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## Management of maxillary single denture fractures: An enigma

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### Abstract

**Background:** The patient's first complete denture experience is predominantly with the single maxillary denture. The opposing mandibular dentition is usually intact or restored by fixed partial dentures or removable partial dentures. In many instances no attempt has been made to restore a partially edentulous mandibular arch. One of the most common prosthodontic failures encountered is the fracture and failure of the single maxillary denture. This often results in continuous repair of the denture. Often, remaking the denture is the best course to follow.

**Objective:** This article will describe the clinically related causes of single maxillary complete denture fracture and propose preventive and corrective measures.

**Methods:** Electronic searches were performed for articles published in PubMed and manual searches were performed in various journals relevant to the topic of removable prosthodontics. Key words such as maxillary, single, denture, reinforcement were used. Initially, 432 articles were found of which 177 articles were selected by electronic and manual searches from 2005 up to 2020 with few classic articles. After exclusion of 152 articles based on the exclusion criteria, 25 articles were finally included in the review.

**Conclusion:** Factors that contribute to the fracture and failure of the single maxillary denture have been discussed to summarize this review, reinforcements within prostheses undoubtedly had some efficacy in improving the mechanical properties, but the levels varied by material, form, and position of the reinforcement.

**Keywords:** maxillary, single denture, fracture

### 1. Introduction

The challenge to provide comfort, retention, function, and esthetics to the patient with edentulous maxillae opposing natural teeth is often difficult.

The problems are numerous. This is often the first complete denture for the patient. Expectations are that after an initial adjustment period, the patient will be able to masticate food and look the same or better than with the natural dentition. Instead, there may be lack of retention, tissue changes of the edentulous ridge accompanied by discomfort, fracture of the maxillary denture base, the need for readjustment of tongue movements for speech and mastication, reorientation of the lips and cheeks for functional movements, and the inevitable appearance changes, resulting in frustration and disappointment for the patient and the dentist<sup>[2]</sup>.

Accurate prosthetic treatment planning and its precise execution impact the optimal outcome of prosthetic rehabilitation in clinical situations where force factors are beyond the operator's control. Such is a situation of isolated edentulous maxilla opposed by mandibular dentition. Presence of unbalanced opposing dentition prevents occlusal balance during function thereby, compromising stability and retention and eventually leading to frequent mechanical failures of the prosthesis<sup>[2]</sup>.

Any factor that exacerbates the deformation of the base or alters its stress distribution may predispose the polymethyl methacrylate denture to fracture<sup>[3]</sup>. The mechanical failure of such dentures under functional masticatory forces, especially in the presence of opposing dentition, is a persistent problem and its prevention is still a challenge for the clinician. Denture fractures cause functional insufficiency, compromised esthetic and financial burden on its users for its

repair or refabrication<sup>[4-6]</sup>. Further, the repaired denture bases become more prone to subsequent fractures if the root cause(s) is not addressed to<sup>[7,8]</sup>.

### Causes of Fracture

Several techniques for making single dentures have been described in the literature, ranging from conventional to functionally generated path technique. Regardless of the technique, if attention is not paid to detail, fracture and failure of the denture may occur<sup>[9]</sup>.

Maxillary denture midline fracture has been related to deformation of the denture base during function, thereby resulting in a flexural fatigue failure. Clinical factors related to single denture failure include:

1. Improperly contoured mandibular occlusal plane
2. High frenum attachments,
3. Occlusal scheme,
4. Occlusal forces,
5. The denture foundation
6. Denture base thickness.

### Proposed Classification of Complete Denture Fractures

In a study conducted by Choudhary S<sup>[10]</sup>, a classification system of complete denture fracture and its incidence in National Capital Region was proposed. In this study, 456 dentures were considered; out of these, 256 were maxillary and 200 were mandibular. The sample size was in correlation with previous studies.

#### Classification System

**Class I:** The fracture line passes through the midline between the central incisors extending to the posterior extension. The fractured fragments may or may not be completely separated.

**Class II:** The fracture line passes through other than midline in a diagonal direction extending to the posterior extension. The fractured fragments may or may not be completely separated.

**Class III:** The fracture line is moon shape passing through the labial or buccal flange. The fractured fragment may or may not be separated.

**Class IV:** The fracture line passes through dentoalveolar structure of the denture, involving two or more teeth. In this, denture base continuity is preserved.

**Class V:** The fracture of a part of artificial tooth or separation of a single tooth from denture.

#### Management

Pre-treatment preparation is a learning period for the patient and the dentist; it varies with the needs of each patient. Some individuals may have maxillary teeth that should be removed. They may have never worn a removable oral restoration. Others may have a long history of complete maxillary denture problems and failures. A fortunate few may simply need to replace an existing worn denture<sup>[11]</sup>. Before fabrication of the new maxillary complete denture the patient should be thoroughly informed of some of the difficulties that may be encountered. The patient's chewing may not be as efficient and reorientation of masticatory and swallowing habits may be necessary. It is important that the patient is fully informed of the treatment plan, possible problems, and the cost, including specialist care, if necessary.

