Correlation between Unilateral Posterior Crossbite, Mandibular Shift and jaw muscles: A review

Peer review status:
No

Corresponding Author:
Dr. Valentina Caridi,
Odontoiatra, Scienze odontostomatologiche e Maxillo-Facciali Roma - Italy

Submitting Author:
Dr. Valentina Caridi,
Odontoiatra, Scienze odontostomatologiche e Maxillo-Facciali Roma - Italy

Other Authors:
Dr. Gabriella Galluccio,
Direttore della Scuola di Specializzazione in Ortognatodonzia , Scienze Odontostomatologiche e Maxillo-Facciali, Roma La Sapienza - Italy

Article ID: WMC004487
Article Type: Systematic Review
Submitted on: 31-Dec-2013, 10:32:29 PM GMT    Published on: 02-Jan-2014, 05:08:42 AM GMT
Article URL: http://www.webmedcentral.com/article_view/4487
Subject Categories: ORTHODONTICS
Keywords: malocclusion/diagnosis; malocclusion/therapy; Unilateral cross-bite; Jaw muscles; Mandibular shift

How to cite the article: Caridi V, Galluccio G. Correlation between Unilateral Posterior Crossbite, Mandibular Shift and jaw muscles: A review. WebmedCentral ORTHODONTICS 2014;5(1):WMC004487

Copyright: This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC-BY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Source(s) of Funding:
None

Competing Interests:
None
Correlation between Unilateral Posterior Crossbite, Mandibular Shift and jaw muscles: A review

Author(s): Caridi V, Galluccio G

Abstract

Posterior crossbite occurs when the top back teeth bite inside the bottom back teeth. When it affects one side of the mouth the lower jaw may have to move to one side to allow the back teeth to meet together. It is unclear what causes posterior crossbites and they may develop or improve at any time from when the baby teeth come into the mouth to when the adult teeth come through. Some treatments widen the upper teeth whilst others are directed at treating the cause of the posterior crossbite e.g. breathing problems or sucking habits. Most treatments have been used at each stage of dental development. Through a careful analysis of the scientific literature, we want to analyze a correlation between unilateral posterior crossbite and mandibular shift and evaluation of jaw muscles in children with and without mandibular shift; we were chosen from "PubMed" several publications about malocclusion/diagnosis; malocclusion/therapy; Unilateral cross-bite; Jaw muscles and Mandibular shift. Early orthodontic treatment of unilateral posterior crossbites with mandibular shifts is recommended. Treatment success is high if it's started early. Evidence that crossbites are not self-correcting, have some association with temporomandibular disorders and cause skeletal, dental and neuromuscular functional components. Allen and others examined the skeletal contributions to posterior crossbites. Smaller maxillary to mandibular intermolar dental width ratio and greater lower face height were the 2 variables most often associated with posterior crossbite. A small maxilla to mandible width ratio may arise from genetic or environmental factors. Upper airway obstruction in the form of hypertrophied adenoids or tonsils and allergic rhinitis can result in mouth breathing and are correlated with the development of posterior crossbites. Those who have been intubated during infancy also have a significantly higher prevalence of posterior crossbites. In children presenting with a functional unilateral posterior crossbite, the maxillary complex is often constricted. This abnormal morphological situation is aetiologically based on a multicausal genetic system and influenced in craniofacial growth by different aetiological factors, such as impaired nasal breathing and muscular dysfunction, as well as prolonged sucking habits after the second year of life. In subsequent craniofacial development, a functional unilateral posterior crossbite leads to increased growth on the non-crossbite side and to impairment in the crossbite side. Progredient adaptation of the soft and hard tissues manifests in a unilateral crossbite and possibly results in facial asymmetry. However, young children with deciduous or early mixed dentition do not necessarily show signs and symptoms of craniofacial functional dysfunction, as this can develop later in growth. Treatment of unilateral functional CB in the primary dentition period is still questionable in
respect to cost-effectiveness and it has been claimed that the main indication for correction in the primary dentition is the correction of functional asymmetry to prevent adverse skeletal mandibular growth. The functional asymmetry observed in unilateral functional CB can contribute to mandibular skeletal asymmetry because during the growth period continuous condylar displacement in the glenoid fossa induces differential growth of the condyles. This symmetric function reflects different development of the elevator muscles on each side of the jaws, leading to a thinner masseter muscle on the CB side, which is already seen in the early mixed dentition. Therefore, early corrections of functional problems should prevent adverse dental and facial development.

Methods

We carried out a careful analysis of the scientific literature about correlation between unilateral posterior crossbite and mandibular shift and evaluation of jaw muscles in children with and without mandibular shift. We were chosen from "PubMed" several publications about malocclusion/diagnosis; malocclusion/therapy; unilateral cross-bite; jaw muscles and mandibular shift.

