Reasons for Removal of Bone Plates after Orthognathic Surgery

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Abstract

Aim: The aim of this prospective clinical trial was to evaluate the reasons for removal of miniplates from patients who had orthognathic surgery over a 7-year period.

Materials and Methods: Fifty consecutive patients with fixed miniplates following orthognathic surgery (11 males and 39 females) aged 20 to 43 years (mean=28±6 years) were recruited into this study. Personal information, dental and medical history, type of orthognathic operation, indications for plate removal, placement site of plates and time between insertion and removal were recorded. The site of plate insertion was classified into right, left and anterior maxilla; right, left and anterior mandible; and chin. All plates were inserted and removed intra-orally under local or general anesthesia. The association between the variables was analyzed using the Pearson correlation and Chi-Square test. For all statistical analysis, the significance level was set at $P \leq 0.05$.

Results: 312 titanium miniplates were inserted in 50 patients. A total of 108 plates (34.6%) were removed. The retention period for the removed plates ranged from 4 months to 4.5 years. The most common sites for plate removal were maxilla (22 patients, 44%) followed by mandible (19 patients, 38%). The most common cause for plate removal was palpable plates (27 patients) followed by infection (13 patients), patient discomfort and preference (7 patients) and plate exposure and wound dehiscence (3 patients). No significant relationships were found between plate removal (including number and location of removed plates and reason for plate removal) and age and gender ($p<0.05$). Reason of plate removal was significantly related to the number of plates ($p=0.001$, $r=0.441$) and the location of removed plate ($p \leq 0.001$, $r= 0.62$). Type of removed plate had no significant relation with reason for plate removal ($p=0.576$, $r=-0.081$), number of plates ($p= 0.62$, $r= 0.072$) and location of removed plates ($p= 0.467$, $r= -0.105$). Reason for performing the orthognathic surgery and type of the orthognathic surgery had no significant relations with the number and location of removed plates and reason for plate removal ($p<0.05$).

Conclusions: Plate removal was attributed to palpable plates, infection, subjective discomfort and patient preference, and plate exposure and wound dehiscence. Plate-related complications caused plate removal which was more likely to occur within the first year of insertion. This should be accounted for during the process of obtaining informed consent.

Keywords: Miniplates, Bone Plates, Plate Removal, Indications for Removal.

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Introduction

Small bone plates have been used for osteosynthesis in maxillofacial surgery since a long time. Plates are inserted as a mean for rigid internal fixation of bone following trauma or planned surgeries such as orthognathic surgery.

It is still controversial whether to remove plates after healing. Some suggested that once a plate accomplished its purpose; it becomes a foreign body and might pose a potential source for problems. [1] Therefore, unless the advantage of removal would be outweighed by the potential morbidity of removal (medical compromise, lack of patient longevity, inaccessibility, etc); plates should be routinely removed regardless the presence of any clinical reason. [1-3]

However, others suggested that removal of plates should be attempted only in the presence of clinical indication. [4, 5] The arguments against plate removal are based on the excellent biocompatibility of the titanium material, the low incidence of complications associated with retained plates, the increased risk of subjecting a patient to general anesthesia and the cost involved in removal. [3-7]

Indications for plate removal include radiation effects, patients' preference, young patient age, palpability, exposure & wound dehiscence, loosening, infection, thermal sensitivity, pain, denture position and migration. [1, 5, 7- 9]

According to the literature, most plates are removed within 12 months after insertion. [5, 7]

This retrospective study examines the reasons for removal of miniplates from patients who had orthognathic surgery over a 7-year period at Jordan University Hospital.

Materials and Methods

Fifty consecutive patients (11 males and 39 females) were recruited into the study from patients who attended the Oral and Maxillofacial Surgery Department at Jordan University Hospital, Amman, Jordan for orthognathic surgery over a 7-year period between 24th July 2003 and 1st July 2010. Patients were 20 to 43 years old (mean=28±6 years).

An invitation to participate in the study was extended to the patients. Each participant was provided with a full explanation of the study and an informed consent was obtained from each participant before being recruited into the study.

Orthognathic patients were selected for this study, as they received planned surgery and the surgical environment is fairly controlled and standardized where plates can be inserted without problems and preoperative infection of operation site is avoided. Trauma patients were excluded from the study as the operation site might get infected before the operation and the operation is difficult to standardize; this would jeopardize the results of the study. Inclusion criteria included patients who attended for orthognathic surgery and were going to receive planned surgery in order to correct jaw relations and skeletal facial problems including facial asymmetry, skeletal class III relation, skeletal class II relation, bimaxillary protrusion, gum smile, hypoplastic maxilla, condylar hyperplasia and anterior open bite.

