Int. J. Oral Maxillofac. Surg. 2017; xxx: xxx–xxx
http://dx.doi.org/10.1016/j.ijom.2017.09.004, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
Orthognathic Surgery

Stability of intraoral vertical ramus osteotomies for mandibular setback: a longitudinal study

A. Y. H. Kung, Y. Y. Leung
Oral and Maxillofacial Surgery, Faculty of Dentistry, The University of Hong Kong, Hong Kong

A. Y. H. Kung, Y. Y. Leung: Stability of intraoral vertical ramus osteotomies for mandibular setback: a longitudinal study. Int. J. Oral Maxillofac. Surg. 2017; xxx: xxx–xxx.

Abstract. This study aimed to investigate the postoperative longitudinal skeletal changes and stability following intraoral vertical ramus osteotomies (IVRO) for orthognathic mandibular setback, and the possible risk factors that might affect the stability. A retrospective cohort study was conducted. Lateral cephalograms were analyzed for the predictor (magnitude of setback and adjunctive procedures) and outcome (stability of vertical and horizontal dimensions) variables at six time points. A total of 152 patients (mean age 24.2 years) were included in the study. Following IVRO, the mandible measured at B-point had moved a mean 0.50 mm posteriorly at 1 week after the removal of intermaxillary fixation (7 weeks postoperative); this was followed by progressive small anterior relapse. At 2 years postoperative, the mean relapse of the mandible after IVRO measured at B-point was 0.05 mm (standard deviation 1.14 mm), representing 0.7% of the mean surgical movement. Large setback (>8 mm) showed significantly higher relapse compared to small setback (<4 mm) at 2 years after surgery ($P = 0.021$). Patients who underwent adjunctive mandibular surgeries other than IVRO showed no significant differences in relapse compared to those who underwent IVRO alone. In conclusion, IVRO for mandibular setback is a stable procedure in the long term, with small relapse of 0.05 mm after 2 years.

Key words: intraoral vertical ramus osteotomy; mandibular setback; stability; cephalometric analysis.

Accepted for publication 12 September 2017

Mandibular prognathism has been shown to be prevalent in Asian people. Lew et al. reported a prevalence of skeletal class III patients in the Chinese population of around 12%[1]. The most common surgical treatments for mandibular prognathism include the intraoral vertical ramus osteotomy (IVRO) and the sagittal split ramus osteotomy (SSRO). The intraoral subcondylar osteotomy was first described by Winstanley in 1968[2]. The IVRO procedure was then refined by Hall and McKenna[3]. In terms of advantages, it has been reported that the IVRO has a relatively shorter surgical time and results in a lower incidence of postoperative neurosensory deficit than the SSRO[4]. However, patients who undergo IVRO require

0901-5027/000001+08

Please cite this article in press as: Kung AYH, Leung YY. Stability of intraoral vertical ramus osteotomies for mandibular setback: a longitudinal study, *Int J Oral Maxillofac Surg* (2017), http://dx.doi.org/10.1016/j.ijom.2017.09.004

intermaxillary fixation (IMF) in the early postoperative period, which may pose a risk to the airway[4–6].

Generally, orthognathic procedures with a minimal amount of relapse result in a stable and long-lasting treatment outcome. According to the literature, IVRO is relatively stable when compared to SSRO[7]. The relationship between the magnitude of setback and relapse following SSRO has been reported in various studies, but this has rarely been reported for IVRO[8].

Several studies have investigated the postoperative stability of IVRO, but these have mostly involved small sample sizes and short follow-up periods[9–11]. Ayoub et al. reported a case series of 16 patients who underwent IVRO, in which a mean 0.5 mm posterior movement of the mandible occurred during the first year postoperative[10]. Chen et al. reported anterior relapse of 1.3 mm in 25 patients who underwent IVRO[11]. The longitudinal changes after IVRO have not been investigated as thoroughly. Knowledge of the postoperative longitudinal skeletal changes may help surgeons and orthodontists to better predict the final clinical outcome and occlusion in the post-surgical orthodontic phase. Moreover, factors that might affect the stability of IVRO are still controversial and not clearly understood. How factors such as the magnitude of mandibular setback and the incorporation of adjunctive mandibular surgeries might affect the skeletal stability after IVRO remains vague with the current evidence.

The purpose of this study was to investigate the longitudinal skeletal changes in the mandible after IVRO and to investigate the factors (magnitude of setback and adjunctive procedures) that might affect the postoperative stability after IVRO. The null hypothesis was that the factors would not affect the skeletal stability after IVRO. The specific aims of the study were to measure the skeletal changes after IVRO occurring during the first 2 years postoperative and to analyze the effects of the magnitude of mandibular setback and adjunctive mandibular procedures on postoperative skeletal stability.

