The prevalence of fracture in acrylic removable dentures in Sulaimani city

*Cheman A. AL-Jmoor**

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Abstract

Background: Despite the advances in dental technology, the fracture of acrylic resin dentures remains as unsolved problem in removable prosthodontics, and numerous attempts has been established to determine the causes.

Objective: The aim of this study was to investigate the prevalence of fractures in Acrylic Removable Dentures in Sulaimani City.

Patients and methods: A questioner was used to collect the data from two dental laboratories. 264 fracture cases were collected. The variables evaluated were; the fracture area, the possible cause of fracture, fracture frequency, place of denture construction, the age of the denture, and the type of Removable Denture, Partial or Complete Denture.

Results: The data result showed; The ratio of fracture incidence in complete denture to partial denture fracture was nearly 4:1, the ratio of upper to lower denture was 2:1, the most common fractures was midline fracture 112 (42.424%), followed by the De-Bonding of the artificial teeth 62 (23.484%). Dropping was the main possible cause of fracture 66 (25%), followed by poor occlusion 38 (14. 393%). 128 (48.484%) of the denture fractures was first time fracture, 136 (51.515%) of the dentures had repeated fracture. 112 (42.424%) of the fractured dentures were constructed by a technician like people (Dan Saz), 76 (28.787%) were constructed in dental hospital. 58 (21.969%) of the fractured dentures were constructed 1 years ago or less, 146 (55.303%) of the fractured dentures were more than 3 years old.

Conclusion: Midline fracture had the highest rate among all the other types of fractures; fracture of upper denture was more than lower dentures. Dropping followed by the De-bonding of the artificial teeth was the most possible cause of fracture. Fracture rate increased among the dentures which were first constructed by a technician like people (Dan Saz). Fracture frequency increased as the denture age increased, also increased among dentures with repeated fracture.

Keywords: *complete denture fracture, tooth de-bonding, midline fracture.*
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Introduction

The loss of teeth impairs patient's appearance, masticatory ability and speech, thus upsetting the quality of their social and personal life [1]. To restore these functions, removable partial and complete dentures are often used. Poly Methyl Methacrylate (PMMA) has been the standard material for constructing removable dentures, it has many desirable properties such as adequate strength, satisfactory thermal properties, dimensional stability, and insolubility in oral fluids, acceptable aesthetics, ease of handling, and moderate cost [2], but, conversely it has disadvantages which lead to denture fracture.

Smith [3] has related denture fracture to two important clinical disadvantages: low flexure fatigue and impact resistance. Hargreaves and Darbar [4,5], in their studies recorded that; fracture in acrylic dentures result from impact force which is occur during an accidental fall, or a bending force, which happen mainly during mastication because of poor adaptation of the denture to the underlying mucosa, or improper occlusion, and morphology of the palate, excessive masticatory forces, or denture deformation during service, such bending force in long-term will contribute to fatigue of the material. The ultimate goal of denture repair is to restore the original shape, strength, and function of the denture with minimum cost and time in order to avoid recurrent fractures. Ioannis Kostoulas, Uzun, Vallittu [6-8], and many other scientists studied the reinforcement of acrylic with different materials to increase the strength and quality and decrease denture fractures.

The purpose of this study was to identify and evaluate the types of fracture, and the possible causes of these fractures in removable denture.

Patients and Methods

The data of 264 cases of denture fracture were recorded by a one examiner using a prepared case

* Assistant Lecturer at Prosthodontic department, School of Dentistry/ Sulaimani University.
Author contact: chemanaljmoor@hotmail.com.

sheet/ questioner. A questionnaire was used for the study; the data were collected from the patients who attained the prosthodontics clinic in the dental school of Sulaimani for denture repair, and from patients who attended a specialist dental hospital for denture repair.

