Metal Mesh Reinforced Denture as a Mean of Preventive Prosthodontics-
A Case Report

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Abstract:
Midline fracture of acrylic resin dentures, resulting from cyclic deformation of the base during function, is unresolved problem in removable Prosthodontics. Various methods have been suggested to reduce the likelihood of denture fracture. All materials have their pros and cons and no satisfactory material is available till date. This article describes a cost effective approach of using metal insert in the form of steel mesh strengtheners for repetitive midline fracture of the maxillary denture.

Keywords: Metal mesh, grid strengtheners, denture fracture, midline denture fracture.

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Introduction
The material most commonly used for the fabrication of complete dentures is poly-methyl methacrylate (PMMA). These polymeric bases present acceptable physical, biologic and esthetic characteristics at moderate expense. However, it is still far from ideal in fulfilling the mechanical requirements of a prosthesis. Fractures in the dentures result from two different types of forces, namely flexural fatigue and impact. The midline fracture in a denture is often a result of flexure fatigue, resulting from cyclic deformation of base during function. Impact fractures usually occur out of the mouth as a result of a sudden blow to the denture or accidental dropping. There are multitudes of other factors which can cause denture fracture. Any factor increasing the stress concentration and deforming the denture base can fracture the denture. Factors which form areas of stress concentration such as large frenum notch, thin or under extended flanges, poorly fitting dentures or lack of adequate relief, dentures with wedged or locked occlusion and those with poor clinical design. Denture base thickness of less than 2mm, patients with shallow ridges, flat palates and decreased inter ridge space could also contribute to denture fracture. Various approaches have been tried to reduce the impact and flexure fatigue failure of the denture. These include; alternative materials to PMMA, such as polyamides, epoxy resins, poly styrene, vinyl acrylic, rubber graft copolymers, polycarbonate and nylon; chemical modification of PMMA with rubber; and addition of materials like carbon, aramid, glass fibres and various types of metal inserts to PMMA. In this article a case of addition of metal insert in the form of stainless steel mesh as a means for preventing the denture fracture is presented. The intention was to provide a fracture resistant yet cost effective approach to a patient with history of repeated denture fracture.
Clinical Report
A 55-year-old, completely edentulous male patient, reported for the prosthetic rehabilitation of maxillary and mandibular edentulous ridges. Medical history revealed that the patient was a known diabete since five years and was under medication for the same. The patient was a denture wearer since 3 years and complained about repetitive midline fracture of the upper denture. Intra-oral examination revealed high frenal attachment and prominent mid palatal suture line. Hard palate was found to be flat and there was decreased inter-ridge space.
Considering the patient's complaint of repetitive fracture of upper denture, medical history and anatomical features the treatment plan was decided. The patient was given the option of reinforcement of denture with metal base, metal mesh or reinforcement of PMMA with other materials e.g. carbon fibre, glass fibre. The patient opted for the most economical treatment of removable dentures with a metal mesh insert.

Procedure:
The preliminary phases of metal mesh denture construction do not differ significantly from conventional resin based techniques. Impressions and casts were generated by the use of accepted prosthodontic procedures. The definitive cast was duplicated with irreversible hydrocolloid. (Alginoplast; Heraeus Kulzer, South Bend, Ind) and poured with autopolymerizing acrylic resin. (DPI, Mumbai, India) into the impression to fabricate an acrylic resin cast. The grid strengthening (Bredent, GmbH & Co.KG, Senden, Germany) was adapted on this acrylic resin cast. Subsequently record bases and occlusal rims were fabricated, fitted and adjusted. At this stage, face bow and jaw relations were used to mount and verify the positions of maxillary and mandibular casts. After verification, prosthetic teeth were arranged according to anatomic functional and esthetic guidelines.

During a subsequent clinical appointment, the tooth arrangement was evaluated intraorally. Jaw relations were carefully observed to verify accuracy of the articulator mounting. Aesthetics and phonetics were evaluated and the necessary corrections were made. The maxillary arrangement was then returned to the master cast and required laboratory procedures were undertaken.

