlight that this particular patient had sufficiently long clinical crowns, enabling the four brackets to be bonded in this way. This technique also did not appear to impact on the torque differential.

Seven months later, the diastema was closed and the patient was debonded (Figure 4). A fixed bonded retainer was placed on the upper central incisors and the patient was also provided with an upper Hawley retainer.

[Figure 4 near here]

Excellent bodily tooth movement and root parallelism was achieved with this technique (Figure 3c), which is also important for stability. This result was also achieved without the use of any finishing bends. Figure 5 show that one year post-debond, the treatment changes have been stable.

[Figure 5 near here]

Discussion and Conclusion

The management of patients with hypodontia can be complex, a multidisciplinary approach is therefore considered the gold standard, with coordinated input from specialists in paediatric dentistry, orthodontics and restorative dentistry. As each specialty plays an important role in the care of these patients, it would be difficult to achieve optimal outcomes if treatment was provided by a single healthcare professional or specialty (Hobkirk et al. 1995). This is especially the case when space redistribution and multiple prosthetic replacements are needed.

This case report has presented a novel technique to enable bodily tooth movement (space closure) with maintenance of root parallelism whilst bonding a minimal number of teeth. Some advantages of this method include:

- It is quick and easy to perform chairside
- It is more cost effective than other possible options such as the use of vertical mini-implants

However, it is important to highlight to patients the importance of meticulous oral hygiene measures as oral hygiene is perhaps more difficult to maintain with this 4-bracket system. In conclusion, this is an effective method for use in cases with reduced anchorage support.

Several other techniques could have been utilised for space closure, including:

1) Use of an upper removable appliance

An upper removable appliance with palatal finger springs to mesialise the central incisor teeth could be used (Figure 6). This gains anchorage from the acrylic baseplate, which covers the hard palate. However, bodily control would

be poor, and this technique would still result in tipping of the incisor crowns. It is also heavily reliant on excellent patient compliance (Ward et al. 2004).

[Figure 6 near here]

2) Use of “V” second order bends

V-shaped second order finishing bends could be placed in the archwire to upright the roots of the central incisors after space closure (Figure 7). However, this would be time consuming and anchorage control would be difficult due to the lack of teeth on the appliance.

[Figure 7 near here]

3) Bond all permanent and deciduous teeth in the upper arch as part of the fixed appliance

Bonding maxillary deciduous canines, first and second molar teeth have previously been documented in the literature as a means of increasing anchorage (Mashouf C and Mashouf KL 2017). However, this patient is only 14 years old and has severe hypodontia. Bonding the posterior deciduous teeth in this way may hasten their loss, which is not beneficial in this particular situation.

4) Use of a McKeag box

This technique was developed in the 1930s and only requires attachments on the two central incisor teeth (Figure 8). It uses an 0.014” or 0.016” stainless steel (SS) archwire which is bent with a W spring between the two incisors and a series of bends to ensure the wire contacts at least three sides of the box. This ensures that as the diastema closes, bodily movement of the teeth is achieved. However, the wirework is very precise and requires a high level of skill. It would also be very time consuming to bend up and therefore is not very practical to carry out chairside.

[Figure 8 near here]

5) Use of orthodontic mini-implants/ temporary anchorage devices (TADs)

Another alternative method to increase anchorage control is the use of TADs or mini-implants. These could be placed vertically in the lateral incisor position to bolster the anterior anchor unit, and a prosthetic tooth with a bracket could be placed on top of the vertical mini-implant (Cope and McFadden 2014). However, mini-implants and TADs are expensive, technique sensitive to place and the patient would have to be subjected to a local anaesthetic. TADs and miniscrew implants can also fail (Papageorgiou et al. 2012).

This case report has presented a novel technique to enable bodily tooth movement (space closure) with maintenance of root parallelism. A summary of other possible techniques to improve anchorage control in similar clinical situations has also been provided.

