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Case Report

Metal mesh matters: A reinforced approach to single maxillary complete denture - Case report

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Abstract

Fracture of complete dentures (CD) can significantly disrupt a patient's daily life, often leading to dissatisfaction and frustration for both the patient and the clinician. Common etiological factors include a single denture opposing natural dentition or fixed prostheses, deep palatal vaults, sharp mid-palatal anatomical ridges, high frenal attachments, and inadequately thick denture bases. Managing patients with a history of repeated denture fractures presents a considerable prosthodontic challenge and often necessitates non-conventional strategies. Conventional heat-cured acrylic resins are limited by poor resistance to occlusal forces, frequently resulting in denture failure. A practical and cost-effective solution is the incorporation of metal reinforcements—such as wires, bars, plates, or meshes—into the PMMA matrix to improve structural integrity. Evidence supports the enhancement of fracture resistance through such reinforcement techniques. This case report highlights the successful prosthetic rehabilitation of a completely edentulous patient using prefabricated metal mesh-reinforced complete dentures. The technique offers a simple, efficient, and economical alternative for managing challenging edentulous scenarios with a history of prosthesis failure.

Keywords: Acrylic resin, Denture fracture, Flexural fatigue, Metal grid Strengthener, Prefabricated metal mesh, Reinforced denture, Sandwiched technique.

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1. Introduction

Fracture of acrylic resin dentures remains a persistent challenge in removable prosthodontics, despite extensive efforts to identify and address its underlying causes. While denture fractures are frequently encountered in clinical practice, the topic has been relatively underrepresented in the literature.[1] According to Darbar et al., the most commonly reported type of denture failure is debonding or fracture of denture teeth (33%) in both complete and partial dentures, followed by midline fractures of complete dentures (29%) and other fracture patterns (38%).[3-5] Polymethyl methacrylate (PMMA) has long been the material of choice for denture bases in removable prosthodontics due to its ease of use, aesthetics, and cost-effectiveness. However, despite these advantages, PMMA exhibits limited mechanical performance, particularly in terms of impact strength and fatigue resistance.[8] These deficiencies often result in flexural deformation under function, leading to stress concentration zones that initiate microcracks and eventually propagate into full fractures, ultimately compromising the denture's integrity and patient satisfaction. Multiple anatomical and mechanical factors can predispose a denture to fracture. These include a deep palatal vault, high frenal attachments, insufficient denture base thickness, the presence of a single denture opposing natural dentition or fixed prostheses, and prominent mid-palatal ridges.[7] Additionally, accidental trauma, such as dropping the prosthesis, may contribute to its failure. Such recurring complications necessitate reinforcing PMMA to enhance its mechanical properties and prolong the prosthesis's longevity.[6]

A wide array of reinforcement strategies has been explored to address this issue, as mentioned in the **Table 1**:[5]

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Table 1:

Reinforcement Strategy	Examples
Metal-reinforced denture bases	Wires, bars, mesh, plates
Alternative polymers	Polycarbonates, polyamides
Chemical modification of PMMA	Cross-linking agents, rubber additives (e.g., butadiene-styrene)
Fiber reinforcement	Glass fibers, carbon fibers, aramid fibers, proprietary materials (Lucitone, Trevalon High, Paladon Ultra)
Visible light-cured resins (VLC)	Light-activated polymerization resins
Metal inserts during heat processing	Pre-fabricated metal components incorporated during processing
Nanocomposite materials	Nanoresins
Advanced high-performance polymers	PEEK (Polyetheretherketone), PEKK (Polyetherketoneketone)

Among these, metal reinforcement within the PMMA matrix has consistently demonstrated significant improvements in fracture resistance, reducing the likelihood of mechanical failure. Such enhancements contribute meaningfully to the clinical success and durability of removable complete dentures.[2]

2. Case Report – 1

A 65-year-old male patient presented to the Department of Prosthodontics and Crown & Bridge at Mansarovar Dental College, Bhopal, with a primary concern of a fractured maxillary denture (**Figure 1**). In addition to the fracture, the patient expressed dissatisfaction with the shade difference of the existing prosthesis and desired a replacement.

