

Complete Denture Repair: A New Classification System Based On a Survey

Dr. Shankar P. Dange¹, Dr. Nikita R. Galgali², Dr. Kishor M. Mahale³,
Dr. Smita A. Khalikar⁴

¹(Joint director DMER and Professor, Department of Prosthodontics, Government dental college and hospital, Aurangabad, India.)

²(Post graduate student, Department of Prosthodontics, Government dental college and hospital, Aurangabad, India)

³(HOD and professor, Department of Prosthodontics, Government dental college and hospital, Aurangabad, India)

⁴(Professor, Department of Prosthodontics, Government dental college and hospital, Aurangabad, India)

Abstract:

Background: The life of a complete denture wearer is abruptly paralyzed by the sudden fracture of the denture which is of utmost necessity for his/her day to day routine life. Despite the high frequency of denture fracture, there is surprisingly little discussion of the subject in the literature. In this article an attempt is made to propose a classification system based on the type of repair possible in different clinical situations of complete denture fractures.

Materials and methods: In this study, the data was collected from 350 patients who reported to the department of prosthodontics with fractured complete denture. Along with a detailed history, the fractured denture was evaluated for different factors. The type of repair possible was determined as per the proposed classification system and the repair was carried out accordingly. The data collected was analyzed statistically using chi square test.

Results: Out of 350 complete denture fracture cases, 196 cases of maxillary and 154 cases of mandibular denture fracture were reported with most common site of fracture being midline fractures [46%]. The type 2 repair [repair requires stabilization] was most commonly carried out for denture fracture cases followed by type 3 repair [repair requires stabilization and reinforcement]. Type 4 repair [repair not possible] was reported to be least common.

Conclusion: Within the limitations of the study it can be concluded that, from the proposed classification system for type of denture repair possible, the type 2 repair was most common [46%] followed by type 3 repair [30%].

Keywords: Denture repair, Denture fracture, Classification of repairs.

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I. Introduction:

The life of a complete denture wearer is abruptly paralyzed by the sudden fracture of the denture which is of utmost necessity for his/her day to day routine life. As part of the dental education faculty, it is always our goal to make the life of denture-wearers easier and happier by investigating and solving the problems related to complete denture patients.¹

PMMA [poly-methyl methacrylate] has been established as the principal material in denture base construction due to its good overall processing as well as user friendly properties. Nevertheless it is generally recognized that despite fulfilling aesthetic requirements, the impact and fatigue strength of PMMA are not entirely satisfactory and this is reflected by the expenditure on a large number of denture repairs annually.²

Denture fracture may be due to a multiplicity of factors rather than the denture base material itself for e.g. factors which form areas of stress concentration such as a large frenal notch, dentures with thin or under-extended flanges, poorly fitting dentures or a lack of adequate relief, dentures with wedged or locked occlusion, poor clinical design and previously repaired dentures. Also, the denture fracture may occur due to faults in denture fabrication, lack of balanced occlusion, and low resistance to fracture of acrylic resin. Fractures in dentures may either result from flexural fatigue or impact. Flexural fatigue occurs after repeated flexing of a material and it can be explained by the development of microscopic cracks in areas of stress concentration. With continued loading, these cracks fuse to an ever growing fissure that insidiously weakens the material. While the catastrophic failure or impact failure results from a final loading cycle that exceeds the mechanical capacity of

the remaining sound portion of the material. The midline fractures of maxillary or mandibular dentures which are most common are often a result of flexural fatigue. The alveolar resorption of the maxilla provokes flexure of the left and right halves of the denture with a fulcrum along midline of the palate. Besides, other sites such as denture border may be involved. Impact failures usually occur out of the mouth as a result of a sudden blow to the denture or accidental dropping whilst cleaning, coughing or sneezing. The failure of artificial teeth includes fractures and detachments. Denture tooth fracture is usually the result of improper handling out of the mouth.^{2,3} Tooth debonding may be the result of incompatible surface conditions at the tooth and base interface. Two factors namely contamination of the surfaces and/or the difference in structure of the two components due to their different processing routes are responsible.⁴

Various methods of denture repair have been reported in literature. Jagger et al in their review for reinforcement of dentures reported three routes to improve the impact properties of PMMA namely- the development of an alternative material to PMMA; the chemical modification of PMMA such as by the addition of a rubber graft copolymer; and the reinforcement of PMMA with other materials such as carbon fibres, glass fibres and ultra-high modulus polyethylene.² Carroll et al [1984] in their study used stainless steel wires for reinforcement of acrylic resin.⁵ Berry and Funk [1971], reported that breakage is most prevalent in patients with neuropsychiatric disorders and suggested use of vitallium strengthener to prevent lower denture breakage.⁶

Despite the high frequency of denture fracture, there is surprisingly little discussion of the subject in the literature. The existing literature does not state any standard classification system of denture fracture.² In this article an attempt is made to propose a classification system based on the type of repair possible in different clinical situations of complete denture fractures. The proposed classification system will be a helpful aid in assessing the type of repair needed and also communicating with dental technician and other professionals.

