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Review Article

Advances in microvascular head and neck reconstruction using free fibula and radial forearm free flap to reconstruct various orofacial defects: a mini review

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ABSTRACT

This mini review explores the efficacy of the free fibular flap and radial forearm free flap in reconstructive surgery, particularly for mandibular and head and neck reconstructions. The free fibular flap is established as the gold standard for mandibular reconstruction, boasting a high success rate and benefits such as a long pedicle, flexible skin island, ample dense cortical bone and minimal donor site morbidity, alongside a flap survival rate of up to 95%. While preoperative virtual surgical planning can improve outcomes for complex defects, its high costs hinder widespread implementation. Conversely, the radial forearm free flap is recognized for its versatility in managing large and medium-sized defects, although it necessitates careful consideration of potential postoperative complications and associated morbidity. Ultimately, both techniques present distinct advantages and challenges, underscoring the necessity for individualized surgical strategies in patient care.

Keywords: Free fibula flap, Head and neck reconstruction, Orofacial defect, Radial forearm free flap

INTRODUCTION

Microsurgical free flaps are regarded as the gold standard for head and neck reconstruction following composite tumor resections. They offer enhanced functional and aesthetic restoration while minimizing donor-site complications. This article outlines our method for this intricate procedure. Free tissue transfer comprises four key stages assessing the defect, preparing the recipient vessels, selecting and harvesting the flap and inserting the flap and performing microsurgical anastomoses. Each step is emphasized, as careful attention to detail is vital for the overall success of the surgery. The primary flaps we utilize include the anterolateral thigh, radial forearm, fibula and jejunum flaps.[1,2] Over the past ten years, the free fibula flap (FFF) has emerged as the preferred method for reconstructing significant defects in the mandible and maxilla. When evaluated against various microvascular transplant options, fibular bone closely resembles the characteristics of the jaws and its length facilitates bone reconstruction after extensive resections. Both skeletal and soft tissue components can be taken as a single composite flap, allowing for the simultaneous repair of bone and soft tissue defects.

The morbidity at the donor site has been reported as minimal, with no significant impact on lower limb function. Specifically, studies have shown no functional limitations in walking and stair climbing. Oral function and postoperative facial aesthetics greatly influence a patient's perception of the outcome following ablative surgery. Numerous studies have been conducted to evaluate function and quality of life after head and neck tumor resections using validated questionnaires and clinical assessments. Generally, long-term follow-up

studies have rated facial appearance, speech, food tolerance and swallowing as satisfactory.[7] The radial forearm free flap is highly esteemed in head and neck reconstructive surgery, recognized as one of the most dependable and adaptable flaps. The microsurgical procedure is generally straightforward thanks to the presence of large vessels and a long pedicle, while the dual superficial and deep venous networks offer numerous microsurgical possibilities. The coaptation of the sensory nerve, which remains a topic of debate regarding sensory restoration and weight-bearing foot reconstruction, has recently seen technical improvements.[10]

REVIEW

Free tissue transfer is an adaptable and effective technique for reconstructing specific head and neck defects resulting from trauma or oncological resections. Microvascular reconstructive surgeries are some of the most time-consuming, technically demanding and labor-intensive procedures in otolaryngology/head and neck surgery departments. Nonetheless, advancements in technology, greater experience and strong training programs have led to microvascular success rates exceeding 97% in many high-volume facilities. With this remarkable success, research focus has moved to improving techniques, broadening applications and enhancing efficiency.[3]

The conventional method for head and neck reconstruction is often seen as difficult, involving a subjective evaluation of complex defects and careful shaping of a bone flap to fit. With the advent of virtual surgical planning (VSP), surgeons can enhance efficiency, precision and patient outcomes. The study by Tang et al, aims to compare VSP to traditional head and neck reconstructions using fibula free flaps, focusing on surgical efficiency and patient results. The findings of this meta-analysis indicate that VSP offers notable advantages, such as improved orthognathic accuracy, reduced ischemic and intraoperative times, without a significant rise in complications.[1]

The primary objectives of reconstruction for any specific defect are to maintain structural integrity, enhance functionality, restore appearance, minimize morbidity and improve the quality of life (QOL). For patients requiring free tissue transfer and rehabilitation utilizing endosseous implant-supported prosthetics, several factors must be taken into account, including patient motivation, overall survival and long-term prognosis. Different types of vascularized bone free flaps for head and neck reconstruction, such as those from the radius, scapula, rib, ilium, femur, fibula and metatarsal bone, have been documented.

Among these, the fibula, ilium and scapula are the most frequently used and well-researched regarding endosseous implant placement and rehabilitation, each having its own benefits and drawbacks depending on whether the maxilla or mandible is being reconstructed, as well as the volume and length of bone and soft tissue required. The impact of radiation therapy on endosseous implant insertion in both native and vascularized bone grafts has been thoroughly investigated, with varied reports on the success of osseointegration in irradiated vascularized bone.

