Clinical
PRACTICE

Unilateral Posterior Crossbite with Mandibular Shift: A Review

David B. Kennedy, *BDS, LDS, MSD,FRCD(C),* ***Matthew Osepchook,*** *BSc, DDS*

Contact Author

Dr. Kennedy
E-mail: *drdavidkennedy@yahoo.ca*

ABSTRACT

Based on this literature review, early orthodontic treatment of unilateral posterior crossbites with mandibular shifts is recommended. Treatment success is high if it is started early. Evidence that crossbites are not self-correcting, have some association with temporomandibular disorders and cause skeletal, dental and muscle adaptation provides further rationale for early treatment. It can be difficult to treat unilateral crossbites in adults without a combination of orthodontics and surgery. The most appropriate timing of treatment occurs when the patient is in the late deciduous or early mixed dentition stage as expansion modalities are very successful in this age group and permanent incisors are given more space as a result of the expansion. Treatment of unilateral posterior crossbites generally involves symmetric expansion of the maxillary arch, removal of selective occlusal interferences and elimination of the mandibular functional shift. The general practitioner and pediatric dentist must be able to diagnose unilateral posterior crossbites successfully and provide treatment or referral to take advantage of the benefits of early treatment.

MeSH Key Words: malocclusion/diagnosis; malocclusion/therapy; orthodontic appliance design; palatal expansion techniques/instrumentation

This article has been peer reviewed.

Posterior crossbite is defined as any abnormal buccal–lingual relation between opposing molars, premolars or both in centric occlusion.[1] The reported incidence of posterior crossbites ranges from 7% to 23% of the population.[1–6] Higher incidence rates may result when an edge-to-edge transverse discrepancy is included in the definition of crossbite.[4] The most common form of posterior crossbite is a unilateral presentation with a functional shift of the mandible toward the crossbite side (FXB); it occurs in 80% to 97% of posterior crossbite cases.[5–7] The prevalence of FXB at the deciduous dentition stage is 8.4% and drops to 7.2% at the mixed dentition stage.[6] The frequency of spontaneous self-correction ranges from 0% to 9%.[5,6] Similarly, the spontaneous development of crossbite that was not present earlier is 7%.[5]

The etiology of posterior crossbite can include any combination of dental, skeletal and neuromuscular functional components. Allen and others[8] 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.[9–11] Those who have been intubated during infancy also have a significantly higher prevalence of posterior crossbites.[12]

Non-nutritive sucking habits are associated with development of posterior crossbite. In 2- to 6-year-old American children, finger-sucking habits were significantly associated with posterior crossbite.[3] A large study of Scandinavian 3-year-old children compared previous or continuing finger and pacifier habits with crossbite.[13] Using logistic regression, pacifier use was associated with increased mandibular intercanine width, decreased maxillary intercanine width and increased incidence of posterior crossbite. Another study of 2- to 5-year-olds reported a significantly higher prevalence of posterior crossbite when a pacifier had been used.[14] Both pacifiers and prolonged digit sucking, particularly if extended beyond age 4, are strongly associated with the development of posterior crossbites.[13–16] It is important to point out that associations between non-nutritive sucking habits, airway obstructions, neonatal intubation and posterior crossbites do not necessarily suggest a cause and effect relation.

Differential Diagnosis

Simple crossbites involving a single tooth occur when teeth are deflected out of line as a result of overretention of deciduous teeth, a deficient arch length or an aberrant eruption pattern.[6] 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. Because of this transverse maxillary deficiency, frequently more crowding is seen in the maxilla than in the mandible. The crossbite side in an FXB often shows a partial or full Class II molar relationship; the non-crossbite side shows a Class I relationship due to rotational closure of the mandible.[17] Pretreatment tomograms reveal an asymmetric condyle position; the non-crossbite side is down and forward in the fossa and the crossbite side is centred in the fossa.[17] Occasionally the mandible is too wide, accounting for a shift of the mandible to FXB, although this is not a common presentation.

