EQUINE ORTHODONTIC TECHNIQUES FOR MANAGEMENT OF INCISOR MALOCCLUSIONS
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Key Points
- Functional orthodontic techniques have been used to correct dentofacial deformities such as parrot mouth in the young horse.
- An understanding of the orthodontic principles of tooth movement and the effects of forces on bone growth will insure the best surgical outcome.
- The combined approach with retention wires of the upper jaw combined with a fixed acrylic and aluminum incline plane has advantages over other techniques to correct parrot mouth.

The principles of orthodontic tooth movement and manipulation of jaw growth and development can be utilized in equine dental practice. A technique to improve or even correct the serious malocclusion of parrot mouth (overjet and possibly overbite) in foals utilizing maxillary retention wires combined with a fixed acrylic and aluminum incline plane, has been used with good results for over twelve years by the author. A description of the corrective procedure and short- and long-term case follow-ups is presented.

Orthodontics is the field of dentistry that deals with the prevention and treatment of dental malocclusions. The objective of equine orthodontics is to correct or prevent dental or dentofacial malocclusions or malalignments through surgery, dental crown equilibration and/or the use of functional dental appliances.

The term “parrot mouth” has been used to describe a horse with rostral malocclusion of the upper incisor teeth in relation to the lower incisor teeth. The condition is seen in horses with a very long maxilla or a very short mandible. The degree of incisor overjet (measured as the distance the upper incisor teeth protrude labial or rostral to the lower incisors) is quite variable in horses with this condition. Foals born with incisor overjet may range from having minimal upper and lower incisor occlusal contact with a slight labial malalignment to having no incisor occlusion with up to 4 cm of distance between the labial surface of the upper and lower incisor arcades (Figure 1).

The premolar arcades in foals with incisor overjet are usually malaligned but often to a lesser degree than are the incisors. The occlusal surfaces of the upper and lower incisors of a young horse with parrot mouth are initially level, but as the foal grows, the incisive bones or premaxillae, drift ventrally causing an overbite. The degree of incisor overbite is measured as the distance the occlusal surface of the upper incisors overhangs or drops ventral to that of and the lower incisors when the mouth is completely closed with the cheek teeth in full occlusal contact (Figure 2).

Parrot mouth has been described as a Class II (overjet) deep bite (overbite) malocclusion, because the mandibular teeth occlude distally (caudally) in relation to the maxillary teeth and the upper incisors are dropped ventral to the occlusal surface of the mandibular incisors.

Figure 1: 6-month-old colt with an overjet and overbite
radiographic cephalometric or skeletal age determinant studies have been done in the equine. Therefore, much of what we know about normal equine occlusion has been hypothesized or extrapolated from other species.4

In a parrot mouth horse, as the upper and lower incisors continue to erupt unopposed, the exposed crowns of the incisors are not worn by normal attrition, causing the lower incisors to become trapped behind the upper incisors. The lower incisors often contact the hard palate and at this point, a distinct bend or downward curvature of the roof of the mouth often develops. Entrapment of the lower incisors behind the upper incisors places caudal pressure on the lower jaw, further retarding rostral mandibular growth and development. The cheek teeth malocclusion leads to the formation of rostral focal overgrowths (hooks) on the upper 2nd premolars (506, 606) and at times, lower sloping (ramps) or focal overgrowths (hooks) on the last lower premolar (708 and 808). The contact ridges (transverse ridges) that form on the cheek teeth arcades along with these overgrowths can worsen the malocclusion by limiting rostral mandibular growth.

Parrot mouth is considered to be an inherited disorder and has shown some familial tendencies in Thoroughbred horses.2 In humans most orthodontic problems unless traumatic are a combination of polygenic and environmental factors.5 A current and ongoing study looking at a gene marker or markers for this condition is being conducted at the Gluck Equine Research Center, University of Kentucky by Dr. Ernest Bailey and Associates. Ethical considerations rise when treating this disorder, and mild esthetic cases should probably be left untreated. Cases with severe malocclusion can be quite functionally debilitating, impairing the ability to apprehend forage and predispose to chronic dental problems, malnutrition and growth retardation.1

