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 – 7, Issue – 4, July– 2024, Page No. : 271 - 276

Enhancing Quality of Life: Prosthetic Rehabilitation Strategies for Mandibular Defects - A Contemporary Narrative Review

[1]Dr. Mopidevi Sneha Prasunna, BDS, PG Student, Drs. Sudha & Nageswara Rao Siddartha Institute of Dental Sciences, Andhra Pradesh

[2]Dr. Tripuraneni Sunilchandra, M.D.S,Professor& HOD, Department of Prosthodontics, Drs. Sudha & Nageswara Rao Siddartha Institute of Dental Sciences, Andhra Pradesh

[3]Dr. Atluri Kaleswara Rao, M.D.S, Professor, Department of Prosthodontics,Drs. Sudha & Nageswara Rao Siddartha Institute of Dental Sciences,Andhra Pradesh

[4]Dr. Sriharsha Babu Vadapalli, M.D.S, Associate Professor, Department of Prosthodontics, Drs. Sudha & Nageswara Rao Siddartha Institute of Dental Sciences,Andhra Pradesh

Corresponding Author: Dr. Mopidevi Sneha Prasunna, BDS, PG Student, Drs. Sudha & Nageswara Rao Siddartha Institute of Dental Sciences, Andhra Pradesh

Citation of this Article: Dr. Mopidevi Sneha Prasunna, Dr. Tripuraneni Sunilchandra, Dr. Atluri Kaleswara Rao, Dr. Sriharsha Babu Vadapalli, "Enhancing Quality of Life: Prosthetic Rehabilitation Strategies for Mandibular Defects - A Contemporary Narrative Review", IJDSIR- July– 2024, Volume –7, Issue - 4, P. No. 271 – 276.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

A brief review of mandibular defects occurs due to oncological reasons but can also result from trauma or infections, causing functional and cosmetic issues. Various prosthetic treatments exist, including a palatal ramp, guide flange prosthesis, and implant-supported fixed prosthesis, tailored to each case. Jaw reconstruction, crucial for preserving oral function, benefits from advanced 3D technology, enhancing preoperative planning and reducing surgical time. Both conventional and advanced techniques aim to restore anatomy and function effectively. Early function oral rehabilitation, including osseointegrated implant-retained prostheses, can occur concurrently with resective and reconstructive surgery, optimizing outcomes.

Keywords: Mandibular defects, Implants, Virtual surgical planning, CAD-CAM

Introduction

Maxillofacial prosthodontics is a challenging field that aims to restore natural function and appearance for patients with facial disfigurements, which can evoke social isolation and psychological distress. Mandibular defects often arise due to tumor resection (such as

squamous cell carcinoma or ameloblastoma), trauma (like gunshot wounds or road accidents), and others. Mandibular continuity is crucial for both function and aesthetics in the oro-maxillofacial region. Loss of mandibular continuity can lead to disocclusion, altered masticatory cycles, facial disfigurements, and speech difficulties. Immediate reconstruction after post-mandibular segment removal is recommended to restore facial symmetry and chewing function.[1]

Classification

These classifications consider factors like defect type, extent, anatomic landmarks osteotomies, and reconstruction nature. They help visualize the defect and devise effective treatment strategies.

Table1:

Sn.	Author	Classification
1.	Cantor & Curtis 1971[2]	Mandibular bony defects are classified based on severity and treatment approach. Class I involves radical alveolectomy while preservation of mandibular continuity. Class II implies mandibular lateral resection beyond the cuspid. Class III refers to resection from the lateral aspect progressing towards the midline. Class IV and V reconstructive surgery using lateral and anterior bone grafts, respectively. Class VI surgical removal of the anterior mandible devoid of subsequent reconstructive measures to reunite the lateral segment.[2]
2.	Pavlov 1974[3]	This classification system provides detailed categorization based on the number of bony fragments remaining and additional factors related to mentum encroachment and defect size. Class I corresponds to one fragment of bone. Class II to two fragments of bone. Class III to three fragments of bone. Subsequent divisions of classes are determined by the extent of encroachment on the mentum, further grouped by the size of the defect within these subgroups.[3]
3.	Desjardins and Laney 1977[4]	The determination of mandibular defect extent involves assessing whether mandibular continuity is maintained or interrupted. Mandibular defects are categorized into two fundamental types: continuity defects and discontinuity defects.[4]
4.	Jewer et al 1989[5]	Mandibular defects are classified based on bony defect extent and condyle status as follows: C represents a defect involving the entire anterior segment, encompassing both the canines. L denotes a defect in a lateral segment excluding the condyle. H indicates a defect in a lateral segment that includes the condyle. The lengths of both L and H segments can vary but do not extend across the midline.[5]
5.	Boyd et al 1993[6]	Mandibular defects are classified based on bony and soft tissue involvement, along with condyle status. The system includes categories like HCL, where C signifies a defect involving the anterior segment with incisors and canines, L denotes lateral defects excluding the condyle, and H indicates lateral defects including the condyle without crossing the midline. Soft tissue defects are identified by S (skin), M(mucosa), and SM(combined skin and mucosa).[6]
6.	Iizuka et al	Mandibular defects are classified based on the type of reconstruction required for fibula bone