Figure 1: Patient's existing denture showing fracture in the midline.

Figure 2: Intra oral view of maxillary and mandibular arches.

Figure 3: a: Primary impression and **b:** Final Impression of the maxillary arch.

Figure 4: Orientation jaw relation and face bow transfer

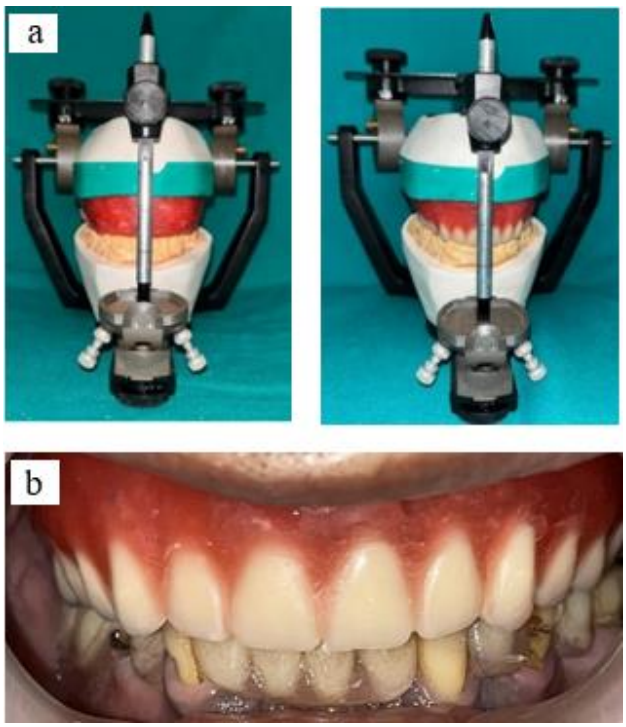

Figure 5: a: Mounted cast on articulator and teeth arrangement done; **b:** Try-in

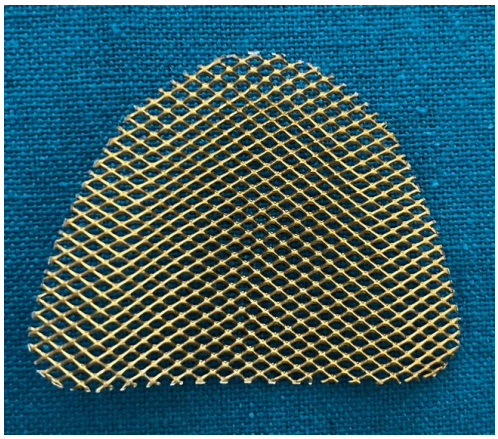

Figure 6: Metal Mesh of 0.4 mm thickness

Figure 7: Adaptation of the metal mesh after dewaxing.

Figure 8: Metal mesh incorporated in maxillary single denture.

Figure 9: Denture insertion of the mesh-reinforced single complete maxillary denture.

Figure 10: Pre and post-denture insertion

Clinical examination revealed a completely edentulous maxillary arch exhibiting moderate ridge resorption, opposing a partially edentulous mandibular arch classified as Kennedy Class IV. The mucosal tissues appeared healthy, with opposing dentition requiring minor modifications. The patient's saliva was of normal consistency, and he exhibited a cooperative and philosophical attitude.

Given the patient's history of recurrent denture fractures and his desire for a more durable prosthesis with cost-effectiveness in mind, a reinforced maxillary complete denture incorporating a prefabricated metal mesh was planned.

