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Piezosurgery: A new and safe technique for distraction osteogenesis in Pierre Robin sequence review of the literature and case report



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ABSTRACT

INTRODUCTION: Pierre Robin sequence (PRS) is characterized by microgenia and retrognathia. Cleft palate and glossoptosis are frequently associated with airway obstruction and difficulty in swallowing. Distraction osteogenesis with micro-distractors has recently been considered as a surgical option during the neonatal age.

CASE PRESENTATION: A 6-week-old female with PRS underwent mandibular lengthening in neonatal age. Mandibular osteotomies were performed with the piezoelectric scalpel.

DISCUSSION: Piezosurgery represents an innovative technique as it offers the maxillofacial surgeon the opportunity to make precise bone cuts without damaging the soft tissue, minimizing the invasiveness of the surgical procedure, and the opportunity of working in a field which is almost totally blood free.

CONCLUSION: The use of a piezoelectric device to perform this kind of surgery provides clinical and surgical results which would be difficult with traditional instruments, not only for the patient's benefit but also for the surgeon's. Preservation of the original bony structure, especially of the cancellous bone, will benefit the bone healing process due to its high estrogenic potential.

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1. Introduction

Pierre Robin sequence (PRS) is characterized by microgenia with retrognathia cleft palate glossoptosis and frequently is associated with airway obstruction and difficulty in swallowing. The respiratory obstruction may be severe and require immediate treatment at birth. Numerous surgical and nonsurgical techniques have been proposed for the treatment of severe respiratory obstruction and feeding difficulties [1].

In the algorithm of processing of the sequence, distraction osteogenesis with micro-distractors has recently been considered as a surgical option which is very important during the neonatal age. The benefits associated with piezoelectric bone surgery can result in significant improvement of new bone formation during distraction osteogenesis in neonatal and pediatric patients [2].

Actually, bone regeneration processes during osteodistraction require minimally invasive surgery with preservation of soft tissues and vascularization. The preservation of osteocytes and periosteal tissue that constitute a biologic couch for bone regeneration is also essential. Piezoelectric osteotomy permits a micrometric selective cut and clear surgical site with the cavitation effect created by irrigation/cooling solution and oscillating tip.

Positive clinical effects of piezoelectric bone surgery are considered accurate cutting and the absence of bone necrosis, while from the biological point of view a clean cut surface with living osteocytes enhances the early release of morphogenetic proteins which have been reported to greatly stimulate bone regeneration.

Histomorphological analyses demonstrated that more inflammatory cells were present in sites where a piezoelectric scalpel had been used. Also, neo-osteogenesis was consistently more active in those bone samples. Moreover, bone around areas treated with the piezoelectric bone surgery technique showed an earlier increase in BMP-and TGF- β 2 proteins as well as a reduction in proinflammatory cytokines [3].

The treatment of airway obstruction in the newborn with PRS is complex; sometimes it may constitute a real surgical emergency [4]. The evolution of devices for osteodistraction and the use of hybrid techniques have allowed surgical treatment in the first few months of life [5].

The complications associated with the use of these devices are, however, well documented and should be taken into account [6]. The authors describe the treatment of a neonate suffering from PRS with severe respiratory obstruction.

2. Case presentation

A 6-week-old female infant with PRS underwent mandibular lengthening in neonatal age. The little patient was admitted to our

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Fig. 1. A 6-week-old female with Pierre Robin sequence.

unit with severe airway obstruction and tracheostomy (Fig. 1). Pre-operative flexible video laryngoscopy showed limited movement of the dorsum of the tongue to the posterior pharyngeal wall and collapse of the epiglottis.

Evaluation by a multidisciplinary team included performing fibroscopic assessment. 3D CT confirmed severe mandibular retrognathia and hypoplasia.

