A Simple and Cost Effective Template for Central Segment Reconstruction of Mandible with Free Fibula Flap

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Abstract

Purpose A variety of templates are being used for mandible reconstruction with free flaps. We describe a simple and cost effective method using a 'K' wire template for the central segment reconstruction of the mandible with free fibula flap.

Materials and Methods Over a period of 5 years from January 2005 to December 2009, there were a total of 386 mandible reconstructions with free fibula flaps of which 262 were central segment reconstructions. The number of osteotomies varied from 1 to 2 depending up on the length of the bone reconstructed. 'V' shaped closing wedge osteotomies were done and the segments were aligned with mini plates. In all the cases a 'K' wire was used in forming a template for the neo mandible from the resected specimen.

Results The bone union was good in all the cases as determined by the orthopantomograms taken at the third month follow up. The most common complication was prognathism of the neo mandible.

Conclusion 'K' wire template is a simple and cost effective device to design the shape of the neo mandible with less osteotomies and align the osteotomised bone segments in an angle that gives a near normal shape.

Keywords Mandible reconstruction · Central segment · Free fibula flap · 'K' wire template

Introduction

The complex oro mandibular defects or en bloc defects occur as a result of resection of T3 and T4 cancers and require reconstruction with composite vascularised free tissue transfer to provide the strength, stability, osseointegration of dental implants and to maintain the contour of the chin. Free fibula flap described by Hidalgo fulfils the above criteria and is the most common composite tissue used to reconstruct the middle third defects of the mandible. Templates are designs or patterns used in re-making of structures and a variety of templates are described in literature for mandible reconstruction with free fibula flaps. We present our experience with 'K' wire template which is simple, cost effective, easy to produce and enables to complete the osteotomies and alignment of the bone segments in relatively short time.

Materials and Methods

Three hundred and eighty six reconstruction were done over a period of 5 years from January 2005 to December 2009 of which 262 [164 male and 98 female] were central segment reconstructions. The age of the patients were ranging from 8 to 73 years. The most common tumour was squamous cell carcinoma at T3 or T4 stage. About 2 to 7 cm of bone was used for reconstructing the central segment and the numbers of osteotomies were ranging from 1 to 2 and majority [254] of them required two osteotomies. Miniplates and screws were used for fixing the segments.

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All the patients with malignant pathology underwent postoperative radiotherapy. Osseointegration of dental implants was done in 10 patients one year after completion of radiotherapy. The period of follow up was ranging from 3 months to 2 years. The post irradiation complications such as plate exposure, extrusion and oro cutaneous fistula were not included in the study. Mandible reconstruction plates were used only in cases where hemimandibulectomy was done on one side with removal of additional bone on the other side. In these patients, cantilever reconstructions were done [5/386] and were not included in this study.

The Template

In this technique, a 15 cm long stainless steel 'K' wire was used which can be moulded to the shape of the central segment. The shape is determined from the resected specimen and a template is made by bending the 'K' wire to the desired shape (Fig. 1).

Osteotomy and Bone Fixation

The osteotomies were planned from distal to proximal end of the fibula taking care of the septal perforators and excess bone is discarded from the proximal part of the bone so as to provide additional length of the peroneal vessels. To enable maximum contact between the segments and to maintain the contour, 'V' shaped osteotomy (Fig. 2a) were made with an oscillating saw after detaching the flap from the donor leg and marking the level of the septocutaneous perforators with methylene blue so as not to damage them during the osteotomy. The apex of the 'V' was placed over the peroneal surface of the fibula and the base was placed

on the inner surface and thus the two limbs of the 'V' cutting across the anterior and posterior surfaces. The intact periosteum along with the blood vessels is separated from the segment of bone to be osteotomised and then the osteotomy is done (Fig. 2b). After the osteotomy was completed, the bone segments were fixed with mini plate and screws. Temporary inter maxillary fixation was done whenever possible and was removed after fixation of the neo mandible with the remnant mandible. This was done to avoid splaying of the ramus by adding extra length of bone. Following this, the reconstructed segments were placed in the mandibular defect and compared with the upper jaw so as to get the proper occlusion. Before incorporation into the remnant mandible, the anterior midline of the central segment and the upper incisors were made to fall in the same line so as to avoid chin deviation and prognathism. After this step, the excess bone was discarded from the proximal part of the fibula and this increases the pedicle length so as to facilitate tension free micro vascular anastomosis. Once this was done, the fibula resembles the central segment of the mandible (Fig. 3) and was then fixed into the native

