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A NEW TREATMENT CONCEPT FOR VELOPHARYNGEAL INCOMPETENCE: GRADUAL DISTRACTION OF THE HARD PALATE

FR Carls,[1] MD, DDS; IT Jackson,[2] MD; Jeffrey Topf,[2] MD; P Schüpbach,[1] PhD; HF Sailer,[1] MD, DDS

[1] *University Hospital Zurich, Department of Maxillofacial Surgery, Switzerland*
[2] *Institute for Craniofacial and Reconstructive Surgery, Southfield, MI, USA*

Abstract

Distraction osteogenesis of the thin bone of the hard palate is possible, as shown in this experimental work. This might be used as a new treatment concept for velopharyngeal incompetence.

Introduction

The incidence of velopharyngeal incompetence (VPI) after primary palatoplasty in patients with cleft lip and palate (CLP) is reported to vary betwen 4.5% and 39%; in general it is as high as 20% to 30%.[1-4] Many procedures have been described to correct VPI. These procedures are designed to alter the relations of the palate and pharynx so that intact musculature can achieve closure. No single operation has proved to be a panacea.[1,5,6]

Although good results have been reported with some of the techniques, the results of pharyngoplasties in general are not entirely satisfactory and various complications of varying severity have been described, e.g., death, nasal airway obstruction and sleep apnoea.[7-10]

The object of the present investigation was to explore a new technique to treat VPI: If the hard and soft palate could be moved towards the posterior pharyngeal wall by distraction osteogenesis,[11-14] this might offer a solution to VPI. The hard palate would be osteotomized and then fixed to the teeth and the osteotomized and non-osteotomized palatal bone. Subsequent distraction of the distal hard palate would then gradually move the soft and hard palate posteriorly until the surgeon and the speech therapist would consider the lengthening to be sufficient. The method devised of gradually distracting the hard palate[15] is described.

Material and Methods

In this investigation six adult female niix-bred dogs weighing 35 to 40 kg were used. Preoperatively they underwent an axial computed tomography (CT) of the hard and soft palate using high resolution CT. It was noted that the horizontal portion of the hard palate in all dogs was approximately 1.5 mm thick.

The impressions of the upper and lower jaws were taken and plaster casts were made. Following this, an individual distraction device was made for each dog using a custom-made orthodontic expansion screw, oriented in a longitudinal direction. The plaster casts were also analysed to register any possible changes of the occlusion due to tooth movement during the experiment by comparing preoperative and postoperative measurements of widths and lengths.

The surgical procedure was undertaken under general anaesthesia and consisted of the elevation of a distally-based palatal flap, maintaining the palatal arteries. The anterior osteotomy crosses the hard palate in the middle and ends about 3 mm medial to the premolars. It then runs perpendicularly to this transverse osteotomy in a sagittal direction to the posterior end of the hard palate. Tantalum bonemarkers were placed on either side of the transverse osteotomy. This enabled the achieved lengthening to be assessed using cephalometric X-rays. The distraction device was inserted and the fixation was achieved using eight titanium miniscrews (4 screws to fix the anterior portion of the device

and 4 screws to fix the osteotomized posterior palatal segment). After latency periods of 12 to 18 days postoperatively the device was distracted daily at a rate of 0.25 mm or 0.5 mm per day.

Before distraction and after the distraction was completed, CT scans and cephalometrics were carried out. The distraction which could be achieved with the custom-made expansion screws was between 7 and 9 mm.

The device was left in place for between five and eight weeks after expansion was completed to allow for bony consolidation of the distracted area. Fluorochrome markers were given at fixed intervals to follow the patterns of bone growth. The animals were sacrificed after six to eight months postoperatively and histological specimens of the entire hard and soft palate were prepared for light and fluoroscopic microscopy without prior demineralization.

Results

The CT scans and cephalometrics revealed a distraction of the osteotomized posterior bone segment of 6 to 8 mm. Changes in the pigmentation of the palatal mucosa indicated an elongation. No signs of inflammation or ischaemia of the palatal mucosa were observed.

CT scans, at one month after completion of the distraction, showed first signs of calcification of the experimental gap from the anterior and posterior bone ends. After 4.5 months calcification was almost complete. Histological investigations showed new bone formation in all dogs in continuity with the original bone margins of the palatal bone. The new bone bridged the experimental gap completely. The soft tissues showed no signs of alteration, in particular no haemorrhage, necrosis or scar formation.

Conclusion

This experiment showed that distraction osteogenesis of the hard palate in dogs is possible. Therefore, posterior positioning of the palate with gradual distraction of the hard palate may be considered as a treatment for VPI in selected patients.

References

1. Morris HL. Velopharyngeal competence and primary cleft palate surgery, 1960-1971: a critical review. Cleft Palate J 1973; 10:62.
2. Hogan VM. A clarification of the surgical goals in cleft palate speech and the introduction of the lateral port control (LPC) pharyngeal flap. Cleft Palate J 1973; 10:331.
3. Van Demark DR, Gnoinski W, Hotz MM, Perko M, Nussbaumer H. Speech results of the Zurich approach in the treatment of unilateral cleft lip and palate. Plast Reconstr Surg 1989; 83:605.
4. Cohen SR, Corrigan M, Wilmot J, Trotman CA. Cumulative operative procedures in patients aged 14 years and older with unilateral or bilateral cleft lip and palate. Plast Reconstr Surg 1995; 96:267.
5. Orticochea M. Construction of a dynamic muscle sphincter in cleft palates. Plast Reconstr Surg 1968; 41:323.
6. Jackson IT, Silverton JS. The sphincter pharyngoplasty as a secondary procedure in cleft palates. Plast Reconstr Surg 1977; 59:518.
7. Musgrave RH, Bremner JC. Complications of cleft palate surgery. Plast Reconstr Surg 1960; 26:180.
8. Nylen B, Wahlin A. Postoperative complications in pharyngeal flap surgery. Cleft Palate J 1966; 3:347.
9. Graham WP, Hamilton R, Randall P, Winchester R, Stool S. Complications following posterior pharyngeal flap surgery. Cleft Palate J 1973; 10:176.
10. Kravath RE, Pollak CP, Borowiecki B, Weitzmann ED. Obstructive sleep apnea and death associated with surgical correction of velopharyngeal incompetence. J Pediatr 1980; 96:645.
11. Ilizarov GA. Basic principles of transosseous compression and distraction osteosynthesis. Ortop Traumatol Protez 1975; 10:7.
12. McCarthy by gradua
13. Rachmiel Surg 199
14. Molina F. major oste
15. Carls FR, J Surg 199

12. McCarthy JG, Schreiber J, Karp N, Thorne CHM, Grayson BH. Lengthening the human mandible by gradual distraction. Plast Reconstr Surg 1992; 89:1.
13. Rachmiel A, Potparic Z, Jackson IT, et al. Midface advancement by gradual distraction. Br J Plast Surg 1993; 46:20.
14. Molina F, Monasterio FO. Mandibular elongation and remodeling by distraction: a farewell to major osteotomies. Plast Reconstr Surg 1995; 96:825.
15. Carls FR, Jackson IT, Topf JS. Palatal lengthening by gradual distraction in dogs. Plast Reconstr Surg 1997 (In press).