### Occlusal Consideration in Mandibular Existing Dentition

After the pre-treatment preparation, impressions are made of the maxillary edentulous arch and the mandibular dentition. A maxillary recording base with a wax occlusion rim is made and a centric relation record is obtained at a vertical dimension of occlusion that provides adequate interocclusal clearance. The maxillary and mandibular casts are mounted on a plane line articulator and a mandibular clutch is made to oppose a registration platform on the maxillary base. A treatment plan that provides for an orderly sequence of care is prepared. If periodontal, surgical, endodontic, or orthodontic treatment for the mandibular teeth is necessary, consultation with the appropriate specialists is advised. A plane of occlusion is determined and the mandibular teeth are modified to conform to this plan. Recontouring certain teeth, reducing super-erupted teeth, or restoring teeth and replacing missing teeth with fixed restorations and/or removable partial dentures may be required.

After the preparatory planning is completed, the restorative phase begins. The mandibular teeth are prepared for restoration or altered according to methods mentioned below, where necessary and final lower working casts are obtained.

#### Methods For Occlusal Equilibration<sup>[12]</sup>

1. **Swensons Technique:** Upper and lower casts are mounted on the articulator. The upper denture is constructed. If the lower natural teeth interfere with the placement of the denture teeth, they are adjusted on the cast and the area is marked with a pencil. The natural teeth are then modified using the marked diagnostic cast as a guide. This technique is simple but time consuming.
2. **Yurkstas Technique:** Use of a commercially available U shaped metal occlusal template that is slightly convex on the lower surface. This template is often an aid in detecting minor deviations in the occlusal scheme.
3. **Bruce Technique:** Use of a clear acrylic resin template fabricated over the modified stone cast. The inner surface of the template is coated with pressure indicating paste and placed over the patient's natural teeth.
4. **Bouchers Technique:** Use of porcelain teeth on edentulous cast. Porcelain teeth abrade the opposing dentulous cast. Similar corrections are made on natural dentition.

#### Prosthetic Phase

In many instances, flexure of the maxillary denture base has resulted in fracture or soreness to the underlying tissues. After the necessary restorative treatment is accomplished, prosthetic measures can be taken to prevent maxillary denture fracture<sup>[11]</sup>.

Some of the common measures adapted in preventive prosthodontics for Single complete denture include:

1. Reinforcement of Acrylic Resin
2. Metal Denture Base

#### 1. Reinforcement of Acrylic Resin

Polymethylmethacrylate (PMMA) is the most commonly used material in the fabrication of dentures because it has a combination of convenient properties. However, the polymethylmethacrylate resin denture base material is not ideal in all respects.

Because PMMA has poor impact strength, fractures often occur in prostheses. Therefore, it is important to increase impact strength to prevent prosthetic fractures. One of the most promising approaches recently used to overcome these

disadvantages is to incorporate various nanoparticles or fibres into the PMMA to act as the reinforcing material. Although there are various nanoparticles; in the literature nanoparticles such as aluminium oxide (Al<sub>2</sub>O<sub>3</sub>), zirconium oxide (ZrO<sub>2</sub>), titanium dioxide (TiO<sub>2</sub>), zinc oxide (ZnO), silicon dioxide (SiO<sub>2</sub>) and silver (Ag) has often been used.

Polymethylmethacrylate, the commonly used denture-base material, is often reinforced with different types of materials. In a study conducted by Kaneyoshi Yoshida *et al.* [13] they evaluated the effect of metal reinforcement and its location on the flexural load at the proportional limit and the flexural deflection of maxillary acrylic resin complete dentures. They concluded that the location of the metal reinforcement affected the fracture resistance of the maxillary acrylic resin complete denture. However there is a weak bond between metal and acrylic, which may serve as weak point for crack initiation and propagation.

Similarly the use of carbon fibres as denture-base strengtheners has been investigated in a number of studies and it has been shown that they strengthen the resin. However, carbon fibres also have several properties that are undesirable in prosthetic constructions, e.g. the black colour of the fibres. The use of carbon fibres might therefore pose an aesthetic problem. For this reason aesthetically more appropriate strengtheners are needed. Glass or aramid fibres might be aesthetically better suited materials for this purpose.<sup>14</sup>

## 2. Metal Denture Base

In many instances where flexure of the maxillary denture base has resulted in fracture or soreness to the underlying tissues, a cast metal base is recommended for the maxillary complete denture [11]. The materials were mainly Co-Cr and Ni-Cr alloys. With respect to their forms, various designs were made by wax-up techniques for cast metal reinforcement. The former can be made into more complex designs than the latter, but their procedures are more complicated and time-consuming. Although both types of reinforcements were more effective than no reinforcement in terms of improving various strength and stiffness properties, cast metal was more effective in direct comparisons of these two metal reinforcements [15].

## Discussion

Factors that contribute to the fracture and failure of the single maxillary denture have been discussed. Recognition of these factors and their prevention or correction will result in a single maxillary denture that is physiologically and functionally acceptable for the patient for an extended period without chronic denture failure.

The problems involved in providing comfort, function, proper esthetics, and retention for the maxillary complete denture patient with natural opposing dentition can be challenging. Careful preparation of the patient is important. It provides the new complete denture patient the opportunity to adapt to a complete denture and allows the dentist to evaluate his patient physically and emotionally before fabrication of the final complete denture.

Methods for planning and fabrication of a denture that provide comfort, function, and stability have been described.<sup>1</sup>

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