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Method of osteotomy fixation and need for removal following bimaxillary orthognathic, osseous genioplasty, and intranasal surgery: a retrospective cohort study

J. C. Posnick[1,2,3,4], E. Choi[5,6], A. Chavda[5,7]

[1]Posnick Center for Facial Plastic Surgery, Chevy Chase, MD, USA; [2]Georgetown University, Washington, DC, USA; [3]University of Maryland School of Dentistry, Baltimore, Maryland, USA; [4]Oral and Maxillofacial Surgery, Howard University College of Dentistry, Washington, DC, USA; [5]Past Chief Resident, Howard University Hospital, Washington, DC, USA; [6]Currently Private Practice, Stockton and Modesto, California, USA; [7]Currently Private Practice, Houston, Texas, USA

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Abstract. The purpose of this study was to determine the incidence and causes of fixation hardware removal after bimaxillary orthognathic, osseous genioplasty, and intranasal surgery. A retrospective study was performed, involving subjects with a bimaxillary developmental dentofacial deformity (DFD) and symptomatic chronic obstructive nasal breathing. At a minimum, subjects underwent Le Fort I osteotomy, bilateral sagittal ramus osteotomies (SROs), septoplasty, inferior turbinate reduction, and osseous genioplasty. The primary outcome variable studied was fixation hardware removal. Demographic, anatomical, and surgical predictor variables were assessed. Two hundred sixty-two subjects met the inclusion criteria. Their mean age at operation was 25 years (range 13–63 years); 134 were female (51.1%). Simultaneous removal of a third molar was performed in 39.9% of SROs. Three of 262 Le Fort I procedures (1.1%) and two of 524 SROs (0.4%) required hardware removal. There were four cases of ramus wound dehiscence, four of ramus surgical site infection (SSI), one of chin SSI, two of maxillary sinusitis, and one of lingual nerve injury; none of these subjects underwent hardware removal. A limited need for fixation hardware removal after orthognathic procedures was confirmed. There was no statistical correlation between hardware removal and patient sex, age, pattern of DFD, simultaneous removal of a third molar, or occurrence of wound dehiscence, SSI, or lingual nerve injury.

Key words: orthognathic surgery; genioplasty; fixation; hardware removal.

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Metal plates and screws have been used to stabilize fractures and osteotomies in the maxillofacial region for the last half century, but the material used, surgical technique, and need for removal has evolved[1]. The metals initially used were stainless steel and vitallium, and these were followed by titanium and its alloys. There is laboratory and clinical evidence confirming the tissue compatibility and high corrosion resistance of titanium and its alloys in the human body[2,3]. In 1991, the Strasbourg Osteosynthesis Research Group recommended that ''the removal of a non-functional plate is desirable provided that the procedure does not cause undue risk to the patient''[4–7]. In earlier years, those advocating routine removal of fixation devices after stable bone union felt that the implant had significant potential to cause problems. Its removal was considered both preventative and prudent. Today, clinicians agree that the medical risk and financial burden incurred in the routine removal of asymptomatic fixation hardware cannot be justified[8–12]. It is currently standard practice to remove fixation plates and screws only when clinically indicated[6,13–20].

Peacock and colleagues recently reviewed the incidence of hardware removal after orthognathic procedures[11]. They documented a need for hardware removal in 12.8% of their patients when followed for a minimum of 2 years. Subjects older than 40 years of age were two times more likely to undergo hardware removal. However, their study did not specify the type and size of hardware placed at each osteotomy site, state the site requiring hardware removal (i.e., maxilla, mandible, chin), or indicate the patient-specific symptoms leading to the need for hardware removal (e.g., perforation through the mucosa, infection, pain, nerve injury, dental injury). Few studies to date have correlated the type of fixation hardware placed at each osteotomy site, the site requiring removal, specific symptoms compelling hardware removal, or the need for hardware removal in association with infection.