	2005[7]	defects, determined by the number of osteotomies. Class I does not require fibula osteotomy; Class II has one; Class III has two; Class IV has more than two osteotomies. Class IV is a unique subtype within Class III defects, specifically identified in female patients with small chins.[7]
7.	Schultz et al 2015[8]	Mandibular defects are classified based on bony defect extent and vascular availability for anastomosis. Type 1 represents unilateral dentoalveolar defects limited to one side of the midline. Type 2 dentoalveolar defects exceed the angle unilaterally. Type 3 implies bilateral dentoalveolar defects not extending beyond either angle. Type 4 comprises bilateral defects extending beyond one or both angles. Each type is further categorized by the availability (A) or non-availability (B) of ipsilateral vasculature for anastomosis.[8]
8.	Brown et al 2016[9]	Mandibular defects are classified based on bony defect extent and condyle involvement. Class I denotes a lateral defect at the mandibular angle without the involvement of the ipsilateral canine or condyle whereas Class I c includes the condyle within the lateral defect at the angle. Class II indicates a hemi-mandibulectomy involving the removal of the ipsilateral canine while sparing the contralateral canine and condyle, Class II c signifies resection of the mandibular condyle, angle, and ipsilateral canine. Class III signifies an anterior mandibulectomy involving both canines but not the angle. Class IV and IV c indicated comprehensive anterior mandibulectomies involving the removal of both canines and at least one angle, with Class IV c, additionally encompassing at least one condyle within the resected area.[9]
9.	Khare and Gupta 2016[10]	A revision of Cantor and Curtis Class I classification introduces subdivisions without altering other classes. Class I now encompasses radical alveolectomy with preservation of mandible continuity. Subdivision A involves the excision of the superior border of the mandible, while subdivision B entails the excision of the inferior border of the mandible.[10]

Diagnostic consideration for prosthetic rehabilitation

In prosthetic rehabilitation, key factors include assessing the mandibular defect location and size, determining the impact of remaining teeth or implants, and evaluating post mandibulectomy issues like rotation, mouth opening, and tongue function. Compromises to vestibular extensions and potential skin grafting due to prior treatments are also critical considerations for developing a personalized treatment plan.[11]

Prosthetic rehabilitation of mandibular defects

Prosthetic rehabilitation for partially edentulous mandibular defect: The rehabilitation of partially edentulous mandibular defect patients varies based on the specific defect nature. For lateral discontinuity defect, where anterior teeth remain following resection, standard principles of partial denture design are applied. This includes using sturdy major connectors, incorporating lingual plates for additional support, and occasionally including non-retentive buccal bracing clasps to manage lateral forces effectively. [11] Standard solutions are customized attachment-retained guiding flanges and two-piece cast partial dentures with semi-precision attachments.[12] In case of mandibular deviation, occlusal ramps may be necessary to accommodate less-than-ideal occlusal relationships.

For defects with maintained or re-established mandibular continuity, considerations include vestibuloplasty, skin grafts, and potential rotation of posterior mandibular

fragments. Implant-retained prostheses are an option, requiring adequate bone thickness and tissue management. Lateral defects may be addressed with swing lock designs or fixed removable prostheses. Complicated cases, like segmental mandibulectomy, may require innovative solutions like fixed implant prostheses with two-layer designs to manage excessive interocclusal restoration space.[13]

Prosthetic rehabilitation for edentulous patients

Prosthetic rehabilitation for edentulous patients with mandibular defects presents challenges like denture instability, compromised oral mucosa, reduced salivary output, and abnormal maxillomandibular relationships causing mandibular deviation. Prognosis varies based on bony resection extent; midline resections typically have poor outcomes, while limited anterior resections may benefit from implants or bone grafting. Tongue condition is critical, with improved mobility enhancing stability, necessitating meticulous prosthesis adaptation and support from areas like the buccal shelf.