Proposed classification system:

Denture fracture classification based on treatment modality/ type of repair possible:

Type of repair possible	Type 1 [Easily repairable]	Type 2 [Repair requires stabilization]	Type 3 [Repair requires stabilization and reinforcement]	Type 4 [Repair not possible/ New denture required]
Description	Simple approximation of fragments can help to repair the fractured denture	Fragments need to be approximated on cast by using different stabilizing materials to facilitate repair of denture	Fractured denture fragments require stabilization plus reinforcement in the form of stainless steel wires, metal mesh, or resin fibres.	Fracture fragments cannot be approximated or missing fragments or history of previous repairs which makes repair impossible hence new complete denture is advisable

II. Material And Methods:

This study was conducted in the Department of Prosthodontics, Government dental college and hospital, Aurangabad, Maharashtra. The data was collected for 2 years from 350 complete denture wearer patients who reported in the department with the chief complaint of fractured dentures. The data was categorized with the following parameters:

- Age and gender of the patient
- Age of the denture
- Reason for the fracture, according to history, given by the patient and clinical analysis of the denture by the clinician.
- Site of the fracture of upper/ lower denture.
- History of previous repair
- Type of repair possible according to proposed classification system

Along with a detailed history, the fractured denture was evaluated for its intraoral fit, stability and other factors like porosity in denture base, occlusal errors etc. and accordingly correlated by the clinician. The type of repair possible was determined in the respective dentures and the repair was carried out accordingly.

The data obtained was compiled on a MS Office Excel Sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States). Data was subjected to statistical analysis using Statistical package for social sciences (SPSS v 26.0, IBM). Descriptive statistics like frequencies and percentage for categorical data, Mean & SD for numerical data has been depicted. Comparison of frequencies of categories of variables with groups was done using chi square test. For all the statistical tests, p<0.05 was considered to be statistically significant.

Figure 1: Type 1 repair [easily repairable]

a. Dentoalveolar fracture of four anterior teeth, b. Repair carried out by using self-cure acrylic resin

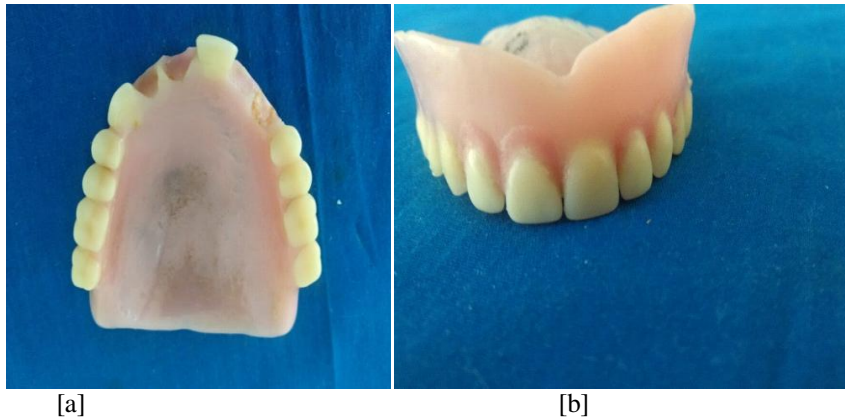


Figure 2: Type 2 repair [repair requires stabilization]

a. Fractured maxillary denture, b. denture stabilized by using matchsticks and sticky wax and the cast poured in dental plaster after blocking the necessary undercuts, c. denture repaired by groove preparation and sealing with self-cure acrylic resin.

