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Digital Design and Prosthodontic Rehabilitation of Mandibular Distal Extension Partial Edentulism Using a Cast Partial Denture: A Clinical Case Report

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Abstract: Mandibular distal extension partial edentulism presents by significantly biomechanical and functional challenges faced at the time of prosthetic rehabilitation because of the difference in support provided by the abutment teeth & residual ridge tissues. When implant supported prostheses or permanent restorations are impractical, the cast partial dentures (CPDs) continue to be a dependable and affordable treatment option for partial edentulous arches. In reference to 36, 37, and 47, the current clinical study details the prosthodontic rehabilitation of a partial edentulous mandibular arch employing a digitally created cobalt chromium CPD framework which was made to replace the missing teeth. Prosthesis insertion, jaw connection procedures, digital framework design, surveying, mouth preparation, framework production, and diagnostic assessment were all done in accordance with accepted biomechanical principles. To provide the best possible support, retention, stability, and advantageous stress distribution, the mandibular framework included a lingual bar major connector, occlusal rests, lattice minor connectors, proximal plates, and circumferential clasp assemblies. To improve mastication, occlusion, and patient comfort, acrylic denture teeth were positioned over the distal extension denture bases. During a follow-up review, the final prosthesis showed adequate retention, stability, aesthetics, and functional efficiency. In order to successfully rehabilitate mandibular partly edentulous arches with cast partial dentures over the long term, this case report emphasises the need for appropriate framework design and biomechanical planning. During follow-up, the cast partial denture showed better mastication and no soft tissue complications, with good retention, stability, functional efficiency, and patient comfort. For mandibular distal extension partial edentulism, digitally generated cobalt-chromium cast partial dentures provides a dependable, affordable, and efficient treatment alternative that guarantees the positive functional outcomes with patient satisfaction.

Keywords: *Cast Partial Dentures, Functional Outcomes, Mandibular Arches, Partial Edentulous Arch, Prosthetic Rehabilitation, Biomechanical Planning.*

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I. INTRODUCTION

In prosthodontic practice, partial edentulism is a frequent oral condition that can be caused by periodontal disease, dental caries, trauma, or the extraction of damaged teeth.[1] Mastication, occlusal stability, speech, facial attractiveness, and general oral health are all negatively impacted by the loss of posterior teeth. In addition to replacing missing teeth, the goal of rehabilitation for partly edentulous arches is to maintain remaining oral tissues, restore function, and enhance patient comfort and confidence.[2]

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Patients with partially edentulous arches can get a variety of treatments, such as overdentures, implant-supported restorations, fixed dental prostheses, and removable partial dentures (RPDs).[3] Cast partial dentures are still a reliable and affordable treatment option, even though implant dentistry has become more popular recently. This is particularly true for patients who have limited resources, insufficient bone support, medical contraindications, or insufficient abutment support for fixed prostheses.[4]

Cast partial dentures offer better retention, support, stability, longevity, even stress distribution, and patient comfort over traditional acrylic RPDs.[5] The cobalt chromium framework reduces the prosthesis's bulkiness while providing strength and stiffness. To maintain periodontal health and guarantee long-term success, proper design principles such as suitable major connections, guiding planes, occlusal rests, indirect retainers, and clasp assemblies are crucial.[6] Due to the disparity in the support provided by teeth and soft tissues, mandibular distal extension and posterior partly edentulous conditions frequently pose biomechanical difficulties. Therefore, to obtain the best possible stress regulation and functional efficiency, careful diagnostic, surveying, mouth preparation, and framework planning are required.[7]

The prosthodontic rehabilitation of a partially edentulous mandibular arch utilising a cast partial denture for the replacement of missing mandibular molars in relation to 36, 37, and 47 employing acrylic denture teeth over a cast metal framework has been described in the current clinical report.

II. CASE REPORT

A 57-year-old male patient reported to the Department of Prosthodontics Crown & Bridge, with the chief complaint of difficulty in mastication due to missing mandibular posterior teeth. The patient wanted an affordable, functional dental prosthesis replacement that would increase oral comfort and chewing efficiency.

A clinical examination showed that the mandibular arch was partly edentulous, with missing teeth in relation to 36, 37, and 47. The remaining dentition showed adequate oral hygiene care and periodontal support. A radiographic examination showed that the abutment teeth had sufficient bone support. The final treatment choice was determined to be a mandibular cast partial denture based on radiological and clinical evidence.

