ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 4, July - 2020, Page No. : 503 – 510

A brief review on prosthetic rehabilitation of mandible following reconstruction with free fibula graft

[1]Dr. Madhumaitri Patra, Post Graduate Trainee, Department of Prosthodontics and Crown & Bridge, Haldia Institute of Dental Sciences and Research, Haldia, India

[2]Dr. Mohsina Hussain, Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

[3]Dr. Anik Sarkar, Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Buddha Institute of Dental Sciences and Hospital, Bihar, India

Corresponding Author: Dr. Mohsina Hussain, Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

Citation of this Article: Dr. Madhumaitri Patra, Dr. Mohsina Hussain, Dr. Anik Sarkar, "A brief review on prosthetic rehabilitation of mandible following reconstruction with free fibula graft", IJDSIR- July - 2020, Vol. – 3, Issue -4, P. No. 503 – 510.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Segmental resection of the mandible may be indicated for various reasons including ablation of malignant or benign tumours, trauma or atrophy and can lead to significant morbidity with resultant loss of form, function and aesthetics such as facial contour disfigurement, loss of lip support, malocclusion and impaired functions such as speech, swallowing and saliva retention. To reconstruct such kind of osseous defects numerous options are available among them free fibula graft is a reliable option because it helps to restore both the mandibular and facial contour and also provides the necessary density and stability for dental implant placement. The possibility of placing end osseous dental implants in the reconstructed areas permits us to overcome the problems related to dental rehabilitation with removable prostheses. Free fibula transfer and application of immediate or delayed end osseous implants has significantly improved the quality of life of a significant number of patients. Careful patient selection within a multidisciplinary team can help to identify patients who are likely to be benefitted from these procedures.

Keywords: Segmental resection, free fibula, immediate implantation, delayed implantation, prosthetic rehabilitation

Introduction

Segmental resection of the mandible may be indicated for various reasons including ablation of malignant or benign tumours, trauma or atrophy and can lead to significant morbidity with resultant loss of form, function and aesthetics. Resection leads to the loss of the alveolar and basal jawbone and the involved teeth, causing significant

impairment of mastication.[1] The advent of microvascular free flaps has provided a reliable and predictable means to restore complex bony and soft tissue defects. Numerous options are available for reconstruction, but the free fibula flap has become the workhorse vascularized graft for composite or segmental defects in the maxilla and mandible. It is considered to be the gold standard because of its reliable vascular supply, versatility, predictability, and potential to be harvested as an osseous, myo-osseous, or osteocutaneous flap.[2–4] Moreover, the fibula has favourable bone quantity and quality with an increased amount of cortical bone content to reduce resorption. It also can receive and integrate dental implants to facilitate prosthetic rehabilitation. Sumi et al.[5] have validated the fibula as a recipient site for dental implants. The possibility of placing dental implants in the reconstructed areas permits us to overcome the problems related to dental rehabilitation with removable prostheses.[6] In many instances, a simple prosthesis can be used but these prostheses are not functional because they take support from the remaining teeth and are not rigidly fixated to the reconstruction. In completely edentulous patients, restoration of oral functions is not possible. The use of endosseous osseointegrated implants is the only option for optimised aesthetic and functional outcome.[7]