The obtained information include; patients gender, type of the removable denture, type of fracture, possible cause of the fracture, place of construction of the fractured denture, age of the denture and the frequency of the denture fracture. The fracture areas were classified into; midline fracture, premolar area, tuberosity area, transverse fracture, canine area, anterior area fracture, and De-Bonding of the artificial teeth. The suggested causes of the fracture were divided into six causes; poor occlusion, poor fitting denture, hard object, dropping, denture against natural teeth, old denture, and any fracture that was not related to any of these possible causes were recorded under other causes of fracture (miscellaneous unknown causes).

The laboratories which first constructed the fractured denture was classified into; constructed in the dental school, in a dental hospital, in a private clinic, and dentures which were constructed by a non- qualified technician like people (Dan Saz). The age of the denture was classified into four groups; up to one year of age, up to two years, up to three years of age, and more than three years old. The frequency of the denture fracture were divided into; first time fracture, second time, third time fracture, and more than three times fracture. And finally the removable denture was classified into; complete and partial dentures, upper and lower.

Descriptive and inferential statistical methods were used to analyze the results of the study; Tables, graphical presentation, numbers, percentages, and Chi-Square test were used to show the comparative significance between the groups at a significant level 5%.

Results

Table (1) and Figure (1) show the distribution of fracture type; the midline fracture had the highest number of occurrence 112 (42.424%), and mostly in upper complete denture 80 (30.303%) of the total cases of the fracture cases. De-Bonding of the artificial teeth had the second highest rate 62 (23.484%), and mostly in the upper complete denture 28 (10.606%) whereas; the anterior area had shown the lowest rate of occurrence among fracture areas. Most of the recorded cases of the fracture were in the upper complete denture 140 (53.030%), as compared to the lower complete denture 60 (22.727%), and to both upper and lower partial dentures 64 (24. 242%). There was very high significant difference in the fracture

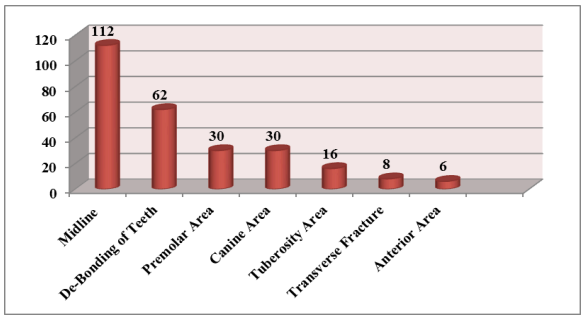

Figure1. Types of Removable Denture Fracture

Table1. Distribution of Fracture type in Removable Dentures

Fracture Type	UCD	LCD	X2	UCD & LCD	UPD & LPD	X2	Total	
							No.	%
Midline	80	30		110	2		112	42.424
De-Bonding of artificial T	28	12		40	22		62	23.484
Premolar Area	Zero	16		16	14		30	11.363
Canine Area	8	2	X2 = 43.9 P=<0.0001	10	20	X2 =79.99 P=<0. 0001	30	11.363
Tuberosity Area	16	Zero		16	Zero		16	6.06
Transverse Fracture	4	Zero		4	4		8	3.03
Anterior Area	4	Zero		4	2		6	2.272
Total No.	140	60		200	64		264	100
Total %	53.03	22.72		75.75	24.24		100	-

U; Upper, C; Complete, D; Denture, L; Lower, P; Partial, T; Teeth

Table2. Distribution of possible cause of fracture of removable dentures

Possible/Suggested Cause of Fracture	UCD	LCD	X2	UCD & LCD	UPD & LPD	X2	Total No.	(%)
Dropping	36	18		54	12		66	(25)
Poor Occlusion	20	4		24	14		38	(14.393)
Other Causes/ Miscellaneous	4	6		10	28		38	(14.393)
Against Natural	26	6	X2 = 4.1 P= 0.3926	32	2	X2= 49.78 P=<0.0001	34	(12.878)
Poor Fit	20	10		30	2		32	(12.121)
Old Denture	20	8		28	Zero		28	(10.606)
Hard Object	14	8		22	6		28	(10.606)
Total No.	140	60		200	64		264	

