



Different Methods of Jaw Reconstruction and Implants

Majid Zolfagharikhoshaneh^{1*#}, Maryam Hassannia^{1#} and Juan F. Sudcalen Jr.^{2†}

¹College of Dentistry, Pines City College, Magsaysay Ave, Baguio, 2600 Benguet, Philippines.

²Faculty and Clinic, College of Dentistry, Pines City College, Magsaysay Ave, Baguio, 2600 Benguet, Philippines.

Authors' contributions

This work was carried out in collaboration between all authors. Author MZ designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MH and JFSJ managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Jaw bones are one of the most important part of human body, since they play a vital role in the appearance, respiration, speech, deglutition and mastication of an individual. Each year, many people need to reconstruct these bones because of trauma, tumors and congenital disorders. This study intends to investigate different jaw reconstruction methods.

Materials and Methods: The present study is a review-library study was conducted by searching the key words of jaw implants, Mandibular Reconstruction and reconstruction in scientific data bases such as Science Direct, Google Scholar and PubMed from 1994 to 2018.

Results: The results of investigating various researches and articles indicated that action taken in order to fix the jaw problems and defects often are classified into two parts: reconstruction and rehabilitation; however, it worth mentioning that reconstruction part is superior to rehabilitation. The reason behind reconstruction is to use different flaps for therapeutic actions.

Conclusion: There are various techniques for reconstruction and rehabilitation of jaw

*Corresponding author: E-mail: m10266z@yahoo.com;

DDM Student

† DMD,

defects, for example, doing a surgery with the use of flaps for reconstructing the jaw is a promising and very useful method, and using new prosthetics, especially titanium prosthesis, improve rehabilitation of an individual greatly and return the patient's esthetic appearance to a great extent.

Keywords: Jaw implants; mandibular reconstruction; reconstruction.

1. INTRODUCTION

Defects and damage in the upper jaw occurs because of different causes, including trauma, the presence of tumors, osteomyelitis, congenital defects such as Hemifacial, Microsomia and Pierre Robin sequence [1]. The lower jaw or mandible plays an important role in human life; some of mandibular roles are:

- Protecting the teeth, and helping in the process of mastication, deglutition, pronouncing and respiration [2].
- The mandible (or lower jaw) is considered a very unique bone in human body and there is several reasons for its great importance [3].
- This bone supports the stabilization of the airway and tongue base. It also helps the process of mastication, deglutition, and speech; however, during the process of mastication, it must withstand a lot of forces [3].
- The findings of this study indicates that the mandible receive's the average of 4346 Newtons occlusive molar force [3].
- The jaw bones have an important role in appearance and esthetic of a person, also many author and researchers refer to "Andy Gump" while mentioning this role of jaw bones; the rationale behind their action is that, this term refers to a caricature about smoking a cigarette that the smoking person does not have the mandibular in it [3].

During reconstruction of the jaw, all of the roles of this organ must be considered which is why the reconstruction of jaw bone is very challenging. Due to the close proximity to the skull bone the complications of its reconstruction might causes irreparable consequences [3]. Each year, thousands of people are in need of jaw reconstruction and surgery [4-7].

In 1976 the first successful mandibular reconstruction was carried out by Panje et al. [3]. These researcher used the thigh tissue to

reconstruct the mandible. The first hard part that was used for restricting the mandibular bone was Vitallium, which is alloy consisting of cobalt, chromium and molybdenum. This alloy was quickly replaced by stronger and more neutral alloys (5 g). Nowadays, titanium-based implants are the most common to use [2]. Furthermore, the jaw and face reconstructing surgeries consist of a wide range of interventions that sometimes leads to growth of soft tissue and changing of hard tissue structures. Reconstruction of jaw and oral cavity defects is a major challenge for oromaxillofacial surgeons [1,8-10].

The defects in this area often are seen in the patients with squamous cell carcinoma [11]. The development of antibiotics has some effects on the infection controlling, new imaging techniques and anesthesia; additionally, it has led to the major changes in jaw and facial reconstruction in recent decades [1,8-9]. This study investigated different jaw reconstruction methods.

2. METHODS

The present study is a review-library study and the relevant data were gathered through searching in scientific databases and related scientific articles. This search was carried out by searching the key words reconstruction , jaw implants, and Mandibular Reconstruction, separately or combined, in Science Direct, Google Scholar, and PubMed scientific databases between the years of 1994 to 2018. After reviewing the abstracts of founded articles, the most related articles were selected and their full text was reviewed.

