Palatal Expanders in the Correction of Bilateral Posterior Crossbite - Which one, When & How?

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This study was conducted to evaluate the clinical efficacy and the treatment outcome of the selected few palatal expanders available today. Patients with Bilateral posterior crossbite in Deciduous, Mixed-dentition and Permanent dentition were chosen. The research material was formed from patients with varying malocclusions, orthodontic models and lateral and frontal cephalometric radiographs as well as frontal photographs. It was observed in this investigation that transverse expansion was achieved by both orthodontic and orthopaedic forces. The duration of treatment ranged from 3 months to 8 months for the various modalities of treatment used. Although posterior crossbite was corrected in a fairly short period of time no single appliance could easily elicit the merits and demerits of the early intervention of the correction of the posterior crossbite.

Key Words
Palatal expanders, Selection, Fabrication, Duration, Effects.

Introduction
In contemporary orthodontic therapy¹, the recreation of a normal dental occlusion remains a fundamental goal. The primary triad of a normal human dental occlusion are:
1. Dentitional development
2. Craniofacial growth
3. Neuromuscular maturation and function

These three factors develop at different time schedules. The development of occlusion is therefore one of the most fascinating and complicated problems in all of developmental biology, presenting the orthodontist with an enormous challenge².

Posterior crossbite is one of the most frequently observed malocclusions of the deciduous and mixed dentition periods. The prevalence of this malocclusion is regarded to be 8%³ and 12%⁴ during the deciduous dentition and 7.2%⁵ during the mixed dentition. Most investigators claim that this abnormality is not self-correcting and they recommend treatment at an early period².³ It is noted that treatment of posterior crossbite in the deciduous dentition period can be realized through the grinding of deciduous teeth that cause premature occlusal contact⁶. The treatment during the mixed dentition period, however, relies on the transverse expansion of the maxillary arch.

Maxillary expansion has long been used as a means of correcting a transverse discrepancy of the maxillary arch, via orthopedic (skeletal), orthodontic (dental), or surgically assisted techniques, with the prime objective of coordinating the maxillary and mandibular denture bases².⁶

In the treatment of posterior crossbite through the transverse expansion of the maxillary teeth, various appliances such as the Coffin spring, Expansion plate⁹, 'W' appliance, Quad Helix appliance¹⁰,¹¹, Hyrax,¹² Haas. Tandem Loop NiTi

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Expander, and Magnets are used. The objective of this study was to evaluate the clinical efficacy and quality of treatment outcome with the few selected palatal expanders viz. Slow arch expansion plate, Rapid palatal expander (HYRAX) - bonded and banded types. Quad Helix appliance, Tandem Loop NiTi Expander and Magnets.

Case Selection

The following criteria were taken into consideration in the selection of cases for this clinical study:

1. Morphologic posterior crossbite due to transverse maxillary deficiency.
2. Angle's class I or Class II Molar occlusion.
4. Both males and females were included.
5. Patient's did not have any craniofacial anomalies.
6. All patient's requiring arch expansion by more than 3-4 mm to correct a constricted maxillary arch.

Preliminary Investigations

The pre-treatment records that were analysed for the study included:

1. Radiographic investigations (Lateral cephalometric & Frontal cephalogram)
2. Study model analysis
3. Frontal photographs
4. Occlusal radiograph of palate

Lateral Cephalogram

The following variables were evaluated:

1. SNA
2. SNB
3. ANB
4. SN-PP
5. SN-Mand-plane
6. SN-1
7. FH-palatal plane
8. FH-OP
9. Maxillary length
10. S-A
11. ANS-SN
12. PNS-SN
13. N-Me

Frontal Cephalogram

The parameters considered were:

1. Biotic width
2. Bizygomatic width
3. Maxillary width
4. Bidental width
5. Maxillary intermolar width
6. Mandibular intermolar width

Study Model Analysis

The following measurements were considered:

1. Maxillary intercanine width (Tip of the cusp on 13 & 23)
2. Maxillary intermolar width (Tip of the buccal cusp of 14 & 24)
3. Maxillary molar width (Tip of the mesiobuccal cusp on 16 & 26)
4. Maxillary molar angulation (Angle of intersection of lines drawn through the mesiobuccal and mesiolingual cusps of the 16 & 26)
5. Mandibular intercanine width (Tip of the cusp on 33 & 43)
6. Mandibular intermolar width (Tip of the cusp on 34 & 44)
7. Mandibular intermolar width (Tip of the cusp on 36 & 46)
8. Palatal depth index = \frac{Palatal height}{Posterior arch width} \times 100

(Khorkhaus Analysis)

Palatal height - measured on the midsagittal plane in the region of first molars on the level of the maxillary occlusal plane. The distance of the perpendicular from the line between the midpoint of the fissures of both upper first molars to the surface of the palate.