Rationale for Early Treatment

Success Rates

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.[4–6,17,18] 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. In 7-year-old children, whose FXB involving first permanent and deciduous molars was treated and followed longitudinally, premolars erupted normally in all 12 treated patients.[6] The type of appliance, follow-up period and criteria used for definition of success also affect the reported success rate. Success rates for FXB treatment with expansion appliances in the early mixed dentition stage range from 84% to 100%.[2,4–6,18–22] Fixed appliances are typically favoured for expansion due to reduced cost and treatment time. Treatment and retention time using the quad helix was a fifth and cost was a third that of the removable expansion plate.[20,21] The increased treatment time and cost for removable expansion plates is a reflection of poor compliance and lost appliances.[20,21]

Self-Correction and Equilibration

The rate of self-correction of crossbites is too low to justify non-intervention.[6,7] Posterior crossbites in the deciduous dentition showed self-correction of between 0% and 9%.[5,6] 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%.[4,5,23] In a study of 76 4-year-old children with posterior crossbite, Lindner[23] reported 50% correction after functional grinding. The greatest chance of correction after selective grinding occurred when the maxillary intercanine width was at least 3.3 mm greater than the corresponding mandibular intercanine width.[23]

Adaptation

There is a growing body of evidence that untreated crossbites will lead to permanent growth alteration, making early treatment crucial. Evidence from tomographic studies has shown that the condyles in child crossbite patients are related asymmetrically within the fossa, but that symmetry is restored after early treatment.[17,24,25] It has been inferred that the glenoid fossa and condyle will undergo remodelling during growth to compensate for condylar asymmetry if left untreated, although no longitudinal research has provided conclusive evidence of glenoid fossa and condylar skeletal adaptation. However, symmetry of the mandible and its rotational position relative to the cranial base is altered in adult patients with untreated posterior crossbites.[26,27] In one study,[27] submentovertex radiographic imaging in 30 adults with unilateral posterior crossbite demonstrated that the mandible is rotated relative to the cranial base but symmetrical within the fossa compared with 30 normal adults. Correction of FXB with maxillary expansion in growing patients has been shown to establish condyle and dental symmetry[17,24] and to realign the mandibular rotation.[17,18] Despite conflicting evidence, one conclusion we can draw is that the muscle,[28] skeletal and joint adaptation in crossbites occurs early in development.[17,27] Once these adaptations are firmly established in adulthood, treatment may require a combined orthodontic and surgical approach. To achieve the potential benefits of correcting FXB, maxillary expansion must be performed early, before fusion of the palatal halves.[29]

Temporomandibular Disorders

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,[30,31] although other studies were unable to find a causal link.[32,33] Therefore, crossbite may be a cofactor in the identification of patients with TMD, but its role should not be overstated.

Treatment Timing

Maxillary expansion should be directed toward opening of the midpalatal suture, as this reduces the likelihood of dental relapse and reduces adverse side effects resulting from tooth tipping.[34] Sutural expansion is more stable than dental tipping[34]; therefore, all efforts should be directed toward maximal sutural opening and minimal dental tipping. During the deciduous and early mixed dentition stages (patients under 8 years of age) smaller forces can be used to achieve sutural expansion, as evidenced by a midline diastema during expansion or by radiographic images that show opening of the suture.[18,34] Another advantage of early treatment (deciduous or very early mixed dentition) is improvement of maxillary arch length deficiency secondary to maxillary constriction, because the permanent incisors are afforded more space before or during eruption than if the crossbite is treated at a later age. When expansion is carried out during the late deciduous dentition, the first permanent molars usually erupt into satisfactory transverse positions (i.e., without crossbite).[6,17,18]

Treatment during the late mixed dentition is difficult because of exfoliating deciduous teeth. Older patients in the early permanent dentition stage (12 years and up) require greater force for expansion and a faster rate of expansion because of growth-related changes in suture biology.[34] Treatment of FXB by maxillary expansion is, therefore, best carried out during the late deciduous or early mixed dentition stages.

Treatment

Treatment of FXB involves expansion of the maxillary arch, removal of occlusal interferences and elimination of the functional shift. Slow maxillary expansion can be used during the deciduous or early mixed dentition stages. With a W arch (**Fig. 1a**), quad helix (**Fig. 1b**), or a fixed expander, such as a Haas (**Fig. 1c**), hyrax (**Fig. 1d**) or superscrew (**Fig. 1e**), the rate of expansion is a quarter revolution of the screw every second or third day and the estimated time to correct the crossbite is 6–12 weeks. Overexpansion is appropriate, to the point where the lingual cusps of the upper molars contact the buccal cusps of the lower molars. The appliance should be left in place to serve as a retainer for an additional 4–6 months (and for a period at least equal to that required to correct the crossbite). When a screw is used as the active mechanism, it can be stabilized with a ligature wire or with composite to prevent relapse.

