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British Journal of Oral and Maxillofacial Surgery 54 (2016) 496–500

BRITISH Journal of Oral and Maxillofacial Surgery
www.bjoms.com

Stability and complications of miniplates for mandibular reconstruction with a fibular graft: outcomes for 544 patients

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Accepted 17 August 2015
Available online 1 October 2015

Abstract

Fibular flaps are usually used for the reconstruction of the mandible, but the use of plate systems, including miniplates and reconstruction plates, has recently been debated. We have made a retrospective study of 544 consecutive patients who had fibular grafts with miniplates used for fixation, and also made retrospective measurements of orthopantomographs from 37 patients to assess the stability of the miniplates used in the fibular flaps. When miniplates were used with fibular flaps there were 10.3% (56/544) complications, of which 4.8% (26/544) were loosening of the screws, 2.6% (14/544) fracture of the plate, 1.5% (8/544) exposure of the plate, and 6.4% (35/544) infection. The median **(IQR)** time at which the complications occurred was 24 (7–48) months. We conclude that loosening of screws is common at the binding interface near the condyle and in the molar region; plates are more likely to fracture near the binding interface in proximity to the molar region; and plates at the chin are the most likely to be exposed. Diabetes and the use of radiotherapy were associated with complications. Our data suggest that miniplates used for mandibular reconstruction are relatively reliable.

Keywords: Mandibular defect; Reconstruction; Miniplate; Complication; Stability

Introduction

Microvascular free flaps are commonly used to reconstruct oromandibular defects, and fibular flaps are the most reliable way to reconstruct a long defect in the mandible. They have the advantage of providing sufficient blood supply and a stock of bone large enough to be shaped to repair a serious defect in the mandible. Plating systems are critical to guarantee the stability of grafted bones, and the most commonly used are reconstruction plates and miniplates.

Single large plates used to stabilise fibular free flaps are difficult to manipulate during the operation and may interfere with the vascular pedicle. They can be prebent, however, which can save operating time and maximise geometrical accuracy. However, a "stress-shielding" phenomenon has been described, which may lead to resorption of bone.[1] Stress shielding happens when the normal forces exerted on the mandible are eliminated by the rigid plate, and bone is resorbed because it is no longer needed to maintain the same load. This decreases the bone mineral content of the neomandible and lessens overall bony strength, so osteonecrosis is common in a neomandible with a reconstruction plate.[2]

Miniplates are fixation plates with a diameter less than or equal to 2.0 mm.[3] They have several advantages including ease of application, short fixation time, little risk of disruption of the vascular pedicle, and ease of removal if necessary.[4] In contrast, because they are smaller, they are

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http://dx.doi.org/10.1016/j.bjoms.2015.08.259

Table 1
Types of defect according to the classification of Jewer et al,[6]

Type of defect	Number (%)
L	239 (44)
H	141 (26)
HC	7 (1)
HCL	6 (1)
LC	72 (13)
LCL	79 (15)

more likely to fracture and result in malunion or non-union of the neomandible.[5]

Some surgeons prefer to use large plates because they doubt the stability of miniplates for fixation of grafted bone and think that they have a higher chance of complications. However, after radiotherapy thick reconstruction plates can often dehisce through the skin, and that is why we use miniplates. We have retrospectively reviewed the reliability and stability of miniplates used for fibular flap reconstruction.

Material and methods

We reviewed the records of 544 consecutive patients who had fibular reconstruction with miniplates (diameter 2.0 mm) during a 10-year period (January 1999-December 2010).

We recorded personal and clinical details, diagnosis, sites and types of defects, smoking history, radiotherapy, duration of follow up, and complications related to the plates. We defined these as: loosening of the screws, fracture of the plate, exposure of the plate, and infection.

We used the standard international HCL classification suggested by Jewer et al,[6] to assess defects: defect C encompasses the central mandibular segment between teeth 33 and 43; defect L extends from the canine tooth to the base of the articular process leaving out the condyle; and defect H encompasses the mandible from the symphysis up to and including the condyle (Table 1). We recorded factors that could be related to the survival of the plate, which included age (less than 65 and 65 or more), sex, smoking, diabetes, radiotherapy, and defects of the mandible (anterolateral or lateral).

We used the following inclusion criteria to study the stability: patients with single defects of the condyle (H and HC); follow up of at least 1 year; and all panoramic radiographs complete. The exclusion criteria were the use of radiotherapy and complications that developed during follow up. A total of 37 patients were included. We measured the mandibular angles of the normal side and the angles on the grafted side, which were formed by fibular bones. Angle A refers to the normal mandibular angle, while angle B refers to the angle formed by the fibular bones. To measure these angles we drew four lines on the panoramic radiographs: line one and line two formed the external margin of the two grafted fibulas; line three was drawn across the tangent of the lowest edge of the mandibular body that crosses the bottom point of

Figure 1. The measurements of Angle A and angle B on orthopantomography.

the mandibular angle; line four was drawn across the most lateral point of the condyle and the most lateral point of the mandibular angle. We defined angle A as the angle formed by lines one and two, while angle B was formed by lines three and four (Figures 1 and 2). The difference between the values of angle A and angle B was recorded as angle C. Serial data for angle C were taken during each follow up and changes in this angle were evaluated, which avoided bias caused by any distortion in the orthopantomographs. Data were entered into IBM SPSS software (version 17.0 IBM Corporation, Armonk, NY, USA) and analysed using Kaplan-Meier analysis, Cox's regression analyses, and a paired sample *t* test ($\alpha = 0.05$).

Results

In all, 544 patients were reviewed, which included 206 women (38%) and 338 men (62%). The mean (SD) age of the patients was 43 (SD = 16.362) years and the mean (SD) duration of follow up 36 (SD = 36.037) months. The most common causes for defects of the mandible were ameloblastoma (n = 168, 31%) and squamous cell carcinoma (n = 148, 27%).

Table 1 shows the type of defects studied, of which 23 (4.2%) had problems with the venous return, and of these, 14 survived. Plates were removed from 52 (9.5%) because of recurrent tumour with metastases, 14 (2.5%) had locally recurrent tumour alone, and 26 (4.7%) had complications

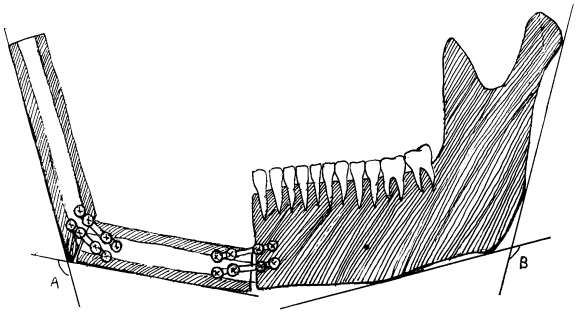

Figure 2. Diagram of the measurements of angle A and angle B.