Fig. 1 The 'K' wire template. A K-wire with a central segment of 3 cm and two lateral segments of 6 cm each. The central segment meets the lateral segments at an angle of 60°

Fig. 2 a The marking for 'V' shaped osteotomy. b On the extreme left is the marking for osteotomy to discard the excess bone

Fig. 3 After osteotomy and approximation of the closing angles the new central segment corresponds to the template

Fig. 5 Three month postoperative X-rays showing good bone union

Fig. 4 The new central segment is fixed into the remnant mandible

mandible (Fig. 4). If the central segment was found protruding beyond mid incisor line, then some more bone was removed from the lateral segments and the final fixation was done. If there was splaying of the ramus, malocclusion or prognathism, excess bone from the lateral segments was removed and occlusion was checked again.

Results

All the osteotomised segments healed well as was seen in 3 month postoperative orthopantomograms (Fig. 5). There were no instances of plate fracture in the postoperative period. The common complications were prognathism (28 patients), deviation of chin (22 patients) and malocclusion (10 patients) (Fig. 6). Patients with malocclusion were managed with revision osteotomy after 1 year. Dental

Fig. 6 Prognathism of the reconstructed mandible seen in our earlier results

rehabilitation with osseous implants was done in 10 willing patients 1 year after irradiation. Mouth opening, jaw occlusion, oral competence, speech and swallowing were used to analyse the functional results. The results were good in 80% and acceptable in 20% of cases.

Discussion

Tumour ablative surgeries of the oral cavity results in severe defects of the facial skeleton. Depending up on the severity of the component loss Daniel [1] classified them accordingly and named those through and through defects of the oro mandibular region as en bloc defects or complex defects. Boyd [2] classified mandibular defects by dividing them into segments [HCL Classification]. Among the en

bloc defects, the anterior defects or the central segment defects are difficult to reconstruct. This is because, they are associated with the loss of anterior skin and require a lip split incision [3] both of which interfere with the post operative appearance.

The free fibula flap described by Hidalgo [4] is the most common composite vascularised free tissue used for reconstruction of complex oro mandibular defects [1]. The techniques in flap design, harvest and osteotomy have undergone changes over the years [5]. The osteotomy of the fibula and the alignment of the osteotomised segments is a significant step in the challenging task of mandibular reconstruction. In order to simplify this step, a variety of mandibular templates are being used. The templates are important because they help in restoring the normal contour of the mandible especially the lower margin, help in planning the number of osteotomies thereby minimizing the periosteal stripping and reducing the vascular compromise. The advantages of using templates are well supported by Hidalgo [3] and Strackee [6]. These templates are made preoperatively from routine X-rays [7], orthopantomograms [8], three dimensional CT scan [9], acrylic jaw impressions [10] and lateral cephalogram [11]. Intra operatively, the templates can be made from the resected specimen [12], reconstruction plate [13], tongue blade template [14], aquaplast [15] template, by jigsaw [16] technique or by preplating systems [17]. Though making a template out of the radiological images are routine, converting the images into practical templates is very demanding and always an element of intuitive mind helps in making the correct osteotomy and there by the contour of the reconstructed mandible [3]. The intra operative methods of making the templates from the specimen or from the defect are more practical but have many disadvantages. Use of reconstruction plates gives good stability. The disadvantages are that there might be damage of the periosteum and thereby can compromise the vascularity of the bone, alter the shape of the neomandible and will require removal at a later date for dental rehabilitation [16]. Closing wedge osteotomies cannot be made in comparison with the tongue blade template [14] and using aquaplast [15] and jigsaw system [16] are not simple or cost effective and may require longer duration and thus prolong the duration of surgery.

The 'K' wire template was described by Wagner [17] and was his preferred method in mandibular reconstruction with fibula flaps. We modified this so as to apply for all the complex mandibular reconstructions. The complications in our study such as prognathism, malocclusion and deviation of chin were found in the earlier days. With increasing experience, our techniques refined and these were largely avoided in the recent years. Compared to the rest of the templates our technique is simple, cost effective and manage to provide and maintain the three dimensional

contour of the mandible. Though this template is custom made, this can be used only for reconstructing the central segment defect of the mandible and not for the angle or ramus of the mandible.

Conclusion

The number of osteotomies and the alignment of the segments in proper angles are important in providing the shape and strength of the reconstructed mandible. 262 central segment defects out of a total of 386 mandible reconstructions over a 5 year period were done using this template with good results. The drawback seen during the initial stages were rectified as the technique was refined and the skills improved. Compared to all the other templates described so far, the 'K' wire template is simple, cost effective and enables the osteotomy and alignment of segments to be completed in quick time.

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