If a removable appliance (**Fig. 1f**) is used, the turning frequency decreases to every fifth to seventh day, as a faster rate tends to displace the appliance. This slower approach is also used for "fan expanders" to prevent the expanding

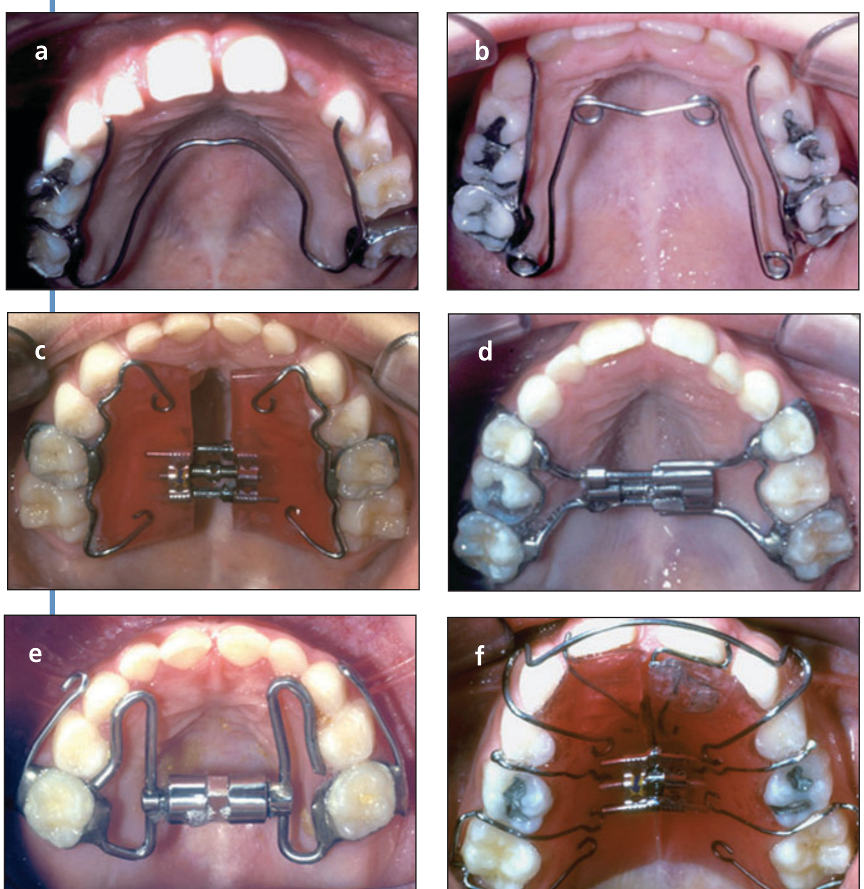

Figure 1: Appliances that can be used for maxillary expansion: **a.** W arch; **b.** Quad helix; **c.** Haas; **d.** Hyrax; **e.** Superscrew; **f.** Removable.

portion of the appliance from riding occlusally. It is imperative that the appliance is made with well-fitting clasps to prevent displacement. Removable appliances are not recommended, as poor compliance may result in relapse of the previous expansion and lower success rates.[4,5,19–21]

Rapid maxillary expansion can be used in the deciduous, early mixed or early permanent dentition stages using a Haas, hyrax or superscrew expander. The rate of expansion is 1–2 quarter revolutions of the screw per day, and the estimated time to treat the crossbite is 2–6 weeks. The patient should be warned that a midline maxillary diastema will be created initially. During the retention stages of care, the diastema will gradually close, often by dental tipping as transeptal fibres approximate the central incisors. Deliberate overexpansion is done to help counteract relapse. Retention is necessary for a minimum of 4–6 months. This can be done either by fabricating a removable retainer or by leaving the appliance in place. With patients in the early permanent dentition stage of development, rapid maxillary expansion is recommended as it will result in a greater degree of skeletal expansion and produce less dental tipping than other protocols.

Potential Side Effects of Treatment

In rapid maxillary expansion, some spontaneous increase occurs in the intercanine width of the mandibular permanent dentition.[35,36] This also occurs to a minimal degree with slow maxillary expansion in the early mixed dentition stage.[17] As the lingual cusps of the maxillary posterior teeth engage against the mandibular posterior teeth, an anterior open bite can develop, especially when second permanent molars are present. This bite opening may be desirable or undesirable. When a tendency for anterior open bite exists, great care must be taken to control molar eruption. Maxillary protraction can occur secondary to the mandibular autorotation caused by the bite opening. Furthermore the mere act of sutural expansion can cause forward movement of the maxilla.[37] This can be useful in Class III cases, especially when maxillary protraction is used in conjunction with maxillary expansion.