Following the informed consent, diagnostic casts were created and first impressions were taken using irreversible hydrocolloid impression material. The casts were surveyed to determine the path of insertion, favourable undercuts, guiding planes, and framework components. [Figure 1] A digitally designed cast partial denture framework was planned using Exocad software to achieve optimum biomechanical stress distribution and framework adaptation. [Figure 2] The definitive framework design incorporated a lingual bar major connector because sufficient functional depth of the lingual sulcus was present. [Figure 3]

The lingual bar provided rigidity with minimal gingival coverage and improved patient comfort. Occlusal rests were prepared on the posterior abutment teeth adjacent to the edentulous areas to provide vertical support and prevent tissue ward displacement of the prosthesis. Minor connectors were designed to connect the occlusal rests and denture base components to the major connector. [Figure 4]

Lattice-type denture base minor connectors were incorporated bilaterally in the distal extension areas to provide mechanical retention for the acrylic resin denture bases replacing teeth in relation to 36, 37, and 47. Circumferential clasp assemblies were planned on the abutment teeth to provide direct retention and stability. Proximal plates were incorporated adjacent to the edentulous areas to improve reciprocation and guide the path of insertion. The framework design was digitally visualized and evaluated before casting.

The preparation of guiding planes and occlusal rest seats on specific abutment teeth was finished. Master castings were produced in Type IV dental stone after definitive impressions were created using elastomeric impression material.

The cobalt-chromium framework was fabricated using conventional casting procedures following digital framework designing. After finishing and polishing, the framework was evaluated intraorally for passive fit, tissue adaptation, retention, and stability. Jaw relation records were obtained, and acrylic denture teeth were arranged replacing missing teeth in relation to 36, 37, and 47. Trial denture evaluation was performed to assess occlusion, phonetics, esthetics, and patient comfort. Following patient approval, the prosthesis was processed in heat-polymerize acrylic resin. After making the required occlusal modifications, the completed cast partial denture was placed intraorally. [Figure 5,6 and 7]

The patient received post-insertion instructions on denture cleanliness, upkeep, insertion, and removal. At follow-up sessions, there was no indication of soft tissue injuries and the patient had increased masticatory efficiency, stability, retention, and comfort.

III. DISCUSSION

For patients who are considered partially edentulous, removable partial dentures (RPDs) remain a reliable and economical treatment option, especially when fixed implant-supported prostheses are not appropriate due to anatomical, financial, or systemic reasons. The preservation of the remaining dentition, favourable stress distribution, proper framework design, and patient adherence to maintenance procedures are all critical to the success of CPD. [10]

In this instance, a cobalt-chromium cast partial denture created digitally using Exocad software was used to restore a mandibular Kennedy Class II alteration arch with missing teeth i.r.t 36, 37, and 47. [Figure 1] Precise framework

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planning, undercut evaluation, insertion path, clasp design, and key connector selection prior to manufacture were made possible by digital workflow. When compared to traditional wax-pattern methods, recent developments in computer-aided design/computer-aided manufacturing (CAD/CAM) technology have greatly increased the precision and predictability of removable partial denture frameworks.[11]

According to Arnold et al., as compared to traditionally manufactured frameworks, digitally developed cobalt-chromium removable partial denture frameworks showed better fit and less modification required. According to their findings, framework design and digital surveys enhance adaptability and reduce laboratory mistakes.[12] In a similar situation, Torii et al. discovered that CAD/CAM-fabricated metal frameworks demonstrated superior clinical adaption and high dimensional correctness, which led to increased patient satisfaction and shorter chairside adjustment times.[13] A lingual bar main connection, occlusal rests, proximal plates, lattice-type denture bases, and circumferential clasp assemblies were all included in the framework design utilised in this instance. The biomechanical ideas presented by Carr and Brown, who stressed that well-designed major connections and rest-clasp assemblies efficiently transmit occlusal stresses while maintaining the periodontal health of abutment teeth, are still in line with these design principles.[14]

The increasing use of digital technology in detachable prosthodontics has been emphasised in a number of recent research. Singh R et al. showed how digital RPD operations maintained acceptable clinical results while increasing manufacturing efficiency and repeatability.[15] Similarly, Campbell et al. found that digital surveys and framework planning improved clinician-dental laboratory communication and decreased framework remakes.[16]

Revilla-León et al.'s findings, which indicate that CAD/CAM removable prostheses provide dependable clinical performance with predictable fit and function, are in line with the positive outcome seen in this instance, which is characterised by satisfactory retention, stability, masticatory efficiency, and patient comfort.[11] The long-term sustainability of digitally generated cast partial dentures when suitable design criteria are adhered to is further supported by follow-up tests that showed no soft tissue irritation or prosthesis-related problems.[17]

This case indicates that the biomechanical benefits of conventional cast partial dentures may be effectively combined with the accuracy and efficiency of modern digital dentistry by integrating digital design tools like Exocad with traditional cobalt-chromium casting procedures.