9. Linder-Harth's and Pont's Index.

Frontal Photographs

The following frontal facial dimensions were measured:

1. Nose length
2. Upper lip length
3. Lip chin length
4. Upper face width
5. Intercanthal distance
6. Nose width
7. Lower face width

Case Reports

Case Report 1

A 14 years old male presented with a convex soft tissue profile, dolicho-facial growth with retrognathic mandible and lip incompetence at rest. The patient had a Class II division 1 malocclusion with an extreme overjet. He was in permanent dentition and presented with a narrow upper arch with bilateral maxillary posterior crossbite. The upper anterior teeth were protruded and over-erupted. The
lower anterior teeth were retarded and slightly crowded. Cephalometric analysis revealed a convex skeletal profile, he had a 7 degree ANB, a high mandibular plane angle and both the upper and lower incisors were placed forwards.

Treatment Objective
The treatment objective was to achieve symmetrical CI-I occlusion without extraction and to improve facial appearance.

First phase of treatment involved the transverse expansion of the upper arch with slow arch expansion screw appliance to correct the Bilateral Posterior crossbite.

Appliance
A removable expansion plate covering the entire palatal vault with an equidistant opening parallel expansion screw placed in the midline. Fabricated out of heat-cure acrylic with retentive Adam's clasps on the first premolar and first molars (See photograph No.1).

Activation
Brought about by turning the key in the screw one quarter turn on every third and seventh day of the week till the objective was achieved.

Expansion was stopped when a Buccal overjet of the posteriors was established. The same screw was sealed with self-cure acrylic resin to avoid further accidental activations. The appliance was used as a retention device till the fixed appliance was strapped.

Duration
The treatment period spanned 8 months for complete correction. The force produced was in the range of 300gms. Overall arch expansion was about 3 mm, in the Molar region. Slight buccal tipping of the posteriors was noted. Produced only dentoalveolar changes without any influence on the Skeletal base.

Case Report 2
A 9 years old female, presenting with a convex profile, protruding and rotated upper incisors, and lip incompetence. She had a Class II malocclusion in the mixed-dentition, with an increased overjet and overbite and crowded maxillary and mandibular incisors. Cephalometric analysis revealed a convex skeletal profile with an increased mandibular plane, severe Class II malocclusion and mandibular retrusion. The maxillary segments were contracted and narrowing of the arches were noted. There was no other craniofacial anomaly.

Case Report 3
A 12 years old female patient presented for orthodontic treatment. There was no remarkable medical history, although mouth breathing habit was
reported by the parents. She presented with a CI-
Malocclusion, anterior open bite, severe overjet and
lip incompetence with a steep mandibular plane.
Patient was in the permanent dentition phase. A
constriction of the maxillary arch resulted in a
v-shaped maxillary arch form with a bilateral posterior
crossbite.

Treatment Objective
To correct the transverse discrepancy of the maxillary
arch and to achieve transverse inter-arch co-
ordination.

Appliance Chosen
Rapid Maxillary Expansion (RME) with Banded
HYRAX. This is a rigid, fixed type, with cast wire
framework attached to stainless steel metal housing,
lodging the active screw. It is adapted on the palatal
vault free from the mucosa with the wires soldered
to the premolar and molar bands. The buccal and the
lingual aspect of the bands from premolar to molar
were soldered with a supporting wire of 0.036" round
stainless steel. The fabrication of the screw appliance
is prepared on a working model and then cemented
into place inside the patient's mouth. Instructions on
the usage of the activation key and oral hygiene
procedures were given (See photograph No. 3).

Activation
The Hyrax screw was activated by turning the
key in the slot provided in the Central Housing Unit
of the Hyrax. The screw was turned two-half turns
each day once in the morning and evening and
gradually reducing the number of activations.

Duration of Treatment
The RME with Hyrax exhibited changes both
at the dental level and very strongly at the skeletal
level. The overall treatment time was 6-8 weeks with
complete correction of posterior crossbite. The force
value exerted was ranging between 300-400 gms.
The transverse dimension achieved was nearly
4-6 mm. The appliance is left in place for an additional
3 months to allow for adequate reossification of the
involved sutural systems. Cold-cure acrylic can be
applied to the screw to stabilize the appliance.

