Journal of Plastic, Reconstructive & Aesthetic Surgery (2016) **69**, 409—416

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

A low-cost method of craniofacial distraction osteogenesis☆

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Received 2 March 2015; accepted 21 October 2015

KEYWORDS
Distraction osteogenesis;
Midface distraction;
Mandibular distraction;
Pierre Robin sequence;
Pfeiffer syndrome

Summary *Aim:* Distraction osteogenesis is an effective treatment modality for the correction of craniofacial deformities. The cost of these devices is significant and may preclude routine use of these distractors in developing countries. Hence, distraction osteogenesis was performed using medical equipment that was readily available in any hospital at minimal cost.
Patients and methods: From 2008 to 2013, a retrospective study was performed on infants and neonates who underwent primary distraction for craniofacial abnormalities. Midface or mandibular distraction was performed because of respiratory impairment and/or globe exposure. The apparatus used included Steinmann pins, stainless steel wires, attachment bolts, orthopaedic pulleys, string and intravenous bags for weights. For midface distraction, a transzygomatic pin was inserted, and a transmandibular pin or a cerclage wire was inserted into the mandible through the symphysis or body of the mandible and connected to the pulley system.
Results: Distraction osteogenesis was performed on five patients — three mandibular distractions (Pierre Robin sequence) and two transfacial distractions (Apert syndrome/Pfeiffer syndrome type III). The mean age, duration of distraction and duration of consolidation at the time of distraction was 60.5 days, 18.6 days and 16.4 days, respectively. The mean length of distraction achieved was 12 mm. Common complications observed were pin loosening, pressure necrosis of the skin and uneven pull. A major disadvantage was the longer hospital stay required.
Conclusion: The African method of distraction is effective, easy and cost effective and could be used in third-world hospitals where surgical expertise or expensive distraction sets are not freely available.

☆ **Details of congress at which the work was presented:** 1) Association of Plastic and Reconstructive Surgeons, South Africa (APRSSA). 2) Annual Congress — 19 October 2013 Champagne Resort, Drakensburg, South Africa.

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http://dx.doi.org/10.1016/j.bjps.2015.10.034

Distraction osteogenesis (DO) was first performed by Codivilla in 1905.[1] In 1951, Ilizarov, a Russian orthopaedic surgeon, fortuitously observed that bone distraction followed by bone lengthening led to the development of the Ilizarov apparatus.[2] McCarthy is the real father of craniofacial distraction. He conducted extensive experimental work on DO and performed the first clinical case in 1992.[3] A quarter of a century later, there has been an explosion in the use of DO to correct craniofacial deformities, ranging from using Steinmann pins only (Arnum)[4] to more complex external and internal devices. The deformities corrected include the cranium, midface, mandible, nose and alveolus. There are a variety of designs and materials for these distractors and include external and internal devices. The cost of these devices is not insignificant. The costs of these devices range from 3100 to 5950 US dollars. Although one to two devices are used for each procedure, sometimes up to five devices are used for some complex corrections. While they are readily used in North America, Europe, Australia and parts of Asia, the cost prohibits its routine use in Africa and other developing countries. We have therefore endeavoured to devise a different surgical method of treatment for DO in our craniofacial unit. This method of treatment should be suitable and effective when used in developing countries. It can also be used in a variety of craniofacial abnormalities that the craniofacial surgeon may encounter requiring urgent surgical management for a compromised airway or exposed globes.

Patients and methods

Patients

From 2008 to 2013, a retrospective study was performed on all the patients with craniofacial abnormalities who underwent this method of distraction at Inkosi Albert Luthuli Central Hospital, Durban, KwaZulu-Natal, South Africa. A total of five patients were identified for this procedure. All of these patients had airway compromise, and three patients required emergency tracheostomies. Two patients (ages 36 days and 59 days old) had exposed globes in danger of ulceration and corneal scarring. Three of the patients (ages 6 days, 59 days and 89 days old) had micrognathia and the Pierre Robin sequence. Two patients had midface hypoplasia, one being an Apert syndrome and the other a Pfeiffer type III syndrome. Emergency tracheostomies were performed on two: one with the Pierre Robin sequence for airway compromise and the other with midface hypoplasia.

The Pierre Robin sequence group had an M to F ratio of 1:2 and an average age of 53.6 days (9—89 days).

The midface distraction group had an M to F ratio of 1:1 and an average age of 74.5 days (59—90 days).

Treatment

A multidisciplinary team consisting of plastic surgeons, paediatricians, neonatal intensive care unit (ICU) staff, physiotherapists, occupational therapists, dieticians and geneticists were involved in the management and decision to operate.

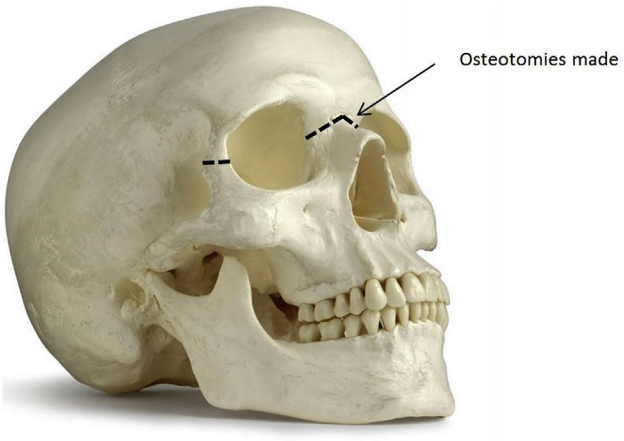

Figure 1 Osteotomies made.

DO was performed on either the midface or the mandible.

Transfacial distraction

There was no osteotomy performed in one patient. The other patient had percutaneous osteotomies performed in the nasofrontal and lateral orbital wall region. Two bone cuts were made: one in the lateral orbital wall and the other through the nasion (Figure 1). There was no latency period, and the distraction process commenced immediately post-operatively.

One or two Steinmann pins were inserted percutaneously in a transfacial plane through both zygomatic bones (Figure 2). These pins were then connected to attachment bolts fitted to both ends of the pins though which a thin stainless steel wire was connected and shaped in a triangular fashion so that the pins form the base of the triangle and the wires the two sides. This ensured the line of pull to be in the midline of the patient's head. A piece of string was then attached to the stainless steel wire and connected to the pulley system, and weights were fastened to the other end of the pulley system (Figures 3 and 4). In our unit, we used intravenous fluid bags as weights. Just enough

Figure 2 Patient 2. Midface distraction in progress.