CASE REPORT

Magical NiTi expander

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SUMMARY

A 24-year-old male patient was referred to our department for expansion of the constricted maxillary arch as a presurgical procedure for the correction of congenital facial disfigurement. On examination, the patient had a convex profile, increased interlabial gap, tongue thrust, limited mouth opening, posterior crossbite, asymmetric 'V'-shaped maxillary arch with severe constriction, crowding of anterior teeth in the maxillary arch and a massive open bite. Radiographic investigations included orthopantomograph and occlusal radiographs. The patient photographs and models were analysed. On careful evaluation, the treatment for maxillary arch expansion was planned with a nickel titanium (NiTi) slow maxillary expander along with fixed mechanotherapy for alignment of teeth. An unexpectedly successful outcome was appreciated from the treatment. An emphasis should be laid on selecting and treating the case of constricted arches with a surgical or non-surgical approach, as expansion can be achieved orthodontically by using NiTi expanders.

BACKGROUND

This is a case of a 24-year-old male patient with severe maxillary constriction who has been treated successfully with maxillary arch expansion using a nickel titanium (NiTi) expander.

The purpose of this article is to report a very unusual outcome from a slow maxillary expander which corrected a number of aesthetic and functional problems of the patient. This case required a multidisciplinary approach involving the fields of orthodontics and dentofacial orthopaedics, oral medicine and radiology and oral surgery.

CASE PRESENTATION

A 24-year-old male patient was referred to the department of orthodontics and dentofacial orthopaedics from maxillofacial surgery unit for expansion of severe maxillary constriction as a presurgical procedure.

The patient history revealed cosmetic disfigurement since birth, limited mouth opening, difficulty in chewing food and the patient was only on a semisolid diet. His medical history and family history were unremarkable. The patient disclosed that he was unhappy with life.

On extraoral examination, the patient had convex profile, with an increased interlabial gap.

Simple tongue thrust between the maxillary and mandibular teeth was noted (figures 1 and 2).

Intraoral examination of the maxillary arch revealed severe maxillary constriction with an asymmetric 'V'-shaped arch having 34 mm of intermolar width with severe crowding and proclination

of anterior teeth. The patient had root stumps with maxillary left first molar (26) which was grossly decayed due to caries.

Examination of mandible showed constriction of the arch, mild crowding with proclination of anterior teeth and congenitally missing mandibular right canine (33).

Further evaluation revealed massive open bite with only the last molar in occlusion. Posterior crossbite was also evident.

INVESTIGATIONS

Radiographic investigation, study models, extraoral and intraoral photographs along with clinical examinations were carried out to diagnose and to plan a proper treatment.

Radiographic investigations like orthopantomograph and occlusal radiograph were undertaken to confirm the existence of a constricted maxilla and a need for its expansion.

Impressions were made with much difficulty as the mouth opening was too limited. Pont's and Linder Harth's model analysis demonstrated severe maxillary constriction in anterior and posterior regions with asymmetric 'V'-shaped arch and crowding in maxillary anterior teeth. The presence of open bite and posterior crossbite was also confirmed. On measurement, the intercanine, interpremolar and intermolar widths were 24.65, 23.67 and 35.21 mm, respectively.

Intraoral and extraoral photographs were taken to aid in planning the treatment and proved very helpful.

TREATMENT

Based on the clinical and investigative findings the treatment planned was to expand the constricted maxilla both anteriorly and posteriorly. On careful evaluation an NiTi expander was chosen which brings about slow expansion of the maxillary arch (figure 3). Fixed mechanotherapy was planned for alignment of maxillary teeth with extraction of left maxillary first molar (26). Mandibular teeth alignment was planned with extraction of the left central incisor (31).

Maxillary and mandibular bonding procedure was carried out using 0.022 slot MBT (McLaughlin, Bennett and Trevisi) brackets, with lingual sheath attached to the palatal surface of the maxillary molar bands for the placement of a palatal expander. Initially an NiTi expander of size 38 mm was used, as the intermolar width of maxillary molars was 34 mm which was 3–4 mm wider than the transverse distance between the maxillary first molar. Expansion was noticed within 3 months and the next size expander, 41 mm, was then

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Figure 1 Pretreatment extraoral photographs showing open bite, tongue thrusting and cosmetic disfigurement.

placed to continue the expansion. After sufficient expansion, the transpalatal arch was placed to maintain the expansion obtained. The amount of expansion noted when comparing the pretreatment and post-treatment models with a Vernier caliper

was as follows: intercanine width increase was 11 mm, interpre-molar width increase was 14 mm and intermolar width increase was 11 mm (figure 4). In the process of expansion, the arch length was increased and the anterior teeth were aligned.