3. FINDINGS

The actions taken for resolving jaw defects often classified into two parts:

- ✓ Reconstruction and Rehabilitation, not to mention that the reconstruction part is more important and prior to the rehabilitation. In reconstruction process the defected parts can be restored and the rehabilitation is

process to bring back the organ's function. In general, tissue transplantation is a method that is employed with the aim of reconstructing and using implant for rehabilitation [11].

❖ **Vascularised free tissue transfer**

Currently, vascularised free tissue transfer is recognized as a standard method for the reconstruction of jaw and facial defects [1]. In this method, the blood vessels and the nervous system are transmitted to the organ again [12]. The success rate of this method is estimated to be 90-94% [13-15]. The process of selecting body part that the required tissue is taken from it and then transferred to defected jaw part, depends on different factors including the type of required tissue, and damaged part in the jaw [13,16-18].

Different types of flaps used for reconstructing the jaw structure and oral cavity are:

- Fibula free flap,
- Radial forearm free flap,
- Scapular free flap and
- Iliac crest free flap.

Flaps are tissue fragments that their vascular connections extend to underlying tissues; hence, when these flaps are transmitted, they are considered a living tissue [19], but they don't have the grafts of a healthy blood connection [19]. Due to this characteristic of flaps, using them brings more satisfactory results.

Fibula free flap: This flap is especially applicable to lower mandibular reconstruction [13,20-22], and is capable of removing angular defects [11]. Numbness of the toes and paws, and creating a complication in the donor organ are some disadvantages of using this flap [11].

Radial forearm free flap: This flap is commonly used for reconstructing side-effects (4 g), and this is useful when its aim is reconstructing the anterior part of the maxilla and edentulous area of the mandible [23], or when the soft tissue requires restoration [11]. The major disadvantage of this flap is some complication caused by its donor part, such as movement impairment and shortage of donor part [1].

Scapular free flap: this type of flap is an osteocutaneous flap and is recommended to be used for complex defects that involve the skin of

the face, mucosa and bone [24]. Dental implants are highly accepted by this flap.

Not to mention that a study conducted on 55 patients in 12 years indicated the success rate of 89% for this flap [25].

Iliac crest free flap: This flap is the best bone tissue for dental implants [20].

In a study the success rate of applying this flap for jaw reconstruction was estimated to be 96% [26].

❖ **Nonvascularized Bone Grafts**

Nonvascularized Bone grafts are used for reconstructing small jaw defects; however, they are not useful for soft tissue defects [3]. The main disadvantages of this method are that it can't be used for patients that has been undergone radiotherapy, and even if it works on these patient, the success rate is very low and its side effects are very high. It should be noted that, most of people who need to reconstruct their mandible, have squamous cell tumors, and usefully went through radiotherapy [3].

3.1 Prosthodontics

Prosthodontics are used for rehabilitation and usually used to replace lost teeth [11].

The osseointegration, is the base line of dental implants that created a revolution in the reconstruction of dental cavities [11]. This technique directly attaches bone tissues to a alloplastic material without involving connective tissue. Using dental implants in cancer patients who undergo radiation therapy is controversial, and it is recommended not to use implant at least for six month after radiotherapy [25]. The success rate of using implants in healthy patient was 92% and in the patients who their bones was undergo radiation therapy estimated to be 86% [11]. Several factors must be considered before using implants for patient who have undergone radiation therapy due to malignancies in the jaw area.

Using hyperbaric oxygen in these patients showed a prophylactic capability of osteoradionecrosis [27]. Of course, radiation dose is also important in osteoradionecrosis. Zygomatic implants are a useful therapeutic method that can be use at the times that

there is no sufficient bone to use for dental implant [11].

3.2 Using Titanium-based Implants

Titanium-based implants (Ti) are one of the mandibular reconstruction technique and each year, many patients with mandibular damages use it [2]. The main disadvantages for extensive use of these implants are that they are in a certain size and shape, in order to be used on different patient, these implants should be cut, which will take a lot of time of a surgeon [2]. To solve this problem, we proposed new computer-assisted imaging methods [28].

