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Long-term stability of mandibular advancement with bilateral sagittal split osteotomy

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ABSTRACT

Introduction: Aim of this study was 1) to evaluate long-term dental/skeletal stability in patients with mandibular retrognathia corrected by BSSO, and 2) to examine factors associated with relapse.
Materials and methods: Seventy-seven of initial 151 study cohort subjects who had undergone orthognathic surgery in 2007–2011 agreed to participate. Present paper presents data on dental/skeletal stability in 46 patients; 31 patients were excluded because of missing calibration indicator in one of the patients' pre-operative cephalometric radiographs, or because of pregnancy. Pre-operative (T1), post-operative (T2) and long-term follow-up (T3) radiographs and patient's files were used in the study.
Results: Based on overjet measurements, mean mandibular advancement was 5.7 mm and mean relapse 0.1 mm. Mean pre-operative overbite was 5.4 mm, reduction at surgery 3.4 mm and mean relapse 1.1 mm, a statistically significant change. Mean mandibular advancement measured from condyle tognathion (Co-Gn) was 6.5 mm. Relapse in Co-Gn was 1.6 mm on average, i.e., about 25% of the advancement. Amount of advancement, fixation method, patient's age or gender or orthodontist/surgeon experience did not have influence on relapse.
Conclusions: Mandibular advancement with BSSO in healthy Class II patients is considered a stable procedure. 25% skeletal relapse was found with clinically non-significant dental changes.

Introduction

Over the last 60 years, orthognathic surgery has become routine practice worldwide in the management of severe malocclusions and dentofacial deformities that are outside the scope of orthodontic treatment alone. Despite progress in osteotomy techniques (Trauner and Obwegeser, 1957; Dal Pont 1961; Hunsuck, 1968; Epker, 1977) and osteosynthesis methods in mandibular advancement (Van Sickels and Richardson, 1996; Thiele et al., 2016), the possibility of treatment relapse remains an issue. Immediate relapse is rare, occurs within days of bilateral sagittal split osteotomy (BSSO), and is caused by fixation failure or positioning condyles incorrectly during surgery (Van Sickels and Richardson, 1996; Dolce et al., 2007). Proffit et al. (2007) have suggested 2–4 mm dental and/or skeletal relapse in lateral cephalometric measurements as "potentially clinically significant", and >4 mm relapse as clinically highly significant. Furthermore, they consider changes during the first post-operative year as treatment related (surgery, orthodontics, short-term physiologic adaptation), and beyond 1 year, as long-term adaptation only indirectly related to the surgery.

Studies on post-surgical stability to up to 2–3 years after mandibular advancement with BSSO indicate minor common relapse (<2 mm) with high individual variation, in which relapse most often is not a clinical problem (Mobarak et al., 2001; Ow and Cheung, 2010; Rocha et al., 2015; Den Besten et al., 2013) or could be corrected with orthodontic compensation. According to Proffit et al. (2007), mandibular length decreases between 1 and 5 years post-treatment in about 20% of patients with mandibular advancement. Systematic review and meta-analysis by Al-Moraissi and Ellis (2015) found no statistically significant difference in skeletal and dental relapse between patients with mandibular advancement with BSSO or distraction osteogenesis up to 3 years post-surgery. A three-dimensional study by Franco et al. (2013) confirmed cephalometric studies: changes of >2 mm were observed in 17% of cases after mandibular advancement 3 years post-surgery.

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Long-term stability studies (i.e., >5 years post-treatment) after mandibular advancement have shown contrasting findings. Eggensperger et al. (2006) and Joss and Thuer (2008) found 50–60% relapse of skeletal mandibular advancement about 12 years post-surgery, while Moen et al. (2011) and Baas et al. (2012) found nearly stable skeletal outcomes. Stockmann et al. (2010) studied occlusal stability 8 years after BSSO and considered an increase in overjet of over 5 mm as relapse: one case in 34 showed relapse and two cases with relapse tendency (i.e., 2–3 mm occlusal change). On the other hand, Moen et al. (2011) reported significant (~40%) dental relapse in connection with skeletal stability. About 25% of patients with mandibular advancement showed a decrease in the mandibular length in the long term due to remodeling at the mandibular condyle; however, concomitant proclination of the lower incisors in about 50% of the cases camouflaged the skeletal relapse (Proffit et al., 2007).

The aims of this study were 1) to evaluate long-term dental and skeletal stability in patients with mandibular retrognathia corrected by mandibular advancement with BSSO, and 2) to examine factors associated with relapse.

Material and methods

The initial study cohort comprised 151 patients who had undergone orthognathic surgery at the Oral and Maxillofacial Unit of Tampere University Hospital, Tampere, Finland, in 2007–2011. The following inclusion criteria were used: mandibular retrognathia, Class II dental relationship with increased overjet, conventional orthodontic treatment including pre- and post-operative phases, mandibular advancement with BSSO as the only surgical treatment, and rigid fixation. Patients with TMJ arthritis, trauma history, cleft lip and palate or craniofacial anomalies, and patients whose orthodontic treatment was performed outside the hospital in question were excluded. Straight-wire orthodontic technique with Roth's bracket prescription had been used in all patients.

