A CLINICAL STUDY OF COMPLETE DENTURE FRACTURES AT FOUR MILITARY HOSPITALS IN JORDAN

Safwan F. Khasawneh, BDS, MDSc, Jamal M. Arab, BDS, MDSc**

ABSTRACT

Objective: To analyze and determine the causes of complete denture fractures.

Methods: Data were collected from patients who attended prosthodontic clinics for denture repairs at four military hospitals. For each patient requiring repair of a fractured complete denture, the variables were recorded: causes of denture fracture, the type of fracture and the history of previous recurrent fractures.

Results: Of 552 repaired dentures 320 (58%) were complete dentures, 154 (28%) were removable partial dentures, which were excluded from the study, and 78 (14%) involved replacement of the teeth that had deboended from the denture bases. The ratio of upper to lower complete denture fractures was approximately 2:1, most of the fractured dentures (63%) were those of males.

Poor fit appeared to be the main cause of denture fracture 116 (36%), and poor occlusion was the second most common cause recorded 54 (17%). Midline fracture was the most common type of fracture during the period of study 195 (61%). Most of the fractured dentures 185 (58%) had previously been repaired once or more.

Conclusion: The total number of complete denture fractures was considerably enhanced by repetitive fractures, which can be reduced by the application of prosthetic principles in constructing and maintaining dentures particularly during the laboratory stages.

Improvements in the processing techniques and the type of resin can reduce the incidence of denture fracture. Various polymers have been developed for use as denture base resins to overcome some of the mechanical deficiencies of polymethylmethacrylate.

Key words: Complete denture fractures, Acrylic resins, Prosthodontics.

JRMS Dec 2003 10(2): 27-31

Introduction

Despite advances in dental technology, it can be seen that the fracture of acrylic resin dentures remains a significant problem and the number of denture fractures has not decreased.

Denture fracture is usually mechanical or accidental [1,2]. Mechanical causes are related to faulty design, faulty fabrication and, or poor materials choice [3-5]. Any factor that exacerbates deformation of the base or alters its stress distribution will predispose the denture to fracture [1,6].

The ultimate goal of denture repair is to attain the original shape and strength of the denture with minimum cost and time. Several techniques and materials have been used to repair fractured dentures. Broken acrylic resin dentures are repaired with autopolymerizing acrylic resin, heat-curing acrylic resin and recently, with visible light-cured resin. Autopolymerizing resin repairs provide a rapid and economic convenience to patients [7-9].

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 [10-12].

The purpose of this study was to identify the causes of the most frequent types of complete denture fractures, which could be related to patients, clinicians and technique.

Method

Data were collected from four prosthodontic clinics attached to prosthetic laboratories in four military hospitals during 16 months. Patients attended for repair of broken dentures were examined and the following

*From the Dental Department, King Hussein Medical Center, (KHMC), Amman-Jordan
Correspondence should be addressed to Dr. S. Khasawneh, P. O. Box 167 Marj AL-Hamam 11733 Jordan
Manuscript received September 2, 2001. Accepted April 17, 2002.

data were recorded.

- Patients' age and gender.
- Denture age at time of fracture
- Denture type (complete or partial, acrylic or metal) previous or recurrent fractures.

To determine the cause and type of fracture, only repaired complete dentures were subjected to careful examination outside and inside the mouth for retention and stability of the denture, type and location of fracture, occlusal contact errors and nature of opposing teeth (natural or artificial, partial or complete denture).

Retention of repaired denture was evaluated by examining the resistance of denture to displacement on removing the denture from the mouth.

Broken dentures were repaired with conventional procedure by using autopolymerizing acrylic resin. Examination and evaluation of repaired dentures were carried out by the same operator in all hospitals. Statistical analysis was accomplished by using SPSS. chi-square test was used to compare categories, the result was considered statistically significant when probability was less than 0.05.

Results

During the study period, a total of 552 dentures were repaired, 320 (58%) were broken complete dentures, 78 (14%) involved replacement of teeth that had debonded or fractured from the denture base, and the remaining 154 (28%) were broken removable partial dentures (Table 1). Removable partial dentures were excluded from this study, because the nature of repairs and the causes of fracture differed from those observed with complete dentures.

The results showed that the ratio of upper to lower complete denture fractures was approximately 2:1 (Table II). Most of the fractured dentures (63%) were related to males, and only 7 patients have more than one fractured denture, and 4 of these patients were males.

The mean age of the fractured lower dentures was slightly more than the upper, it was 8.1 years for the lower, 7.6 years for the upper, and the mean age for all the fractured dentures was 7.8 years (Table III).

Upper complete dentures were most liable to lose a tooth during eating or after dropping compared with lower dentures, of 78 replacements of the teeth that had debonded or fractured 59 (78%) were in upper dentures.

Midline fracture was the most common type of fracture in this study, 195 (61%), of those midline fractures, 139 (71%) occurred in the upper dentures, and 56 (29%) in the lower dentures (Table IV).

Using chi-square analysis revealed significant difference between the site of fracture in upper dentures and the site of fracture in lower dentures, $P < 0.001$).