In the short term, one can expect a 4-mm increase in arch perimeter secondary to correction of FXB in the deciduous or early mixed dentition stage of development.[38] Long-term follow-up shows that about 85% of this perimeter increase is retained.[39] However, Gianelly[40] warns that although the increase in maxillary arch perimeter is stable, it is not always a good strategy for all cases of arch length deficiency as mandibular expansion is not stable.

THE AUTHORS

Dr. Kennedy practices orthodontics in Vancouver and Richmond, B.C.

Dr. Osepchook is a general dentist in Burnaby and Langley, B.C., and a clinical instructor at the University of British Columbia, Vancouver, B.C.

***Correspondence to:** Dr. David Kennedy, 200-650 W 41st Ave., Vancouver, BC V5Z 2M9. E-mail: drdavidkennedy@yahoo.ca.*

The authors have no declared financial interests.

References

1. Moyers R. Handbook of orthodontics. 2nd ed. Chicago: Year Book Medical Publishers, Inc; 1966. p. 332–41.

2. Thilander B, Lennartsson B. A study of children with unilateral posterior crossbite, treated and untreated, in the deciduous dentition — occlusal and skeletal characteristics of significance in predicting the long-term outcome. *J Orofacial Orthop* 2002; 63(5):371–83.

3. Infante PF. An epidemiologic study of finger habits in preschool children as related to malocclusion, socioeconomic status, race, sex and size of community. *ASDC J Dent Child* 1976; 43(1):33–8.

4. Kurol J, Bergland L. Longitudinal study and cost–benefit analysis of the effect of early treatment of posterior crossbites in the primary dentition. *Eur J Orthod* 1992; 14(3):173–9.

5. Thilander B, Wahlund S, Lennartsson B. The effect of early interceptive treatment in children with posterior crossbite. *Eur J Orthod* 1984; 6(1):25–34.

6. Kutin G, Hawes RR. Posterior cross-bites in the deciduous and mixed dentitions. *Am J Orthod* 1969; 56(5):491–504.

7. Schroder U, Schroder I. Early treatment of unilateral posterior crossbite in children with bilaterally contracted maxillae. *Eur J Orthod* 1984; 6(1):65–9.

8. Allen D, Rebellato J, Sheats R, Ceron AM. Skeletal and dental contributions to posterior crossbites. *Angle Orthod* 2003; 73(5):515–24.

9. Oulis CJ, Vadiakas GP, Ekonomides J, Dratsa J. The effect of hypertrophic adenoids and tonsils on the development of posterior crossbite and oral habits. *J Clin Pediatr Dent* 1994; 18(3):197–201.

10. Kerr WJ, McWilliams JS, Linder-Aronson S. Mandibular form and position related to changed mode of breathing — a five-year longitudinal study. *Angle Orthod* 1989; 59(2):91–6.

11. Bresolin D, Shapiro PA, Shapiro GG, Chapko MK, Dassel S. Mouth breathing in allergic children: its relationship to dentofacial development. *Amer J Orthod* 1983; 83(4):334–40.

12. Kopra DE, Davis EL. Prevalence of oral defects among neonatally intubated 3- to 5- and 7- to 10-year old children. *Pediatr Dent* 1991; 13(6):349–55.

13. Ogaard B, Larsson E, Lindsten R. The effect of sucking habits, cohort, sex, intercanine widths, and breast or bottle feeding on posterior crossbite in Norwegian and Swedish 3-year-old children. *Am J Orthod Dentofacial Orthop* 1994; 106(2):161–6.

14. Adair SM, Milano M, Lorenzo I, Russell C. Effects of current and former pacifier use on the dentition of 24- to 59-month old children. *Pediatr Dent* 1995; 17(7):437–44.

15. Lindner A, Modeer T. Relation between sucking habit and dental characteristics in preschool children with unilateral crossbite. *Scand J Dent Res* 1989; 97(3):278–83.

16. Warren JJ, Bishara SE. Duration of nutritive and nonnutritive sucking behaviors and their effects on the dental arches in the primary dentition. *Am J Orthod Dentofacial Orthop* 2002; 121(4):347–56.

17. Hesse KL, Artun J, Jondeph DR, Kennedy DB. Changes in condylar position and occlusion associated with maxillary expansion for correction of functional unilateral posterior crossbite. *Am J Orthod Dentofacial Orthop* 1997; 111(4):410–8.