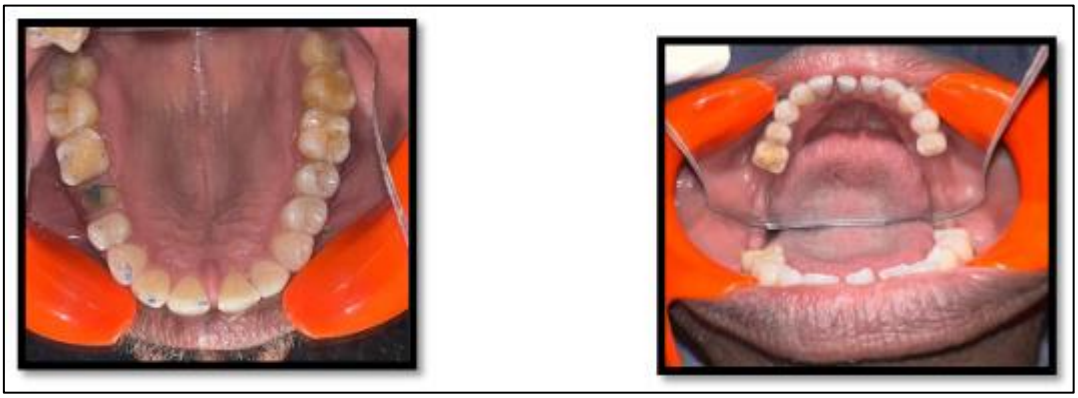

Fig 1 Pre-operative Intraoral Photographs Showing the First Impression Made to Determine the Path of Insertion, Favourable Undercuts, Guiding Planes, and Framework Components

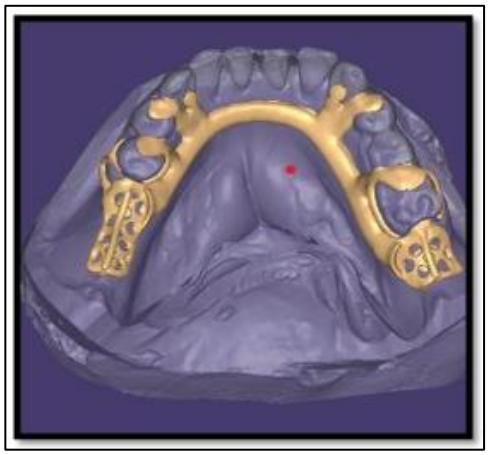

Fig 2 Designing of CPD Framework from Exocad Software (Digitally)

Fig 3 Final Cast Partial Denture done on the Mandibular Cast

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Fig 4 Final Cast Partial Denture (CPD) Preparation done with Various Lattice-Type Denture Base Minor Connectors Placed.

Fig 5 Final CPD Placement in the Patient's Mouth (Left Lateral View)

Fig 6 Final Cast Partial Denture in the Patient's Mouth (Right Lateral View)

Fig 7 Final Cast Partial Denture in the Patient's Mouth (Occlusal View)

IV. CONCLUSION

This case demonstrates how a digitally constructed cobalt-chromium cast partial denture may successfully rehabilitate a mandibular distal extension partial edentulism. The best possible support, retention, and stability of the prosthesis were made possible by careful diagnosis, suitable biomechanical planning, and adequate framework design. The precision and predictability of framework manufacture were improved by the use of digital design. Occlusal harmony, comfort, aesthetics, and masticatory function were all successfully restored by the final prosthesis. Patient acceptability and clinical performance were found to be good in the follow-up examination. This example shows that cast partial dentures are still a dependable, affordable, and successful treatment option for individuals who are partly edentulous.

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- Informed Consent: Obtained from the patient before the treatment commencement and also for publication
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- *Authors Contribution:*

✓ Operating Contribution – Dr. Echha, Dr. Saransh Malot
✓ Design and Planning- Dr Echha, Dr Vivek Sharma, Dr Saransh Malot, Dr Manhit Singh Lehl, Dr. Jai Poonam Bhati, Sannisth Sadrani.
✓ Manuscript writing: Dr. Echha, Dr. Saransh Malot, Dr Jai Poonam Bhati

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