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Richa Wadhawan
Professor, Oral Medicine,
Diagnosis & Radiology, Pdm
Dental College & Research
Institute, Bahadurgarh,
Haryana, India

Chanchala Kumari
Private Practitioner, Sahaj
Dental Care, Ramgarh,
Jharkhand, India

Deepali Verma
Private Practitioner, My Dentist
Dental Clinic, Bhopal, Madhya
Pradesh, India

Sushma Mishra
Private Practitioner, Shree Sai
Dental Clinic, Tikamgarh,
Madhya Pradesh, India

Nidhi Mishra
Private Practitioner, Gurukripa
Advanced Dental Care, Indore,
Madhya Pradesh, India

Souhardya Sanyal
Dental Surgeon, Institute Of
Dental Education & Advance
Studies Gwalior, Madhya
Pradesh, India

Corresponding Author:
Richa Wadhawan
Professor, Oral Medicine,
Diagnosis & Radiology, Pdm
Dental College & Research
Institute, Bahadurgarh,
Haryana, India

Prosthetic rehabilitation of hemimandibulectomy patients with mandibular guiding flange prosthesis: A deep dive

Richa Wadhawan, Chanchala Kumari, Deepali Verma, Sushma Mishra, Nidhi Mishra and Souhardya Sanyal

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Abstract

Hemimandibulectomy, involving the removal of half of the mandible, poses significant challenges in functional and aesthetic rehabilitation. This review delivers a thorough examination of prosthetic strategies, with a focus on mandibular guiding flange prostheses. These prostheses are specifically designed to guide mandibular movement and enhance masticatory function, making them a crucial tool in prosthetic care. The review highlights the effectiveness of these prostheses in managing mandibular deviations and restoring proper occlusion. Success in rehabilitation relies on precise prosthesis design, optimal occlusal guidance, and the integration of additional reconstructive techniques. Evidence indicates that mandibular guiding flange prostheses significantly improve masticatory efficiency, speech quality, and overall patient satisfaction. The review also explores how various factors such as the extent of mandibular resection, individual anatomical and physiological conditions, and supplementary reconstructive procedures affect the prosthesis's efficacy. Examination of design modifications and material choices offers opportunities to enhance function and comfort. Mandibular guiding flange prostheses play a pivotal role in managing hemimandibulectomy patients, providing substantial benefits in guiding mandibular movement and restoring functional and aesthetic parameters. Future research should focus on long-term outcomes and innovations in design to further optimize the effectiveness of these prostheses. This review provides a comprehensive analysis of the mandibular guiding flange prosthesis, covering its historical development, current use, and future potential in treating hemimandibulectomy cases.

Keywords: Hemimandibulectomy, mandibular guiding flange prosthesis, mandibular rehabilitation, prosthetic management, oral rehabilitation, squamous cell carcinoma

Introduction

Hemi mandibulectomy, the surgical removal of one half of the mandible, presents significant challenges in restoring oral function and aesthetics [1]. This procedure often results in impaired chewing, speech, and swallowing, as well as facial asymmetry [2]. Oral Squamous Cell Carcinoma (OSCC) is one of the most prevalent carcinomas of the oral cavity, ranking as the 12th most common cancer worldwide, with particularly high incidence rates in India [3]. OSCC frequently involves the tongue, floor of the mouth, and mandible, necessitating the excision of affected tissues and adjacent lymph nodes [4]. Managing these cases poses difficulties for general surgeons, oral surgeons, oral radiologists, prosthodontists, and dentists, both in treating the disease and facilitating recovery post-treatment [5]. The challenges and management following a hemi mandibulectomy (Figure 1) are significant, as the loss of mandibular continuity can greatly impact chewing, speech, and swallowing. This often results in jaw deviation toward the affected side, facial asymmetry, drooling, and decreased aesthetic appearance [6].

Immediate jaw reconstruction is crucial for restoring facial symmetry, dental arch alignment, and stable occlusion [7]. Traditional prosthetic approaches have had mixed success, underscoring the necessity for innovative solutions to enhance patient outcomes [8].



Courtesy: Phibadahun Sohmat, Ramashanker, Raghuwar Dayal Singh, Sunit Kumar Jurel, Pooran Chand. Use of mandibular guidance prosthesis with the buccal guide flange in hemimandibulectomy patient. International Dental Journal of Student Research 2020; 8(3):118–121.