Surgical and Prosthetic Phase –

Surgical phase

The placement of the dental implants into the fibula has to be done prior to complete closure osteotomies, so that it can allow for a long linear segment of bone that does not show any rotation under the torque of dental implant delivery. Placing the endosseous implants are better while the fibula is still pedicled to the leg for minimizing ischemia time. A periosteal dissection along with periosteal reflection is not done to maximise the blood supply. So the Implants are placed in a flapless technique for preventing periosteal stripping and decrease the risk of devascularisation followed by failure of the free fibula flap. Reconstructive and implant-prosthetic planning can be done in two steps, 1) Reconstruction planning which allows to identify the best positioning of the bony flap for good morphological as well as prosthetic results. 2) Implant placement planning to determine the proper position and number of the proposed implants with the use of data gained from CT scan and computer aided design (CAD) software. Implant placement can be done at the time of surgery, or after surgery under local anesthesia. In cases where radiation therapy is given, implant placement has to be delayed for 13–20 months after the completion of radiation therapy.[8] Ablative defects with significant soft tissue deficit may require a skin paddle to reconstruct adequately. This causes a problem to load dental implants immediately because the bone and prosthesis interface is made up of mobile skin. This makes the prosthesis and peri-implant region difficult to clean. The prosthesis may compress the skin sometimes, which often leads to necrosis because the skin paddle usually is too thick in most patients for it to provide acceptable peri-implant results. Alternatively, Jaw in a Day is limited to using an osseous fibula flap with no major soft tissue component. The native oral mucosa, preferably with keratinized gingiva, should be present to allow primary closure over the bone flap.

The osteotomies should be slightly over prepared, paying close attention to widening the cortices with the final drill. Fibula bone does not expand or compress as well as native jaw bones, and over-torqueing implants can result in stress risers developing in the fibula bone, possibly leading to fibula fracture or subsequent crestal bone loss. After the final implant osteotomy is completed, it should be irrigated thoroughly and inspected for the presence of soft tissue and other debris.[9] Placing dental implants into

fibula bone is similar to placing implants in to dense type 1 mandible. Following manufacturer guidelines for dense bone implant placement is helpful.[8]The implants are then screwed into the bone and hand-torqued to the appropriate value. The implants generally are placed at bone level or in part slightly supracrestal as the surface of the fibula is sloped. It is not uncommon to have 1 thread or 2 threads of the implant body exposed on the buccal side while the lingual side is at the bone level. Once the implant is placed, primary stability determined by the usual techniques.

Prosthetic phase

Implants has to be uncovered 5–6 months after placement. Before stage II surgery, a panoramic radiograph has to be taken to assess the bone level surrounding the implants and to check whether any infection is present or not. The implants are not to be immediately loaded. While placing the healing abutment, implant osseointegration has to be checked. After soft tissue healing, it will be possible to proceed with the prosthetic phase. Type of prosthesis has to be determined by knowing patients need, available space for restoration and number of implants. Different types of prostheses which can be employed are: - RPD: Overdenture (bar-retained or O-ring-retained), given by Ferrario et al. (2004); SFPD: Screw-retained prosthesis, given by by Ferrario et al. (2004); CFPD: Cement-retained prosthesis, given by Preiskel and Tsolka (1998).[8]

Complications can be categorised as: Prosthetic failure which requires removable or repair, abutment-prosthesis screw loosening necessiates re-tightening, and prosthesis fracture. In addition, patient satisfaction regarding both the aesthetics and function of the entire reconstruction was assessed using a questionnaire with five possible rating categories: (A) excellent/very good – the patient was entirely satisfied, and the prosthesis could not be detected with the tongue (seamless between dental prosthesis and the new alveolar process); (B) good – the patient was entirely satisfied, but the prosthesis could be detected with the tongue; (C) sufficient/satisfactory – aesthetic shortcomings and/or discomfort during chewing were reported, but a replacement was not necessary; (D) poor – the patient requested an improvement to be made to the prosthesis; and (E) unsatisfactory – the patient was completely dissatisfied and required a new prosthesis, but declined replacements of the same type or made with the same material (Hickel et al., 2010)[8]

