

CAUSES AND TYPES OF DENTURE FRACTURES — A STUDY

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ABSTRACT

The objective of this study was to determine the causes and types of denture fractures in patients who came for dental treatment to Khyber College of Dentistry, Peshawar. In this cross sectional study 160 patients were the subject study. They were seen over a period of 3 months. After obtaining informed consent, a Pre-structured questionnaire was used to collect the data regarding the causes and types of denture fractures. Adult male and female patients with age above 40 years were included in this study. Eighty-eight were males (55%) and 72 were females (45%). The mean age was 55.68 ± 7.73 years. This study revealed that the most common denture fracture occurred outside the mouth from impact as a result of accidents such as accidentally dropping the denture from the mouth while coughing or dropping the denture. The liability of denture to accidental fractures is 56% ($n=35.0$). It could be concluded that damage to removable dentures is quite frequent and provides much distress and cost to the patients. These difficulties can be best prevented by regular examinations of the mouth and dentures. A new, more suitable method of reinforcing the base of dentures during preparation is also needed.

Key Words: Denture fracture, Acrylic resin, Prosthodontics.

INTRODUCTION

One of the most common causes of denture fracture includes wear and tear over time.¹ Following years of use, the denture undergoes many stress cycles due to chewing and daily wear. In addition, thermal cycling due to hot and cold foods and beverages, acidity due to certain foods and moisture in the mouth are other examples of factors that may contribute to the wear of the denture.² Another cause of denture failure is progressive bone loss and reduction in jaws size due to bone resorption, leading to problems with the fit of the denture.³ Consequently, the denture moves around in the mouth and the lack of stability leads to the development of stress and pressure points within the denture, which ultimately leads to fatigue failure.⁴

Dentures are most commonly fabricated from the heat cure acrylic resin, poly methyl methacrylate.⁵ This material is not ideal in every respect but it is the combination of various desirable properties rather than one single property that is the basis for its selection in many prosthetic applications including denture fabrication. Despite its desirable aesthetic qualities it is still far from ideal in fulfilling all the ideal mechanical requirements of a prosthetic appliance. Fracture of dentures is an unresolved problem. The life of a complete denture wearer can be abruptly paralyzed by the sudden fracture of his/her denture, which is of utmost necessity for his/her day to day activities. Broken acrylic resin dentures may be repaired with auto-polymerizing acrylic resin, heat-curing acrylic resin and recently, with visible light-cured resin. Auto-polymerizing resin repairs provide a rapid and economic convenience to patients.⁶ Unfortunately, the repaired units may lose some of their original transverse strength. Furthermore, fracture of repaired dentures often occurs at the junction of old and new materials rather than through the center of repair.^{7,8}

Despite increasing costs incurred by patients and health providers on the repair of these prostheses, literature regarding the causes and ways of prevention of denture failure is sparse. As dental health providers, it is always our goal to improve the quality of life of

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denture-wearers by investigating and solving problems related to complete denture patients. This study was undertaken to investigate the causes of denture fracture and devise ways of reducing these problems in the future, either by using proper load application or use of high impact strength resin and metal reinforcement.

METHODOLOGY

This cross-sectional descriptive study was conducted in the Department of Prosthodontics, Khyber College of Dentistry, Peshawar from October 2015 to December 2016. Approval of the hospital ethical committee was taken. The purpose, procedures and benefits of the study were explained to the patients. An informed consent and their willingness to participate in the study were ensured. They were assured of maintaining confidentiality of their personal and other data collected from their records. A total of 160 subjects were included.

The sampling was done according to following criteria:

- Age and gender of the patients
- Age of the denture at time of fracture
- Reason of breakage, according to history given by the patient and clinical analysis by the clinician
- Site of the fracture

A detailed history of the fracture was taken from the patient and the denture was assessed for retention, stability and occlusal errors by the clinician. The denture repair procedure was done using a conventional method with auto-polymerizing acrylic resin.

The collected data was analyzed using SPSS version 22. Percentages and frequencies were calculated for categorical variables like type of denture fracture, gender, age of denture. Mean and standard deviation was calculated for numerical variables like age. Chi-square test was applied for gender wise comparison keeping $p < 0.05$ as significant.

RESULTS

A total of 160 subjects were examined in the study, 88 males and 72 females. Male to female ratio in the study was 1.2:1. The age ranged above 40 years with the mean age of 55.68 ± 7.73 as shown in Table 1. Frac-

tures were common during 6 to 12 months of denture use as shown in Table 2. Impact fracture was the most common cause of damage (35.0%) shown in Table 3. The most frequent type of damage was breakdown of acrylic base, There was statistical significant relationship between types of denture fracture with gender ($p=0.001$) see Table 4. On the other hand, there was statistical

TABLE 1: GENDER DISTRIBUTION

Gender	Frequency	Percentage
Male	88	55
Female	72	45
Total	160	100

Mean age is 55.68 ± 7.73 years

TABLE 2: DENTURE AGE DISTRIBUTION

Age of the Denture	Frequency (n)	Percentage
< 6 months	26	16.3
6 – 12 months	82	51.2
12 – 36 months	52	32.5
Total	160	100