The purpose of this retrospective cohort study was to determine the incidence of hardware removal in a consecutive series of subjects undergoing, at a minimum, bimaxillary orthognathic, osseous genioplasty, and intranasal surgery. It was hypothesized that when using consistent osteotomy design and fixation techniques, the need for hardware removal would be limited and not influenced by the subject's sex, age, pattern of dentofacial deformity (DFD), the simultaneous removal of a third molar, occurrence of wound dehiscence, surgical site infection (SSI), or lingual nerve injury. The specific aims of the study were to: (1) document the hardware placed at each osteotomy site (i.e., maxilla, mandible, chin) when used to treat a spectrum of bimaxillary DFDs, and (2) document the need for hardware removal at each location and the rationale for doing so.

Materials and methods

Study design and sample

To address the research objectives, a retrospective cohort study was designed and implemented. The sample was derived from the patients treated by one surgeon (JCP) in a private practice setting, with surgery performed at a single hospital (MedStar Georgetown University Hospital, Washington, DC, USA) between 2004 and 2013. Subjects had undergone a minimum of 2 years follow-up at the close of the study (range 2–11 years). The study sample included subjects with a spectrum of bimaxillary developmental DFDs also involving the chin and with symptomatic chronic obstructive nasal breathing. The subjects then underwent a minimum of Le Fort I osteotomy, bilateral sagittal ramus osteotomies (SROs) of the mandible, osseous genioplasty, septoplasty (submucosal resection), and reduction of the inferior turbinates. Patients were excluded if their jaw deformity had previously been operated upon, or was syndromic, cleft-related, post-traumatic, or tumor-related. Patients not residing in North America were also excluded, as long-term follow-up was geographically inconsistent. Other standard exclusions for semi-elective orthognathic surgery per routine included the use of nicotine products for at least 3 weeks prior to surgery, current use of bisphosphonate medication, immunosuppressed status, and insulin-requiring diabetes. All subjects were confirmed to be cardiovascularly stable without pulmonary disease, renal disease, or a known coagulation disorder. The Georgetown University Institutional Review Board approved the study protocol.

Predictor variables

The predictor variables were grouped into the following categories: demographic, anatomical, operative, and complications.

The demographic variables collected included age of the patient at operation and sex.

The anatomical variables studied included the pattern of the developmental DFD, location of jaw osteotomy, and presence of a mandibular third molar undergoing simultaneous extraction. With regard to the pattern of the developmental DFD, each subject was classified at presentation into one of six common jaw growth patterns: primary mandibular deficiency, maxillary deficiency with relative mandibular excess, asymmetric mandibular excess, short face, long face, and bimaxillary dental protrusion. In addition, there was an atypical category that included DFDs influenced by parafunctional oral habits such as thumb sucking. The second anatomical variable was the site of the osteotomy requiring fixation; these included the maxilla at the Le Fort I level, the ramus of the mandible in association with an SRO, and the symphysis of the mandible (osseous genioplasty). The third anatomical variable was the presence of a mandibular third molar requiring simultaneous removal. This was further categorized as fully impacted (no exposure through the oral mucosa) or erupted/partially erupted (exposure through the oral mucosa).

Operative variables studied included the method and type of osteotomy fixation and the method of mandibular third molar management. The Le Fort I osteotomy fixation was with four titanium L-plates (Stryker Corporation, Kalamazoo, MI, USA)[21]. If the degree of maxillary advancement and lengthening created a defect that required an interpositional graft, then an additional microplate was placed across each inset graft[22]. The SRO was fixated with three bicortical titanium screws of 2.3 mm in diameter (Stryker Corporation)[21]. The length of the screws varied between 14 mm and 18 mm according to the width and separation of the bones. The three screws were placed at locations where bicortical bone overlap was best, but also with the intention of avoiding dental roots, maximizing the distance between screws, and avoiding placement of the screws too superiorly (i.e., close to the alveolar crest)[23]. Occasionally, if fixation with three screws was deemed inadequate, either additional screws or a plate with monocortical screws was placed to achieve fixation. The ramus osteotomy fixation was placed through a transbuccal trocar. Chin osteotomy fixation was with two surgeon-contoured straight titanium plates (Stryker Corporation)[21,24]. Each plate crossed the osteotomy and was secured on each side with