Primary implant placement in a free flap is generally conducted during the flap's harvest and insertion or in native bone during tooth extraction prior to radiation therapy. Secondary implant placement occurs after allowing an appropriate healing period. VSP which involves computer-aided surgical planning and the creation of surgical guides utilizing CAD/CAM technology, significantly enhances both the primary and secondary placement of implants. It facilitates accurate anatomical assessment and the development of a personalized plan for the precise positioning of free flaps and implants.[4]

The free fibular flap is widely utilized and recognized as the gold standard for mandibular reconstruction, boasting a strong success rate. Its benefits include a long pedicle, a flexible skin island, a sufficient length of dense cortical bone, a consistent bone shape, minimal donor site morbidity, excellent union rates, resistance to collapse, segmental blood supply, the option for two skin paddles and a straightforward harvesting process, with flap survival rates reaching up to 95%. Preoperative virtual surgical planning plays a crucial role and is particularly vital for complex defects. However, the high costs of these models pose a disadvantage and they have not yet become an essential component of surgical practice.[13]

Sriram et al indicate that radiotherapy can negatively impact implant survival rates if it is given too early, in excessive doses and prior to tumor removal. They introduced a new evidence-based clinical decision-making algorithm designed to help determine the best sequence of treatments for head and neck cancer (HNC) patients.

The overall success rate of dental prostheses is satisfactory, highlighting their importance in the rehabilitation of HNC patients. To enhance survival rates and patient outcomes, it is essential to consider factors such as the dosage and timing of radiation therapy, as well as the placement of the implant, to improve functionality, aesthetics and comfort.[5] Reconstructing complex defects in the head and neck is quite difficult, especially when multiple soft-tissue subunits are involved. The osteocutaneous fibular flap has constantly been refined to enhance its soft-tissue qualities, including the addition of a second skin island. Lucattelli et al aimed to assess the results of oromandibular reconstruction using a double-skin paddle fibular free flap (DSPFFF) with three distinct techniques: a central de-epithelialized

skin paddle, a distally-based double-skin paddle (DSP) and a proximally and distally-based DSP.

The DSPFFF proved to be effective and dependable for reconstructing complex and extensive head and neck defects, yielding overall good functional results and a low complication rate. The meta-analysis indicated that the distally-based DSPFFF had more favorable outcomes compared to the proximally and distally-based DSPFFF. Furthermore, the distally-based DSPFFF demonstrated a lower rate of complications in comparison to the other technique.[6]

For more than 30 years, radial forearm free tissue transfer (RFFF) has proven to be a highly dependable reconstructive method for head and neck oncological defects. Given its high reliability, there has been a growing focus on reducing donor site morbidity, much of which arises from the techniques used for closure.[8] The study by Ranganath et al, aimed to compare surgical morbidity, functional and aesthetic restoration and health-related quality of life in patients undergoing intra-oral reconstruction with anterolateral thigh (ALT) versus radial forearm (RFF) free flaps. The results indicate that the ALT provides similar flap survival rates and oral function while causing less donor site morbidity compared to the RFF for intra-oral reconstruction.

However, the selection of a free flap should take into account surgeon and patient-specific factors that may not be captured in the studies included in this meta-analysis.9 Radial forearm free flap reconstruction for head and neck cancer is quite common and is often referred to as a workhorse flap. While this flap generally has reliable anatomy, surgeons must be aware of potential anatomical variations and how to address them. Breik et al, present the cases of two patients who underwent oral reconstruction and had anomalies in the radial artery identified during the elevation of a radial forearm free flap.

In Case 1, the dominant branch of the radial artery was found to connect with the common interosseous artery about 9 cm from the first wrist crease. In Case 2, there was abnormal distal branching of the radial artery approximately 4 cm from the first wrist crease. Successful reconstruction using the flap was achieved in both instances.[11] The radial forearm free flap is highly valuable for head and neck reconstructions because of its versatility and capability to repair large and medium-sized defects. However, there are several factors that practicing surgeons should be mindful of. The use of the radial forearm free flap is linked to common postoperative complications and notable morbidity associated with the surgical procedure.[12]

CONCLUSION

In conclusion, both the free fibular flap and the radial forearm free flap are valuable options for reconstructive surgery, particularly in mandibular and head and neck reconstructions. The free fibular flap is regarded as the gold standard in mandibular reconstruction due to its high success rate and several advantages, including a long pedicle, flexible skin island, substantial length of dense cortical bone, consistent bone shape, minimal donor site morbidity and a high flap survival rate of up to 95%. Preoperative virtual surgical planning can enhance outcomes, particularly for complex defects, although the associated costs of these models limit their widespread adoption. On the other hand, the radial forearm free flap is noted for its versatility in addressing large and medium-sized defects. Nevertheless, surgeons must consider potential postoperative complications and significant morbidity linked with this flap. Both techniques offer unique benefits and challenges, highlighting the importance of tailoring surgical approaches to individual patient needs while factoring in the complexities of each option.

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