Fig 1: A patient with left hemimandibulectomy

The mandibular guiding flange prosthesis is a specialized device designed to address these issues by restoring proper occlusal relationships, improving mastication, and assisting in comprehensive oral rehabilitation (Figure 2) [9].

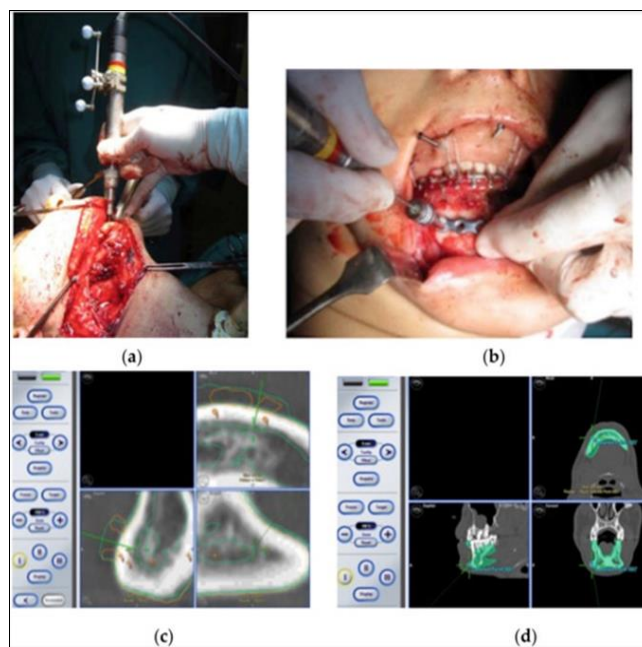


Courtesy: Phibadahun Sohmat, Ramashanker, Raghuwar Dayal Singh, Sunit Kumar Jurel, Pooran Chand. Use of mandibular guidance prosthesis with the buccal guide flange in hemimandibulectomy patient. International Dental Journal of Student Research 2020; 8(3):118–121.

Fig 2: Guiding flange prosthesis extending superiorly from the buccal clasp.

Historical and current approaches for managing mandibular defects include traditional guiding flange prostheses, surgical reconstruction with subsequent partial dentures, osseointegrated implants, and removable prostheses [10]. The guiding flange prosthesis, designed based on pre-surgical imaging and tailored to each patient's specific anatomical features, offers a customized and flexible solution to enhance mandibular function, speech, and aesthetics following surgery [11]. It is particularly valuable during the interim phase when secondary procedures, such as bone grafting, are planned, and healing is required before a definitive prosthesis can be created [12]. Historically, inter-maxillary fixation was used to reduce mandibular deviation associated with mandibulectomy [13]. This method involved arch bars and elastics for 5–7 weeks post-surgically and was feasible only for patients with resections confined to the mandible and minimal associated soft-tissue loss. In cases involving extensive resections, scar

contracture, or radiation therapy, this approach often exacerbated mandibular deviation due to tight wound closure and scar contracture rather than muscle imbalance [14]. The guiding flange prosthesis has proven effective in stabilizing the mandible and improving function [15]. For instance, a case review highlighted its transformative impact for a patient who underwent a hemimandibulectomy from the left side condyle to the medial region [16]. Despite previous reconstruction attempts, including a free fibula bone graft that failed (Figure 3), the guiding flange prosthesis emerged as a pivotal intervention, providing vital support and functionality [17].

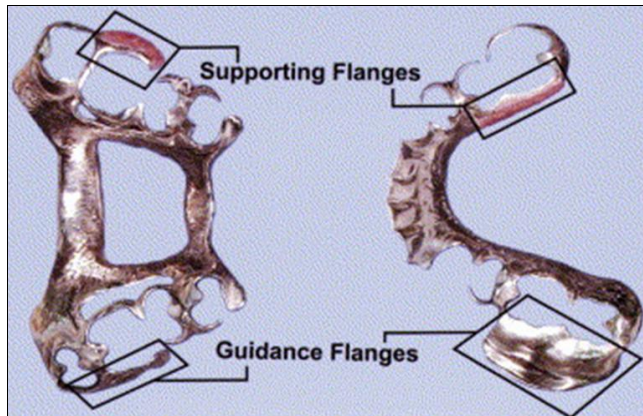


Courtesy: Sozzi D, Filippi A, Canzi G, De Ponti E, Bozzetti A, Novelli G. Surgical Navigation in Mandibular Reconstruction: Accuracy Evaluation of an Innovative Protocol. J Clin Med. 2022; 11(7):2060.