U; Upper, C; Complete, D; Denture, L; Lower, P; Partial

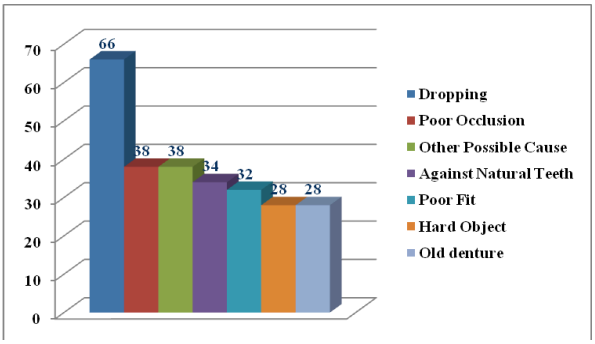

Figure 2. Possible causes of Denture fracture

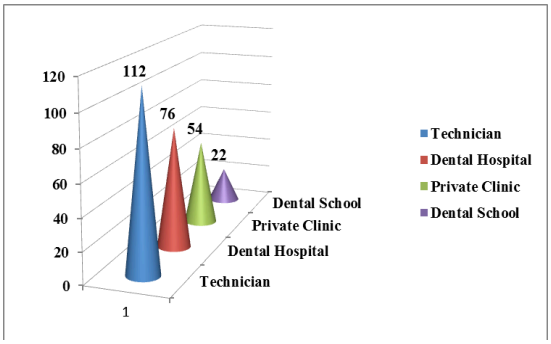

Figure 3. Manufacturing Laboratories

Table3. Relation between Fracture type and possible cause of Fracture

Cause of fracture	Midline Area	De-Bonding of teeth	Premolar Area	Canine canine	Tuberosity Area	Transverse Fracture	Anterior Area	Total No. (%)
Dropping	30	12	8	8	6	Zero	2	66 (25)
Poor Occlusion	18	6	10	4	Zero	Zero	Zero	38 (14.393)
Other causes/ miscellaneous	4	16	2	10	Zero	4	2	38 I14.393)
Against Natural	14	Zero	2	6	6	4	2	34 (12.878)
Poor Fit	20	2	6	Zero	4	Zero	Zero	32 (12.121)
Hard Object	8	16	2	2	Zero	Zero	Zero	28 (10.606)
Old Denture	18	10	Zero	Zero	Zero	Zero	Zero	28 (10.606)
Total	112	62	30	30	16	8	6	264 (100)
	(42.424)	(23. 484)	(11.363)	(11.363)	(6.06)	(3.03)	(2.272)	

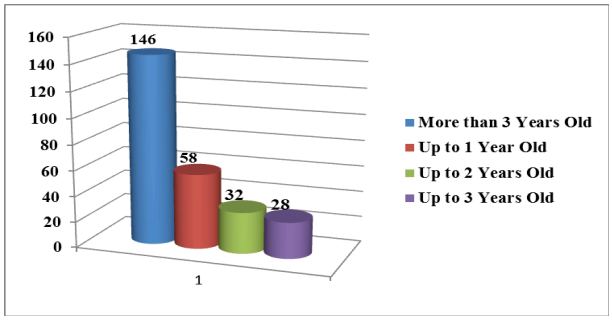

Figure 4. The age of the Fractured Denture

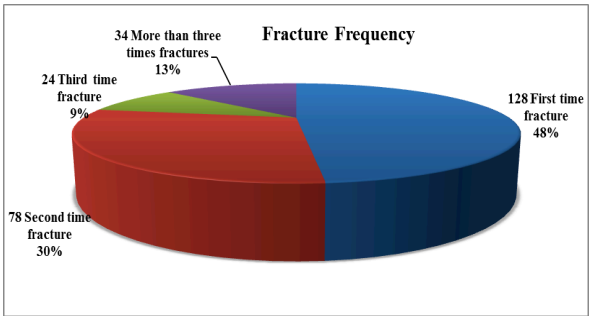

Figure 5. Frequency of Denture Fracture

type of upper and lower complete denture (P 0.0001), and of complete and partial dentures of both arches (P 0.0001), as shown in Table 1.