Disclaimer statements

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Tables

Syndrome	Prevalence of hypodontia	Severity of hypodontia most commonly associated
Cleft lip and palate	48.7%[1]	Mild[1] (1-2 teeth missing)
Down's syndrome	54.6%[2]	Moderate[2] (3-5 teeth missing)
Ectodermal dysplasia	65%[3]	Severe[3] (>6 teeth missing)
Pierre Robin syndrome	44.1%[4]	Mild[4]
Van der Woude syndrome	86%[5]	Variable[5,6]
Hemifacial microsomia	32.9%[7]	Mild[7]

Table 1: Syndromes associated with hypodontia
[1]Bartzela et al. 2013, [2]Palaska and Antonarakis 2016, [3]Bergendal 2010, [4]Andersson et al. 2010, [5]Lam et al. 2010, [6]Oberoi and Vargervik 2005, [7]Maruko et al. 2001

Features presenting in patients with severe hypodontia	
Patient concerns	
Aesthetic concerns	Hobkirk et al. (1995)
Functional concerns	Holliday et al. (2014)
Psychological implications	Kotecha et al. (2013), Durey et al. (2014)
Extra-oral features	
Reduction in lower anterior face height	Kreczi et al. (2011)
Class III skeletal profile	Acharya et al. (2010)
Intra-oral features	
Retained deciduous teeth	Aktan et al. (2012)
Delayed dental development	Ruiz-Mealin et al. (2012)
Infra-occlusion	Sundram and Walmsley (2003)
Increased overbite	Kreczi et al. (2011)
Microdontia	Brook (1984)
Impacted canines	Brin et al. (1986)
Spacing	Hobkirk et al. (1995)
Large midline diastema	Huang et al. (1995), Abraham et al. (2014)
Necking of bone/ lack of alveolar development	Sundram et al. (2003)
Anchorage control	Durey et al. (2014)
Uprighting teeth	Carter et al. (2003)
Retention and stability	Carter et al. (2003)