Fig 3: The fibula flap is inset and fixed through a recorded drill and surgical navigation.

In cases where maxillary teeth are absent on the side of the mandibulectomy, the primary goal is to reposition the remaining mandible to facilitate basic chewing functions and enhance facial appearance [18]. The guiding flange prosthesis, often crafted from clear acrylic with wire components positioned toward the posterior, has proven effective in stabilizing the mandible [19]. A maxillary stabilization plate is also employed to prevent shifting of the maxillary teeth. Interim and long-term use often serves as a temporary measure, with the guiding flange prosthesis providing a provisional solution until a permanent restoration can be designed and fitted [20]. If the patient successfully maintains the correct medio-lateral alignment, the prosthesis may be discontinued [21]. However, some patients might continue using the guiding flange prosthesis for an extended period due to financial constraints, time limitations, or an uncertain prognosis for a definitive solution [22]. Despite advances in reconstructive surgery and prosthodontics, over 50% of patients with head-and-neck cancer report ongoing issues with chewing function [23]. Innovations in reconstructive surgery and dental implants provide hope for enhanced quality of life, but interim solutions like the guiding flange prosthesis remain crucial for guiding the residual mandible into a functional position and enhancing chewing efficiency [24]. Design considerations for the rehabilitation of a patient following a

hemi mandibulectomy with a mandibular guiding flange prosthesis include several crucial factors [25]. Customization of the prosthesis is critical, necessitating precise measurements and impressions to achieve an optimal fit and functionality tailored to the patient's unique anatomy [26]. Material selection is also vital; the chosen materials, typically acrylic resins (Figure 4) or metals, must be durable, biocompatible, and capable of withstanding oral conditions [27].



Courtesy: Şahin N, Hekimoğlu C, Aslan Y. The fabrication of cast metal guidance flange prostheses for a patient with segmental mandibulectomy: A clinical report. *J Prosthet Dent.* 2005 Mar; 93(3):217-20.

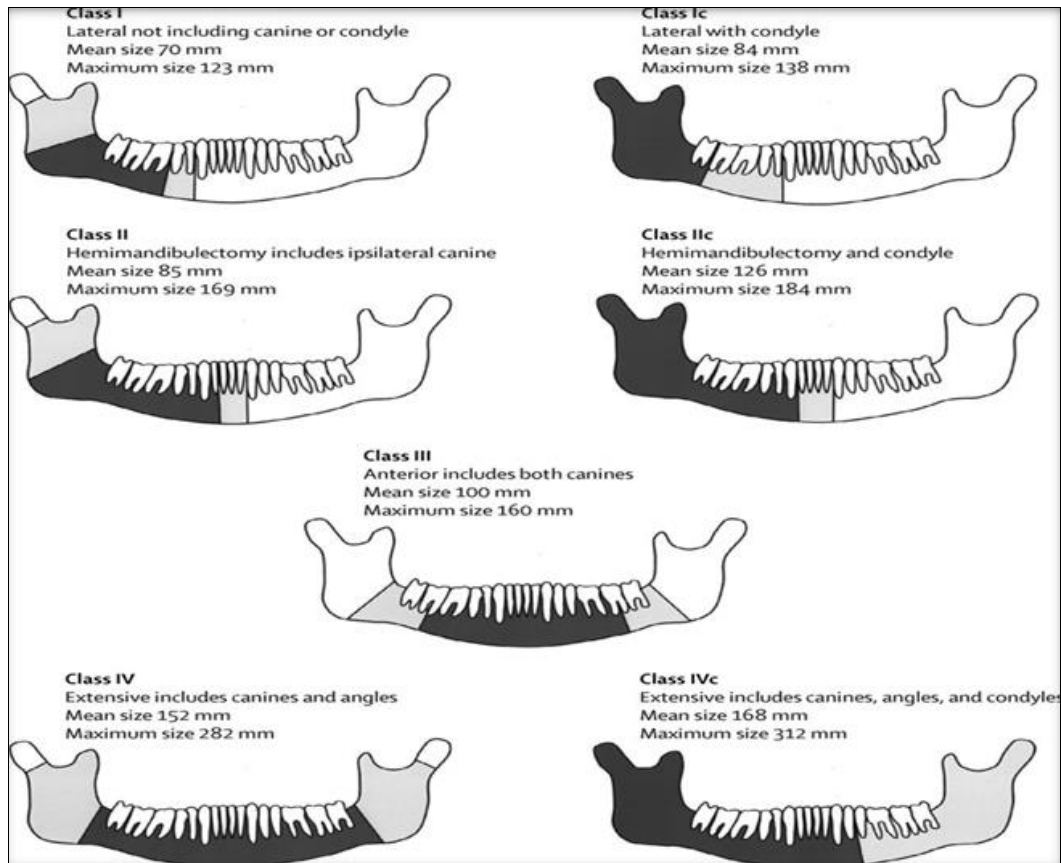
Fig 4: Guiding flange prosthesis made of cast metal