2.1. Procedure

The maxillary complete denture was fabricated following standard clinical and laboratory protocols with reinforcement modifications:

1. Preliminary impressions were recorded: the maxillary arch using medium-fusing impression compound (DPI Pinnacle™) (**Figure 3**a) and the mandibular arch using irreversible hydrocolloid (Septodont Mariflex™). Primary casts were poured using impression plaster (Gem Stone™).
2. A custom tray for the maxillary arch was fabricated with auto-polymerizing acrylic resin (DPI RR Cold Cure™), following the adaptation of a wax spacer.
3. Border molding of the maxillary tray was carried out using low-fusing greenstick compound (DPI Pinnacle Tracing Sticks™), followed by a final impression using zinc oxide eugenol paste (DPI Impression Paste™) (**Figure 3**b). Alginate (Septodont Mariflex™) was again used for the final impression of the mandibular arch.
4. Definitive casts were poured using Type III dental stone (Gem Stone™).
5. Temporary denture bases and occlusal rims were fabricated on the final casts.
6. Maxillary orientation was recorded with a facebow (Hanau™ Springbow, Whip Mix, USA) and transferred to a semi-adjustable articulator (Hanau™ Wide-Vue, Whip Mix, USA) (**Figure 4**).

7. Tentative maxillomandibular relations were established. Centric relation was recorded and the casts were mounted accordingly. The teeth arrangement was completed (**Figure 5**a).
8. A trial insertion was performed to assess esthetics, phonetics, and fit (**Figure 5**b).
9. Flasking was completed. Prior to dewaxing, a prefabricated metal mesh was contoured using universal pliers and set aside for later incorporation (**Figure 7**).
10. After dewaxing, a tin foil substitute (DPI Heat Cure Cold Mould Seal™) was applied. The pre-shaped metal mesh was again adapted on the maxillary cast and adjusted as needed. A layer of heat-cure acrylic resin was first placed on the cast, over which the mesh was embedded to create a sandwich-like structure. Conventional packing, pressing, and curing were followed using DPI Heat Cure™ resin.
11. The metal mesh, being only 0.4 mm thick (Jinguang denture reinforcement mesh upper- golden™), reinforced without increasing the bulk of the denture.
12. After polymerization, the denture was deflasked, finished, polished, and tried in the patient's mouth. (**Figure 8**) Occlusal adjustments were made as necessary, and the final reinforced maxillary complete denture was delivered (**Figure 9**).
13. Post-insertion instructions were given. The patient was reviewed at 24 hours, one week, and one month. He reported satisfaction with the comfort, appearance, speech, and overall functionality of the new prosthesis (**Figure 10**).

3. Case Report- 2

A 70-year-old male patient visited the Department of Prosthodontics and Crown & Bridge with complaints of chipping in his existing fixed dental prostheses in the upper right, left posterior, and anterior regions. Additionally, he sought correction of a dislodged prosthetic bridge in the lower left posterior area. The patient expressed a desire to replace the entire maxillary fixed prosthesis with a new solution.

Intraoral evaluation revealed a fractured fixed bridge in the upper arch and an opposing mandibular bridge. The oral mucosa appeared healthy, and the opposing dentition required minor adjustments. Salivary flow was normal in consistency. The patient displayed a cooperative yet demanding demeanor.

The primary concern was achieving a comfortable prosthesis that restored functional efficiency, especially in chewing. Considering his reluctance toward extractions and previous dental history, the existing prostheses were removed, and decoronation was performed. The decoronated teeth were then restored with glass ionomer cement (GIC), and a single maxillary complete denture reinforced with a prefabricated metal mesh was planned.(**Figure 11-2)**

3.1. Justification of the treatment plan

The treatment plan was developed to address the patient's specific clinical, psychological, and financial needs. The patient presented with a fractured fixed partial denture in the maxillary arch, and his primary concern was restoring functional masticatory efficiency with a comfortable prosthesis. A key factor influencing treatment was the patient's strong reluctance to undergo further extractions and his limited financial resources, which rendered a fixed implant-supported prosthesis unfeasible. Initially, alternative treatment modalities were considered and discussed with the patient. A conventional fixed PFM (porcelain-fused-to-metal) bridge was ruled out due to a history of similar prosthetic failure and the compromised nature of the remaining abutment teeth, which lacked adequate crown structure and ferrule effect. Similarly, the option of performing multiple extractions followed by post and core restorations was rejected based on the patient's aversive disposition toward surgical intervention.