The baby was treated by applying distraction KLS-Martin micro devices (Zurich) placed through an external Risdon-type incision. After two days latency, the activation rates were 1.5 mm per day based on a three-per-day rhythm. The activation period was 15 days with a 60 day consolidation period. The osteotomies were performed externally using a Piezosurgery device manufactured

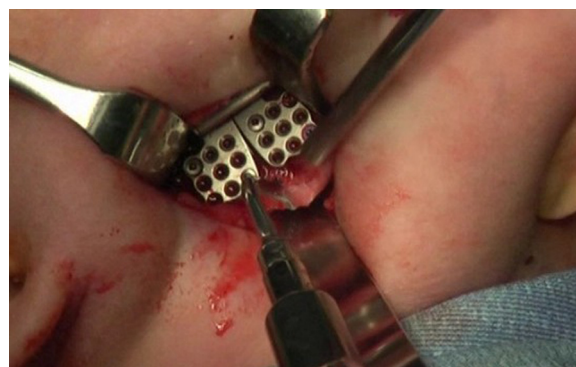


Fig. 3. (A) Pre-op 3D CT showing severe mandibular hypoplasia with retrognathia at 6 weeks old. (B) Post-op 3D CT showing normal mandibular development two years after the distraction procedure.

by Mectron Medical Technology (Carasco, Italy) which allows great cutting accuracy and the possibility of use in very restricted areas (Fig. 2).

After the early distraction protocol at the age of 3 months, the maxillo-mandibular relationship was within 2 mm of the incisors edge to edge.

Comparison of pre-distraction and post-distraction lateral CT scans confirmed a significant improvement in the airway space. Direct visualization with flexible endoscope demonstrated the airway changes (Fig. 3). The infant was successfully decannulated seven days after the active phase of the distraction (20 mm). Improvement in feeding was seen following mandibular distraction and removal of the nasogastric tube (Fig. 4). The last control was performed at the age of 28 months (Fig. 5). The baby had a regular follow-up.

3. Discussion

Piezoelectric surgery is based on the use of ultrasound for the cutting of bone. It represents an innovative technique as it offers the maxillofacial surgeon the opportunity to make precise bone cuts without damaging any soft tissue, minimizing the invasiveness of the surgical procedure, and the opportunity of working in a field which is almost totally blood free [7].

In 2001 the Italian odontostomatologist Tomaso Vercellotti introduced an angled piezoelectric short saw, which presented benefits for osteotomies during oral surgery with no side effects on

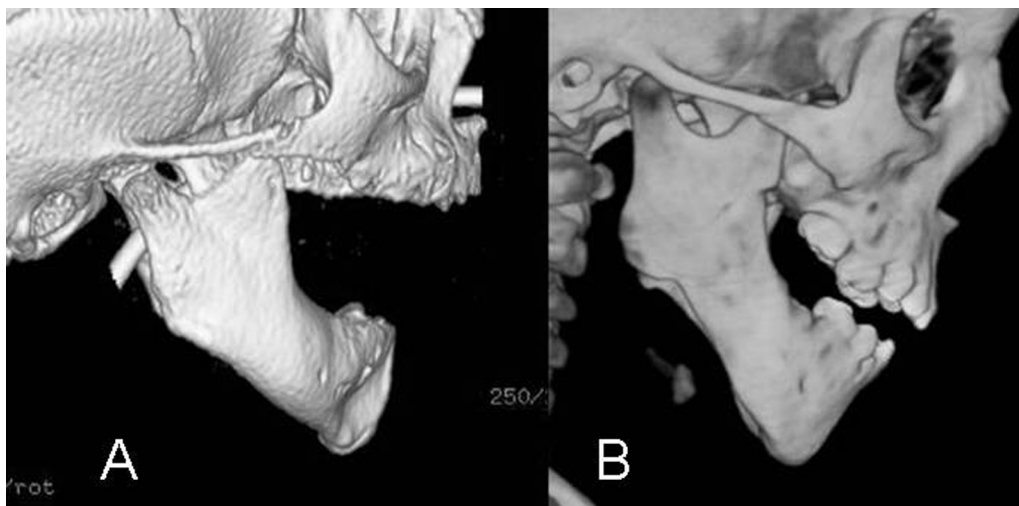


Fig. 2. Intraoperative right osteotomy performed with piezosurgery and placement of the distractor device (same on the left).

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