To be included, patients should receive rigid internal fixation after one of the following types of orthognathic surgery: bimaxillary osteotomy, maxillary advancement, maxillary pushback, maxillary impaction, mandibular advancement and/or mandibular pushback.

The following data were recorded for all patients: Age, gender, education, occupation, address, marital status, dental and medical history, type of orthognathic operation, indications for plate insertion and removal rate, placement site of plates, time between insertion and removal and clinical indications for removal. The site of plate insertion was classified into right, left and anterior maxilla; right, left and anterior mandible; and chin.

All plates were inserted and removed intra-orally.

All patients who underwent plate removal procedures had been given both intra- and postoperative antibiotics at the time of plate insertion. The surgical procedures were performed under general and local anaesthesia at Jordan University Hospital.

None of the patients who went through plate removal had any significant underlying medical conditions that might predispose compromised immunity, such as diabetes mellitus, steroid therapy or other immune disorders.

One investigator conducted all clinical and radiographic examinations and thoroughly assessed each patient before and after plate removal. Intra examiner reliability was performed on 10 duplicate examinations using Kappa statistics. Kappa was 1 indicating substantial agreement as examination criteria were very clear and simple.

Statistical Analysis

The data were analyzed using the SPSS computer software (Statistical Package for the Social Sciences, version 11.0, SPSS Inc., Chicago, IL, USA). The association between the variables was analyzed using the Pearson correlation and Chi-Square test. For all statistical analysis, the significance level was set at $P \leq 0.05$.

Results

Fifty consecutive patients (11 males and 39 females) were recruited into the study from patients who received orthognathic surgery at the Oral and Maxillofacial Surgery Department (Jordan University Hospital, Amman, Jordan) over a 7-year period between 24 July 2003 and 1 July 2010. Patients were 20 to 43 years old (mean=28±6 years).

The reasons for orthognathic surgery were facial asymmetry, skeletal class III relation, skeletal class II relation, bimaxillary protrusion, gum smile and others (hypoplastic maxilla, condylar hyperplasia and anterior open bite) (Table 1).

Table (1): Patients' distribution according to the reasons for orthognathic surgery (n=50).

Reason for Surgery	*Number of patients*	*Percent (%)*
Facial asymmetry	*11*	*22*
Skeletal class III relation	*19*	*38*
Skeletal class II relation	*10*	*20*
Bimaxillary protrusion	*17*	*34*
Gum smile	*29*	*58*
Others	*21*	*42*

The types of orthognathic surgery were bimaxillary osteotomy, maxillary advancement, maxillary pushback, maxillary impaction, mandibular advancement and mandibular pushback (Table 2). Twenty two patients (44%) required a second surgery, 19 of whom in the form of genioplasty (38%) and 3 in the form of segmental surgery (6%).

Table (2): Patients' distribution according to the type of orthognathic surgery (n=50).

Type of Surgery	*Number of patients*	*Percent (%)*
Bimaxillary osteotomy	*43*	*86*
Maxillary advancement	*15*	*30*
Maxillary pushback	*16*	*32*
Maxillary impaction	*35*	*70*
Mandibular advancement	*11*	*22*
Mandibular pushback	*36*	*72*

Three hundred and twelve titanium miniplates were inserted in 50 patients. Plates were inserted in right, left and anterior maxilla; right, left and anterior mandible; and chin. Types of plates used were titanium 4 hole straight plate without bar, 4-hole straight plate with bar, 4-hole L shaped plate with bar, 4-hole L shaped plate without bar and 6-hole genioplasty plate. The plates were 1.1 mm thick and the monocortical screws had a diameter of 2.0 mm. Table (3) presents the distribution of plate type and number according to the site of plate insertion.

A total of 108 plates (34.6%) were removed. The retention period for the removed plates ranged from 4 months to 4.5 years. The mean retention period of removed plates was 12 months.

Regarding the site of plate removal, 7 patients (14%) had plates removed from right maxilla, 15 (30%) patients had plates removed from left maxilla, 7 patients (14%) had plates removed from right mandible, 11 (22%) patients had plates removed from left mandible, 1 (2%) patient had plates removed from the chin and 9 (18%) patients had all their plates removed. The most common sites for plate removal were maxilla (22 patients, 44%) followed by mandible (19 patients, 38%).

The most common cause for plate removal was palpable plates (27 patients) followed by infection (13 patients), patient discomfort and preference (7 patients), and plate exposure and wound dehiscence (3 patients). Table (4) presents the reasons for plate removal.