The clinical presentation of FXB is a unilateral crossbite with a functional shift of the mandible toward the crossbite side. A centric occlusion (CO) to centric relation (CR) discrepancy is evident in an FXB, whereas CO and CR are usually coincident in a true unilateral crossbite. A bilateral crossbite due to skeletal imbalance between maxillary and mandibular transverse dimensions differs from an FXB only in degree of severity; the maxillary to mandibular width discrepancy is less with FXB. Lateral shift of the mandible in an FXB results in a mandibular skeletal (and often dental) midline deflection to the crossbite side. The maxillary arch is usually symmetrical with coincident maxillary dental and skeletal midlines. The maxilla is transversely constricted in an FXB with marginal ridges in line and absence of simple dental crossbite.

We selected a studies in which the appraisal of the dentition phase was carried out according to the following definitions: (1) primary dentition, when all the primary teeth were erupted; (2) early mixed dentition, when the first permanent molars and incisors were erupting; (3) intermediate mixed dentition, when the permanent incisors and first molars had fully erupted, with presence of the primary canine, first molars, and second molars; (4) late mixed dentition, when the primary canines and molars had exfoliated, with eruption of the permanent canines and premolars.

A study of Alarcón et al evaluated electromyographic activity of jaw muscles at rest and during maximal voluntary clenching in maximal intercuspation between growing individuals with unilateral posterior cross-bite without functional mandibular lateral shift during closure and matched individuals with normal occlusion. The asymmetry index was calculated for each muscle area to quantify the degree of asymmetry between sides. The masseter/anterior temporalis ratio during clenching was also recorded.

Review

For early treatment to be viable, success rates for the chosen treatment method must be high enough for patients to see a justification for attempting treatment. Treatment in the deciduous dentition stage is usually followed by correct transverse eruption of first permanent premolars. Despite this, it may be prudent to postpone treatment until the first permanent molars erupt to rule out self-correction and to incorporate these teeth into the appliance. The rate of self-correction of clobites is too low to justify non-intervention. Posterior crossbites in the deciduous dentition showed self-correction of between 0% and 9%. Removal of functional interferences has been shown to be useful only in patients under the age of 5, with success rates ranging from 27% to 64%. In a study of 76 4-year-old children with posterior crossbite, Lindner reported 50% correction after functional Grinding. Early correction of posterior crossbites may help prevent signs and symptoms of temporomandibular disorder (TMD). Recent research has shown a correlation between posterior crossbite and the signs and symptoms of TMD, although other studies were unable to find a causal link. Therefore, crossbite may be a cofactor in the identification of patients with TMD, but its role should not be overstated.

Lippold et al reported a study in which they analyse the orthodontic treatment effects for patients with functional unilateral posterior crossbite in the late deciduous and early mixed dentition using a two-step procedure: initial maxillary expansion followed by a U-bow activator therapy. In the treatment group 31 patients and in the control group 35 patients with a mean age of 7.3 years (SD 2.1) were monitored. The time between the initial assessment (T1) and the follow-up (T2) was one year. The orthodontic analysis was done by a three-dimensional digital model analysis. Using the ‘Digimodel’ software, the orthodontic measurements in the maxilla and mandible and for the midline deviation, the overjet and overbite were recorded. Their scientific aims were to examine,
in detail, the treatment effects of orthodontic interventions in comparison to normal growth effects in the control group in patients presenting functional unilateral posterior crossbite, specifically regarding: the sagittal, vertical and transversal dimensions of the maxilla and mandible; the midline deviation between the anterior teeth of the maxilla and mandible and the sagittal overjet and vertical overbite. Transversal maxillary expansion was statistically very significant in the therapy group between T1 and T2 for the intercanine distance, the anterior, median and posterior transversal widths. For the control group, a very significant growth effect was detected for the intercanine distance and the anterior transversal width between T1 and T2. No significant differences were measured for the median and posterior transversal widths. The difference between orthodontic treatment effects in the therapy group and normal maxillary growth in the control group at T2 was very significant. Statistically, a very significant difference for the intercanine distance, the anterior, median and posterior transversal widths were observed between the therapy group and the control group. The transversal basal arch length in the anterior, middle and posterior regions indicated a statistically very significant increase between T1 and T2 in the therapy group. The control group showed a highly significant difference between T1 and T2 for the median palatal base arch length. The palatal depth of the first deciduous molars was highly significantly reduced in the therapy group. In contrast, the control group did not show significant changes between T1 and T2.

Lenguas et al examined the activity of jaw muscles at rest and during maximal voluntary clenching (MVC) in children with unilateral posterior crossbite (UPXB) and functional lateral shift in the early mixed dentition and to evaluate sex differences. At rest, no differences were found between sexes for any muscle areas or asymmetry and activity indexes. No differences were found between XB and NONXB sides. During MVC, however, significant sex differences were found in AT and MA activity, with higher sEMG values in males than in females, on both XB and NONXB sides. Asymmetry indexes, activity indexes and MA/AT ratios did not show significant differences between the sexes. Activity was symmetric both in males and in females.

