



Evaluation of Osteocutaneous Radial Forearm Free Flap in Maxillofacial Reconstruction: A Literature Review

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Abstract

Maxillofacial reconstruction surgery has largely depend on local flaps for soft tissue reconstruction and nonvascularized bone grafts for bony reconstruction. The paradigm shift has been to vascularized free tissue for larger soft tissue, bone, or composite defects in the head and neck and biologic agents such as bone morphogenic proteins (BMP), blood components such as platelet-rich plasma and fibrin, and tissue engineering. Although osseous-free flaps are acknowledged as a superior reconstructive option, there are a number of different flaps – iliac crest, fibula, scapula or radial forearm. Each of these has benefits and disadvantages for the reconstruction, with success defined by flap survival, donor site morbidity, capacity for normal speech, ethetics, oral competence and diet and successful dental rehabilitation. The osteocutaneous radial flap is reliable, and relatively simple to harvest, which will ensure that it remains one of the established reconstructive options in most maxillofacial units. The introduction of prophylactic internal fixation augments the role of the osteocutaneous radial flap for repair of defects that require a relatively small volume of bone and an appreciable area of thin soft tissue, specially when a long vascular pedicle is desirable. This includes low level defects of the maxilla, some defects of the mandible, and niche reconstructions, such as the orbital rim. The focus of this review are different surgical techniques, indications and outcomes of osteocutaneous radial forearm free flap in Maxillofacial reconstruction.

KeyWords: Maxillofacial reconstruction surgery, osteocutaneous radial forearm free flap.

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Introduction:

Maxillofacial reconstruction surgery has largely relied on local vascularized flaps for soft tissue reconstruction and nonvascularized bone grafts for bony reconstruction. The paradigm shift has been to vascularized free flaps for larger soft tissue, bone, or composite defects in the head and neck and biologic agents such as bone morphogenic proteins (BMP), blood components such as platelet-rich plasma and fibrin, and tissue engineering. (1)

Controversy remains around the extent of mandibular defects and need for vascularized bone grafts. Our specialty literature cites 9 cm as a

critical length however, traditional reconstruction sources from the orthopedic literature say that 6 cm is the maximum extent of free grafting. The significant amount of tissue vascularity and reduced load requirements of the head and neck make larger span defects amenable to free grafting in maxillofacial reconstruction(2)

The most complex and controversial area in head and neck reconstructive surgery is the management of maxillary, midface, and skull-base tumors not only in terms of pathology control or cure but in the best methods of oral and facial reconstruction and rehabilitation.(3)



Although osseous-free flaps are approved as a superior reconstructive option, there are a number of potential donor sites – iliac crest, fibula, scapula or radial forearm. Each of these has advantages and disadvantages for the reconstruction, with success defined by flap survival, donor site morbidity, capacity for normal speech, esthetics, oral competence and diet and successful dental rehabilitation.(4)

The focus of this review are different surgical techniques, indications and outcomes of osteocutaneous radial forearm free flap in Maxillofacial reconstruction.

Methods

We reviewed English language articles published on PubMed between January 1990 and the end of July 2022. We used keywords that were unique to the databases and combined them with free-text terms. Those used were: osteocutaneous radial forearm; free flap; maxillofacial and reconstruction. We found 35 referenced abstracts; and these were read by the first author.

Full-length reports of using osteocutaneous radial forearm for maxillofacial reconstruction were included. Reports which did not relate to the flap of interest; or there was insufficient data about maxillofacial reconstruction; reconstruction without free tissue transfer; conference abstracts; and duplicate referenced abstracts; were excluded.

A total of 35 abstracts were read. Of these; 9 provided adequate data and details for the purposes of this review. The first author read the 8 papers to find out the name of the institution, the aim of the article, the different harvesting techniques of the flap, indications and outcomes of using of this flap, donor site morbidity and how to prevent, post operative complications, and the method of rehabilitation with or without the need for implants. All data on outcome were recorded even when they were not complete.

Results

We divided the publications into 4 categories to show different surgical techniques during OCRFFF harvest (3 articles), indications of flap usage (4 articles), outcomes and donor site morbidities (2 articles), and flap complications (1 articles).

Table 1 shows the aims of the publications. Most were reports of series that showed the overall experience and outcomes of using OCRFFF in maxillofacial reconstruction.

Different surgical techniques

- The skin flap elevation is easiest in the subfascial plane. Starting on the ulnar aspect, proceed as far as the lateral (radial) border of the flexor carpi radialis. The distal pedicle is ligated and divided. If the initial dissection is in the suprafascial plane, the fascia must be incised along the lateral border of the flexor carpi radialis
- Retract the flexor carpi radialis. Avoid damaging the median nerve which lies medial to the distal aspect of the tendon. Retraction exposes the flexor pollicis longus and pronator quadratus, which are incised along the length of the bone graft to reach the ulnar (anteromedial) aspect of the radius.
- Preserve sufficient muscle cuff to protect periosteal perforating vessels passing through the muscles from the inferior surface of the radial pedicle. Most perforators run close to or in the lateral intermuscular septum which remains attached to the lateral aspect of the bone graft.(5)
- Osteotomy technique The end osteotomies are beveled to avoid over-cutting and stress concentration. The horizontal anteromedial osteotomy is performed from the ulnar aspect with a fine fissure burr using the 'postage stamp' method.
- Shift to the radial aspect and mobilize flap, Retract the brachioradialis and dissect on the deep surface of the muscle to identify the osteotomy site, taking care to preserve the attachment of the intermuscular septum to the lateral aspect of the bone. pedicle. A maximum of 11–13 cm can be harvested. The proximal dissection is completed as normal and finally bone plating the radius.
- Another technique in 2015 by Man QW et al. Flowthrough technique From Radial Forearm Flap for free fibula osteocutaneous flap was reported. (6)
- Also, in 2016 Gonzalez-Castro et al. introduced a Double-Barreled Radial Forearm Flap aiming to get the length and the width required for a bony flap to accept osteointegrated implants. (7)