Discussion

Mandibular resection secondary to malignant or benign causes, can lead to extensive composite defects, which result in loss of function, form and aesthetics leading to a dramatic loss in quality of life of the patient. Free tissue transfer followed by dental rehabilitation can the premorbid condition to some extent. Various donor sites have been used to obtain graft material for mandibular reconstruction, such as iliac flap, the scapula flap, the radial forearm flap, and the fibula flap. Among these alternatives, the fibula free flap has demonstrated high reliability, adaptability and has seen encouraging functional, aesthetic, and survival rate outcomes in reconstruction of maxillo-mandibular defects in the last few decades. This flap was popularized by Hidalgo[2] and it has been demonstrated to be very reliable for the reconstruction of mandibular defects following ablation of benign or malignant tumours, osteonecrosis, osteomyelitis, traumas or atrophy (Mücke et al., 2009; Bianchi et al., 2009, 2011).[10,11] The long and reliable vascular pedicle and the possibility of multiple osteotomies allows accurate adaptation of the bone flap to the native bone quite precisely, with an ultimate satisfying reconstruction of the facial contour (Chiapasco et al., 2006; Disa and Cordeiro, 2000; Ferrari et al., 1998).[1,7,12]In cases of composite soft tissue and osseous defects, a skin paddle in association

with the fibular bone segment can be used for reconstruction of both intraoral and extra-oral soft tissue defects (Disa and Cordeiro, 2000; Ferrari et al., 1998; Hayter and Cawood, 1996).[7,12,13]The donor site morbidity is limited and most patients are not troubled by their symptoms (Nocini et al., 1998).[14] The fibula free flap has been demonstrated to be very suitable for both immediate and delayed prosthetic rehabilitation with implant-supported prostheses (Kildal et al., 2001; Jaquiéry et al., 2004; Roumanas et al., 1997).[15,16,17] Fibula is a tubular bone with sufficient width and height to place implants, bicortical purchase during implant placement to facilitate osseointegration is an additional advantage (Hayter and Cawood, 1996).[13] Insufficient height of the fibula can sometimes hinder the insertion of dental implants as its height is rarely greater than 14 cm (Chiapasco et al., 2006; Smolka et al., 2008).[1,6] Wu and colleagues reported a decrease in success rate with time with 1-year and 5-year implant success rate of 95% and 87% respectively. Infection, tumour recurrence and soft tissue proliferation accounted for the majority of failures in their series(Wu, 2008).[18] Their study was confirmed by Granström in 631 implants.[19] Chiapasco et al. followed 16 patients with implants and implant supported prostheses for a mean of 50 months and determined that the implant success and survival rates were 98.6% and 93.1% respectively (Chiapasco, 2006).[1] Teoh et al.[20] report survival rates of 97.0%, 97.0% and 79.9% at 1, 5 and 10-years follow up, respectively. On fibula flaps, longer implants allow bicortical anchorage which seems to be a positive factor for success due to increased stability.[21] Foster[22] states that implantation in fibula is overall successful and observes complete osteointegration in 99% of cases, up to 100% in irradiated bone. For Roumanas,[17] the implant survival rate in fibula flap is 94.6%, whereas Chiapasco et al.[1] report more nuanced results with 98.6% implant success and 93.1% survival rate. Some authors prefer not to differentiate between osseointegration and implant survival. Sclaroff et al.[21] report 97.5% osseointegration and 88% implant survival after loading. The overall success rate is also influenced by post-operative radiotherapy; Urken et al., reoprted a 92% overall success rate without irradiation, 86% with post implantation radiotherapy and 64% with preimplantation radiotherapy.[4] According to Colella et al.,[22] no increased failure rate is expected for radiation doses under 45 Gy. Other authors[6] observe early complications only in irradiated bone. A 6-week lag time should be considered between surgery and the beginning of radiotherapy so as to not compromise osseointegration.[4]

Urken et al.[4] were the first to propose primary rehabilitation with implantation at the same time as reconstruction. Similarly, Sclaroff et al.[21] proposed a one-step reconstruction procedure with the graft harvest and the implantation performed in the same sitting, A period of 6 months was given for healing followed by the placement of the abutments after 4 weeks and finally followed by the prosthetic stage.