TABLE 3: CAUSES OF DENTURE FRACTURE

Cause of Denture Fracture	Frequency (n)	Percentage
Poor fit	35	21.9
Warpage	2	1.3
Inaccurate setup	9	5.6
Inherent limitations in acrylic	8	5.0
Single complete denture	12	7.5
Deep labial and buccal frenal notch	5	3.1
Bulbous ridges	9	5.6
Strong elevator muscles	2	1.3
Accident/Impact	56	35.0
Mastication	22	13.8
Total	160	100.0

TABLE 4: ASSOCIATION OF TYPES OF DENTURE FRACTURE WITH GENDER

Gender	Types of Fracture			Total	Pearson-Chi square	P value
	Hairline Fracture	Acrylic Resin Breakage	Loosening of Tooth			
Male	11	72	5	88	13.19	0.001
Female	24	40	8	72		
Total	35	112	13	160		

P value highly significant: 0.001

TABLE 5: ASSOCIATION BETWEEN THE AGE OF DENTURE AND THE TYPE OF FRACTURE

Age of Denture	Types of Fracture			Total	Pearson chi-square	P value
	Hairline Fracture	Acrylic Res-in Breakage	Loosening of tooth			
< 6 months	5	21	0	26	13.63	0.009
6 – 12 months	19	33	9	61		
12–36 months	11	58	4	73		
Total	35	112	13	160		

P value highly significant : 0.009

significant relationship ($p=0.009$) between the age of denture and the type of fracture as illustrated in Table 5 which shows that with increasing age of denture acrylic resin fracture is more likely.

DISCUSSION

This study revealed that the most common denture fracture 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. The liability of denture to accidental fractures is 56% ($n=35.0$).

The second most common fracture is poor denture fit 35% ($n=21.9$) especially in the upper arch, where it was the prime cause of denture fracture. Ill fitted dentures flex during function around the midline and due to cyclic loading during mastication, lead to fatigue fracture.⁷ This result agrees with previous studies where midline fracture was a common problem in upper complete dentures.^{9,10} Midline fracture of a denture base represents flexural fatigue failure, resulting from cyclic deformation of the base during function.¹¹ Any factor that alters the stress distribution of the denture base can predispose the denture to fracture.

Denture fracture due to heavy masticatory load was 13.8% ($n=22$). Excessive wear of the artificial teeth can predispose the denture to fracture but other factors are probably more significant.¹²

Fracture due to single complete denture opposed by natural teeth was 12% ($n=7.5$). In such cases heavy masticatory load from the opposing natural teeth and unbalanced occlusion in the presence of inclined and over-erupted natural teeth that oppose the denture will be the significant cause of denture fracture.¹³

Presence of deep incisal notches represent points of weakness where they act as stress raisers, contributing to midline fracture of maxillary dentures.¹⁴ In this study, 3.1% ($n=160$) of dentures midline fractures involving deep incisal notch in the midline. Studies have shown that under load maximum tensile stresses are on palatal aspect of the denture.¹⁵ Factors that contribute to stress concentration will propagate cracks influencing rate of

failure. Both the presence of notches and diastema act as a stress concentrators thereby influencing the risk of failure.¹⁶

Other causes which contributed approximately 18.8% ($n=30$) to dentures fractures were related to bulbous ridges, inaccurate setup, warpage, inherent limitations of acrylic and strong elevator muscles. These findings agree with the results of other studies that show that sharp changes in contour, pinholes, inclusions and deep scratches may all cause stress intensification and will predispose dentures to fracture.^{17,18} In this study majority of denture fractures (51.2%) occur between 6 to 12 month of its use, as compared to the previous studies performed by other authors showing 63% of denture fractured within 3 years of its provision. This may be due to breakdown of the material with age and this represents fatigue phenomenon.¹⁹ Therefore fracture of the denture base in situ often occurs by a fatigue mechanism in which relatively small flexural stresses, over a period of time, eventually lead to the formation of a small crack, which propagates through the denture, resulting in fracture.

About 5% of the fractured dentures were broken due to Acrylic resin breakage with age; this represents a fatigue phenomenon, while long-term water and saliva sorption will lower the fatigue resistance of the acrylic resin.²⁰ The problem of acrylic resin fracture can be reduced by the use of the improved high impact resin.²¹ Reinforcing denture base could be achieved by using continuous electrical-glass (E-glass) partial fibers reinforcement.²² It enhances mechanical strength of denture bases such as the transverse strength and impact strength. Clinical function may induce stresses, which, after a period of a few years bring about deterioration in the denture base material and so hasten failure.

CONCLUSIONS

From this study, the following conclusions can be drawn;

Damage to removable dentures is quite frequent causing much distress and cost for patients

Repeated fractures can be reduced by proper design and construction of dentures

Using high impact resin can reduce the problem of denture fracture.

New suitable methods of reinforcing the denture base should be used e.g continuous E glass fiber.