The prosthesis should provide effective occlusal guidance to ensure proper bite alignment, preventing malocclusion and excessive wear on remaining teeth, thus facilitating efficient chewing [28]. Adequate stability and retention are essential and can be achieved through techniques such as dental implants or precision attachments to prevent displacement [29]. Additionally, aesthetic integration is important for seamlessly blending the prosthesis with the patient's natural dentition and facial features, thereby restoring facial symmetry and enhancing appearance [30]. The clinical implementation involves a comprehensive initial assessment, including clinical and radiographic evaluations, to inform the prosthesis design [31]. This is followed by prosthesis fabrication, starting with a provisional device to refine fit and function. The final prosthesis undergoes meticulous adjustment and fitting to ensure comfort and optimal functionality, with regular follow-up care to monitor the prosthesis, address any issues, and make necessary adjustments [32]. Challenges such as prosthesis adaptation, occlusal imbalance, tissue changes, and patient compliance must be managed through custom adjustments, ongoing patient education, and regular evaluations to ensure long-term success and improve the patient's quality of life [33]. Management of mandibular continuity defects due to odontogenic tumor-like ameloblastoma, often aggressive and occurring in the posterior mandibular region, typically necessitates surgical resection of part or the entire mandible [34]. Mandibular resection without continuity defects is less debilitating compared to resection with continuity defects, i.e., mandibular discontinuity. Problems associated with mandibular continuity defects include deviation, retrusion, and rotation of the residual mandibular segment [35]. Deviation occurs toward the resected side, with inferior rotation upon closure and retrusion in position [36]. Bone graft reconstruction or the use of metal plates for mandibular continuity at the time of surgery can improve patient rehabilitation [37]. However, without treatment, there is a loss of occlusion due