De Santis et al.[23] proposed a two-step protocol of delayed implantation with reconstruction in the first sitting the implantation performed after a waiting period of 6 months. Primary implantation reduces rehabilitation time in oncologic patients and therefore is associated with an earlier recovery and better quality of life. Theoretically, the rate of success of primary and secondarily placed implants are comparable. When implanting at the same time as that of mandibular reconstruction, the implant topography should be determined after the bone graft is temporarily fixed with the native bone.[24] Implantation sites should be free and not interfered with the screws used to stabilize the bone. The implant-to-prosthesis axis angle should not exceed 15 degrees.[24] However,

immediate placement of the implants may add to certain complications like compromising the bone viability leading to bone necrosis, lengthening the operative procedure or resulting in implant malposition.[7] Moreover, implantation at the same time as the reconstruction is technically challenging as the angulation and position of implant placement, graft placement, prosthetic outcome and the condition of soft tissues must all be considered. Some authors report that primary procedures results in a less precise implant placement, associated with the impossibility to place an implant retained denture.[25] The main indications for this one stage procedure remain benign and low-grade tumours, and small defects on the body of the mandible.[24,26,27]

When delayed implant placement decided, a time gap of at least 6–12 months should be provided after the grafting, when bone remodelling and muscle healing are complete.[1] Some authors consider that bone remodelling is most critical during the first 6 months after bone grafting.[29] This waiting period makes implant placement safer and ensures success reducing implant failure resulting from inadequate placement and infection. Moreover, initial treatment with a conventional prosthesis, when possible, allows the clinician to assess the functional status of the patient prior to recommending implant placement as a definitive treatment plan. It also allows for the tissues to heal and revascularize completely resulting in a disease-free period before the initiation of extensive dental procedures take place.[28]Advantages of a delayed implantation are: to be able to select fit, well-motivated and overtly disease-free patients and enough time to plan the procedure in consolidated jaws, with bone contouring and soft tissue surgery performed at the same operation (Hayter and Cawood,1996).[13]

The prognostic factors for implant survival are the pathology itself, the extent of bone and soft tissues surgical defects, the type of flap harvested and post-operative radiation therapy. Ferrari et al[12] observed higher failure rates in patients reconstructed after malignant tumour resection, in presence of Class III-IV bone defects and composite defects of both hard and soft tissue involvement, when an osteocutaneous flap was used and in patients who underwent implant placement in irradiated bone.

The poorer implant prognosis were due to the effects produced by radiotherapy on both hard and soft tissues: mucositis, xerostomia, reduced vascularity of soft tissues with impaired resistance to infection and reparative fibrosis and production of hypocellular, hypovascular and hypoxaemic tissue on bone, with potential development of osteoradionecrosis (Hayter and Cawood, 1996; Hundepool et al., 2008).[13,30] To reduce the risk of failure several authors (Hayter and Cawood, 1996)[13] recommend a recovery period of at least 12 months following irradiation before attempting implantation. In the study by Ferrari et al.[12], early or late complications due to the reconstruction or to the implant placement were observed in 7 patients (50%). Smolka et al. (2008)[6] reported early complications in 41.5% of cases and late complications in 38.2%. Following dental rehabilitation close follow-up is mandatory to prevent restorative failures that may develop as a result of infection and inflammation such as peri-implantitis, soft tissue problems and late implant failures. Since the purpose of oral rehabilitation includes restoring the aesthetic and functional aspects to the pre-morbid condition, an analysis of nutrition, speech, oral competence and facial appearance perception is essential during the follow-up. Iizuka et al. (2005)[31] in his study showed that the persistence of functional deficits was observed in only a minority of the patients examined. The

quality of life is dramatically improved by either the primary or delayed rehabilitation treatments in patients undergoing segmental resection of mandible.[32] Despite good results, continuous improvements should be done to increase the functionality of the implants and of the prosthesis. Advanced medical imaging and computer-assisted navigation surgery might help improve the surgical technique. In the future, regenerative therapy can revolutionise the treatment options. Bone Morphogenetic Proteins (BMP-7) could be used for the reconstruction of major mandibular defects as it has been shown to enhance peri-implant osseointegration and bone regeneration.[33]

Conclusion

Rehabilitation of patients undergoing segmental mandibular resection after free flap transplantation can be challenging. Free fibula transfer and application of immediate or delayed endosseous implants has significantly improved the quality of life of a significant number of patients. Careful patient selection within a multidisciplinary team can help to identify patients who are likely to be benefitted from these procedures.