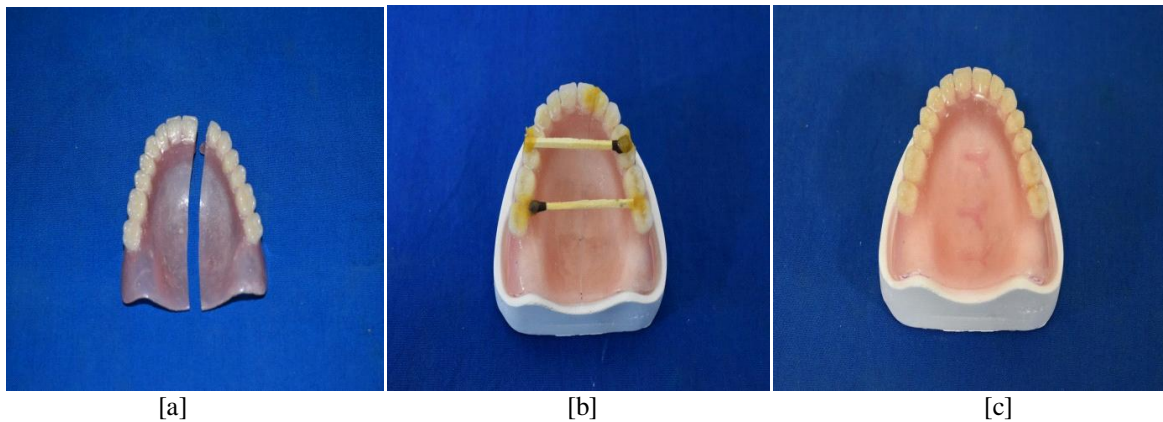


Figure 3: Type 3 repair [repair requires stabilization and reinforcement]

a. Fractured mandibular denture, b. Fracture fragments approximated and stabilized by using cyanoacrylate adhesive and sticky wax, c. groove preparation and wire placement, d. Groves sealed by self-cure acrylic resin.



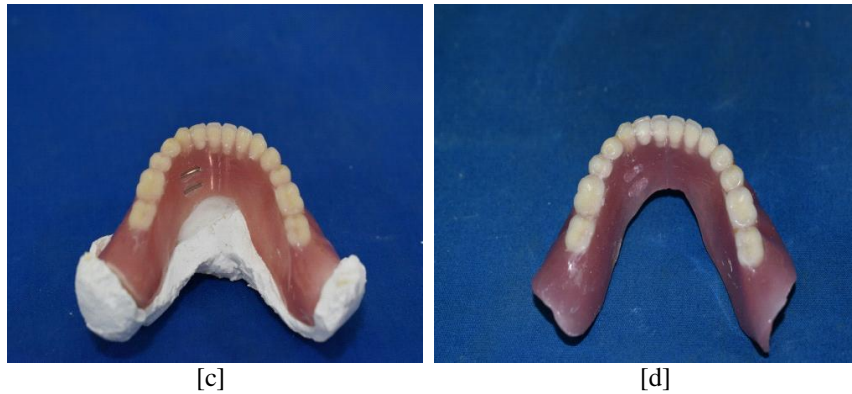


Figure 4: Type 4 repair [repair not possible]

- a. Multiple fragment fracture where fracture fragments cannot be approximated, b. denture with history of repair multiple times rendering it unrepairable.



III. Results:

In this study, a total of 350 patients [Male=280, Female=70] were examined and evaluated for complete denture fracture and the type of repair possible in them. Among the fracture cases, 196 cases of maxillary denture fracture and 154 cases of mandibular denture fracture were reported. Out of 350 cases, 42 dentures [14 maxillary & 28 mandibular dentures] had history of previous repair.

The table-1 shows the number of fractures in relation with the age of denture. It suggests that maximum number of fractures were seen in the denture age group of 2-4 years post- delivery followed by second most common in 0 to 2 years with upper denture & 4 to 6 years with lower denture.

Table-2 shows number of upper and lower denture fractures in relation with site of fracture, suggesting highest frequency for Midline fracture [46%] with both upper & lower dentures. The second most common site for maxillary denture was tooth fracture and flange fracture, and for mandibular denture it was oblique line other than midline fracture.

Table-3 shows frequency distribution as per reasons for fracture, indicating that 'fall' being the most common reason [52%] for denture fracture, followed by poor retention and stability [22%].

Table-4 shows type of repair possible in fractured upper and lower dentures. The type 2 repair [repair requires stabilization] was most commonly carried out in the fractured denture cases in this study followed by type 3 repair [repair requires stabilization and reinforcement]. Graph-1 shows distribution as per type of repair possible in upper and lower dentures.