Several techniques to correct this condition have been described in the literature. A case report of a fixed acrylic bite plane being used to partially correct a 2 cm overjet in a 5-month-old foal has been reported.6 A technique developed to help correct mild (less than 1 cm) incisor overjet in young horses involves placing a tension band wire on the upper jaw to retard rostral maxillary and premaxillary growth.7 This technique is contraindicated in foals with more than 1 cm of overjet or that have developed an overbite trapping the lower jaw. In these cases, a fixed acrylic platform with a metal incline plane is also used to place dorsal pressure on the upper incisors, thus preventing or correcting the overbite. Contact of the lower incisors with the incline plane during mastication tends to pull the lower jaw rostrally, promoting its rostral growth. Additionally, the thickness of the acrylic platform and incline plane contacting the lower incisors separates the premolars which decreases the rostro-caudal lock on the cheek teeth. This allows the lower jaw to move forward independently of the upper jaw.1, 8-11 In older animals where benefit of natural growth cannot be obtained, other surgical corrective options such as mandibular osteodistraction should be considered.12,13 However, osteodistraction required long-term hospitalization, specialized surgical instrumentation and expertise, and is more expensive than other techniques. This paper will describe the orthodontic wiring and application of an
incline plane to manage foals with the more severe parrot mouth condition and report on the author’s 12 years of experience with the technique used on over 50 foals.

**Surgical Technique**

Foals with parrot mouth should be carefully examined for other congenital or developmental abnormalities. The owner/trainer should be advised about breed registry requirements, the possible genetic origin of the parrot mouth condition, the likely success of surgery, the risks and benefits as well as costs of functional orthodontic treatment. Using parrot mouth horses for breeding should be discouraged.

The earlier treatment is initiated, the greater the correction can be expected. Young foals in the rapid stages of growth respond faster and more completely to treatment, but to avoid interference with the eruption of the intermediate incisors (02s), treatment should be postponed until these teeth are in wear (6-12 weeks). Foals that are candidates for orthodontic correction should have a full set of skull radiographs and occlusive measurements taken prior to proceeding with correction. Foals need not be weaned prior to surgery but should be on a diet consisting of pelleted feed and good pasture or chopped hay.

An IV catheter is placed and the foal premedicated with broad-spectrum antibiotics and a nonsteroidal anti-inflammatory drug. The mouth is thoroughly rinsed with a dilute (less than 0.1%) chlorhexidine solution. The foal is sedated with xylazine HCl, 1.1 mg/kg, IV and general anesthesia is induced with ketamine HCl 2.2 mg/kg, IV. Anesthesia is maintained with a solution consisting of xylazine HCl (500 mg), ketamine HCl (1000 mg) and guaifenesin (1 liter, 5% solution) (i.e., triple drip), given slowly, intravenously, to effect.

The foal is positioned in lateral recumbency. During the procedure, oxygen is delivered at 10 liters/minute through a one-centimeter diameter nasal tube. The exposed crowns of the incisor teeth are reduced and leveled to allow a flat surface for aluminum plate contact. A small area just ventral to the rostral aspect of the facial crest is clipped and surgically prepped. With one hand in the mouth, the interdental space between PM3 and PM4 on the upper dental arcade is identified and an imaginary line visualized to the lateral side of the face. This will correspond to the path of the pin tract. A small stab skin incision is made just below and parallel to the facial crest between PM3 and PM4 taking care to avoid branches of the dorsal buccal nerve. A 3.2 mm diameter Steinmann pin is introduced through the skin incision and directed between the reserve crowns of PM3 and PM4 in a slightly dorsal to ventral direction just above the buccal gum line, exiting in the mouth 2-3 mm above the palatal gingiva. Care should be taken to avoid the palatine artery, which lies about 3 mms medial to the palatine surface of the teeth. Intra-operative radiographic and fluoroscopic examinations are helpful and necessary at times to properly position the pin between the teeth without damaging the cheek teeth roots. The pin is removed and without moving the soft tissues a 14 gauge, 3.8 cm long, hypodermic needle is placed in the created hole to act as a wire guide. A section of 18 gauge (1.0 mm), malleable stainless steel orthopedic (cerclage) wire is cut to a length at least three times the distance from PM4 to the central incisor teeth. One end of the wire is placed through the hub of the needle to enter the oral cavity at the gingival margin. The needle is removed over the free end of the wire. The free end of the wire is then doubled back and passed through the skin incision closely following the exit path of the wire down to the bone and then pushed through the buccal mucosa into the buccal space on the lateral aspect of the cheek teeth. Care should be taken to avoid catching soft tissue of the cheek or damaging a branch of the facial nerve during the process. The ends of the wire are grasped with a forceps and pulled rostrally out of the mouth to form a
loop around the distal aspect of the reserve crown of PM3. Kinking the wire should be avoided because this may predispose the wires to early breakage from fatigue. The small skin incision is left open to heal by second intention. The foal is repositioned in lateral recumbency on the opposite side and the procedure for wire placement is repeated on the opposite arcade.