References

1. Chiapasco M, Biglioli F, Autelitano L, Romeo E, Brusati R: Clinical outcome of dental implants placed in fibula-free flaps used for the reconstruction of maxillomandibular defects following ablation for tumors or osteoradionecrosis. Clin Oral Implants Res 17(2): 220e228, 2006
2. Hidalgo DA. Fibula free flap: a new method of mandible reconstruction. Plast Reconstr Surg 1989;84:71–9.
3. Hidalgo DA, Rekow A. A review of 60 consecutive fibula free flap mandible reconstructions. Plast Reconstr Surg 1995;96:585–96 [discussion: 597–602].
4. Urken ML, Buchbinder D, Costantino PD, et al. Oromandibular reconstruction using microvascular composite flaps: report of 210 cases. Arch Otolaryngol Head Neck Surg 1998;124:46–55.
5. Sumi Y, Hasegawa T, Miyaishi O, Ueda M. Interface analysis of titanium implants in human vascularised fibula bone graft. J Oral Maxillofac Surg 2001;59:213–6.
6. Smolka K, Kraehenbuehl M, Eggensperger N, Hallermann W, Thoren H, Iizuka T, et al: Fibula free flap reconstruction of the mandible in cancer patients: evaluation of a combined surgical and prosthodontic treatment concept. Oral Oncol 44(6): 571e581, 2008
7. Disa J, Cordeiro P. Mandible reconstruction with microvascular surgery. Semin Surg Oncol 2000;19:226–34.
8. Sozzi D, Novelli G, Silva R, Connelly ST, Tartaglia GM, Implant rehabilitation in fibular free flap reconstruction: A retrospective study of cases at 1-18 years following surgery, Journal of Cranio-Maxillofacial Surgery (2017), doi: 10.1016/j.jcms.2017.06.021.
9. Patel A, Harrison P, Cheng A, Bray B, Bell RB. Fibular reconstruction of the maxilla and mandible with immediate implant-supported prosthetic rehabilitation: Jaw in a day. Oral and Maxillofacial Surgery Clinics. 2019 Aug 1;31(3):369-86.
10. Mücke T, Haarmann S, Wolff KD, Hölzle F: Bisphosphonate related osteonecrosis of the jaws treated by surgical resection and immediate osseous microvascular reconstruction. J Craniomaxillofac Surg 37(5): 291e297, 2009
11. Bianchi B, Ferri A, Ferrari S, Copelli C, Multinu A, Di Blasio C, et al: Microvascular reconstruction of mandibular defects in paediatric patients. J Craniomaxillofac Surg 39(4): 289e295, 2011
12. Ferrari S, Raffaini M, Bianchi B, Sesenna E: Secondary oro-mandibular reconstruction using