Ultimately, a treatment plan involving decoronation of the compromised teeth and the fabrication of a single maxillary complete denture was selected. This approach directly addressed the patient's desire to avoid extractions and, crucially, was selected to preserve the residual alveolar ridge. Preservation of the ridge is vital for long-term prosthetic stability and patient comfort. Furthermore, this option provided a cost-effective solution for restoring function and aesthetics. To mitigate the significant occlusal forces from the opposing intact mandibular PFM bridge, the denture was specifically designed with a prefabricated metal mesh reinforcement. This reinforcement provides enhanced strength and fracture resistance, ensuring the long-term stability and functional longevity of the prosthesis.

3.2. Procedure

Standard complete denture fabrication protocols were followed with additional modifications as described:

1. Prior to impression making, root submergence therapy (decoronation) was performed, and the remaining roots were restored using glass ionomer restorative cement (GC Gold Label 2™) for teeth 12, 13, 14, 15, 16, 18, 22, 23, 24, 25, and 28 (**Figure 13**).
2. Preliminary impressions were made: the maxillary arch with medium-fusing impression compound (DPI Pinnacle™) (**Figure 14**a), and the mandibular arch using alginate (Septodont Mariflex™). The primary casts were poured using impression plaster (Gem Stone™).
3. A wax spacer was adapted, and a custom tray was fabricated for the maxillary arch using auto-polymerizing acrylic resin (DPI RR Cold Cure™).
4. Border molding was completed using low-fusing greenstick compound (DPI Pinnacle Tracing Sticks™). The final maxillary impression was made using light body elastomeric impression material (Accusil Light

Body – Prevest DenPro™) (**Figure 14**b), while the mandibular impression was made again with alginate.

5. Definitive maxillary casts were poured with Type III dental stone (Gem Stone™).
6. Temporary denture bases and occlusal rims were fabricated.
7. Maxillary orientation relation was recorded using a facebow (Hanau™ Springbow, Whip Mix, USA) and transferred to a semi-adjustable articulator (Hanau™ Wide-Vue, Whip Mix, USA).
8. Tentative jaw relations were recorded, and casts were mounted. Teeth were selected and arranged in accordance with prosthodontic principles for trial.
9. The trial denture was assessed intraorally to verify comfort, occlusion, phonetics, and esthetics before processing.
10. Flasking was performed. A prefabricated metal mesh was adapted onto the master cast using universal pliers and reserved for placement post-dewaxing.
11. After dewaxing, a tin foil substitute (DPI Heat Cure Cold Mould Seal™) was applied. The mesh was rechecked for accurate adaptation. A thin layer of dough-stage resin was placed on the cast, followed by careful positioning of the metal mesh, creating a "sandwich" design. The denture was then packed, pressed, and processed conventionally using DPI Heat Cure™ resin.
12. The incorporated metal mesh (0.4 mm thick) reinforced the denture without adding unnecessary bulk.
13. Once polymerized, the denture was retrieved, finished, polished, and delivered to the patient (**Figure 15**). Occlusal adjustments were made intraorally to ensure proper function.
14. Post-insertion instructions were provided. The patient was reviewed after 24 hours, one week, and one month. He expressed satisfaction with the esthetics, comfort, speech, and mastication achieved with the maxillary complete denture (**Figure 16**).

Figure 11: Patient's OPG and existing intraoral view with chipped off PFM bridge.

Figure 12: Intra oral view of maxillary and mandibular arches.

Figure 13: Decoronation and Restoration with restorative GIC.

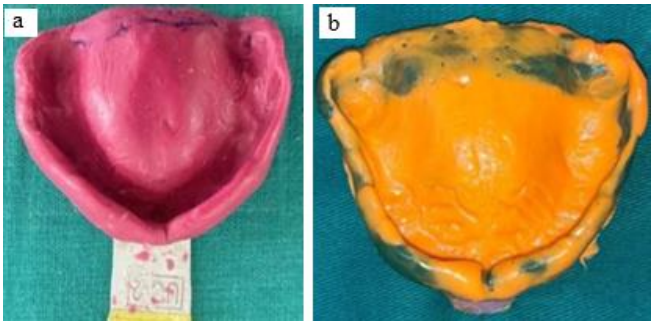

Figure 14: a: Primary impression and **b:** Final Impression of the maxillary arch.