Case Report 4
A 9 years old female, reported to the clinic with
irregular alignment of teeth in both the arches. On
examination, she had a convex profile, protruding
upper incisors, lip incompetence and lip trap. She
had a Class II Malocclusion in the permanent
dentition with an increased overjet. Cephalometric
analysis reveals a convex skeletal profile, with an
prognathic maxilla an orthognathic mandible and a
steep mandibular plane. There was narrowing of the
maxillary dental arch with bilateral posterior cross
bite in the upper arch. The overall facial height of
this individual was higher.

Treatment Objective
1. Unravel the upper and lower anterior crowding
2. Correcting the bilateral posterior crossbite
3. To correct the Class II Malocclusion
4. To reduce the overjet

Appliance Chosen
A Rapid Maxillary Expansion Appliance
(Screw) with Bonded Hyrax. This features an ultra
smooth trapezoid shaped body that fits perfectly into
the palatal vault. Anatomically bent laser welded
retention arms were easily soldered to molar bands.
An arrow is laser etched into the screw body
indicating the direction of activation. The screw
selected had an expansion of 9 mm and length of
13 mm. The posterior occlusal coverage of the acrylic
of about 3 mm acts as a posterior bite block to aid in
inhibiting the eruption of the posterior teeth, an
advantage in treating patients with long facial heights;
as well as in the correction of anterior crossbites.
The posterior bite blocks are cemented into place
with polycarboxylate cement (See photograph No. 4).

Activation
Appliance is activated one, full turn per day for
two weeks. The expansion key is ligated with a long
piece of dental floss to prevent aspiration. Strict oral
hygiene instructions were advised.

Duration of Treatment
The patient was appointed at two-week intervals
until the expansion of the appliance was terminated.
The average amount of force was 400 gms and the
expansion with this type of appliance is 6-8 mm in a
period of 6-8 weeks of active expansion treatment.
The patient was reviewed every six weeks till the
reossification of the midpalatal suture occurred.
Parents and patients should be advised about the
diastema opening between the upper central incisors.
The RME appliances was cleaned and polished after
achieving the desired correction and can serve as
an interim retention appliance.

Therapeutic Advantages
1. Correction of Crossbite
2. Addition of arch length
3. Correction of axial inclination of the posterior teeth
4. Spontaneous correction of Class II malocclusion
5. Preparatory phase for FJO
6. Mobilization of the maxillary sutural system
7. Reduction of nasal resistance
8. Broadening the smile

Case Report 5

A 18 years old male patient reported to the clinic with proclined upper incisors and increased visibility of the upper incisors. On examination, he had a convex profile, mesofacial type with a near normal mandibular length. Mandibular plane angle was high with an increased overjet & incompetent lips. He had full complement of the permanent teeth with Angle’s Class II Malocclusion. Upper arch was narrow and constricted and revealed bilateral posterior crossbite. Cephalometric analysis revealed a posterior divergent face, mild ANB discrepancy and both upper and lower incisors were proclined to their dental bases.

Treatment Objective
1. To reduce the overjet/overbite
2. Correct the transverse discrepancy of the maxilla
3. To correct the Class II molar relation
4. To derotate the first permanent molars
5. Distalize the maxillary first permanent molars

Appliance Chosen

To overcome the limitations of conventional expansion appliances, a Tandem Loop NiTi temperature activated palatal expander was selected to produce light continuous pressure on the midpalatal suture while simultaneously uprighting, rotating and distalizing the maxillary first molars. The appliance consists of 0.035” thermal activated Nickel Titanium in tandem soldered to a metal casing which houses two adjustable 0.032” stainless steel extensions on both sides and inserted into the lingual sheaths on the first molars. An elastomer may be placed for more security. This appliance is designed to be adapted in the palatal vault and are available in different intermolar widths, ranging from 26 mm to 47 mm and generates a force of 180-300 gms. The appliance is selected by measuring the amount of expansion needed, then adding 3 mm for overcorrection (See photograph No. 5).

Activation

The passive appliance will lie slightly outside the molar bands. Distorting the nickel titanium for insertion produces an initial activation. Freeze gel packs are placed on the assembly kit before cementation. This cooling will allow for easy insertion into the Lingual Sheaths. The expander is handled only by the molar attachments to avoid warming the nickel-titanium. The appliance stiffens in the mouth and may cause initial discomfort. The patient can alleviate this by sipping a cold liquid which will make the nickel titanium more flexible. The forces produced are both orthodontic and orthopedic and very gentle and continuous.

Duration of Treatment

Slow expansion has been shown to produce the best physiologic changes, both orthopedic and orthodontic. The appliance corrected the bilateral posterior crossbite in 4-6 weeks time with a force value of 180-300 gms. As the force value was light, it produced widening rather than an actual separation of the suture.