Indications

- It has an effective role when only a relatively small volume of bone is required for specific areas



such as the anterior maxilla, the ascending ramus, angle, and posterior non-tooth-bearing regions of the mandible, and specially when a soft tissue lining component is required. (8)

- It has been sued that the radial flap is more cost-effective than other free flaps, and in selected circumstances it may be more appropriate because of the high success rate of the flap combined with a relatively low incidence of serious systemic morbidity related to the donor site.(9)
- The introduction of PIF will consolidate the role of the osteocutaneous radial flap for repair of defects that require a relatively small volume of bone and an appreciable area of thin soft tissue, particularly when a long vascular pedicle is desirable to avoid a vein graft. This includes low level, class 1 and 2 defects, of the maxilla when the segment of bone provides additional support to the drape of the skin component. and reconstruction of the mandible as described earlier. The flap also has a number of niche roles such as reconstruction of the orbital rim and nasal defects.(10)
- It is still useful as a first choice of flap: when there is appreciable peripheral vascular disease as the radial artery is usually relatively unaffected,(11) and when there is other serious comorbidity; it is the preferred option of the patient for functional reasons such as lower limb or hip mobility, and as a salvage flap when other reconstructive options have been tired.(12)

Outcomes and donor site morbidities

With rigid fixation of the residual radius, donor site morbidity has been diminished, and indications for this flap have expanded. Specifically, the anterior maxillary arch and the ascending ramus, angle, and posterior body of the mandible (nontooth-bearing areas) are the sites most amenable to the thin bony stock of the harvested radius. The pliable forearm skin is ideal for the soft tissue defects. We believe that the OCRFF with bone has a definite role in the reconstruction of select head and neck defects.(13)

Complications

In 2022 Le JM et al. published study suggests that the rate of nonunion and odds of having a late complication were significantly greater in the OCRFFF compared to the FFF following oncologic mandibular reconstruction. However, flap success, early complications (<30 days), and

length of hospital stay were comparable between the two flaps.(14)

DISCUSSION

The maxillomandibular complex is a complicated structure with multiple functions such as mastication, breathing, swallowing, speech, and lip competency, located in a esthetically demanding region of the head and neck. maxillofacial reconstruction has been revolutionized with the use of free tissue transfer and microvascular surgery, which provide adequate reliable bone and soft tissue from distant sites for reconstruction of the defect.(15)

Selection of the appropriate reconstructive technique is the most important part of the whole procedure. there are a number of potential donor sites including iliac crest, fibula, scapula or radial forearm. Each of these has benefits and disadvantages for the reconstruction.

The osteocutaneous radial flap is robust, reliable, and relatively simple to harvest, which will ensure that it remains one of the established reconstructive options in most maxillofacial units.

One of Limitations of OCRFFF is its use for bony reconstruction in the head and neck because of the morbidity of harvesting the radius and the limited bone stock, to solve this The introduction of PIF is the most important recent development in surgical techniques. In our original report a 3.5mm steel dynamic compression plate (DCP) was placed on the anterior surface of the radius, using a conventional anterior approach, and over the donor site defect.

There is a great trend towards the use of lower profile 2 and 2.4mm locking reconstruction plates because they are less rigid and less likely to cause stress protection. The plates seem to be equally effective in clinical practice, are more readily adapted, less palpable, and the incidence of hardware-related problems may be lower. (9)

Also, in 2016 Gonzalez-Castro et al. introduced a Double-Barreled Radial Forearm Flap aiming to get the length and the width required for a bony flap to accept osteointegratedimplants.(7)

osteocutaneous radial flap for repair of defects that require a relatively small volume of bone and an appreciable area of thin soft tissue, particularly when a long vascular pedicle is desirable to avoid a vein graft. This includes low level, class 1 and 2 defects, of the maxilla when the piece of bone provides additional support to the drape of the skin



component and the ascending ramus, angle, and posterior body of the mandible (nontooth-bearing areas).

Conclusion

osteocutaneous radial flap still has effective role in repair of defects that require a relatively small volume of bone and an appreciable area of thin soft tissue, mainly when a long vascular pedicle is desirable. This includes low level defects of the maxilla, some defects of the mandible, and orbital rim reconstruction. It remains useful as a first choice of flap when there is appreciable peripheral vascular pathology, when there are other serious synchronized medical conditions; if it is the preferred choice of the patient for functional reasons such as mobility of the lower limb or hip, and as a salvage flap when other reconstructive options have been tired.

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