With both wire loops protruding from the oral cavity, the foal is positioned in dorsal recumbency and a pad placed caudal to the poll to hyperextend the neck, leaving the roof of the mouth parallel to the ground. The wire loop on each side is pulled tight and twisted several times on itself in the interdental space. The loop should be twisted by directing the buccal portion of the loop ventrally and the palatal portion of the loop dorsally. While twisting, the loop should be positioned close to the hard palate to avoid any of the wire contacting the occlusal surface of the first cheek teeth. The twisted loops from each side are pulled forward and brought around the labial edge of the incisor arcade and twisted together. The wires should lie across the labial surface of the incisors at the gum level. The ends of the wires are cut and bent ventrally so the twist lies tucked in the groove between the two incisors. A 3.2 mm thick plate of perforated aluminum is sized to fit over the occlusal surface of the upper incisors and extend caudally over the hard palate. Paraffin rope strips are placed at gum level around the labial side of the upper incisors, pulled under the wires on each side, and extended several centimeters caudally on the roof of the mouth to form a dental “dam” for supporting the acrylic while it hardens. Hard-setting dental acrylic (Lange’s Dental Acrylic) is mixed until it is tacky and placed within the boundary of the paraffin rope. The thin aluminum plate is rested on the occlusal surface of the upper incisors rostrally and the soft mass of acrylic caudally.

With first appliance applications, the plate should lay flat in foals with a severe overbite. This will cause less occlusal gap and allow some premolar occlusion on the tips of the transverse ridges. Once the overbite is corrected at the second and subsequent applications the plate can be elevated caudally off the palate with acrylic to act as a more aggressive incline plane. After the acrylic begins to set, the paraffin rope is removed and the acrylic is molded by hand in the roof of the mouth. The acrylic is extended laterally and rostrally to incorporate the wires and labial surface of the upper incisor arcade. The acrylic is formed with the curved rostral edge of the metal plate resting on the occlusal surface of the upper incisors and the caudal edge of the plate level with or slightly more dorsal than the rostral aspect. This creates a flat or inclined surface for the lower incisors to contact, freeing the mandible from caudal force and creating a slight rostral pull as the incisor teeth slide over the plate during mastication. As the foal chews, dorsal pressure is also applied to the upper incisors and premaxillae, eventually lifting them into a more normal position. The acrylic should cover the twisted ends of the wire, the wire loops and the gingivae to prevent the wire from irritating the soft tissue. Splinting the upper incisor arcade with acrylic is important to stabilize the teeth so the force of the orthodontic wires is prevented from spreading or twisting the incisors. The band of acrylic around the upper

**Figure 3:** Follow up lateral skull radiograph of a 9-month-old foal with orthodontic wires and acrylic appliance with an aluminum incline plane
incisor teeth, the orthodontic wires and the perforations in the plate, holds the acrylic incline plate firmly in the roof of the mouth stabilizing the appliance (Figure 3).

After the acrylic sets, the foal is allowed to recover from anesthesia and is placed back with the dam. Most foals quickly learn to nurse with the appliance in place. Foals that do not nurse well are supplemented with a complete foal ration.

Postoperative care consists of keeping the skin wounds clean until they are healed. While adjusting to the orthodontic appliance, most foals are kept on oral omeprazole for 4-5 days to help prevent gastric ulcers. Postoperatively, foals usually eat and nurse well after 1-2 days of adjustment. The plate and wires are checked daily by the stable help to detect loose or broken wires or loose acrylic. The patient also needs to be examined by a veterinarian on a monthly basis to ensure that the appliance is secure and not causing any soft tissue problems intraorally.

The bite plate wears thin over time from lower incisor contact and typically after 3-6 months, the appliance or wires break and must be removed. If correction is not complete at that time, the surgical procedure is repeated until the desirable results are achieved. The overbite of most foals corrects approximately 5 mm every 3-6 months. The most rapid correction is noticed between 2-8 months of age after which improvement continues slowly until the horse is approximately 19 months old.

Results

Fifty-four foals with incisor overjet greater than 0.7 cm were examined and treated by the author between January 2000 and December 2011. Medical records were reviewed and follow-up telephone questionnaires carried out in 2012.

The group consisted of 36 Thoroughbreds, 9 American Quarter Horses, 3 American Saddlebreds, 2 Warmbloods out of Thoroughbred mares, 1 Arabian and 1 Morgan, 2 American Paint Horses. The sexes were nearly unequally distributed (23 fillies and 38 colts). At the time of initial surgery, the foals ranged in age from 8 weeks to 9 months of age with a mean of 4.9 months of age. The incisor overjet at the time of initial surgery, ranged from 4 mm to 3 cm. The incisor overbite ranged from 0 to 2.5 cm. The foals underwent 1-4 surgeries over a 4-14 month period. The foals had a mean of 2.5 surgeries over an average period of 9.4 months.