to deviation of the residual mandible and anterior open bite, affecting the patient's masticatory function and aesthetics [38]. This results from muscle function imbalance due to the removal of muscle on one side, changes in jaw relationship, and reduced tooth contacts [39]. Even though immediate reconstruction aims to enhance arch relationship, facial symmetry, and occlusion, muscle function often remains compromised. Although it is a challenging task, such patients can be rehabilitated using prostheses, which may be palatal or mandibular-based guiding prostheses [40]. In a mandibular guiding prosthesis, the buccal guide flange is attached to the mandibular prosthesis on the non-resected side, extending superiorly to the maxillary teeth and guiding the mandible laterally and superiorly into proper occlusion [41]. The flange maintains the mandible in the correct position for vertical masticatory strokes and prevents its deviation. The extension may be made from acrylic resin, heavy wire loop, or cast in alloy. Mandibular resection results in aesthetic disfigurement, impaired speech articulation, problems with mastication, difficulty in swallowing, and mandibular deviation towards the resected side [42]. Surgical reconstruction might not always be feasible. Prosthodontic rehabilitation plays a crucial role in such patients to regain form and function. Mandibular deviation is dictated by the extent of hard and soft-tissue ablation during surgery, the type of surgical closure, the extent of tongue function impairment, remaining teeth available for occlusion, and the degree of loss of sensory and motor function [43]. Methods used to minimize deviation include skin grafts and flaps for wound closure, inter-maxillary fixation during surgery, mandibular guidance prosthesis, and intensive physiotherapy. The success rate depends on the situation and extent of the mandibular resection, the amount of adjacent soft tissue removed during surgery, and the presence or absence of natural teeth [44]. Mandibular resection leads to mandibular deviation towards the defect side, resulting in loss of occlusion on the unresected side, altered mandibular movements, aesthetic disfigurement, and difficulty in swallowing, impaired speech, and articulation. Surgical reconstruction may not be feasible in every case. Prosthetic rehabilitation, along with physical therapy, helps to regain form and function in such patients and enhance their quality of life [45]. This can be accomplished by using various guidance prostheses, which can efficiently retrain the mandible after resection procedures to achieve a functional occlusal relationship, thereby enabling early advancement to a nearly perfect functioning permanent restoration [46]. Resection leads to aesthetic deficits, functional disabilities, occlusal disabilities, and, most significantly, psychological distress for the patient [47]. The rehabilitation of such patients is quite challenging. This review presents an overview of various aspects of prosthetic rehabilitation for mandibulectomy patients to correct mandibular deviation, improve mastication, speech, and aesthetics, and thus enhance their quality of life [48]. A classification of mandibular defects described by Cantor and Curtis is useful for understanding these conditions [49]. Although the classification system is suggested primarily for edentulous patients, it is also applicable to partially edentulous patients. Cantor and Curtis Classification: Class I: Mandibular resection involving an alveolar defect with preservation of mandibular continuity. Class II: Resection defects involve loss of mandibular continuity distal to the canine area. Class III: Resection defect involves loss up to the mandibular midline region. Class IV: Resection defect involves the lateral aspect of the mandible but is augmented to maintain pseudo articulation of bone and

soft tissues in the region of the ascending ramus. Class V: Resection defect involves the symphysis and parasymphysis region only, augmented to preserve bilateral tempo-

mandibular articulations. Class VI: Similar to Class V, except that mandibular continuity is not restored.



Courtesy: Mani Ragbir J S Brown Hisham Mehanna. Reconstructive considerations in head and neck surgical oncology: United Kingdom National Multidisciplinary Guidelines. *J Laryngol Otol.* 2016; 130(S2):S191-S197.

Fig 5: Cantor and Curtis classification

This review consolidates insight into the various mandibular guidance prostheses used to correct mandibular deviation following partial mandibulectomy and the rehabilitative aspects of mandibular deviation [50].

Discussion

Rehabilitation following a hemi-mandibulectomy presents significant challenges due to the loss of mandibular continuity and the resultant deviation and inferior rotation of the mandibular occlusal plane [51]. Immediate reconstruction is generally recommended to improve facial symmetry and masticatory function, though over 50% of head and neck cancer patients still experience impaired masticatory function despite advances in surgical and prosthodontic techniques [52]. Aramany and Myers advocated for inter maxillary fixation achieved with arch bars and elastics for five to seven weeks immediately after surgical resection [53]. This method helps maintain the residual mandible in the proper maxilla mandibular position, facilitating the healing of the defect and associated scar formation with the teeth in occlusion [54]. The use of inter maxillary fixation in the immediate postoperative period reduces the need for extensive muscle retraining, with the degree of mandibular deviation being inversely proportional to the fixation duration [55]. Fattore *et al.* proposed using a two-piece Gunning splint for both inter maxillary fixation and as a guidance appliance for edentulous patients following hemi section of the mandible [56]. This appliance consists of upper and lower splints made from plaster models [57]. To achieve maximum lateral stability, the