Discussion

In orthodontics, there is a lack of evidence regarding the effects of early treatment of a functional unilateral posterior crossbite in the deciduous and/or early mixed dentitions. Harrison and Ashby focused on a need for randomised clinical trials for posterior crossbites in children. The review for the ‘Cochrane collaboration’ postulates a structured treatment protocol, informed consent and compliance with the Helsinki criteria. Randomised clinical trials in orthodontics should aim to differentiate the impact of orthodontic treatment from natural growth effects and possible self-healing tendencies. Petren and Bondermark were among the first authors to establish a randomised clinical trial for unilateral posterior crossbite correction with an untreated control group. The patients were allocated to four different groups: therapy group using quad-helix, therapy using removable expansion plate, therapy using composite onlay and a control group. However, these authors did not use bonded acrylic expansion plates according to McNamara as we used in our present study. The expansion effects were similar in the study of Petren and Bondermark to our study regarding the transversal maxillary expansion. Primozic et al. showed in a randomised clinical trial the effects of early orthodontic treatment on palatal volume increase. In their study, a control group with non-crossbite was used. All patients with crossbite were treated with a maxillary expansion device, comparable to the one used in our present study. The randomised clinical trial by Petren and Bondermark showed the successful use of a quad-helix appliance for expansion in the mixed dentition for patients with unilateral posterior crossbite. They used a randomisation of patients with unilateral crossbite into four groups: quad-helix, expansion plate, composite inlay and untreated control group. A comparable study by Thilander et al evaluated different treatment methods such as grinding and application of expansion plates for the treatment of a functional unilateral posterior crossbite in the deciduous dentition. As a control group, children of identical age with normal buccal occlusion were used, although no randomisation was performed between the groups. However, the positive effect of early interceptive treatment for dentoalveolar development was demonstrated by the results of this study. Geran et al. performed a prospective study in the mixed dentition using a bonded acrylic splint rapid maxillary expansion device to assess treatment effects in comparison to those in a control group without malocclusion. Other studies using a bonded palatal expansion device, as was used in our study, were based on a different initial diagnosis and a higher mean age of the patients. Lippold et al’s randomised clinical trial on functional unilateral posterior crossbite in the late deciduous and early mixed dentition showed the clinical efficacy of an early orthodontic treatment protocol in a one-year period. Castelo et al’s study talks about masticatory
muscle thickness in young children with unilateral posterior crossbite. Ultrasound scanning (US) is a reliable and safe method to investigate superficial muscles in vivo, as shown in previous child studies (Raadsheer et al., 1996; Rasheed et al., 1996; Kiliaridis et al., 2003). The anterior temporalis thickness at rest was statistically thicker for the crossbite side than the normal side in the MCB (mixed crossbite) group. Masseter muscle thickness showed a positive correlation with bite force, but the anterior temporalis thickness in the PCB (primary crossbite) and MCB groups was not related to bite force. Masticatory muscle thickness and bite force did not present a significant correlation with occlusal contacts, weight, or height. Lenguas et al. evaluated SEMG activity of jaw muscle areas at rest and during MVC (maximal voluntary clenching) in children with UPXB (unilateral posterior crossbite) and functional mandibular lateral shift in the early mixed dentition, as well as sex differences. SEMG analysis of the jaw muscles in children with UPXB and functional mandibular lateral shift in the early mixed dentition showed no sexual dimorphism at rest, but in MVC, significant sex differences were found in the activity of both XB (crossbite) and NONXB (noncrossbite) TA (anterior temporalis) and MA (masseter) muscle areas, with higher values in males than in females. Muscular activity was symmetrical at rest and during MVC in both sexes. Sexual dimorphism should be considered in diagnosing and treating children with UPXB and lateral shift in the early mixed dentition. Long-term studies with larger samples are needed to investigate the potential consequences of sex differences during MVC if the malocclusion remains untreated and to determine the implications for treatment.

**Conclusion(s)**

Orthodontic treatment of a functional unilateral posterior crossbite with a bonded maxillary expansion device followed by U-bow activator therapy in the late deciduous and early mixed dentition is an effective therapeutic method, as evidenced by the results of this RCT. Children with unilateral functional CB exhibit a greater facial asymmetry than children without this malocclusion in all the dentition phases investigated with the greatest differences seen for the lower part of the face. Literature’s analysis, about jaw muscles’s activity, shows that Masseter and anterior temporalis muscle thickness correlated with maximum bite force in the normal occlusion. During the early mixed dentition, a posterior crossbite presented differences in functional and anatomical variables of the stomatognathic system.

**References**

13. “Three-dimensional evaluation of facial asymmetry in association with unilateral functional crossbite in the primary, early, and late mixed dentition phases”; Jasmina Primozić; Giuseppe Perinetti; Stephen
Richmond; Maja Ovsenik; Angle Orthod. 2013; 83:253-258


15. “Activity of jaw muscles in unilateral cross-bite without mandibular shift”; Jose Antonio Alarcón, Conchita Martín, Juan Carlos Palma, Mario Menéndez-Núñez; Archives of Oral Biology Volume 54, Issue 2, Pages 108-114, February 2009