Figure 2 Pretreatment intraoral photographs displaying anterior open bite with only the last teeth in occlusion and posterior crossbite.

Figure 3 NiTi expander at low temperature and at room temperature.

Figure 4 Pretreatment and post-treatment models showing the increase in intercanine, interpremolar and intermolar width.

Maxillary left second molar (27) was taken as the anchorage. During alignment 27 had almost taken up the place of the extracted 26 (figures 5 and 6).

A single incisor extraction was performed as a space gaining method to relieve crowding, correct proclination and align the mandibular teeth. In the process, the mandibular arch was also expanded and teeth were aligned simultaneously with the corrections in the maxillary arch (figures 7 and 8).

This was a unique case treated with an NiTi slow maxillary expander which converted the asymmetric 'V'-shaped maxillary arch into a well aligned symmetric 'U' shaped arch, corrected crossbite. The anterior open bite was also corrected. With the treatment results, the patient was pleased with the aesthetic improvement and the enhanced functional ability to chew the food (figures 9 and 10).

Figure 5 Maxillary arch photographs: before, during and after expansion.

OUTCOME AND FOLLOW-UP

The patient was referred to the Oral & Maxillofacial unit for surgery to facilitate further cosmetic enhancement.

Maxillary expansion using an NiTi expander coupled with fixed mechanotherapy yielded excellent outcome and also corrected the open bite with simultaneous alignment of the teeth.

DISCUSSION

Narrow maxilla has been recognised from thousands of years.¹ An estimated 25–30% of all orthodontic patients can be benefited from maxillary expansion.² Transverse maxillary expansion corrects posterior crossbite, which moves the maxilla forward, increases space in the arch and repositions the crowded permanent teeth.³ Broadly, expansion appliances can be categorised into two:

Figure 6 Maxillary occlusal models: before, during and after expansion.

rapid maxillary expansion (RME) appliances and slow maxillary expansion (SME) appliances. RME appliances generate heavy forces across the midpalatal suture and bring about split in the suture.⁴ This kind of suture opening brings about patient discomfort and can only be carried out until adolescence as the suture becomes increasingly tortuous and interdigitated as age advances.⁵ This patient presented to the department at an age of 24 years, so RME could not be the treatment of choice.

SME appliances produce light force and open the suture at a rate that is close to the maximum speed of bone formation.³ According to Storey,⁶ slow expansion produces suture separation at a rate that maintains the integrity of maxillary sutures by allowing for bone remodelling. According to Bell,⁷ the rate of midpalatal suture separation in slow expansion allows a more tolerable response than the disruptive nature of RME, so tissue

integrity is maintained associated with greater stability and less potential for relapse. Thus slow maxillary expansion was the treatment of choice in our patient after careful evaluation of the clinical records.

To overcome the limitations of various slow expanders, like Quad helix and W arch, Arndt⁸ in 1993, developed an NiTi expander and this was the expander of choice for our patient. The NiTi expander is a tandem loop temperature-activated palatal expander with the ability to produce light, continuous pressure on the midpalatal suture. This appliance is capable of correcting posterior crossbite and molar rotation and requires little patient cooperation and laboratory work.⁸

Severe posterior crossbite with constricted maxilla was corrected in our patient with this appliance and an improvement in intermolar width was noticed. Intermolar width change is a

Figure 7 Mandibular occlusal photographs: before, during and after expansion.

Figure 8 Mandibular occlusal models: before, during and after expansion.

reflection of the total amount of dental and dentoalveolar expansion produced by the appliance. Intermolar width was found to be significantly increased in our patient, similar to the

studies reported by other authors.^{9–13} Pretreatment and post-treatment study model comparison revealed a highly significant increase in the intermolar width of 11 mm in our patient with an NiTi expander, which was remarkably very high. Rate of increase in intermolar width is up to 10 mm in RME and upto 8 mm in SME.¹⁴ Bell and Lecompte⁹ in their study showed an increase in the intermolar width of 5.3 mm, Frank and Engel¹⁰ reported an increase of 5.88 mm, Ciambotti *et al*¹¹ showed an increase in the intermolar width of 6.26 in patients with NiTi expanders, Karaman¹² showed an increase of 8.5 mm, and Nanda and Mazban¹³ also reported an increase in intermolar width. To the best of our knowledge our case showed the maximum increase in intermolar width.