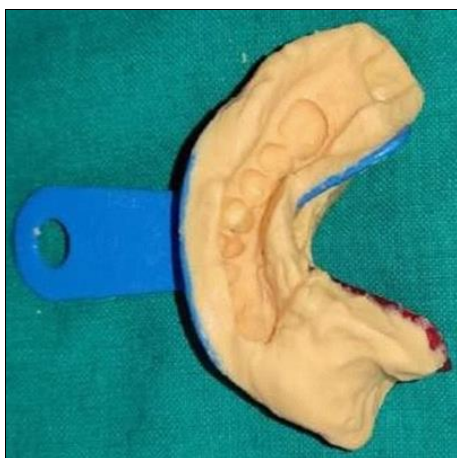
upper splint includes all standing teeth and the palatal vault, while the lower splint incorporates teeth and vestibular flanges acting as guide planes for mandibular closure [58]. These splints are articulated in the intercuspal position and fused together with a heated polymer. The resulting soft plastic splint guides the jaw movements comfortably and can be worn at night. This appliance has a relatively short shelf life and should be replaced with a more definitive acrylic or metal appliance once the patient adapts to the closure path [59]. Guidance prosthesis can be fabricated for either the maxilla or mandible in the absence of primary wound complications. These interim prostheses help reestablish acceptable occlusal relationships and proprioception [60]. Once a satisfactory occlusal relationship is achieved, the guidance prosthesis may be discontinued or used occasionally to reinforce proprioceptive mechanisms [61]. Robinson and Rubright suggested a cast mandibular resection restoration when the mandible can be manipulated into an acceptable maxilla mandibular relationship but the patient lacks the motor control to achieve occlusion [62]. This mandibular guidance prosthesis features a removable partial denture framework with a metal flange extending laterally and superiorly on the buccal aspect of the non-defect side's premolars and molars [63]. This flange, which can be made of acrylic resin or cast chrome-cobalt metal (Figure 6), guides the mandible into the appropriate inter cuspal position [64]. In cases of resistance, an acrylic resin guidance ramp, which can be periodically adjusted, is preferred.



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. *J Clin Images Med Case Rep.* 2021; 2(6):1502.

Fig 6: Cast metal alloy framework

Resection Guidance Restorations for maxillary prostheses, an interim ramp may be used [65]. This prosthesis, typically fabricated from acrylic resin with cast or wrought-wire retainers, covers the full palate and is adjusted to fit the patient's mouth [66]. A maxillary impression is made, and a mix of auto-polymerizing acrylic resin is added to the palatal prosthesis to establish an index in the palate. This process is repeated to create a glide path that helps the mandible reach the inter-occlusal position without interference. The maxillary ramp is advised post-operatively to facilitate adjustment and prevent scar tissue contracture. Once the mandible exhibits more freedom of movement, palatal ramp adjustments are necessary to achieve a desirable maxilla mandibular relationship [67]. After an acceptable intercuspal position is established; occlusal equilibration is generally required to maintain the mandibular position [68]. Rosenthal's approach involved arranging two rows of maxillary posterior teeth on the unresected side. This double row of teeth on the maxillary prosthesis helps guide the mandible into a more desirable maxilla mandibular relationship through cuspal interlocking and provides a broader occlusal surface [69]. The fabrication process begins with an impression taken using alginate and the formation of suitable mandibular and maxillary casts (Figures 7 and 8).



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. *J Clin Images Med Case Rep.* 2021; 2(6):1502.

Fig 7: Primary impression



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. *J Clin Images Med Case Rep.* 2021; 2(6):1502.

Fig 8: Primary cast

The diagnostic casts are surveyed (Figure 9), and undercuts are blocked.



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. *J Clin Images Med Case Rep.* 2021; 2(6):1502.

Fig 9: Surveying of diagnostic cast

The design of the partial denture framework is outlined (Figure 10), and mouth preparation is completed.



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. J Clin Images Med Case Rep. 2021; 2(6):1502.

Fig 10: Design of cast partial framework is outlined on cast.

A final impression is made using light body and rubber base material, and the master cast is poured (Figure 11).



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. J Clin Images Med Case Rep. 2021; 2(6):1502.

Fig 11: Final impression

The master cast is duplicated in agar, and a refractory cast is poured. On the refractory cast, the wax pattern is adapted (Figure 12).



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. J Clin Images Med Case Rep. 2021; 2(6):1502.

Fig 12: Wax pattern adaptation with metal guide flange

The metal framework wax pattern includes a major connector, such as a lingual bar, and embrasure clasps on the posterior teeth on the un-resected side. The guide flange extends 7-10 mm laterally and superiorly on the buccal aspects of the bicusps and molars from the shoulder portion of the direct retainer on the un-resected side. This flange engages the maxillary teeth during mandibular closure, thereby directing the mandible into an appropriate intercuspal position. The angulations of the guiding ramp are fabricated using wax records of the posterior teeth with approximately 3 mm separation and the mandible maximally deflected toward the un-resected side. Sprues are attached, the wax pattern is invested, and casting is completed. The casting is retrieved, finished, and polished. The partial denture framework is verified in the mouth and adjusted using rouge and chloroform or disclosing wax. For performing the altered cast technique, double spacer wax is adapted over the minor connector, and a record base is fabricated (Figure 13).