Centric registrations pose challenges due to altered proprioception and muscle imbalances, often necessitating non-anatomical tooth placement and neutrocentric occlusion to accommodate angular closure paths. Maxillary anterior teeth are usually positioned lingually, while mandibular anterior teeth are labial, with posterior teeth positioned to enhance stability and compensate for mandibular deviation. Implant-retained overlay dentures may improve aesthetics and mastication, particularly with preserved tongue function.

Conventional complete dentures may suffice if denture-bearing surfaces are favorable in maintained or re-established mandibular continuity but compromised tongue function. However, pre-prosthetic surgical procedures or implant placement may be necessary in unfavourable cases. Implants in both the mandible and maxilla, especially in anterior regions, can improve retention and stability, with the number depending on the opposing arch status. Meticulous consideration of anatomical factors and innovative prosthetic solutions are crucial for successful rehabilitation in these patients.[13]

Recent advances

The rohner reconstructive technique: The process of mandibular reconstruction utilizing a prefabricated fibula flap entails preparing the fibula with implants and a skin graft, guided by 3-D templates for precise implant placement. The flap can be revascularized before transfer to the recipient site, guided by occlusion with a provisional prosthesis. Surgery is planned on a skull model to tailor the fibula and determine implant positions, with implants placed using templates during surgery. A skin graft forms a new gingiva, and the flap is isolated to prevent tissue fusion before transfer with osteotomies based on the template. Stabilization with plates enables precise defect reconstruction.[14]

The Alberta reconstructive technique: Surgical digital design and stimulation employs digital planning and 3D printing for precise jaw reconstruction, reducing surgical time and improving accuracy. SDS-assisted reconstructions offer benefits such as reduced ischemia time and better spatial relationship preservation, which are crucial for oral rehabilitation. The Alberta Reconstructive Technique (ART) combines immediate implant placement planned with SDS, enhancing both flexibility and efficiency. Additive manufacturing ensures accurate, immediate implantation, even in case of malignant disease. In contrast to delay implant protocols, this technique approach was assessed for its safety, effectiveness, precision, efficiency, aesthetic, and cost efficiency.[15]

The Sydney modified Alberta reconstruction technique (SMART)

The Sydney Modified Alberta Reconstruction Technique (SMART) utilizes computer-guided planning and implant placement for mandibular and maxillary reconstruction, making it ideal for challenging tumor cases. It involves digital planning to determine the positioning of implants and bone flaps, facilitated by custom guides. Unlike ART, SMART utilizes patient-specific plates and intraoral implant drilling guides. Osteotomies are performed using cutting guides, followed by fixation of the fibula. In the second stage, adjustments to the skin paddle and the replacement of healing abutments with an acrylic stent complete the process after implant insertion and revascularization.[16]

Jaw in a day technique: Levine et al. introduced the "jaw in a day" concept, which enables reconstruction using fibula-free flaps with immediate dental implants and comprehensive rehabilitation all in one surgical session. Materialize Pro Plan software facilitated virtual planning for precise occlusal alignment. Fibula positioning, typically 15mm below the occlusal plane, allowed for prosthesis accommodation and maintained hygiene space. Surgery followed virtual plans, aided by cutting guides for mandibular osteotomies and fibula shaping. Dental laboratory fabrication produced a prosthesis and occlusal splint for surgical positioning, securing the fibula prosthesis complex with implants and a reconstruction bar, and achieving primary closure beneath the prosthesis.[17]

Conclusion

Advances in CAD-CAM technology and immediate implantation techniques have revolutionized dental rehabilitation following fibula-free flap reconstruction, minimizing wait times and patient discomfort. CAD-CAM facilitates accurate implant planning without the need for conventional impressions. The fibula jaw in a day approach enables immediate implant placement, followed by osseointegration and provisional prosthesis fitting, demonstrating success in single-stage maxillomandibular reconstruction across diverse case studies.

Acknowledgments

I express sincere gratitude to all contributors to this review article. Dr. T. Sunil Chandra, Professor & HOD of the Department of Prosthodontics, provided invaluable guidance and support, greatly enhancing our work with expertise and insightful feedback. I am also thankful to Dr. A. Kaleswara Rao professor of the Department of Prosthodontics and Dr. Sriharsha Babu, associate professor of the Department of Prosthodontics, for facilitating access to essential resources and literature that enriched our content. Lastly, we acknowledge all researchers whose studies we referenced, laying the groundwork for our exploration of this topic.