revascularized bone flaps. Minerva Stomatol 47(3): 75e85, 1998

13. Hayter JP, Cawood JI: Oral rehabilitation with endosteal implants and free flaps. Int J Oral Maxillofac Surg 25(1): 3e12, 1996
14. Nocini PF, Gotte P, Bedogni A, Chiarini L, De Santis G: Functional rehabilitation of the atrophic jaws with revascularized free fibula flap and implant supported prosthesis. J Craniomaxillofac Surg 26(1): 133e134, 1998
15. Kildal M, Wei FC, Chang YM, Chen HC, Chang MH: Mandibular reconstruction with fibula osteoseptocutaneous free flap and osseointegrated dental implants. Clin Plast Surg 28(2): 403e410, 2001
16. Jaquiéry C, Rohner D, Kunz C, Bucher P, Peters F, Schenk RK, et al: Reconstruction of maxillary and mandibular defects using prefabricated microvascular fibular grafts and osseointegrated dental implants, a prospective study. Clin Oral Implants Res 15(5): 598e606, 2004
17. Roumanas ED, Markowitz BL, Lorant JA, Calcaterra TC, Jones NF, Beumer 3rd J: Reconstructed mandibular defects: fibula free flaps and osseointegrated implants. Plast Reconstr Surg 99(2): 356e365, 1997
18. Wu Y, Huang W, Zhang Z, Zhang Z, Zhang C, Sun J. Clinical outcome of dental implants placed in fibula-free flaps for orofacial reconstruction. Chin Med J 2008;121(19):1861–5.
19. Granström G. Osseointegration in irradiated cancer patients: an analysis with respect to implants failures. J Oral Maxillofac Surg 2005;63(5):579–85.
20. Foster RD, Anthony JP, Sharma A, Pogrel MA. Vascularized bone flaps versus nonvascularized bone grafts for mandibular reconstruction: an outcome analysis of primary bony union and endosseous implant success. Head Neck 1999;21(1):66–71.
21. Sclaroff A, Haugey B, Gay W, Paniello R. Immediate mandibular reconstruction and placement of dental implants at the time of ablative surgery. Oral Surg Oral Med Oral Pathol 1994;78(6):711–7.
22. Colella G, Cannavale R, petenero M, Gandolfo S. Oral implants in radiated patients: a systematic review. Int J Oral Maxillofac Impl 2007;22(4):616–22.
23. De Santis G, Nocini P, Chiarini L, Bedogni A. Functional rehabilitation of the atrophic mandible and maxilla with fibula flaps and implant-supported prosthesis. Plast Reconstr Surg 2004;113(1):88–98.
24. Chang Y, Santamaria E, Wei F, Chen H, Chan C, Shen Y, et al. Primary insertion of osseointegrated dental implants intoi fibula osteoseptocutaneous free flap for mandible reconstruction. Plast Reconstr Surg 1998;102(3):680–8.
25. Gürlek A, Miller M, Jacob R, Lively J, Schusterman M. Functional results of dental restoration with osseointegrated implants after mandible reconstruction. Plast Reconstr Surg 1998;101(3):650–9.
26. Jagdeep S, Chana M, Yang-Ming C. Segmental mandibulectomy and immediate free fibula osteoseptocutaneous flap reconstruction with endosteal implants: an ideal treatment method for mandibular ameloblastoma. Plast Reconstr Surg 2004;113(1):80–7.
27. Schmelzeisen R, Neukam F, Shirota T, Spechet B, Wichmann M. Postoperative function after implant insertion in vascularised bone grafts in maxilla and mandible. Plast Reconstr Surg 1996;97:719–25.
28. Garett N, Roumanas E, Blackwell K, Freymiller E, Abemayor E, Wong W, et al. Efficacy of conventional

and implant-supported mandibular resection prostheses: study overview and treatment outcomes. J Prosthet Dent 2006;96:13–24.

29. Altundal H, Celebiler O, Capa N. The rehabilitation of facial shotgun wound with free fibula flap and retained overdenture: case report. J Trauma 2009;66:1718–23.
30. Hundepool AC, Dumans AG, Hofer SO, Fokkens NJ, Rayat SS, van der Meij EH, et al: Rehabilitation after mandibular reconstruction with fibula free-flap: clinical outcome and quality of life assessment. Int J Oral Maxillofac Surg 37(11):1009e1013, 2008
31. Iizuka T, Hoflinger J, Seto I, Rahal A, Mericse-Stern R, Smolka K: Oral rehabilitation after mandibular reconstruction using an osteocutaneous fibula free flap with endosseous implants. Factor affecting the functional outcome in patients with oral cancer. Clin Oral Implants Res 16: 69e79, 2005
32. Vu DD, Schmidt BL. Quality of life evaluation for patients receiving vascularised versus nonvascularized bone graft reconstruction of segmental mandibular defects. J Oral Maxillofac Surg 2008;66(9):1856–63.
33. Tatakis DN, Koh A, Jin L, Wozney JM, Rohner MD, Wikesjö UME. Periimplant bone regenration using Rh BMP-2/ACS in a canine model: a dose–response study. J Periodontol 2002;37:93–100.