Patients who were treated by using these implants needs to take care of the tissues around the implant permanently and systematically [29]. Patients with higher risk of inflammation of tissues around the implant, such as patients with partially edentulous and chronic periodontal disease, must be examined precisely [30]. Different studies have shown that areas that were infected before implant placement, especially in patients with advanced periodontitis, can cause colony formation around the implant. Patients with poorly controlled diabetes mellitus and cigarette smoker are exposed at high risk.

4. DISCUSSION

Currently, there are various methods of jaw reconstruction, that majority of this method are based on the flaps and implants usage; also, if all conditions are met, their success rate would be above 90% (4 g). Selecting the type of implant depends on the type of jaw defect and the donor part, and by using proper method more satisfactory result would be obtained. Nowadays, the use of non-vascularised tissue is replaced with the vascularised tissue in jaw reconstruction surgeries and surgeons prefer to use vascularised tissue.

Different articles recommended that using osseointegrated implants for reconstructing jaw defects is the best way to achieve good results, since it helps facial esthetic recovery and have high success rates. Using this method on patients undergoing radiation therapy should be carried out with great care and there are some contraindications to this method. However, due to high incidence of the side effects and the low success rate, some consideration should be taken. One of the important considerations is appropriate time interval after

radiotherapy to perform an implant placement procedure.

Advances in biomaterials and implant materials increased the success rate in reconstruction of the jaw and oral cavity restorations, and in addition it helped in restorative dentistry improvements.

5. CONCLUSION

Problems and defects in the jaw can lead to many adverse consequences for the patient and, even can affects the mental health of an individuals due to the problems caused in the esthetic appearance of them. Currently, there are various techniques for the reconstruction and rehabilitation of jaw defects, and using the flaps for regeneration and reconstruction is one of the promising methods; also the use of new prosthetics, especially titanium prosthesis, is a great help for individual rehabilitation and increases the esthetic of the person to a great extent.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mehta RP, Deschler DG. Mandibular reconstruction in 2004: An analysis of different techniques. *Current Opinion in Otolaryngology & Head and Neck Surgery*. 2004;12(4):288-93.
2. Al-Ahmari A, Nasr EA, Moiduddin K, Anwar S, Kindi MA, Kamrani A. A comparative study on the customized design of mandibular reconstruction plates using finite element method. *Advances in Mechanical Engineering*. 2015;7(7): 1687814015593890.
3. Benjamin W. *Mandibular reconstruction: Special considerations in TMJ and Condyle Reconstruction*; 2010.