18. Bell RA, LeCompte EJ. The effects of maxillary expansion using a quad-helix during the deciduous and mixed dentitions. *Amer J Orthod* 1981; 79(2):152–61.

19. Bjerklin K. Follow-up controls of patients with unilateral posterior cross-bites treated with expansion plates or the quad-helix appliances. *Am J Orofac Orthop* 2000; 61(2):112–24.

20. Ranta R. Treatment of unilateral posterior crossbite: comparison of the quad-helix and removable plate. *ASDC J Dent Child* 1988; 55(2):102–4.

21. Hermanson H, Kurol J, Ronnerman A. Treatment of unilateral posterior cross-bite with quad-helix and removable plate. *Europ J Orthod* 1985; 7(2):97–102.

22. Erdinc A, Ugur T, Erbay E. A comparison of different treatment techniques for posterior crossbite in the mixed dentition. *Am J Orthod Dentofacial Orthop* 1999; 116(3):287–300.

23. Lindner A. Longitudinal study of the effect of early interceptive treatment in 4-year old children with unilateral cross-bite. *Scand J Dent Res* 1989; 97(5):432–8.

24. Myers DR, Barenie JT, Bell RA, Williamson EH. Condylar position in children with functional posterior crossbite: before and after crossbite correction. *Pediatr Dent* 1980; 2(3):190–4.

25. Pinto AS, Buschang PH, Throckmorton GS, Chen P. Morphological and positional asymmetries of young children with functional unilateral posterior cross-bite. *Am J Orthod Dentofacial Orthop* 2001; 120(5):513–20.

26. Pirttiniemi P, Raustia A, Kantomaa T, Pyhtinen J. Relationships of bicondylar position to occlusal symmetry. *Eur J Orthod* 1991; 13(6):441–5.

27. O'Byrn BL, Sadowsky C, Schneider B, BeGole EA. An evaluation of mandibular asymmetry in adults with unilateral posterior crossbite. *Am J Orthod Dentofacial Orthop* 1995; 107(4):394–400.

28. Throckmorton GS, Buschang PH, Hayasaki H, Pinto AS. Changes in the masticatory cycle following treatment of posterior unilateral crossbite in children. *Am J Orthod Dentofacial Orthop* 2001; 120(5):521–9.

29. Melsen B. Palatal growth studied on human autopsy material. A histologic microradiographic study. *Am J Orthod* 1975; 68(1):42–54.

30. Alamoudi N. The correlation between occlusal characteristics and temporomandibular dysfunction in Saudi Arabian children. *J Clin Pediatr Dent* 2000; 24(3):229–36.

31. Egermark-Ericksson I, Carlsson GE, Magnusson T, Thilander B. A longitudinal study on malocclusion in relation to signs and symptoms of cranio-mandibular disorders in children and adolescents. *Eur J Orthod* 1990; 12(4):399–407.

32. Sari S, Sonmez H, Oray GO, Camdeviren H. Temporomandibular joint dysfunction and occlusion in the mixed and permanent dentition. *J Clin Pediatr Dent* 1999; 24(1):59–62.

33. Keeling SD, McGorray S, Wheeler TT, King GJ. Risk factors associated with temporomandibular joint sounds in children 6 to 12 years of age. *Am J Orthod Dentofacial Orthop* 1994; 105(3):279–87.

34. Bell RA. A review of maxillary expansion in relation to rate of expansion and patient's age. *Am J Orthod* 1982; 81(1):32–7.

35. Haas AJ. Palatal expansion: just the beginning of dentofacial orthopedics. *Amer J Orthod* 1970; 57(3):219–55.

36. Haas AJ. Long-term posttreatment evaluation of rapid palatal expansion. *Angle Orthod* 1980; 50(3):189–94.

37. Sarver DM, Johnston MW. Skeletal change in vertical and anterior displacement of the maxilla with bonded rapid palatal expansion appliances. *Amer J Orthod Dentofacial Orthop* 1989; 95(6):462–6.

38. Berlocher WC, Mueller BH, Tinanoff N. The effect of maxillary palatal expansion on the primary dental arch circumference. *Pediatr Dent* 1980; 2(1):27–30.

39. McNamara JA, Baccetti T, Fianchi L, Herberger TA. Rapid palatal expansion followed by fixed appliances: a long-term evaluation of changes in arch dimension. *Angle Orthod* 2003; 73(4):344–53.

40. Gianelly AA. Rapid palatal expansion in the absence of crossbites: added value? *Am J Orthod Dentofacial Orthop* 2003; 124(4):362–5.