Table (2) and Figure (2); represent the possible causes of denture fractures. The main possible cause of fracture was dropping 66 (25%), which was the highest in upper complete denture 36 (13.636%). Poor occlusion recorded the second most possible cause of fracture which was again higher in upper complete denture. Insignificant difference was found in the possible causes of denture fracture when comparing upper to lower complete denture (P = 0.3926), but there was very high significant difference in the possible causes of denture fracture when comparing fractures of complete to partial dentures (P<0.0001) as seen in Table 2.

Figure (3) shows the manufacturing laboratories, where 42.424% of the fractured dentures were first constructed by non-qualified technician like people (Dan Saz), and 28.787% were constructed in dental hospitals, and only 8.333% were constructed in the dental school of Sulaimani university. Table (3) shows the association between fracture type and the possible cause of fracture, 26.785% of midline fracture caused by dropping, 33.333% of premolar area fracture caused by poor occlusion, and 25.806% of De-Bonding of the artificial teeth caused by hard object.

Figure (4) represents the age of fractured dentures, it appears that 55.303% of the fractured dentures were more than three years in service, and 10.606% were only three years in service. Figure (5) shows that 48.484% of the dentures fractured for the first time, and 29.545% of the dentures were fractured for second time, and third time fracture recorded minimum percentage.

Discussion

Fracture of poly methyl methacrylate resin dentures remains a significant problem in clinical use. Acrylic dentures basically fractures due to factors leading to stress concentration and increased flexing, the factors underlying any particular denture fracture can be difficult to ascertain due to the very large number of variables including function, processing and handling of the denture, 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 [5].

Midline fracture was the most common type of fracture in the present study, representing (42.424%) of all the fractured cases, and mostly in upper complete denture. Very high significant difference was found in the fracture type of upper and lower complete denture, and in the fracture types of both complete and partial dentures.

This result is in consistence with the results of many studies worldwide. Vallittu [9] and Safwan [10] found that; the most common type of damaged denture was upper complete denture. Amit [11] and Darbar [5], in their studies of complete denture fracture also found that; midline fracture was the most common type of fracture, and most commonly seen in upper complete denture. Midline fracture is mostly due to crack initiation and propagation from stressed areas, representing a flexural fatigue failure after substantial use in vivo, resulting from cyclic deformation [12]. Darbar [5] stated that; any factor that exacerbates the deformation of the base or alters its stress distribution may predispose the denture to fracture, especially those factors that arise from stress concentration area such as; a large frenal notch, dentures with thin or under extended flanges, or a lack of adequate relief, dentures with a wedged or locked occlusion, poor fitted denture, presence of the opposing lower natural teeth and dentures which have been previously repaired. In addition; poor laboratory technique, use of porcelain teeth increase the stress concentration at the tooth/ denture base interface, heavy or uneven masticatory forces, unbalanced occlusion, and patients related habits [13,14], diastema and maxillary tori are other common causes for midline fractures of upper dentures [15,16].

The adhesion between artificial teeth and the denture base is an important factor for the

integrity of removable full and partial denture; this in turn might affect the patient's satisfaction, reflected by quality of life indicators [17,18], most commonly, acrylic denture teeth are used for this purpose. Many studies confirmed that detachment of resin dentures teeth from the base is a common reason for repair [19]; this event might occur either inside or outside the mouth, the causes are related to handling errors during the fabrication process, material related issues or force overload during the time in service [20].

De-bonding of the artificial teeth was the second most common type of fracture in the present study, which represent (23.484%) of the total fracture cases, the occurrence of the De-Bonding of the artificial teeth was more in upper complete dentures as compared to lower complete denture, and partial dentures. Darbar [5] in his survey of denture fracture found that (33%) of the repairs carried out were due to De-Bonding of the artificial teeth. Vallittu [9] in his study found that; the most frequent type of damage was breakdown of the acrylic base and loosening of artificial tooth. Bayraktar [21], in his study of fracture and tooth De-Bonding in removable dentures reported that; the most commonly needs repair was upper complete denture and the De- Bonding of artificial teeth.