Patients were treated with orthodontics to achieve the best possible post-operative occlusion, and were evaluated jointly by the treating orthodontist and oral and maxillofacial surgeon about 3 months before the operation to ensure the best possible post-operative occlusal stability. In patients with short anterior face height and deep bite (overbite ≥4 mm, n = 30, 70% of patients), the mandible was rotated clockwise with mandibular advancement to reduce overbite and to increase face height. In these patients, Spee's curve was not straightened pre-surgically, and immediately post-surgery, these patients had tooth contacts in the front and on the second, and sometimes also on the first, molars. Open bite in premolar and molar areas was closed with orthodontics post-surgically by extruding lower premolars and molars. In all cases, a surgical splint was used during the operation to obtain the planned occlusion. The splint was removed in all cases once ostheosynthesis had been attained, and no maxillomandibular fixation was used. Four senior orthodontists treated all of the cases, and three senior surgeons performed the operations with or without a resident.

In all, 77 (51%) of the 151 participants signed an informed consent form to participate in the present long-term follow-up study, which took place an average of 6 years (range 4–8 years) after their operations. Subjects were examined by one researcher (J.P.) at the Oral and Maxillofacial Unit, including clinical study on occlusion and TMJ function using Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) recommendation (Schiffman et al., 2014). A lateral head radiograph was obtained only in persons with good-quality pre-operative (T1) and post-operative (T2) radiographs and calibration indicator to adjust for magnification (Fig. 1). Furthermore, quality of life was evaluated with the Orthognathic Quality of Life Questionnaire (Cunningham et al., 2000). Ethical approval was obtained from the Ethics Review Committee of the Joint Municipal Authority of the Pirkanmaa Hospital District, Finland (see Fig. 2).

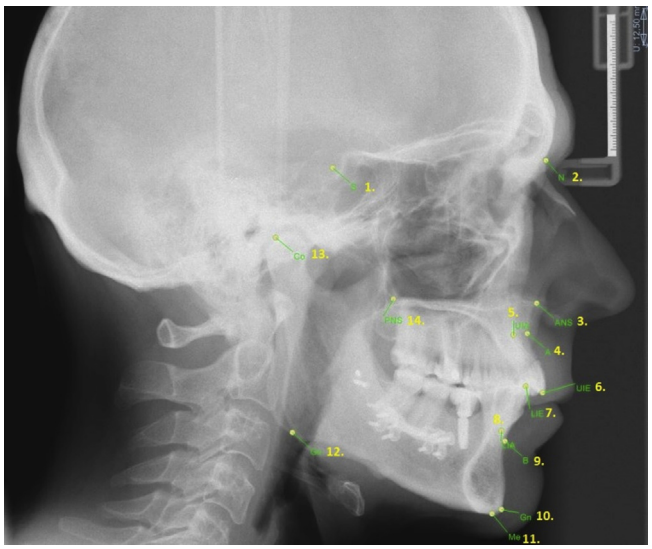

Fig. 1. Points used in the cephalometric analysis (Planmeca Romexis Cephalo). Cephalometric analysis was based on the following points: 1. Sella, 2. Nasion, 3. Anterior nasal spine, 4. A-point, 5. Upper incisor apex, 6. Upper incisor edge, 7. Lower incisor edge, 8. Lower incisor apex, 9. B-point, 10. Gnathion, 11. Menton, 12. Gonion, 13. Condyle, 14. Posterior nasal spine.

The present article presents data on dental and skeletal stability in 46 patients; 31 patients had to be excluded either because of a missing calibration indicator (n = 29) in one of the patients' pre-operative cephalometric radiographs, or because of pregnancy (two cases). The mean age of the participants was 43 years (range 21–63 years, SD 11); they comprised 34 (74%) women with a mean age of 42 years (range 21–63 years, SD 12), and 12 (26%) men with a mean age of 45 years (range 32–62 years, SD 11). Bicortical screws were used in 11 patients for osteotomy fixation, and miniplates in 35 patients.

Dental and skeletal stability

Assessment of dental stability was based on clinical measurements of overjet and overbite measured by treating orthodontists

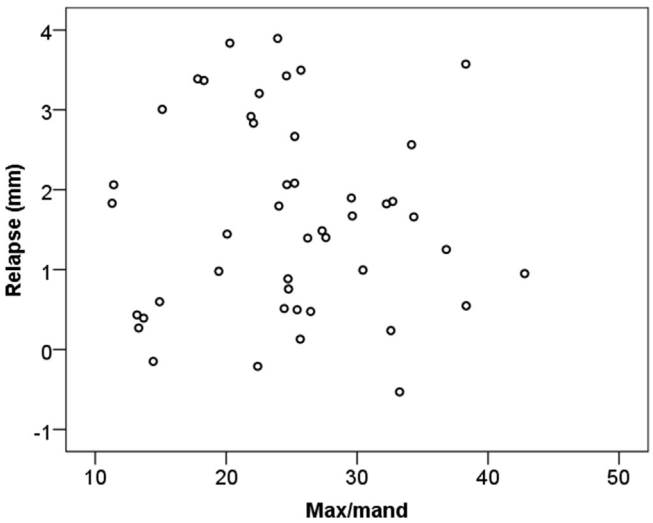

Fig. 2. Amout of skeletal relapse (Condyle-Gnathion, mm) was not found to be associated with presurgical maxillomandibular vertical relationship (°).

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