Table 2: An overview of the presenting features in patients with hypodontia

Figures

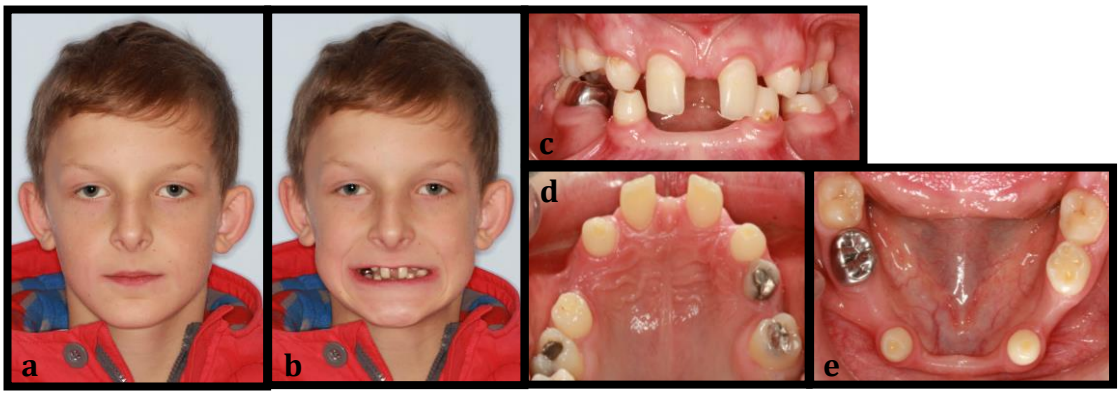

Figure 1(a-e): Pre-treatment extra-oral and intra-oral photographs

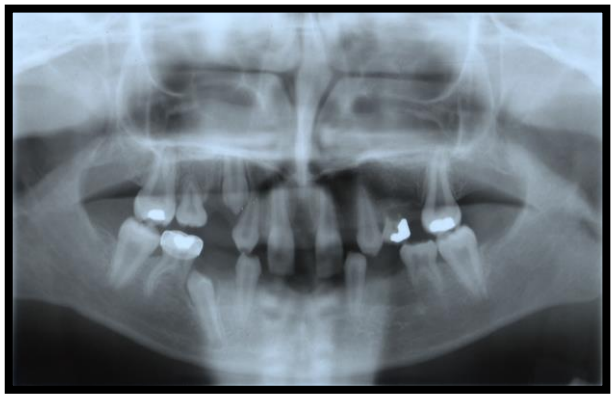
Figure 2: Pre-treatment DPT

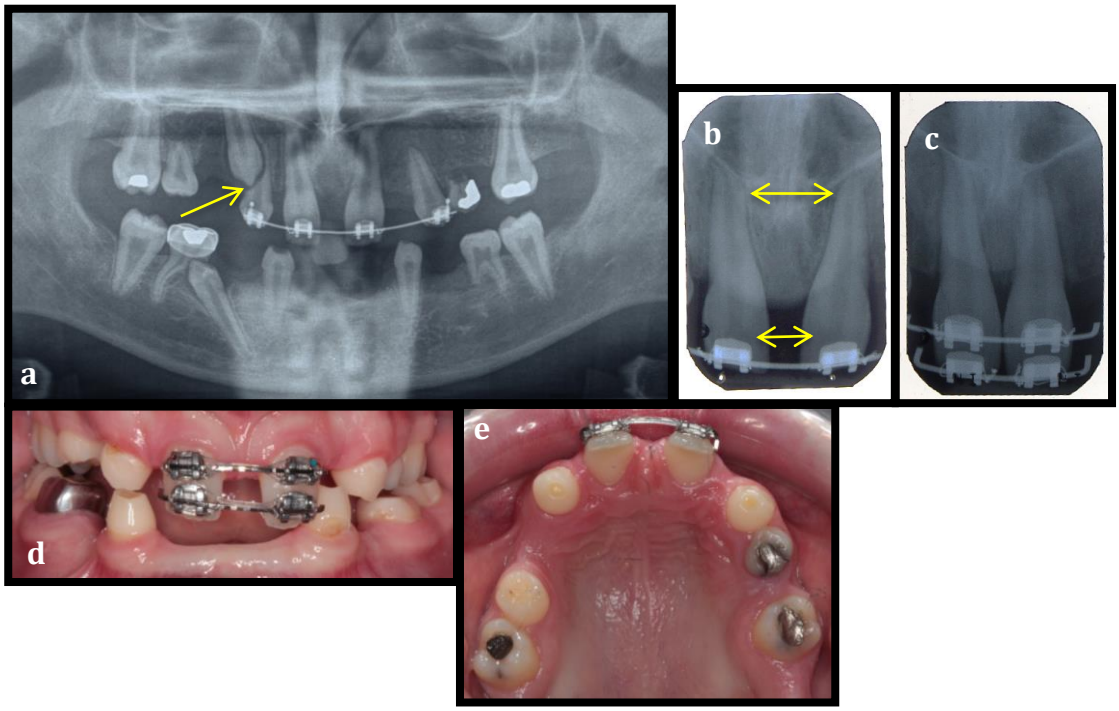

Figure 3(a-e): Mid-treatment records

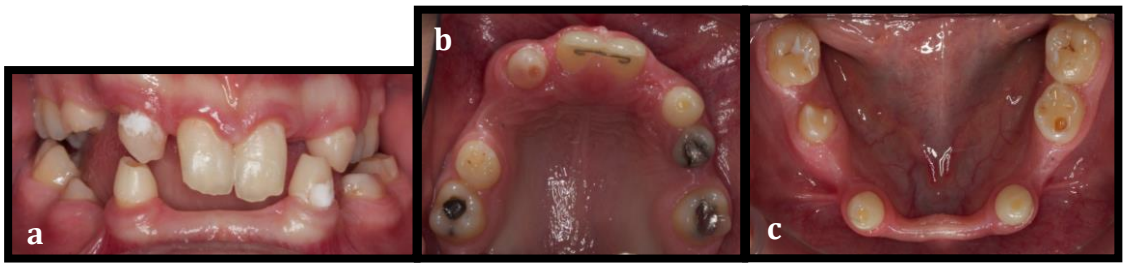

Figure 4(a-c): Debond photographs

Figure 5(a-c): One year post-debond photographs

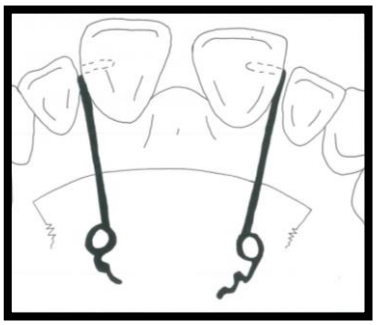
Figure 6: Diagram of an upper removable appliance showing palatal finger springs to close a midline diastema

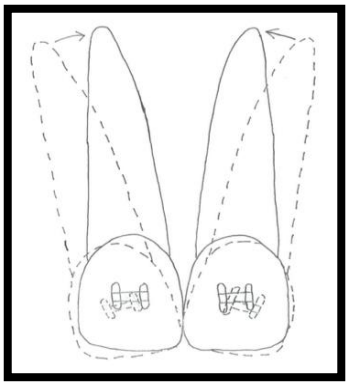
Figure 7: Diagram to demonstrate the tooth movement which occurs with V-shaped second order uprighting bends

Figure 8: Demonstration of a McKeag box with bands on the central incisors