

Resorption of fibula bone following mandibular reconstruction for osteoradionecrosis

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Abstract

The free fibular flap is commonly used for mandibular reconstruction because of its length, consistent blood supply, and relative ease of harvest. The bone has been shown to maintain mass over time, which confers a potential advantage over other osseous flaps. We know of no published papers on changes in height of fibular bone in patients treated for osteoradionecrosis (ORN). We measured the change in bony height over time as an indirect measure of bone mass. We identified 17 patients (mean age 65, range 49–80 years) who had had reconstruction with a free fibular flap for mandibular ORN. Of them, 10 had fixation with a reconstruction plate, and serial radiographs were available for inclusion in the study. Three measurements were taken on at least 2 rotational tomograms for each patient. Two observers recorded measurements at 25, 50, and 75% of the distance along the bone. Mean change in fibular height (mm) and percentage change were calculated. The interval between radiographs ranged from 5 months 4 days to 20 months 14 days. There was a reduction in fibular height in 8/10 cases, with a mean reduction of 1.5 mm (range 2.6–0.3), or 11%. Our results show a moderate reduction in fibular height, which is comparable with a previously published series of patients without ORN who had reconstruction with miniplates. The stress shielding effects of reconstruction plates were less evident in our patients than in previously published material.

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Introduction

The free fibular flap is one of the most commonly used osseous flaps for reconstruction of segmental mandibular defects and it has several advantages over other osseous free flaps. These include length of the pedicle, segmental blood supply, the option of 2-team operating, and the potential for a number of soft tissue pedicles, which give more versatility in the reconstruction of mucosal and cutaneous defects.

The choice of fixation of the flap is debatable, and opinion is divided between the use of miniplates or reconstruction plates. Reconstruction plates can be attached to the native

mandible before segmental resection and therefore maintain the occlusion more consistently than miniplates. The use of three-dimensional modelling derived from computed tomography (CT), which allows reconstruction plates to be pre-bent, reduces operating time and improves accuracy. The importance of load-sharing or load-sparing fixation is yet to be fully assessed.

Published papers report variable resorption of free fibular bone after transfer and most authors use fibular height as an indirect measure of bone density. Mean fibular height decreased by 10% or less when miniplates were used in a group of 35 patients followed up for a minimum of 2 years.¹ Conversely, increased resorption of fibular bone has been seen when reconstruction plates were used. Zoumalan et al. found a 20% mean reduction in fibular height in 7 patients after 12 months,² which was thought to be caused

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by the stress-shielding effect conferred by the reconstruction plates. The pathophysiological theory suggests increased demineralisation, reduced strength, and possible osteoporosis. In contrast, the greater loading of bone when using miniplates may cause biomechanical stimulation and lead to the bony height being maintained or even increased. The effect of radiotherapy and the influence of other factors such as cardiovascular disease and diabetes on resorption rates are poorly understood.

The fibular height and resorption rate are important for decisions regarding rehabilitation with osseointegrated dental implants. Again, published reports show mixed results; some units report good integration of the implants despite appreciable resorption,² whereas other groups have used aggressive techniques such as vertical distraction osteogenesis or onlay grafting to increase height before implantation.³ The variations in these results may be related to differing interpretations of a “successful” outcome.

We know of no published papers that exclusively report changes in the height of fibular bone in patients treated for osteoradionecrosis (ORN). We present the resorption rates for fibular bone after the use of reconstruction plates in a series of 10 patients and compare our results with those in published reports.

Patients and methods

We searched the hospital information system to identify all patients who had undergone reconstruction with a fibular free flap after mandibular resection for ORN. A total of 17 patients were identified over a 3-year period (March 2009–March 2012) and of them, 10 had had reconstruction with a fixation plate and had serial radiographs available for inclusion in the study. Three measurements were taken on 2 rotational tomograms for each patient (tomograms with the widest time interval were used). To reduce variability between observers, 2 observers measured the fibular height at 25, 50 and 75% of the distance along the bone. Fixation hardware was used to calculate the change in magnification between images and thereby adjust for magnification error. All measurements were taken using the calliper tool in the picture archiving and communication system (PACS), and results were collated and analysed using Microsoft Excel. The mean fibular height was then calculated from the 3 measurements on the postoperative and interval rotational tomogram. The differences were then calculated for each patient and for those with a reduction in fibular height. The mean change in height (mm), and the percentage change were calculated.

Results

Ten patients were included in the study. The mean age was 65 years at the time of operation (range 49–80). The interval between the radiographs ranged from 5 months 4 days to 20 months 14 days. There was a reduction in height in 8/10

fibulas (Table 1). The mean reduction for the 8 fibulas was 1.5 mm (range 2.6–0.3) or 11%. In 2 cases the mean height increased (Fig. 1). Our results ranged from a 4% gain to an 18% loss in height. There was no correlation between the length of the interval between the radiographs and the amount of resorption.

Discussion

Our results show a reasonable maintenance of fibular height over time in patients who had reconstruction with a fibular free flap and plate fixation for ORN. A comparison of our results with previous studies is shown in Table 2.

The Memorial Sloan-Kettering group published results of 35 patients undergoing fibular free flap reconstruction.¹ They compared their results with iliac crest and radial forearm free flaps for reconstruction after mandibular resection for a variety of diseases. For the fibular flaps the follow-up range was 24–104 months (mean 47). Resorption ranged from 0 to 33% (mean 7%), and was 10% in those who had had radiotherapy before reconstruction. This is similar to the result of our study (11%), but with a longer follow-up period. They did not specify numbers where there was an increase in fibular height or no change (Table 2).

Zoumalan et al. reported their results of fibular free flap reconstruction for benign odontogenic diseases.² They showed a mean resorption of 20% but did not expand on the range or loss of height. Reconstruction plates were used in all cases and they suggested that the increased resorption was caused by the effects of stress-shielding. Of the 4 patients who had osseointegrated implants at the time of publication, 2 had had them placed at the time of reconstruction. The time to integration and follow-up intervals were not published but no implants failed despite the loss of fibular height (Table 2).

Raoul et al. published their results of fibular reconstruction with implantation from 1996 to 2007.⁴ Their series included 4 patients treated for ORN. They reported an average 3 mm resorption of fibular crest in 16 patients but did not postulate why it was so marked. Conversely, in 14 patients there was no change in height. They did not give percentage figures (Table 2).

A mean 2.5 mm peri-implant reduction or resorption has been reported in distracted fibulas.³ Lizio et al. found that distraction osteogenesis after transfer led to increased complications and appreciable resorption. In comparison, Raoul et al. did not find that fibular height was restrictive when it came to offering dental implants.⁴ This finding is similar to that of Zoumalan et al.²

It has been suggested that radiation therapy before operation causes increased resorption of fibular bone after reconstruction. Our series, although small, suggests that there can be reasonable preservation of fibular mass when reconstruction plates are used in these patients with a similar result (11%) to that of Disa et al. (10%) who used miniplates.¹ In their series, 10/35 patients had had radiotherapy, 6 before

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