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Research Article

Comparison of free Hand, Semi-Guided and Full-Guided Approach in Mandible With free Fibula Flap: Care Series and A Review of the Literature

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Abstract

Introduction: Reconstruction of mandible defects, associated with ablative tumor resection, major trauma or congenital deformities, is still a challenge for the current head and neck reconstructive, as patients post-reconstruction expectations are getting more demanding regarding to accuracy, functional and aesthetic parameters.

Methods: In this article, we present our experience utilizing the osseocutaneous fibula free flap for mandible reconstruction using free hand, semi-guided or full-guided approach. A wide review of the recent literature has also been conducted to compare our results with these reported from other institutions.

Results: Various clinical studies comparing free-hand, semi-, and fully guided approaches have widely reported that guided approaches have significant advantage in achieving normal dental occlusion, precise restoration of bony segments and an aesthetically acceptable jaw contouring. These results are in in correspondence with our clinical experience.

Conclusions: Mandibular reconstruction performed with the tranditional free-hand approach is strongly affected with the surgeon's critical ability and clinical experience; though, satisfactory facial appearance and function were also achieved. Semi- and fully guided approach increase the precision of reconstruction and the predectability of the final functional and aesthetic result. The increased demand for financial resources, planning time, and advanced equipment used in CAD/CAM technology should be taken into consideration.

Introduction

Reconstruction of mandible defects, associated with ablative tumor resection, major trauma or congenital deformities, is still a challenge for the current head and neck reconstructive, as patients post-reconstruction functional and aesthetic expectations are getting more demanding [1]. The fibula free flap was initially described in 1989 by Hidalgo and remains the cornerstone in mandible reconstruction offering the adequate soft tissue volume, the biocritical osseous substrate and the dependable vessels in the pedicle [2,3]. Malocclusion and facial deformity are the main issues. To prevent them, natural joint position and accurate mandible contouring must be maintained postoperatively [1]. For decades these functional and aesthetic considerations were strongly associated with subjective criteria, such as the surgeon's experience and technical skills (free hand approach) [4]. However, the recently emerged technology of Computer-Assisted Surgery (CAS), Virtual Surgical Planning (VSP) and Surgical Design And Simulation (SDS) lead to new perspectives (guided approach) [4,5]. Cutting guides and patient-specific (custom) reconstruction plates are used to accurately transfer the virtual planning at the operation filed (semi-guided or full-guided approach), minimizing the risk for malocclusion or facial deformity [4,5]. Guided by the final patient occlusion, the mandible reconstruction planning should incorporate dental implant rehabilitation considerations [6]. Guided reconstruction approach has also been widely documented in literature with minimal flap vascular compromise and reduced overall operation time [4,6-8]. The main objective of this study is to compare the efficiency of free-hand, semi-guided and full-guided approach to mandible reconstruction with free fibula vascularized flap, regarding to accuracy, functional and aesthetic parameters. In this article, we present our experience utilizing the osseocutaneous fibula free flap for mandible reconstruction using free hand, semi-guided or full-guided approach.

Materials and Methods

In this article, we present our experience utilizing the osseocutaneous fibula free flap for mandible reconstruction using free hand, semi-guided or full-guided approach. Five of our patients managed with a semi-guided system, while four patients underwent fully guided mandible reconstruction. The location and the extend of the mandible deficit, the anatomical specificities, and the second stage dental implant rehabilitation determined our final reconstruction plan. During follow-up, patients were clinically and radiographically evaluated to evaluate the efficacy of reconstruction and dental rehabilitation. A wide review of the recent literature has also been conducted to compare our results with these reported from other institutions. In previously published studies, a similar methodology workflow was implemented in order to compare those three procedures [5,9-12].