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. J Clin Images Med Case Rep. 2021; 2(6):1502.

Fig 13: Double spacer wax adapted and record base fabricated

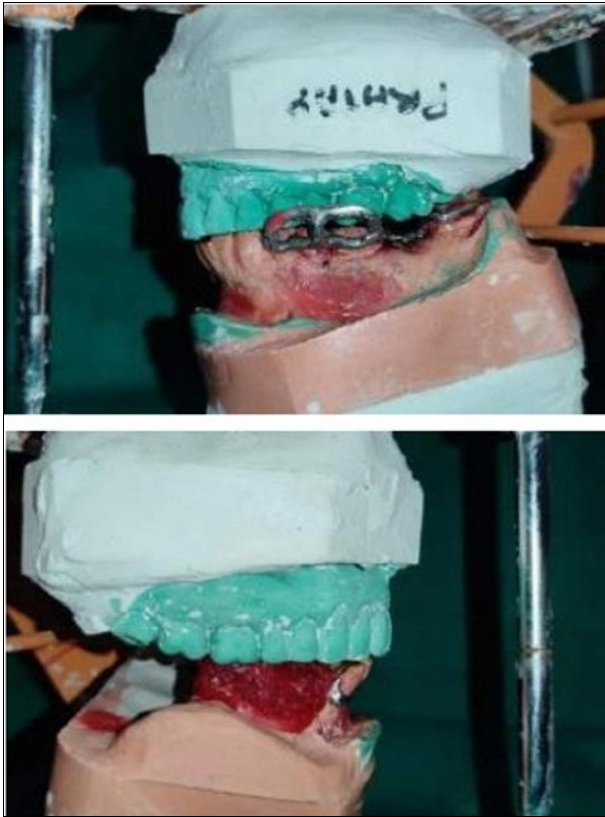
A final impression is made using tissue conditioner. The master cast is sectioned, and adaptation is checked by placing the framework over it. Serrations are made on the master cast for better interlocking of the sectioned pieces (Figure 14).



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. J Clin Images Med Case Rep. 2021; 2(6):1502.

Fig 14: Serrations are made for interlocking

Beading and boxing are done to pour the altered cast, and the final framework is seated to check its adaptation over the altered master cast. Bite registration is performed using a bite registration tray, and jaw relations are recorded. The cast is mounted on a mean value articulator. Teeth arrangement and try-in are done, and occlusion is checked (Figure 15).



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. *J Clin Images Med Case Rep.* 2021; 2(6):1502.

Fig 15: Bite registration

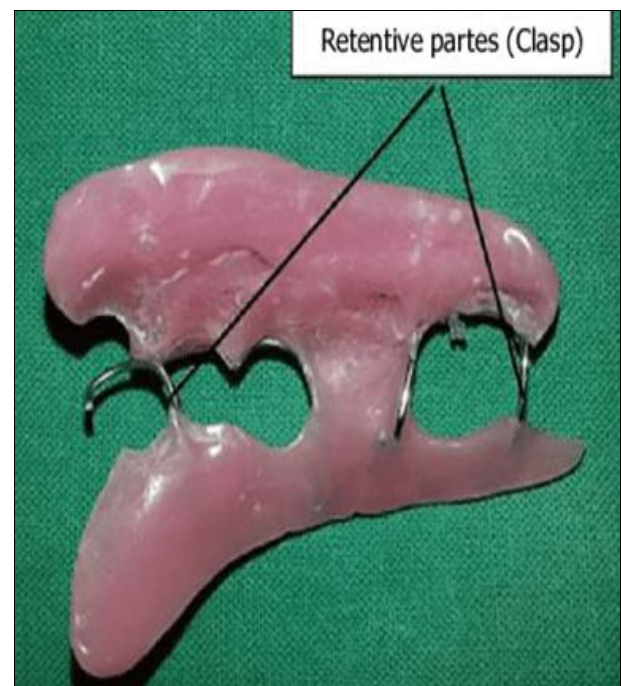
The complete framework is processed in heat-polymerized acrylic resin. Self-cure acrylic is adapted over the metal guide flange in the framework, and buccal indentation of opposing maxillary teeth in occlusion is recorded to guide the mandible into a specific closing point. The final prosthesis is delivered after confirming the proper seating of the framework and the angulation of the guide flange (Figure 16).⁷⁰



Courtesy: Thakur J, Parlani S, Jain N, Damade S, Jajoo K, Dwivedi P. Definitive guiding flange prosthesis for management of hemimandibulectomy: A case report. *J Clin Images Med Case Rep.* 2021; 2(6):1502.

