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Clinical Paper
Temporomandibular Joint

Transport distraction osteogenesis as a method of reconstruction of the temporomandibular joint following gap arthroplasty for post-traumatic ankylosis in children: a clinical and radiological prospective assessment of outcome

V. Bansal, S. Singh, N. Garg, P. Dubey
Department of Oral and Maxillofacial Surgery, Subharti Dental College, Subharti University, Meerut, Uttar Pradesh, India

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Abstract. This clinical and radiographic study investigated the use of transport distraction osteogenesis in unilateral temporomandibular joint (TMJ) ankylosis patients. Six patients aged between 4 and 8 years were selected for the study; the mean preoperative maximal inter-incisal opening (MIO) was 3.5 mm without lateral and protrusive mandibular movements. The ankylotic mass along with the posterior border of the ascending ramus was exposed via 'lazy-S' incision. A gap arthroplasty was performed, followed by a 'reverse L' osteotomy on the posterior border of the ramus. In-house manufactured extraoral distraction devices were used for this prospective study. Follow-up clinical and radiographic evaluation was carried out for 13–27 months after completion of the activation period. After a mean follow-up of 19 months, the mean MIO was 29.1 mm and the lateral and protrusive movements changed from none to slight. Cone beam computed tomography images of all patients showed remodelled neocondyle created by transport distraction

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osteogenesis with no statistically significant differences observed for average cancellous bone density, trabecular number, and trabecular spacing between the neocondyle of the operated side (test) and the condyle of the non-operated side (control). Neocondyle formation by transport distraction osteogenesis using the in-house distraction device is a promising treatment option for TMJ reconstruction in ankylosis patients.

Key words: temporomandibular joint (TMJ); ankylosis; distraction osteogenesis; TMJ reconstruction; CBCT; in-house distractors.

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Temporomandibular joint (TMJ) ankylosis is a very distressing structural condition in which there is immobility (complete/partial) of the TMJ. This condition is characterized by formation of an osseous, fibrous, or fibro-osseous mass fused to the base of the skull, which is associated with difficulties in speech and mastication, poor oral hygiene, problems of restricted airways, and impeded eruption of teeth. TMJ ankylosis in children can lead to severe progressive facial disfigurement, including micrognathia, reduced facial height, occlusal discrepancy, and poor jaw–neck definition, which aggravates psychological stress and severely affects the patient's quality of life[1–4]. TMJ ankylosis occurs commonly in the first and second decades of life (35–92%) and is often associated with trauma (13–100%); other causes include local or systemic infection (0–53%) and systemic disease[3].

The management of TMJ ankylosis requires restoration of anatomy, form, and function, along with occlusal stability and prevention of re-ankylosis. When seen in children, future symmetrical growth must also be considered[5,6]. A variety of techniques such as condylectomy, gap arthroplasty, interpositional arthroplasty, and joint reconstruction using autogenous, alloplastic, and xenogeneic bovine bone grafts have been described in the literature[7–10], but because of the unique anatomical structure of the TMJ and its special physiological functions, none of these techniques has proven to be entirely satisfactory and the management of the condition remains a challenge. Harvesting an autogenous bone graft has disadvantages, such as exploration of a second surgical site and the resulting secondary bone defect[11–14].

In recent years, distraction osteogenesis has become an effective method for the treatment of congenital craniofacial deformities and acquired skeletal defects. In 2009, Kaban et al.[15] recommended the use of transport distraction osteogenesis to reconstruct the ramus–condyle unit in TMJ ankylosis patients. The history of distraction osteogenesis begins with the old techniques of repositioning and stabilization of bone fractures, which was used by Hippocrates in 460–377 BC[16]. The surgical technique of distraction osteogenesis, as described by Ilizarov in 1951[17], has long been used in the reconstruction of defects of the long bones. The first clinical application of distraction osteogenesis for craniomaxillofacial deformities in the human mandible was reported in 1992 by McCarthy et al.[18]. Stucki-McCormick[19] was the first to report the use of distraction osteogenesis for the re-establishment of the condyle in two developmental disorder cases in 1997. The aim of the current study was to report the clinical and radiological outcomes following the use of transport distraction osteogenesis in the management of paediatric unilateral TMJ ankylosis patients.

Materials and methods

Patient and distractor device selection

Six patients presenting with unilateral TMJ bony ankylosis, ranging in age from 4 to 8 years (mean: 6 years), were selected for this study. All patients presented for treatment between the years 2010 and 2011, and all had a history of a fall (average 2 years previously) (Table 1). On intraoral examination, patients had primary to mixed dentition. The mean preoperative maximal inter-incisal opening (MIO) was 3.5 mm with an absence of lateral and protrusive mandibular movements. A detailed medical and dental history was recorded. Ethics committee approval was obtained and informed consent was provided by the parents after a discussion on the different TMJ reconstructive techniques. In-house manufactured stainless steel, external, uni-axial distractors, with two holes for 2.0-mm diameter Schanz pins, were initially used in this study (Fig. 1). The distraction device used in our study is similar to the osteodistraction system used by Molina and Ortiz-Monasterio[20]. During the initial phase of the study, loosening of the distraction device after 2 months was reported in three cases. To overcome this complication, four-pin distraction devices were used in the next three cases.

Follow-up of the patient ranged from 13 to 27 months after completion of the activation period. Internal distractor devices were not used due to the high cost, non-availability, and the requirement for a second procedure for removal.

Surgical procedure

Surgery was performed under general anaesthesia after all necessary laboratory investigations had been carried out and radiographs obtained. A pre-auricular 'lazy-S' incision[21] was used to approach the TMJ region along with the posterior border of the ramus of the mandible (Fig. 2). The ankylotic mass was resected, creating a gap of more than 1 cm, depending upon the size of the ankylotic mass, without placement of any interpositional material. In one of the six cases a medially displaced native disc was used to reline the temporal fossa; in the remaining five cases, the glenoid fossa was not lined by interpositional material, assuming that there would be formation of a pseudo disc or fibro-cartilaginous cap over the leading edge of the transport segment, as reported by other authors[22,23]. The MIO achieved intraoperatively was 35 mm, failing which an ipsilateral and contralateral coronoidectomy was performed. The entire lateral surface of the ramus and angle was exposed via the lower part of the aforementioned incision. Teeth were placed in occlusion by hand, and a 'reverse L' osteotomy[22] (Fig. 3) was outlined on the posterior border of the ramus (25 mm downward from the sigmoid notch, 10 mm anteriorly from the posterior border of the ramus)[24]. The segment within the 'reverse L' becomes the transport disc. The vertical limb of the 'reverse L' is designed parallel to a vector that will position the transport disc into the glenoid fossa[24]. A corticotomy was initially done, then two Schanz pins were introduced, one in the distal segment and one in the proximal segment, through a stab incision in the skin, and inserted into the bone in a predetermined position so that the vector