The laboratory processing procedure was completed till the dewaxing stage. At this time the pre-adjusted metal mesh was adapted using the method described by Nerli et al. Fig 1 shows the adapted mesh placed over the cast. The processing was completed in the usual manner. Fig 2 shows metal mesh incorporated in the processed denture.

Discussion
Maxillary denture midline fracture has been related to deformation of denture base during function, thereby resulting in a flexural fatigue failure. Clinical factors related to single denture failure include: improperly contoured mandibular occlusal plane, high frenum attachment, occlusal scheme, occlusal forces, the denture foundation, and denture base thickness. Midline fracture of denture base is a flexural fatigue failure, resulting from cyclic deformation of the base during function. Deformation may be exacerbated by, changes in denture base, tooth wear or changes in the supporting tissue, notably the ridge resorption. Fracture, however, is the result of the initiation and propagation of a crack, and this requires the presence of a stress raiser or point of localized stress. Sharp changes in contour, pin holes, inclusions, deep scratches, and residual processing stresses may all cause stress intensification. A survey indicated that most failures occurred because of deep notching at midline labial frenum and crack initiate at the tip of notch where there is high local stress concentration.

Various polymers have been developed for the use as denture base resins to overcome some of the mechanical deficiencies of PMMA such as polyamides, epoxy resins, polystyrene, vinyl acrylate, rubber graft copolymers, polycarbonate and nylon. But no satisfactory material is available till date. Chemical modification of PMMA with rubber is most successful and widely accepted and is an alternative to conventional PMMA denture base resins. However, high cost restricts its routine use. Other addition of materials to PMMA has been successful but they too have their own disadvantages. Carbon fibres have difficult handling characteristics and poor esthetics due to black colour. Aramide fibres have yellow colour and fibres exposed at the surface of the resin present a rough surface that cannot be polished and can be uncomfortable to the patients. Glass fibres have the problem of tissue irritation from the protruding fibres.

A grid strengthening for acrylic resin denture base is available in stainless steel and gold plated metal in thickness of 0.4 mm. Numerous round perforations 2.5 mm in diameter are purported to produce a good resin bond and thus reinforce the acrylic resin denture base. This helps in reducing the incidence of fracture of acrylic resin denture base by preventing propagation of cracks and increasing fatigue resistance of acrylic resin.
It has been reported that the degree of mucosal ulceration is a function of denture base deformation. Denture base deformation is also considered to be a contributing factor in ridge resorption, with acrylic resin bases exhibiting a lateral deformation 8.5 times greater than that of metal bases. It is known that dentures made with metal inserts show less lateral deformation in function. The use of metal insert in this case would also overcome the problem of ridge resorption associated with diabetic patients. In a study by Duymus et al, the highest results were obtained from denture bases reinforced with stainless steel mesh in comparison with results obtained from denture base reinforced with round or semi-round wire. The stainless steel mesh reinforcement significantly improved the fracture resistance of acrylic denture base resin. The technique of incorporation of metal mesh used in this case does not significantly increase the weight of the denture; also a uniform layer of acrylic can be attained without increasing the thickness of the base. Metal inserts can be added in the form of wires, plates, fillers or mesh. These metals strengtheners have shown a beneficial effect on the fracture resistance of PMMA, however, dentures reinforced with a strengthener sometimes fracture due to poor adhesion between the acrylic resin and the metal strengtheners. Various approaches have been given to increase their beneficial effect. These include, sandblasting, silanization and metal adhesive resins. Position and length of metal inserts have also been related with significant resistance to flexure and reduced likelihood of fracture of acrylic resin bases. Other preventive measures include; a good processing technique, using higher strength polymers, palatal relief in the anterior portion of palate, avoiding deep incisal spaces and increasing the bulk of base material in areas most subject to deformation (palatal to incisors). Placing a thin beading around a heavy labial frenum to improve seal has a strengthening effect.

**Conclusion:** Various methods of management of repeated denture fracture have been mentioned in literature, but most of them have tedious laboratory procedures and high cost restricts their use. Reinforcement of denture with metal mesh proves to be a promising economical and simple option not only to the patient as well as to the clinician.


References

Legends

Fig 1 Adapted metal mesh over the cast.

Fig 2 Metal mesh inserted denture.