Table-1: Number of upper or lower complete denture fractures in relation to age of denture:

Age of denture	Denture U/L		Total
	L	U	
0 to 2 yrs	35	49	84
2 to 4 yrs	84	56	140
4 to 6 yrs	63	35	98
> 6 yrs	14	14	28
Total	196	154	350

Table-2: Site of fracture in upper and lower dentures:

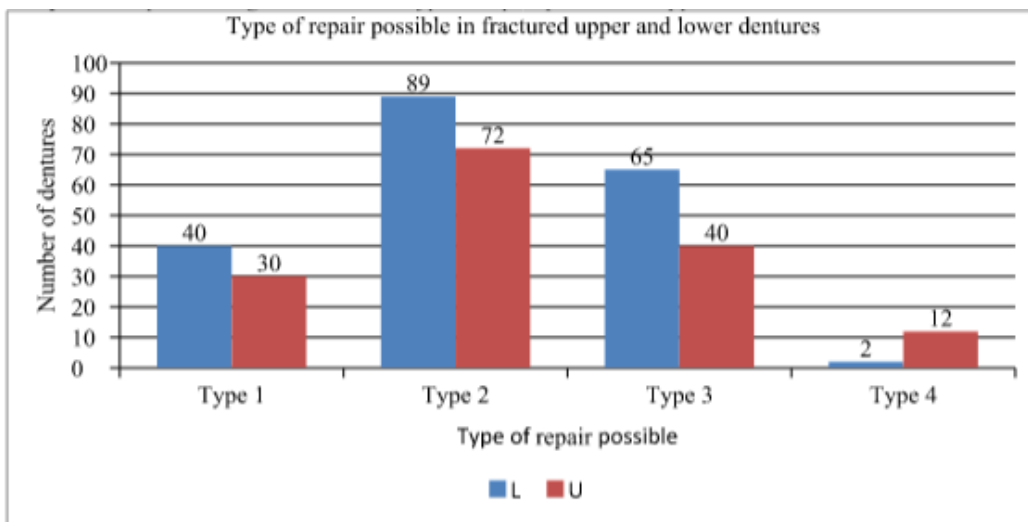
Site of fracture	Denture U/L		Total
	L	U	
Dentoalveolar fracture	28	7	35
Fracture of part of tooth	14	28	42
Flange fracture	0	28	28
Midline fracture	105	56	161
Multiple fragment Fracture	0	14	14
Oblique line other than midline fracture	49	21	70
Total	196	154	350

Table-3: Distribution as per reasons for fracture:

Reasons for fracture	Frequency	Percent
Poor retention and stability	77	22.0
Biting hard food	70	20.0
Fall	182	52.0
Acrylic base defects	14	4.0
Poor occlusion	7	2.0
Total	350	100.0

Table-4: Type of repair possible in fractured upper and lower dentures:

Type of repair possible	Denture U/L		Total
	L	U	
Type 1	40	30	70 [20%]
Type 2	89	72	161[46%]
Type 3	65	40	105[30%]
Type 4	2	12	14[4%]
Total	196	154	350



Graph-1: Graph showing distribution of type of repair possible in upper and lower dentures:

IV. Discussion:

The present study revealed that midline fracture [46%] was the most common site of fracture for both maxillary and mandibular denture with ‘fall or accidental dropping of denture’ being the most common reason for denture fracture which is in agreement with previous studies.^{1,3} Midline fracture in the upper denture has been related to the cyclic deformation of the base during function. Fracture usually originates from the labial notch area which should be rounded than a sharp one. The less surface area and thinness in the middle part of the lower denture are responsible for the fracture. Presence of deep incisal notches, diastema and thin labial flanges for esthetics and comfort factors of the patient act as stress raisers and contribute to midline fracture of the maxillary denture. Accidental dropping of denture, patient negligence during insertion, removal and cleaning of denture are among the major causative factors for lower denture fracture.¹

This study reports 'fall or accidental dropping of denture' as prime cause for denture fracture [52%]. In this study, various factors like biting hard food, defects in acrylic denture base like scratches, porosities and voids etc, lack of balanced occlusion, poor retention and stability have also been reported to cause denture fracture. Denture fracture is a result of multiplicity of factors and various techniques and materials have been reported in the literature for the repair of fractured denture.