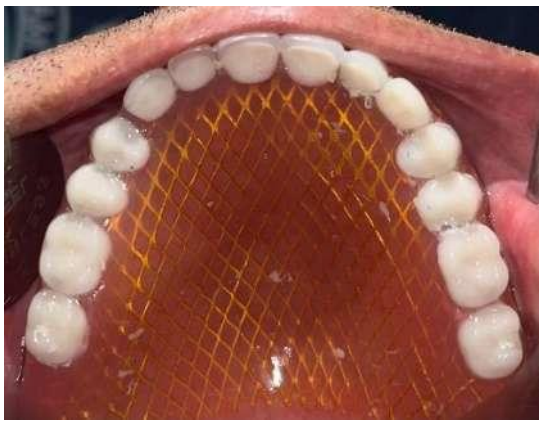

Figure 15: Metal mesh incorporated in maxillary single denture.

Figure 16: Post-denture insertion

4. Discussion

Fractures in removable complete dentures are most commonly the result of two primary mechanical stressors: impact forces and flexural fatigue. Impact-related fractures typically occur due to accidental drops during handling by the clinician, technician, or patient. Conversely, flexural fatigue results from repeated, low-magnitude cyclic loading during mastication, leading to microcrack initiation and propagation within the denture base over time. Anatomical variables and prosthesis design factors also play a critical role in how stresses are distributed throughout the denture.[8-11]

Maxillary ridge resorption creates a fulcrum in the midline region of palate. Reinforced denture base with metallic framework provides strength and better fracture resistance.[12] Uneven stress distribution, especially in areas of high concentration, predisposes the denture to fracture. Polymethylmethacrylate (PMMA), the conventional material of choice for denture bases, is widely appreciated for its ease of use and esthetics. However, it has well-documented limitations in terms of low impact strength and poor fatigue resistance, making it vulnerable to fracture under prolonged or excessive occlusal loading. To mitigate these issues, reinforcement techniques have been developed, with one effective method being the incorporation of prefabricated metal mesh within the denture base. These meshes, generally made of stainless steel or gold-plated alloys and about 0.4 mm thick, offer an open-grid configuration that enables strong mechanical interlocking with the acrylic resin. This reinforcement minimizes the spread of microcracks and significantly improves the denture's resistance to both impact and flexural fatigue. Additionally, the inclusion of metal mesh helps ensure a uniform thickness of the acrylic resin, avoiding bulkiness while enhancing the prosthesis's strength and longevity. Single maxillary dentures, in particular, are more prone to fracture due to factors such as opposing natural dentition, poor ridge form, prominent frenal attachments, or occlusal discrepancies. In such scenarios, mesh reinforcement becomes especially advantageous as it provides structural support without compromising function or comfort. Overall, metal mesh reinforcement offers a practical, economical, and minimally invasive solution to increase the service life of complete dentures, especially in patients with a history of prosthetic failures.

5. Conclusion

Managing patients with a history of complete denture fractures presents a unique challenge for prosthodontists. Reinforcement strategies, such as incorporating prefabricated metal meshes into conventional heat-cured acrylic dentures, have emerged as valuable tools in such clinical scenarios. These reinforcements substantially enhance the impact strength and fatigue resistance of the prosthesis compared to non-reinforced designs. The use of metal mesh not only strengthens the denture base but also provides a cost-effective and time-efficient alternative to more complex or invasive options. Its integration into the acrylic resin during fabrication represents a simple yet reliable approach to improving the overall durability of removable complete dentures, ultimately leading to greater patient satisfaction in terms of function, comfort, and longevity.

6. Patient Consent

In this study patient written and informed consent has been taken.

7. Source of Funding

None.

8. Conflict of Interest

None.

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