Fig 16: Final Prosthesis

Semi-anatomic teeth were used for esthetics, with occlusal grinding to allow freedom in lateral movements and minimize lateral stresses. The mandibular guide flange prosthesis, used during the initial healing phase, helps maintain the mandible's correct occlusal relationship with the maxilla and improves chewing efficiency^[71]. It typically involves a maxillary cast framework that engages all maxillary teeth and a mandibular cast partial denture. The prosthesis includes a buccal plate on the framework to engage the buccal vestibule and extend toward the retro molar pad, controlling mandibular movement during function. The guiding flange, made from clear acrylic resin with a precision attachment, enhances both function and aesthetics^[72]. The mandibular guide flange is introduced in the second week post-surgery to prevent mandibular deviation and maintain the proper medio-lateral alignment of the mandible. It includes features like a serrated U-shaped loop for support and circumferential clasps (Figure 17) with mesial and distal rest to prevent prosthesis flexing. The lingual plate counters the buccal clasp, offering rigidity and improved stabilization.

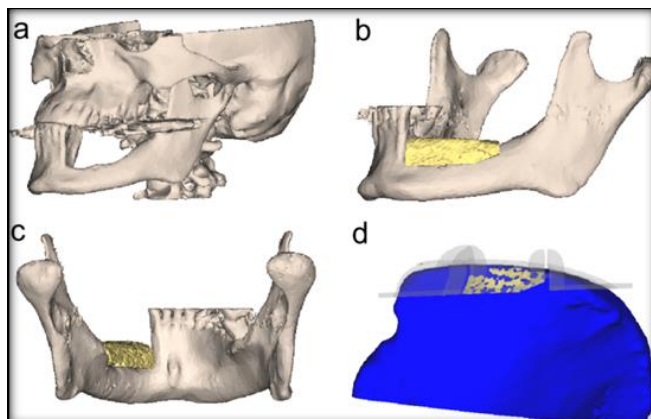


Deenadayalan L, Rajendran A, Ujjayanthi S, Challa P. Prosthodontic management of hemimandibulectomy patients to restore form and function - A case series. *J Prosthodont.* 2017; 26(8):688-95.

Fig 17: Mandibular guiding flange prosthesis with retentive clasp

Despite advances, some patients may still struggle to sustain the correct occlusal relationship, necessitating the continued use of guiding flange prosthesis. This approach helps in effective mastication and maintains the mandible's alignment with the maxilla for optimal function^[73].

Future Directions: Advancements in materials science, digital prosthetic design, and implant technology hold promise for further improving the efficacy and comfort of mandibular occlusal flange prostheses. The integration of computer aided design/ computer aided machining CAD/CAM technology and 3D printing may streamline the design and fabrication process, leading to more precise and personalized prosthetic solutions (Figure 18)^[74].



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Fig 18: CAD/CAM in hemimandibulectomy patient

Conclusion

The mandibular guiding flange prosthesis is a crucial temporary solution for patients undergoing hemimandibulectomy, significantly aiding in functional and aesthetic rehabilitation. By offering essential support during the interim period, this prosthesis facilitates the transition to definitive prosthetic solutions, enhancing both quality of life and functional outcomes. Through meticulous design, fabrication, and adjustment, these prostheses play a vital role in re-establishing mandibular continuity and improving patient satisfaction. The success of hemi-mandibulectomy rehabilitation hinges on the nature of the surgical defect, the patient's cooperation, and effective prosthetic management, supported by an early physiotherapy program. When both arches have teeth, the proprioceptive feedback is improved, allowing the prosthesis to reeducate mandibular muscles and achieve an acceptable occlusal relationship. Continued advancements in prosthetic technology and materials promise to further refine this approach, ultimately leading to better patient outcomes and enhanced functional and aesthetic results.

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