According to this study, the denture repairs were classified into four types. In type 1 repair, the fracture fragments can be easily approximated and glued together directly with the help of cyanoacrylate and/or self-cure acrylic resin. This study reports most of the dentoalveolar and flange fractures along with few midline fractures were easily repairable. Nitkin et al suggests the use of a thin coat of cyanoacrylate adhesive to accurately and easily assemble the fractured segments of a denture which facilitates the quick repair of dentures.⁹ The Type 2 repair [repair requires stabilization] is most common [46%] as per the results of this study. Most of the midline fractures and oblique line fractures required stabilization in some form as found in the data collected in this study. In the literature, the use of small wooden sticks or matchsticks, long burs, sticky wax and cyanoacrylate for stabilization of denture fragments have been reported. The parts of denture are held together, undercuts are blocked and the dental plaster is poured into the denture base to fabricate a repair cast. The fracture line is widened and beveled and repair resin is applied. The denture is then cured in a pressure pot at 20 psi pressure for 30 minutes.^{9,10} In type 3 repair which is second most common [30%], the fractured denture requires stabilization as well as reinforcement in the form of metal wires, glass fibres etc. According to this study, most of midline fractures and oblique line fractures belonged to this category. Carroll and Fraunhofer in their study of wire reinforcement of acrylic resin prosthesis reported that when stainless steel wire is used as a reinforcing system for autopolymerizing resin, greater transverse strength is obtained with the use of wires of larger dimension. The 0.051 inch diameter wires imparted increase in transverse strength that should be clinically significant.⁵

Jagger et al in their review on the reinforcements of dentures reported the use of rubber polymer to reinforce acrylic resin. The objective of the rubber reinforced or 'high impact' resins is that they absorb greater amounts of energy at a higher strain rate before fracture than the standard resins. They also reported the use of chemical modifiers like carbon fibres, Kevlar fibres, glass fibres, metal inserts and ultra-high molecular weight polyethylene to strengthen the PMMA resin. Carbon fibres can be added to PMMA as loose strands or in woven mat form. Bowman & Manley (1984) confirmed that the reinforcement of upper dentures with carbon fibre/PMMA inserts significantly reduced the number of breakages. The mean life of the reinforced denture was twice that of the unreinforced. The use of a metal adhesive resin (Meta Dent®) composed of a conventional powder liquid [poly methyl methacrylate and methyl methacrylate] system containing 5% of 4-methacryloxyethyl trimellitate anhydrite (4Meta) in the monomer has been reported to improve the bond strength between metal and resin.²

Uzun et al in their study based on effect of five woven fibre reinforcements on the impact and transverse strength of denture base resin reported that Carbon fibers have been shown to improve flexural and impact strength, prevent fatigue fracture, and strengthen the resin, but due to undesirable dark color they might pose an esthetic problem. Glass or Kevlar fibers might be materials esthetically better suited for this purpose. However, Kevlar fibers are also unaesthetic. Polyethylene fibers are almost invisible in denture base acrylic resins. And they concluded that Polyethylene and glass-reinforced acrylic resin specimens were significantly more resistant to impact strength.⁷

Nagai et al in their study based on repair of denture using woven metal and glass fibre, treated the repair surface with methylene chloride and concluded that reinforcement with glass fiber and methylene chloride pretreatment increased the transverse strength and a modulus of elasticity of the denture base. Although various methods have been proposed for repairing fractured denture bases, the use of autopolymerizing acrylic resin, which generally allows for a simple and quick repair, is the most popular. However, dentures repaired with autopolymerizing acrylic resin alone often experience a re-fracture at the repaired site. One of the reasons for this unfavorable phenomenon is the insufficient transverse strength of autopolymerizing acrylic resin, which is lower than that of heat-polymerizing acrylic resin.⁸

In the type 4 repair which is least common [4%], the repair is not possible due to multiple fragment fracture where the denture fragments cannot be approximated or they are missing. Also it includes those cases where the repair is complicated due to history of multiple previous repairs. If the patient is having history of multiple denture fractures, the use of metal mesh or high strength denture base resin should be considered while new denture fabrication.

Thus, it is the duty of every dental clinician to analyze and examine the fractured denture for the cause of its fracture and to repair it by using the best type of repair possible. At times, if the repair of denture is not possible then new dentures needs to be fabricated and delivered to the patient, thereby making the life of denture wearer happier and easier.

V. Limitations:

The proposed classification system in this study focuses on only the type of repair possible in different clinical situations of complete denture fracture. It does not consider repair of fractured removable partial dentures, cast partial dentures and overdentures. Also it is based on the most commonly carried out routine treatment modalities for denture repairs. The classification system needs to be evaluated for its validation and reliability by conducting further clinical studies to support this classification.

VI. Conclusions:

Within the limitations of the study it can be concluded that, from the proposed classification system for type of denture repair possible in different denture fracture conditions:

- Type 2 repair was most common [46%], that is most of the fractured dentures required stabilization for their repair.
- Type 3 repair was second most common, that is 30 % of fractured dentures required stabilization and some reinforcing material for their repair to strengthen and enhance the properties of denture.
- Type 1 repair was third most common [20 %] and type 4 repair was least common [4%].

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