References

1. Swatantra Agarwal, Praveen G, Samarth Kumar Agarwal, Sankalp Sharma. Twin Occlusion: A Solution to Rehabilitate Hemimandibulectomy Patient- A Case Report. J Indian Prosthodont Soc. 2011; 11: 254-257.
2. Robert Cantor, Thomas A. Curtis. Prosthetic Management of Edentulous Mandibulectomy Patients. Part 1. Anatomic, Physiological, and Psychological considerations. J Prosthet Dent 1971; 25: 446-457. doi: 10.1016/0022-3913(71)90236-8.
3. Pavlov BL. Classification of Mandibular Defects. Stomatologiia.1974; 53: 43-46. PMID: 4610902.
4. Desjardins RP, Laney WR. Prosthetic Rehabilitation after Cancer Resection in the Head and Neck. Surg Clin North Am. 1977; 57: 809-822. doi: 10.1016/s0039-6109(16)41290-9, PMID: 331521.

5. Jewer DD et al. Orofacial and Mandibular Reconstruction with the Iliac Crest Free Flap: A Review of 60 cases and a new method of classification. PlastReconstr Surg. 1989; 84: 391-403. PMID: 2762397.
6. Boyd JB, Gullane PJ, Rotsein LE, Brown DH, Irish JC. Classification of mandibular defects. PlastReconstr Surg. 1993; 92: 1266-1275. PMID: 8248401.
7. Iizuka T, Häfliger J, Seto I, Rahal A, Mericske-Stern R, Smolka K. Oral Rehabilitation after Mandibular Reconstruction using an Osteocutaneous Fibula Free Flap with Endosseous Implants: factors affecting the functional outcome in patients with oral cancer. Clin Oral Implants Res. 2005; 16: 69-79.
8. Schultz et al. Classification of mandibular defects and algorithm for microvascular reconstruction. PlastReconstr Surg.2015; 135: 743-754.
9. Brown JS, Barry C, Michael Ho, Shaw R. A new classification for mandibular defects after oncological resection. Lancet Oncol 2016; 17: 23-30. doi: 10.1016/S1470-2045(15)00310-1, PMID: 26758757.
10. Khare A, Gupta SB. A revised prosthetic classification of surgical impairment due to mandibulectomy. J Prosthet Dent. 2016; 116: 471-473. doi: 10.1016/j.prosdent.2016.03.009. PMID: 27132784.
11. Beumer J, Marunick MT, Esposito SJ. Maxillo-Facial Rehabilitation, prosthodontic and surgical management of cancer-related, acquired, and congenital defects of the head and neck. 3rd edition. Quintessence publication.2011.
12. Munot VK, Nayakar RP, Patil R. Prosthetic rehabilitation of mandibular defects with fixed-removable partial denture prosthesis using precision attachment: A twin case report. Contemp Clin Dent 2017; 8: 473-478. doi: 10.4103/ccd.ccd_117_17. PMID: 29042738.
13. Lan YH, Yang HY, Chang HH, Lin LD, Wang TM. Resolution of excessive interocclusal restoration space post-mandibulectomy using a two-layer retrievable fixed implant-supported prosthesis: a case report. J Prosthodont.2022; 31: 367-373. doi: 10.1111/jopr.13497. PMID: 35184343.
14. Rohner D, Bucher P, Hammer B. Prefabricated Fibular Flaps for Reconstruction of Defects of the Maxillofacial Skeleton: Planning, Technique, and Long-Term Experience. Int J Oral Maxillofac Implants 2013; 28: 221-229. doi: 10.11607/jomi.te01. PMID: 24066339.
15. Seikaly et al. The Alberta Reconstructive Technique: An Occlusion-Driven And Digitally Based Jaw Reconstruction. Laryngoscope 2019; 129: 1-14. doi: 10.1002/lary.28064.PMID:31241771.
16. Johal M, Leinkram D, Wallace C, Clark JR. The Sydney Modified Alberta Reconstruction Technique (SM-ART) for dental rehabilitation following mandibulectomy or maxillectomy. Int.J. Oral Maxillofac. Surg. 2021; 50: 615-618. doi: 10.1016/j.ijom.2020.09.013. PMID: 33069518.
17. Qaisi Md, Kolodney K, Swedenburg G, Chandran R, Caloss R. Fibula Jaw in a Day: State of the Art in Maxillofacial Reconstruction. J Oral Maxillofac Surg. 2016; 74: 1284.1-1284.15.