Impact failure is a predominant mode of denture failures, it is also a primary cause of fracture of maxillary dentures, denture fractures occurs outside the mouth from impact as a result of accidents such as expelling the denture from the mouth while coughing or dropping the denture. Dropping was the main suggested cause of fracture in the present study 66 (25%), and it was more in upper complete denture than in lower. This finding was not in consistence with Safwan's study, in which poor fit was the main cause of fracture in upper dentures, whereas dropping was the main cause in the lower dentures, which is in consistence with the present study. A non-significant difference was found in the possible causes of denture fracture when comparing upper to lower complete denture, but there was a very high significant difference in the possible causes of denture fracture when comparing fractures of complete to partial dentures.

Changes in the occlusal design as a result of unbalanced occlusion, have been shown to affect base deformation and tooth wear, this ultimately leads to occlusal imbalance, and will have an effect on functional deformation. Wear of teeth can occur when natural or porcelain teeth oppose acrylic resin teeth and in patients with heavy occlusion or abrasive diets, such wear affects the occlusal balance and predisposes the denture base to fracture [22]. The second possible cause of denture fracture was poor occlusion 38 (14.393%) in general; also fracture of upper dentures due to poor occlusion was more than lower and partial dentures together.

The highest number of denture fracture 112 (42.424%) happened among dentures which were first constructed and provided to the patient by a non qualified technician like people, known locally in Kurdistan as (Dan Saz). To ensure the success of the prosthesis the dentist must understand the various factors that contribute to its optimal performance such as; physical, mechanical, physiological, anatomical, psychological, & biological factors [23], such a science and knowledge is not available to those technician like people (Dan Saz), a fact that might explain the high number of fracture among the dentures that was first constructed by them.

There is a widespread of those non-qualified people, who works privately, and provide dental services ranging from dental filling, tooth extraction, and construction of dental prosthesis both fixed and removable prosthesis to the locals. There is almost no study or records that might provide any information about this type of dental service and/ or non- qualified technicians like people, although their presence is a fact and an unfortunate reality.

The reason of the increased numbers of dentures constructed by those technicians like peoples is the level of the nation education and knowledge, and the absence of suitable and/or enough professional dental service in the past and in the present in some areas, which direct the people to seek the service by those people. This subject needs to be investigated more by the authorities, and collect more information to know the level of the problem, and then take the steps toward solving it in the future.

Clinical evidence indicates that the majority of fractures, which occur to prosthodontics structures, happen after a period of many years, such failures generally are not related to an episode of acute overload but result from fatigue failure [24]. A study by Johnston [25] showed that 68% of acrylic resin dentures break within a few years after fabrication, this is caused primarily by impact failure when the denture is accidentally dropped on a hard surface or by fatigue failure when the denture base deforms repeatedly through occlusal forces.

The highest number of fractures in the present study 146 (55.303%), occurred in dentures with age of more than three years in service, this result was similar to Vallittu [9] when reported that; fractures in acrylic resin-based partial dentures were occurring after 3 years in clinical use.

Beyli [26] reported that; auto polymerizing resin repairs provide a rapid and economic

convenience to patients but unfortunately the repaired units appear to lose 40% to 60% of their original transverse strength. In addition to the technical efficiencies in the repair of dentures, Smith3 found from his study that 56% of the total fracture dentures had previously been repaired. This was not in consistence with the present study where, the first time denture fracture had the highest number 128 (48.484%) of fractures, and the second time fracture had the second highest rate of fracture 78 (29.545%).

Conclusion

The result of the present study was in consistence with other worldwide related studies. Midline fracture was the main type of fracture, and its occurrence in upper was more than in lower dentures, among the possible causes of fracture, dropping had the highest rate.

Denture fractures is a multi-factorial incidence, however, repeated denture fracture, the age of the denture, the quality of the denture, and the place where they were first constructed, are other enhancing factors to denture fracture, more investigations need to be done in this regard, to over come this every day long-lasting problem.

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