Materials and methods

Study design and patients

To address the research purpose, the investigators designed and implemented a retrospective cohort study. The study population was composed of patients with dentofacial deformities who underwent orthognathic surgery in the Oral and Maxillofacial Surgery Department of the Faculty of Dentistry, The University of Hong Kong.

The inclusion criteria were: (1) patients with mandibular prognathism with or without asymmetry treated with bilateral IVRO as part of, or the whole of, the procedure; (2) age older than 18 years; (3) the requirement for conventional orthognathic surgery with pre- and post-surgical orthodontics; (4) postoperative follow-up for 2 years. Patients were excluded as study subjects if they presented with craniofacial syndromes such as cleft lip and palate, had preoperative temporomandibular joint (TMJ) degenerative diseases, had a history of head and neck trauma, or of previous orthognathic or TMJ surgery, and if they had not had preoperative orthodontic treatment.

Surgical procedures

The orthognathic surgeries were performed under general anaesthesia. All patients received IVRO as the mandibular ramus surgery for mandibular setback. Some patients underwent concurrent adjunctive anterior mandibular surgery (anterior subapical osteotomy and/or genioplasty) and/or maxillary procedures such as a Le Fort I osteotomy with or without segmentalization, depending on their dentofacial deformities. Five specialists with at least 8 years of orthognathic surgery experience performed these surgeries. The surgical IVRO procedure is described below.

An incision of the mucosa was made lateral to the external oblique ridge, from the ascending ramus to the second molar region. A mucoperiosteal flap was raised to expose the lateral mandibular ramus to the posterior border and the sigmoid notch. The sigmoid notch and the posterior mandibular border of the mandible were identified and retracted with a sigmoid notch retractor (No. 01-03760/03750; Leibinger, Irving, TX, USA) and a posterior border retractor (01-01580; Leibinger), respectively. The osteotomy cut was initiated with an oscillating saw (Hall micro100; Zimmer, Warsaw, IN, USA) with a 70-degree saw blade (micro-sagittal saw blades, No. 5053-28; Zimmer). The saw blade was worked in a superior–inferior direction along the vertical ramus until it reached the sigmoid notch and the inferior border. The osteotomy was completed with a curved osteotome. The condylar (proximal) segment was mobilized to rest on the lateral position of the ramus (distal) segment, allowing passive adaptation of the two segments. The contralateral side was osteotomized in the same manner. The mandible was set back according to the thin occlusal wafer splint. Any identifiable bone obstacles were trimmed to ensure good adaption of the two segments. A coronoidectomy was not performed. IMF was applied with the occlusal wafer. Panoramic radiographs were taken on day 2 postoperative to confirm that the condyle was seated in the glenoid fossa. The IMF was maintained for 6 weeks postoperatively.

Outcome measures

The primary outcome of this study was the skeletal changes to the mandible in the anteroposterior and vertical dimensions within the first 2 years postoperative. Stability of the mandible was assessed by determining the differences between measurements of three mandibular reference points (B-point, menton, and pogonion) obtained at six different time points: preoperative (P), 7–14 days postoperative (T1), 7 weeks postoperative (T2), 6 months postoperative (T3), 1 year postoperative (T4), and 2 years postoperative (T5).

The following were secondary outcomes: the analysis of factors including patient demographics such as age, sex, and notable clinical relapse (defined as relapse of $\geq$2 mm); adjunctive mandibular procedures (mandibular procedures other than IVRO) in relation to surgical stability; and relapse in relation to the magnitude of setback.

Data collection

Serial preoperative and postoperative cephalometric radiographs were retrieved. Lateral cephalometric radiographs with magnification of 1.23 times were taken (Orthoralex 9200X; Gendex, Hatfield, Pennsylvania, USA). The lateral cephalometric radiographs obtained at the following specific time-points were traced: preoperative (P), 7–14 days postoperative (T1), 7 weeks postoperative (T2), 6 months postoperative (T3), 1 year postoperative (T4), and 2 years postoperative (T5). The following five reference points were identified on the lateral cephalometric radiographs: sella (S), nasion (N), B-point (B), menton (M), and pogonion (Pg).

The *x–y* coordinate system constructed for analysis included a horizontal axis with its origin starting at point S and forming an angle of 7° downwards from the SN plane, named SNx. A vertical line running through S was drawn perpendicular to this

Please cite this article in press as: Kung AYH, Leung YY. Stability of intraoral vertical ramus osteotomies for mandibular setback: a longitudinal study, *Int J Oral Maxillofac Surg* (2017), http://dx.doi.org/10.1016/j.ijom.2017.09.004