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Original research article

Mandibular sagittal split osteotomy vs mandibular distraction osteogenesis in treatment of non-syndromic skeletal class II patients

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ARTICLE INFO

Article history:
Received 31 December 2014
Received in revised form
8 June 2015
Accepted 17 December 2015
Available online 27 January 2016

Keywords:
Retrognathia
Mandibular advancement
Mandibular condylar resorption
TMJ disorders
Mono-directional distraction device

ABSTRACT

Introduction: Mandibular retrognathia is a common skeletal congenital dysgnathia. In many cases of skeletal class II patients require the surgical operation. Orthognatic surgery offers mandibular bilateral sagittal split osteotomy (BSSO) as the most common procedure to make the advancement of the mandible. However, the alternative, mandibular distraction osteogenesis (MDO), is prevalent nowadays and beneficial in particular cases.

Aim: The purpose of this study is to show the effect of MDO and BSSO done on 20 patients at Specialist Children's Hospital in Olsztyn, Poland between 2011 and 2013, performed by the same surgeon – KD. Authors would like to present the details of treatment planning and management of these methods as well as the protocol of usage of the distraction device.

Material and methods: The sample consisted of 74 lateral cephalometric X-rays. Criteria for cephalometric comparison were angular cephalometric variables: SNB and SN/GoGn (Steiner analysis). The criteria for inclusion into this study were as follows: males and females with skeletal class II pattern plus dentofacial and dental abnormalities like skeletal open bite. The mean age of the subjects was 17.9 years.

Results and discussion: Our comparison study showed that there was no statistically significant difference between results of BSSO postoperatively and MDO post-distraction. However, there is a need of long-term data on stability of both methods.

Conclusions: Study shows that MDO may offer another option for treatment of skeletal class II malocclusions in growing patients and after growth spurt.

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http://dx.doi.org/10.1016/j.poamed.2015.12.004

1. Introduction

Skeletal class II pattern is mostly characterized by skeletal malformation of mandible which is small or retruded.[1–3] In skeletal class II there are various types of corrective surgical approaches: maxillary set back, segmental osteotomy of maxilla with extraction of maxillary premolars, mandibular advancement, bilateral sagittal split osteotomy (BSSO), genioplasty and mandibular distraction osteogenesis (MDO). The most common orthognatic surgical procedure to treat class II dento-skeletal deformities is BSSO with or without genioplasty.[1,4,5]

BSSO is performed to make the advancement of the mandible and maintains its popularity because of its versatility. At Maxillo-Facial Clinic the maxillofacial surgeon performs BSSO with Epker modification. The major advantage of BSSO is stable and predictable procedure for advancements of less than 6 mm in patients with low or normal mandibular plane angle.[4–6] Costs of operation are much smaller than MDO. Stable rigid fixation techniques (miniplates and screws instead of wires) improve the skeletal stability of BSSO and in consequence minimize the relapse.[1,5] One of the most predictable limitations of BSSO is the risk of relapse in cases with high mandibular plane angle and when used for larger advancements of more than 7–10 mm due to the inability of the muscles to be acutely stretched.[4,7] It is reported that relapse occurs in up to 30% of BSSO cases (an average of 2 mm).[1,2] For greater advancements bone grafting is needed. Another major concern of BSSO is represented by neurosensory disturbances (NSD) and possible inferior alveolar nerve (IAN) damage.[1] Incidence of NSD of IAN ranges from 9.0% to 84.6% objectively and 100% subjectively in the first week after operation to 0%–87% at one year after surgery.[1] Occasionally BSSO causes temporomandibular joint (TMJ) damage – remodeling, resorption of the condyle of mandible or progressive condylar resorption (PCR)[5,6,8] due to striping of periosteum and musculature off the proximal segment, what decreases its vascularity.[9] Lateral flaring of the proximal segment of mandible leads to lateral shift of the mandibular condyle, causing its lateral torque. A common operative complication represents unfavorable fractures, known as 'bad splits', occurring in 0.5%–5.0% cases, for example when third molars are extracted.[10] Indications to perform BSSO are: patients after growth spurt with maxillomandibular hypoplasia, facial asymmetry, congenital micrognathia and skeletal class II cases.

The technique of MDO became a prevalent surgical treatment of retrognathia and mandibular asymmetry.[1,11] It has a history of more than 100 years; Ilizarov developed main concepts in the animal experiments in 1952, but in maxillofacial surgery MDO was used for the first time in 1992 by McCarthy for bony expansion in patients with complex skeletal abnormalities like hemifacial microsomia and Nager's syndrom.[12] MDO is a surgical-orthopedic method for bone lengthening based on a new bone formation between two bones in the osteotomy site stimulated by gradual traction, parallel to the vector of distraction.[11,13–15] The traction generates tension within the callus, forming the reparative callus/bone. Bone regenerate consists of three zones: two zones of mineralization and fibrous interzone with collagen bundles.[16] Gradual forces made by two bones pulled by screw-driven appliance stimulate proliferation of the osteoblast precursor cell population in the center of the distraction gap. Differentiation and recruitment of osteogenic cells at the host bone margins causes new osteoid deposition and mineralization,[14–17] forming the bone of woven type. Additionally, the process of bone distraction has an impact on surrounding tissues (skin, fascia, blood vessels, nerves, muscle, ligament, cartilage, and periosteum) initiating a sequence of adaptive changes called distraction histogenesis.[14]

Distraction appliances can be classified into: extraoral (unidirectional, bidirectional, multidirectional) and intraoral (tooth-borne, bone-borne, hybrid).[18]

Advantages of MDO method are: long-term stability of the final effect of treatment due to osteogenesis and histogenesis, inducing soft-tissue adaptation and minimizing the relapse.[5,19] The possible advancement of mandible is high due to gradual amount of bone formation during an active phase, even 20 mm.[1,4] Further, the site of osteotomy is placed behind lower second molars, distally to the pterygo-masseteric muscular sling what prevents from IAN damage and provide a safe procedure.[6] Additionally, no bone graft is needed and less periosteal stripping occurs in comparison with BSSO method.[8,14] MDO can be performed at any age, including young children.[7] MDO is considered to reduce the incidence of IAN dysesthesia.

The main disadvantage represents high costs of distraction devices.[13] Moreover, MDO treatment requires two operations: to apply the appliance and to remove it. The device may cause patient discomfort during treatment and shortly after operation, for example: sounds at TMJ, muscle tenderness and difficulty in jaw opening. Furthermore, MDO without a proper device orientation can develop an occlusal impairments like open bite and asymmetries.[19,20]

Indications to use MDO method are: growing patients and after growth spurt with severe malocclusions – non-syndromic mandibular retrognathia, maxillofacial syndromes, congenital diseases, dyzostozes (e.g., Pierre Robin, Treacher Collins, Goldenhar syndrome) or congenital micrognathia. MDO is commonly used to treat obstruction sleep apnea in newborns, rarely adults.[21] Major contraindications represent: children under six years of age, osteoporosis, allergy to metals, oncological treatment and patient's mental disorders.

It is stated that postoperative neurosensory disturbances and condylar resorption was reported in BSSO and MDO groups and differences were not significant.[1,22]

2. Aim

The aim of our study is to assess the postoperative results of two methods of treatment: MDO and BSSO by means of cephalometric analysis regarding 20 patients, who undergone the procedures at Specialist Children's Hospital in Olsztyn, Poland between 2011 and 2013.

3. Material and methods

The reliability test (paired Student *t*-test with a significance level of $P < 0.05$) and error analysis test (Dahlberg formula)