- Available:<https://www.utmb.edu/otoref/Grnds/mandib-recon...08.../mandib-recon-2010-08.pdf>
4. Oshida Y, Tuna EB, Aktören O, Gençay K. Dental implant systems. *International Journal of Molecular Sciences*. 2010; 11(4):1580-678.
 5. Markwardt J, Weber T, Modler N, Sembdner P, Lesche R, Schulz MC, et al. One vs. two piece customized implants to reconstruct mandibular continuity defects: a preliminary study in pig cadavers. *Journal of Cranio-Maxillofacial Surgery*. 2014;42(6):790-5.
 6. Bujtár P, Simonovics J, Váradi K, Sándor GK, Avery C. The biomechanical aspects of reconstruction for segmental defects of the mandible: a finite element study to assess the optimisation of plate and screw factors. *Journal of Cranio-Maxillofacial Surgery*. 2014;42(6):855-62.
 7. Louis PJ, Gutta R, Said-Al-Naief N, Bartolucci AA. Reconstruction of the maxilla and mandible with particulate bone graft and titanium mesh for implant placement. *Journal of Oral and Maxillofacial Surgery*. 2008;66(2):235-45.
 8. Schrag C, Chang YM, Tsai CY, Wei FC. Complete rehabilitation of the mandible following segmental resection. *Journal of surgical oncology*. 2006;94(6):538-45.
 9. Mukerji R, Mukerji G, McGurk M. Mandibular fractures: Historical perspective. *British Journal of Oral and Maxillofacial Surgery*. 2006;44(3):222-8.
 10. Esposito M, Grusovin MG, Coulthard P, Worthington HV. The efficacy of various bone augmentation procedures for dental implants: a Cochrane systematic review of randomized controlled clinical trials. *International Journal of Oral & Maxillofacial Implants*. 2006;21(5).
 11. Ó'Ferraigh P. The modern methods in the surgical reconstruction and rehabilitation of the orofacial region: A review of the literature. *TSMJ*. 2008;9:44-7.
 12. Mitchell DA. *An introduction to oral and maxillofacial surgery*: CRC Press; 2014.
 13. Burkey BB, Coleman JJ. Current concepts in oromandibular reconstruction. *Otolaryngologic clinics of North America*. 1997;30(4):607-30.
 14. Robb G. Free-Flap Mandibular Reconstruction: A 10-Year Follow-up Study. *Archives of Facial Plastic Surgery*. 2004;6(1):65-6.
 15. Pohlenz P, Blessmann M, Blake F, Li L, Schmelzle R, Heiland M. Outcome and complications of 540 microvascular free flaps: The Hamburg experience. *Clinical oral investigations*. 2007;11(1):89-92.
 16. Urken ML, Buchbinder D, Costantino PD, Sinha U, Okay D, Lawson W, et al. Oromandibular reconstruction using microvascular composite flaps: Report of 210 cases. *Archives of Otolaryngology–Head & Neck Surgery*. 1998;124(1):46-55.
 17. Frodel JJ, Funk GF, Capper DT, Fridrich KL, Blumer JR, Haller JR, et al. Osseointegrated implants: a comparative study of bone thickness in four vascularized bone flaps. *Plastic and Reconstructive Surgery*. 1993;92(3):449-55; discussion 56-8.
 18. Hidalgo DA, Pusic AL, Wei F-C. Free-flap mandibular reconstruction: A 10-year follow-up study. *Plastic and Reconstructive Surgery*. 2002;110(2):438-49.
 19. Chandu A, Bridgeman A, Smith AC, Flood S. Reconstructive techniques for the repair of oral and maxillofacial oncological procedures: What are they, how do they work and what do they look like? *Australian Dental Journal*. 2002;47(2):99-105.
 20. Genden E, Haughey BH. Mandibular reconstruction by vascularized free tissue transfer. *American Journal of Otolaryngology*. 1996;17(4):219-27.
 21. Shaw RJ, Sutton AF, Cawood JI, Howell RA, Lowe D, Brown JS, et al. Oral rehabilitation after treatment for head and neck malignancy. *Head & Neck: Journal for the Sciences and Specialties of the Head and Neck*. 2005;27(6):459-70.
 22. Brown J, Magennis P, Rogers S, Cawood J, Howell R, Vaughan E. Trends in head and neck microvascular reconstructive surgery in Liverpool (1992–2001). *British Journal of Oral and Maxillofacial Surgery*. 2006;44(5):364-70.
 23. Villaret DB, Futran NA. The indications and outcomes in the use of osteocutaneous radial forearm free flap. *Head & Neck: Journal for the Sciences and Specialties of the Head and Neck*. 2003;25(6):475-81.
 24. Deschler DG, Hayden RE. The optimum method for reconstruction of complex lateral oromandibular-cutaneous defects. *Head & Neck: Journal for the Sciences and Specialties of the Head and Neck*. 2000;22(7):674-9.

25. Urken ML, Bridger AG, Zur KB, Genden EM. The scapular osteofasciocutaneous flap: A 12-year experience. Archives of Otolaryngology-head & Neck Surgery. 2001;127(7):862-9.
26. Shenaq SM, Klebuc MJ. The iliac crest microsurgical free flap in mandibular reconstruction. Clinics in Plastic Surgery. 1994;21(1):37-44.
27. Kanatas A, Rogers S, Martin M. A practical guide for patients undergoing exodontia following radiotherapy to the oral cavity. Dental Update. 2002;29(10):498-503.
28. Toro C, Robiony M, Costa F, Zerman N, Politi M. Feasibility of preoperative planning using anatomical facsimile models for mandibular reconstruction. Head & Face Medicine. 2007;3(1):5.
29. Todescan S, Lavigne S, Kelekis-Cholakias A. Guidance for the maintenance care of dental implants: clinical review. J Can Dent Assoc. 2012;78(1):107.
30. Karoussis IK, Kotsovilis S, Fourmousis I. A comprehensive and critical review of dental implant prognosis in periodontally compromised partially edentulous patients. Clinical Oral Implants Research. 2007; 18(6):669-79.

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