Therapeutic Benefits
1. Corrected the Bilateral Posterior Crossbite
2. Light and continuous force level
3. Derotated the maxillary first permanent molars (Mesio-lingual rotations)
4. Distalized the maxillary molars
5. Uprighting of the mesially inclined molars
6. Self-activated by body temperature
7. Produces both orthopedic and orthodontic responses

Case Report 6

A 20 years old female patient reported to the clinic with a straight profile and Angle’s Class I dentoalveolar malocclusion. On examination, she had a normal lip closure and irregularly aligned upper and lower anteriors. The maxillary arch was constricted and in crossbite with the lower in centric occlusion. Mandibular arch appeared normal except for the lower anterior crowding. Cephalometrics revealed a Class I molar relationship with a average mandibular plane, normal profile and a mesofacial pattern. The overall facial height was within normal limits.

Treatment Objectives
1. To correct the maxillary discrepancy
2. Unravel the upper and lower anterior crowding
3. Reduce the overjet/overbite
4. Maintain the class I occlusion

Appliance Chosen

Intra-maxillary expansion and orthopedic movement of the palatal shelves can be brought about by the usage of Samarium - cobalt magnets. These
Magnets were modified from magneforce i.e. the magnetic molar-distalizing system. It consists of four miniaturized cylindrical samarium cobalt magnets, encased in a steel sleeve. Each magnet had a finely machined hole in the center and was coated with a biocompatible polymer to avoid leach out products. Two 0.016 stainless steel wires with a bent stop near the cistal and mesial ends. The wires and magnets can be used interchangeable on either side. All the first permanent molars were banded and wire mesh was welded onto the steel sleeve of the magnets and finally bonded to the molar bands (See photograph No. 6).

Activation

The magnets should have solid contact against the molar band. The maxillary magnets and the mandibular magnets were present in repulsion on each wire for use. The magnets were colour embossed to ensure the magnetic poles activation. Both the magnets on the bands were cemented in place simultaneously using polycarboxylate cement. The patients jaws must be separated and during cementation the air gap between the upper and lower magnets should be minimal. A extra-oral force in the form of chin cup is given to keep the jaws in occlusion at bed time. As the magnets begin to separate from one another the forces will diminish. The forces should be reactivated every three to five weeks by moving the magnets more buccally.

Duration of Treatment

The magnets of the magneforce produced the desired changes in the maxillary segments in 10-12 weeks period. The force value measured 200-300 gms where there was no air gap between the upper and lower magnets.

Therapeutic benefits

1. Gentle & continuous forces can be generated since the magnets are fixed
2. No patient co-operation needed for force application
3. More predictable treatment time
4. Accelerated tooth movement
5. Minimal local irritation
6. Esthetically attractive
7. Correction of cross bite with reduced mobility and discomfort

Contraindication

1. Hyper-sensitivity to any component of the system.
2. Not for use on patients with pacemakers.
3. Avoid entering an area containing a MRI diagnostic device.
4. Re-use of magnets is contraindicated due to bucking of repelling magnetic fields and wearing down of the protective polymer coating on magnets.

Summary

One of the dilemmas facing the orthodontic clinician is whether or not to intervene before the eruption of the permanent dentition. The goal of early treatment is to correct the existing or developing skeletal, dentoalveolar and muscular imbalances to improve the environment before the eruption of the permanent dentition is complete. During the last two decades, increased interest has been expressed in early treatment by a ponderable segment of the orthodontic community.

It is not the purpose of this clinical case report to debate whether or not the posterior crossbite can be altered by various treatment strategies. It is sufficient to say that there are many protocols in existence that can be used successfully in the early mixed dentition and permanent dentition to produce changes of significance in skeletal, dentoalveolar and muscular structures. Every effort should be made to select those protocols that require little or no patient co-operation, if appropriate. Hence, the various treatment modalities discussed here on the correction of bilateral posterior crossbite has its own merits and demerits. As we all know the cardinal rule, catch them early in cases of crossbites, hence every effort is made to time the treatment appropriately so as to maximize the treatment benefit in the shortest period of time.

Lastly for a successful and early orthodontic intervention “Choose an appliance for the patient and not a patient for the appliance.”
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1. Pre-treatment

1. Slow Arch Expansion Appliance

1. Post Treatment

2. Pre-treatment

2. Quad Helix Appliance

2. Post Treatment

3. Pre-treatment

3. Hyrax in situ - Radiograph

3. Occlusal Film Radiograph

3. Rapid Maxillary Expansion (RME) Banded Hyrax

3. Post treatment
References