Buccal tipping of maxillary first molars was noted, which is in conjunction with studies carried out by other authors.^{11–13}

Expansion was noted not only at the molar region but also at the intercanine and premolar regions which was 11 mm and 14 mm, respectively, which can be attributed to stainless steel palatal extension of an NiTi expander.⁸ This increase in intercanine and interpremolar width is in concordance with the study made by Ferrario *et al*.¹⁵ Increase in intercanine width was also noted by Bell and Lecompte⁹ and Frank and Engel.¹⁰

Improvement of palatal width was also noted. NiTi expanders generate 400 g of force, though insufficient to separate progressively mature suture still brings about orthopaedic expansion similar to RME. This is in correlation to animal studies conducted by Cotton.¹⁶ On contrary Lander and Muhl¹⁷ reported that suture separation was low with SME than when compared with RME.

Radiographic evidence of midpalatal suture separation was found to be less obvious in the NiTi than in the RME group.¹² Occlusal radiographs seldom show palatal separation during slow expansion procedures. However, in our case, maxillary arch expansion was quite obvious on the postexpansion occlusal radiograph (figure 11).

Crowded maxillary anterior teeth were well aligned with expansion appliance and fixed appliance therapy which went on simultaneously. Crowding in this patient was because of arch length/tooth size discrepancy. Crowding was relieved due to

DURING-TREATMENT PHOTOGRAPHS

Figure 9 Postexpansion intraoral photographs demonstrating correction of open bite and posterior crossbite.

Figure 10 Postexpansion extraoral photographs occlusal and dental enhancement.

increase in arch perimeter. This is in coordination with the fact stated by Adkins¹⁸ that arch perimeter increases with expansion and more space is available for the teeth in the arch for proper alignment.

An NiTi expander brings about correction of rotated molars as it is flexible and thus effective than when compared with RME appliances, which are rigid.⁸

Before Expansion

After Expansion

Figure 11 Occlusal radiographs: before and after expansion.

Mandibular arch expansion was noted in this patient during maxillary expansion similar to the reports of Sandstrom *et al*¹⁹ which showed increase in intermolar width. On the contrary Frank and Engel¹⁰ showed no increase in the mandibular intermolar width.

Maxillary arch in our patient was severely constricted with an asymmetric 'V'-shaped palate, crowded teeth and severe open bite which was successfully treated. Asymmetric maxillary arch was corrected to a well-aligned symmetric arch with expansion and alignment. Two separate expanders were used in sequence of size, similar to Corbett.²⁰ Available in sizes from 26 mm to 47 mm, NiTi expanders are very effective forms of SMEs.⁸

Severe open bite in the patient was well corrected and this may be due to intrusion of the buccal teeth, which is similar to the fact stated by Corbett.²⁰

The outcome of this case was unusually excellent which can be attributed to the use of NiTi shape memory alloy. The introduction of NiTi alloy into orthodontics is because of its ability to develop light continuous forces that prove more effective than heavy intermittent forces in teeth movement.²¹ The NiTi component has a transition temperature of 94°F. At room temperature, the expander is too stiff to bend for insertion. When chilled, the expander softens and allows easy manipulation. When placed inside the mouth it stiffens with the body temperature and starts exerting expansion forces of 350–400 g, which is relatively uniform.⁸

This type of expander can also be successfully used in patients with cleft palate²² where the patients always need expansion of the palate as their treatment protocol.

CONCLUSION

NiTi expander is a viable treatment option for any kind of posterior crossbite and constricted maxilla. It can be substituted for SME and RME appliances. This appliance expands both posterior as well as anterior teeth. It helps to correct rotations and open bite, provides space for the teeth in the arch and requires minimal patient cooperation and laboratory procedure and is a hygienic appliance.

Ultimately the clinician's choice of an expander will depend on his or her initial diagnosis and treatment goals.

Learning points

- ▶ An emphasis should be laid on selecting and treating the case of constricted arches with a surgical or non-surgical approach, as expansion can be achieved orthodontically by using NiTi expanders.
- ▶ NiTi expander is an effective slow maxillary arch expander for treating posterior crossbite.
- ▶ The expander also helps in correction of rotation, increases space in the arch thus relieving crowding and corrects open bite.
- ▶ NiTi expander is both a patient and a clinician friendly appliance.

Competing interests None.

Patient consent Obtained.

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