Results

Various clinical studies comparing free-hand, semi-, and fully guided approaches have widely reported that guided approaches have significant advantage in achieving normal dental occlusion, precise restoration of bony segments and an aesthetically acceptable jaw contouring [1-5]. The refinement and standardization of these methods have come under research in terms of accurate three-dimensional surgical planning with the perspective of achieving predictable and accurate functional and aesthetic result [8,13-16]. These results are in in correspondence with our clinical experience. The freehand technique depends heavily on subjective factors, including the surgeon's expertise and intraoperative decision-making during manual shaping of the fibular segments to form the new mandible, including osteotomies and reconstruction plate bending [1,14,17]. In the semi-guided approach, fibular segments can be adjusted in a more repeatable manner compared with the conventional free-hand method, while still allowing intraoperative adjustment [16-19]. A fully guided approach transfers digital planning to the surgical field using patient-specific cutting guides and customized fixation plates based on virtual surgical planning [8]. Precise osteotomies and fibular segment adjustments yield a reproducible reconstruction pattern with satisfactory facial contour, proportions, and symmetry [3,6]. However, based on our case series, we did not mention a significant reconstructive advantage between the semi-guided and the full-guided approach.

Discussion

Fibula Free Flap (FFF) was introduced in 1989 by Hidalgo and still remains the cornerstone for reconstruction of mandibular defects larger than 4 cm, as satisfactory pedicle vascularity, bone length, and dental rehabilitation with implants are obtained [2,18,19]. Free-hand procedure is strongly dependent on the surgeon's skills and intraoperative judgement. However, previous reports are consistent with our results, indicating that acceptable function can also be achieved with the conventional technique without virtual surgical planning [4]. Recently, CAD/CAM technological evolution ensured precise translation of the digital plan in the surgical field. Many studies have shown a decrease in operative times and an increase in the accuracy of osteotomies, fibular segment adjustment, facial contour and dental implant rehabilitation [20,21]. Osteotomies and fibular segment alignment are standardized according to virtual surgical planning, ensuring guided implant placement and restorative precision [22]. On the other hand, the functional recovery was comparable to the conventional freehand technique, regarding acceptable speech, mandible mobility, and mastication efforts. Nevertheless, despite these technical advantages, the superiority of computer-assisted reconstruction over conventional techniques remains controversial because functional outcomes such as mouth opening, mastication, speech, and patient satisfac-

tion are frequently reported to be comparable between techniques [20,23,24]. The drawbacks of CAD/CAM technology include increased financial and time resources, as well as the technologically advanced equipment [11]. Semi-guided technique combines virtual surgical planning with specific intraoperative manual adjustments when anatomical challenges are evident, serving as a hybrid of conventional freehanded and fully guided algorithms [18,19,25,26]. The results of the semi-guided procedure, regarding facial contour and symmetry, mandibular mobility, implant rehabilitation, occlusion, speech, and mastication, were comparable to those obtained with the fully guided procedure. The semi-guided approach could thus be considered as a reliable alternative to the standard full-guided technique, when there is functional or time limitations, especially in cases with less demanding defect for reconstruction.

Conclusions

Technologically advanced procedures (semi- or fully guided) are generally beneficial regarding precision at functional and aesthetic outcomes in comparison to free-hand techniques. Mandibular reconstruction performed with the tranditional free-hand approach is strongly affected with the surgeon's critical ability and clinical experience; though, satisfactory facial appearance and function were also achieved. Semi- and fully guided approach increase the precision of reconstruction and the predectability of the final functional and aesthetic result. The increased demand for financial resources, planning time, and advanced equipment used in CAD/CAM technology should be taken into consideration to establish a careful, individualized algorithm that, according to the patient's characteristics, can be implemented in the choice of treatment strategy in fibula free flap reconstruction [26]. Further research should be undertaken to standardize the optimal computer-assisted surgical approaches in daily practice by head and neck reconstructive surgeons. Individualization of the patient's needs will offer a treatment algorithm for patients treated with free fibula flaps weighing the advantages and disadvantages of those three surgical approaches.

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