REFERENCES

- 1 Praveen B, Babaji HV, Prasanna BG, Rajalbandi SK, Shreeharsha TV, Prashant GM. Comparison of Impact Strength and Fracture Morphology of Different Heat Cure Denture Acrylic Resins: An In vitro Study. *J Int Oral Health*. 2014;6:12-16.
- 2 Ayaz EA, Bagis B, Turgut S. Effects of thermal cycling on surface roughness, hardness and flexural strength of polymethylmethacrylate and polyamide denture base resins. *J Appl Biomater Funct Mater*. 2015;13:e280-86.
- 3 Anitua E, Alkhraist MH, Pinas L, Begona L, Orive G. Implant survival and crestal bone loss around extra-short implants supporting a fixed denture: the effect of crown height space, crown-to-implant ratio, and offset placement of the prosthesis. *Int J Oral Maxillofac Implants*. 2014;29:682-89.
- 4 Faot F, Garcia RC, Del Bel Cury AA. Fractographic analysis, accuracy of fit and impact strength of acrylic resin. *Braz Oral Res*. 2008;22:334-39.
- 5 Kul E, Aladag LI, Yesildal R. Evaluation of thermal conductivity and flexural strength properties of poly(methyl methacrylate) denture base material reinforced with different fillers. *J Prosthet Dent*. 2016;116:803-10.
- 6 Cilingir A, Bilhan H, Geckili O, Sulun T, Bozdog E, Sunbuloglu E. In vitro comparison of two different materials for the repair of urethan dimethacrylate denture bases. *J Adv Prosthodont*. 2013;5:396-401.
- 7 Faot F, Costa MA, Del Bel Cury AA, Rodrigues Garcia RC. Impact strength and fracture morphology of denture acrylic resins. *J Prosthet Dent*. 2006;96:367-73.
- 8 Vallittu PK, Lassila VP, Lappalainen Niom R. The effect of notch shape and self-cured acrylic resin repair on the fatigue resistance of an acrylic resin denture base. *J Oral Rehabil*. 1996;23:108-13.
- 9 Choi M, Acharya V, Berg RW, Marotta J, Green CC, Barbizam JV, et al. Resinous denture base fracture resistance: effects of thickness and teeth. *Int J Prosthodont*. 2012;25:53-59.
- 10 Cilingir A, Bilhan H, Baysal G, Sunbuloglu E, Bozdog E. The impact of frenulum height on strains in maxillary denture bases. *J Adv Prosthodont*. 2013;5:409-15.
- 11 Diaz-Arnold AM, Vargas MA, Shaull KL, Laffoon JE, Qian F. Flexural and fatigue strengths of denture base resin. *J Prosthet Dent*. 2008;100:47-51.
- 12 Katsoulis J, Nikitovic SG, Spreng S, Neuhaus K, Mericske-Stern R. Prosthetic rehabilitation and treatment outcome of partially edentulous patients with severe tooth wear: 3-years results. *J Dent*. 2011;39:662-71.
- 13 Upadhyay SR, Singh SV, Bhalla G, Kumar L, Singh BP. Modified functionally generated path technique for single complete denture against non-modified natural dentition. *J Oral Biol Craniofac Res*. 2012;2:67-71.
- 14 Nejatidanesh F, Peimannia E, Savabi O. Effect of labial frenum notch size and palatal vault depth on stress concentration in a maxillary complete denture: a finite element study. *J Contemp Dent Pract*. 2009;10:59-66.
- 15 Hashem M, Binmgren MA, Alsaleem SO, Vellappally S, Assery MK, Sukumaran A. The impact of polymerization method on tensile bond strength between denture base and acrylic teeth. *J Contemp Dent Pract*. 2014;15:315-18.
- 16 Prombonas AE, Vlissidis DS, Maria PA, Nikolas PA. The stress state of the fraenal notch region in complete upper dentures. *Med Eng Phys*. 2012;34:1477-82.
- 17 Cheng YY, Cheung WL, Chow TW. Strain analysis of maxillary complete denture with three-dimensional finite element method. *J Prosthet Dent*. 2010;103:309-18.
- 18 Anasane N, Ahirrao Y, Chitnis D, Meshram S. The effect of joint surface contours and glass fiber reinforcement on the transverse strength of repaired acrylic resin: An in vitro study. *Dent Res J (Isfahan)*. 2013;10:214-19.
- 19 Kappert PF, Kelly JR. Cyclic fatigue testing of denture teeth for bulk fracture. *Dent Mater*. 2013;29:1012-19.
- 20 Lassila LV, Vallittu PK. Effect of water and artificial saliva on the low cycle fatigue resistance of cobalt-chromium dental alloy. *J Prosthet Dent*. 1998;80:708-13.
- 21 Agha H, Flinton R, Vaidyanathan T. Optimization of Fracture Resistance and Stiffness of Heat-Polymerized High Impact Acrylic Resin with Localized E-Glass FIBER FORCE(R) Reinforcement at Different Stress Points. *J Prosthodont*. 2016;25:647-55.
- 22 Vallittu PK, Ruyter IE, Ekstrand K. Effect of water storage on the flexural properties of E-glass and silica fiber acrylic resin composite. *Int J Prosthodont*. 1998;11:340-50.

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