Table (3): The distribution of plate type and number according to the site of plate insertion.

Site	*Number of plates*	*Type of plates*
right maxilla	*88*	*4-hole L shaped plate with bar, 4-hole L shaped plate without bar*
left maxilla	*88*	*4-hole L shaped plate with bar, 4-hole L shaped plate without bar*
anterior maxilla	*7*	*4 hole straight plate without bar, 4-hole straight plate with bar*
right mandible	*48*	*4 hole straight plate without bar, 4-hole straight plate with bar*
left mandible	*49*	*4 hole straight plate without bar, 4-hole straight plate with bar*
anterior mandible	*2*	*4-hole L shaped plate without bar*
chin	*30*	*4-hole L shaped plate without bar, 4-hole L shaped plate with bar, 4-hole L shaped plate without bar, 6-hole genioplasty plate*
all sites	*312*	*4 hole straight plate without bar, 4-hole straight plate with bar, 4-hole L shaped plate with bar, 4-hole L shaped plate without bar and 6-hole genioplasty plate*

Table (4): The reasons for plate removal among the study population (n=50).

Reason for plate removal	*Number of patients*	*Percent (%)*
Palpable plate	*27*	*54*
Infection	*13*	*26*
Patient preference and discomfort	*7*	*14*
Exposed plate	*3*	*6*

Correlations

Pearson correlation and Chi square tests showed no significant relationships between plate removal (including number and location of removed plates and reason for plate removal) and age and gender ($p<0.05$). The number of removed plates had no significant relations with age ($p= 0.38$, $r= 0.127$) and gender ($p= 0.606$, $r= 0.075$). The location of removed plates had no significant relation with age ($p= 0.424$, $r=0.116$) and gender ($p= 0.192$, $r=0.188$). Also, the reason for plate removal had no significant relation with age ($p= 0.973$, $r= 0.005$) and gender ($p=0.95$, $r= -0.009$).

The reason of plate removal was significantly related to the number of plates ($p=0.001$, $r=0.441$) and location of removed plate ($p\leq0.001$, $r= 0.62$).

The type of removed plate had no significant relation with the reason for plate removal ($p=0.576$, $r=-0.081$), number of plates ($p= 0.62$, $r= 0.072$) and location of removed plates ($p= 0.467$, $r= -0.105$).

The reason for performing the orthognathic surgery (chief complaint) and type of the orthognathic surgery had no significant relations with the number and location of removed plates and reason for plate removal ($p<0.05$).

Discussion

It is worth highlighting the fact that the removal of plates is not automatically synonymous with a failure of treatment.

In this cohort prospective study, all patients were

recalled and followed up and this increased the strength of this study when compared to previous studies that failed to recall all the patients. [7]

Considering the time that the plates stayed *in situ* before removal, most plates were removed within 12 months after insertion. This concurs the findings of previous studies. [5, 7]

Palpable plates, infection, plate exposure, and patient discomfort and preference, were the major causes for plate removal in this study. This is in agreement with previous studies. [5, 7- 9] The thin oral mucosa and numerous microorganisms in oral cavity might be the reason behind the recorded reasons for plate removal in this study.

The removal rate of plates in this study was 34.6% and this is in accordance with the results of Kuhlefelt et al. (2010). [9]

In this study, age and gender were not found to have any relation with the removal of plates. This concurs the results of Kuhlefelt et al. (2010). [9] However, it disagrees with Manor et al. who found that age is a risk factor for plate removal among patients who had undergone orthognatic surgery. [10]

There is no relation between site and plate removal. This concurs the results of Brown et al. (1989) who studied plate removal in orthognathic patients. [3] However, it disagrees with the findings of Bakathir et al. and this might be due to the fact that they studied trauma patients and young children. [6]

Removal of miniplates is a controversial topic in oral and maxillofacial surgery. Originally, miniplates were designed to be removed on the completion of bone healing. The introduction of low profile titanium miniplates has led to the routine removal of miniplates becoming comparatively rare in many parts of the world.

Those who recommend the routine removal of plates do so on the basis that once a plate accomplished its purpose, it becomes a foreign body and might pose a potential source for problems, and that plate removal is considered a preventive measure and allows avoiding possible risks of growth restriction in pediatric patients.[1,11-13]

The arguments against plate removal are based on the excellent biocompatibility of the titanium material, the low incidence of complications associated with retained plates, the increased risk of subjecting a patient to general anesthesia and the cost involved in removal. [3-5, 7, 14]

The question to remove or retain plates might be resolved only with time and with the increased use of biodegradable materials. However, the biodegradable plates are associated with similar complications like metallic plates but still avoid second surgery to remove the plates in most cases. [15]

Therefore, the authors adopt the suggestion that unless the advantage of removal would be outweighed by the potential morbidity of removal (medical compromise, lack of patient longevity, inaccessibility, cost, etc), plates should not be routinely removed.