Orthodontic appliances were removed or replaced when they showed signs of wear (e.g., broken wires, worn aluminum plates, or loose or broken acrylic). One or a combination of these problems occurred between 2 weeks and 6 months after application of the orthodontic device. Most foals developed some degree of transient gingivitis beneath the acrylic appliance, most notably on the labial aspect above the upper incisors. Dark staining of the deciduous upper incisor crown cementum was common. The wires grooved the exposed dental crowns of the upper incisors of most foals. During the course of treatment, a small valve diastema was observed between upper deciduous PM3 and PM4 on all foals.

Complications at the time of surgery were minimal. One foal experienced transient hemorrhage following puncture of the palatine artery. This was managed with towel pressure over the vessel for 10 minutes before successfully completing the procedure. Recurrent bleeding occurred in one foal (both sides) that required the wires to be placed forward between the 06 and 07 teeth. No anesthetic-associated problems were encountered. Transient postoperative facial swelling, which slowly resolved in 5-6 days, was noted around the skin incisions in 6 foals. Transient, unilateral facial nerve paralysis (neuropraxia) was observed in 1 foal but this spontaneously resolved in 2-3 weeks. Young nursing foals were supported nutritionally for 12-24 hours post surgery until they were able to manage nursing with the orthodontic appliance in
place. The orthodontic device appeared to irritate the udder and cause discomfort for several mares (especially primiparous mares with small teats) noted to resent the foal nursing. These mares were milked for several days and the foals bottle-fed with this milk before being gradually reintroduced to suckling the mare. Feed typically packs around the wires and buccal pouches of most foals but this was easily managed by daily oral lavage administered by caretakers.

The preliminary results on a follow-up study in 54 horses over the course of treatment and 1-5 years post treatment showed that all cases improved. Correction of overjet ranged from 0.7 to 2.4 cm in overjet (corrected). Average improvement with the first appliance and wire application was 4 mm in overbite and 5 mm in overjet. Average additional improvement with the second application of appliance and wires was an additional 6 mm in overjet and complete correction of overbite. Four horses experienced crowding of permanent incisors or retention of deciduous incisor teeth. Two horses at 2-3 years of age had retained deciduous central upper incisors with the permanents erupting rostral to the deciduous teeth. One yearling lost a 103 (central deciduous incisor) when the acrylic loosened and a permanent replacement tooth did not erupt in this horse. Cheek tooth malocclusions were not accurately measured and documented. Abnormal wear patterns (06 upper hooks, caudal lower last cheek teeth hooks, and exaggerated transverse ridges) recurred and had to be repeatedly corrected during the time the appliance and wires were in place and also during the period between removal of the acrylic appliance and long term follow-up.

Discussion

Several different approaches have been taken in the management and/or correction of parrot mouth in the horse. The condition is not life threatening and many horses with proper dental care and feeding management, have had productive performance careers despite this malocclusion. Functional orthodontic correction during the first 6 to 18 months of life when the equine skull is in a rapid phase of growth and development, does improve the horse’s occlusion. Most owners of horses that have received orthodontic correction have reported improvement in quality of life for the horse after treatment.

Monkey studies have shown that the TMJ is capable of functional adaptation when the mandible is displaced in a forward direction. Rat experiments have shown anterior displacement of the mandible and bone remodeling following functional orthodontic device application will increase the total mandibular length and modifications in the glenoid fossa. Cranial sutures in the maxilla have been shown to respond to both compression and distraction forces to retard or accelerate bone expansion. This effect is seen in the midpalatal suture as well as other sutures of the facial bones in histological rat studies as well as biopsies in children. No long-term radiographic or cephalometric studies have been done in the horse after orthodontic treatment, but clinically the bones of the jaws of the horse respond to orthopedic and orthodontic forces in a similar fashion.

Other orthodontic techniques including the use of retention wires on the upper jaw with no incline plane have been successfully used in foals with incisor overjet without an overbite. Surgical distraction osteogenesis has been used to correct maxillary deviation in the foal and has been used by this author and others to correct parrot mouth in yearlings. It appears that the combined approach with retention wires on the upper jaw combined with a fixed acrylic and aluminum incline plane has advantages over other techniques. With proper surgical technique and attention to detail, correction of the malocclusion is more rapid with minimal complications when using this combined functional orthodontic approach.