Our current practice is to only remove miniplates when they are symptomatic, when they are encountered at further surgery or on request from the patient, which is in accordance with the views of the consultants in the UK and other studies. [4, 7]

Our experience with the removal of miniplates compares with previously published reports. This longitudinal follow-up at 1-7 years indicates that plate-related problems leading to removal are likely to occur during the first year after insertion. This should be discussed and considered during obtaining patients' informed consent.

Conclusions

In this study, plate removal was caused by palpable plates, infection, subjective discomfort and patient preference and plate exposure and wound dehiscence. Plate-related complications leading to removal were more likely to occur

within the first year of insertion, a fact that should be accounted for during the process of obtaining informed consent.

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أسباب إزالة الصفائح العظمية بعد الجراحة الفكية العمودية

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الملخص

الهدف: هدف هذه الدراسة هو تقييم الأسباب الموجبة لإزالة الصفائح الصغيرة من أجسام المرضى الذين خضعوا لجراحة الفك العمودية على مدى فترة قدرها 7 سنوات.

المواد والطرق: شملت الدراسة 50 مريضاً من ذوي الصفائح الصغيرة في أعقاب جراحة فكية عمودية (11 من الذكور و39 من الإناث) بعمر (20– 43) سنة (متوسط العمر= 28±6 سنوات). وتم تسجيل: معلومات شخصية، والتاريخ السّني والمرضي، ونوع المعالجة الفكية العمودية، ومؤشرات إزالة الصفائح، وموقع وضع الصفيحة، والزمن بين إدخال الصفائح وإزالتها. وقد صُنّف موقع إدخال الصفيحة إلى: الفك العلوي الأيمن والأيسر والأمامي، والفك السفلي الأيمن والأيسر والأمامي، والذقن. وقد تم إدخال جميع الصفائح وإزالتها من داخل الفم تحت التخدير الموضعي أو العام. وقد جرى تحليل الارتباط بين المتغيرات باستخدام ارتباط بيرسون واختبار مربع كاي. أما مستوى المعنوية فقد كان ($P \geq 0.05$) لجميع التحليلات الإحصائية.

النتائج: تم إدخال 312 من صفائح التيتانيوم الصغيرة في أجسام 50 مريضاً.

وقد جرى نزع ما مجموعه 108 صفائح (34.6%). وبلغ زمن الاحتفاظ بالصفائح المنزوعة بين 4 أشهر و4 سنوات ونصف السنة. أما أكثر مواقع نزع الصفائح شيوعاً فكانت: الفك العلوي (22 مريضاً بنسبة 44%)، ثم الفك السفلي (19مريضاً بنسبة 38%). وأما أكثر أسباب نزع الصفائح شيوعاً فكانت: الصفائح المحسوسة (27 مريضاً)، ثم الالتهاب (13 مريضاً)، ثم عدم راحة المريض وتفضيله نزع الصفيحة (7 مرضى)، ثم بروز الصفيحة وانفلاقها (3 مرضى). ولم توجد علاقات ارتباط بين نزع الصفائح (بما في ذلك عدد الصفائح ومواقعها وأسباب إزالتها) وبين كل من العمر والجنس. وقد ارتبط سبب إزالة الصفائح معنوياً مع عدد الصفائح وموقع الصفيحة المنزوعة. ولم يكن لنوع الصفيحة المنزوعة ارتباط معنوي بسبب نزع الصفيحة أو عدد الصفائح أو موقعها. وكذلك فإن سبب إجراء الجراحة الفكية ونوع تلك الجراحة لم تكن لهما علاقات معنوية مع عدد الصفائح المنزوعة أو موقعها أو سبب إزالتها.

الاستنتاجات: كان سبب نزع الصفائح عائداً إلى: الصفائح المحسوسة، والالتهاب، وعدم ارتياح المريض وتفضيله نزع الصفيحة، وبروز الصفائح أو انفلاقها.

وقد كانت التعقيدات المرتبطة بالصفائح والتي سببت إزالتها محتملة الظهور إبان السنة الأولى من زرعها. وهذا يجب أن يوضع في الاعتبار.

الكلمات الدالة: الصفائح الصغيرة، الصفائح العظمية، نزع الصفائح، مؤشرات النزع.