Differences in the apparent cause of fracture between upper and lower dentures were presented in Table V. Poor fit was the main cause of fracture in upper dentures 84 (40%), whereas dropping was the main cause in the lower dentures 42 (39%). Lack of balanced occlusion was the second cause of fracture in upper dentures 40 (19%), while it was the third cause of fracture in lower dentures 14 (13%). Highly significant difference was found between the causes of fractures in upper and lower dentures $P < 0.001$).

Denture fractures occurred both outside and inside the mouth during function. The majority of upper denture fractures 196 (92%) occurred inside the mouth during function and the remainder 16 (8%) occurred outside the mouth, whereas out of 108 repaired lower dentures 46 (43%) had been broken outside the mouth through impact as a result of dropping.

Less than one half 135 (42%) of repaired dentures had been repaired for the first time, and the remainder 185 (58%) had previously been repaired once or more (Table VI). There was a difference in the incidence between upper and lower denture that had been repaired for the first time, (39% for the upper denture and 48% for the lower ones). Statistical analysis of the data showed that no significant difference was found between the repetition of fractures in upper dentures and repetition of denture fractures in lower dentures $P = 0.27$.

Discussion

Midline fracture was the most common type of fracture in this study, represented 35% of the total denture repairs carried out. Of those 139 (71%) were seen in upper complete dentures and 56 (29%) were seen in lower complete dentures. These findings are consistent with other studies [1-3], which have shown that midline fracture was a common problem in upper complete dentures.

Midline fracture of a denture base represents a flexural fatigue failure, resulting from cyclic deformation of the base during function. Any factor that alters the stress distribution of the denture base can predispose the denture to fracture. Presence of deep incisal notches represent a point of weakness in that it might act as a stress raiser and so contribute to midline fracture of maxillary dentures, in this study the majority of upper dentures 108 (78%) which had been repaired of midline fracture, involved a notch in the midline.

Poor fit was the main cause of denture fracture in this study. Poor fit denture is flexed in the mouth during function about the midline or approximately, so, movement of the denture during mastication will cause fracture due to a series of repeated small loadings, which lead to fatigue failure. If the notch is sufficiently sharp, the local stress concentration may exceed the breaking strength of the acrylic material and a crack will form which will run right through to complete failure under repeated loadings. Fracture of a denture in the mouth by a single bite is very improbable, because the load required to cause fracture ranged from 180-800 Ib [5], much higher than that which a denture wearer appears to be capable to produce during function, 13-16 Ib [10], Beyli and Von Fraunhofer (1981) found that poor fit was the most common cause of denture fracture in 12 out of

15 dental laboratories involved in this survey [11].

In the current study, poor occlusion was the second cause of denture fracture, 54 (17%) dentures were fractured due to heavy or uneven masticatory loads. Of these 44 (14%) were single complete dentures opposed by a residual natural dentition, in such cases heavy masticatory load from the opposing natural teeth and unbalanced occlusion in the presence of inclined and overerupted natural teeth which oppose the denture will be the significant cause of denture fracture, excessive wear of the artificial teeth can predispose the denture to fracture but other factors are probably more significant.

The results have shown that inadequate thickness and defect in acrylic base, such as voids inside the material, porosity, inclusions, deep scratches, and residual processing stresses caused fracture for 52 (16%) dentures. Beyli and Von Fraunhofer [1] and Smith [5] concluded from their study that sharp changes in contour, pin holes, inclusions and deep scratches may all cause stress intensification and will predispose the denture to fracture. Fracture, however is the result of initiation and propagation of a crack and this requires the presence of point of localized stress.

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 lower denture to accidental fractures is more than the upper, out of 54 (17%) accidental fractures 42 (13%) occurred in lower dentures, and 12 (4%) were in upper dentures, this difference in the incidence of accidental fractures between upper and lower dentures can be explained from the difference in the shape, size, and width in the midline area between upper and lower dentures.

Nine percent of the fractured dentures were broken due to material breakdown with age; this represents a fatigue phenomenon, while long-term water and saliva sorption will lower the fatigue resistance of the acrylic resin. Hargreaves [2] concluded from her study that the physical properties of methylmetacrylate did not deteriorate with age, but that 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.

Most of the fractured dentures 185 (58%) had previously been repaired one or more times, and of these 62 (19%) had been repaired three or more times. Autopolymerizing 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 [11]. In addition to the technical deficiencies in the repair of dentures. Smith (1961) found from his study that 56% of the total fractures had previously been repaired while only 6% had been repaired three or more times, of these repairs 58% were cold–cured and 42% heat cured, whereas in the present study all repairs were cold-cured.

The result has shown that 14% of the total repairs were replacement of the teeth that had debonded or fractured from the denture base resin. The most common causes which prevent optimum bonding between the teeth and denture base resin are indiscriminate use of separating medium and faulty boil out procedures, also tooth debonding may be exacerbated by unbalanced occlusion and heavy masticatory load.

Different precautions can be made to reduce the incidence of denture fractures through, maximal denture retention and stability, uniform occlusal loading and balanced articulation. Using higher strength polymers (high-impact resins), a good processing technique to eliminate surface defects and inclusions within the denture base, reducing the need for a deep frenal notch by a frenectomy, adequate thickness in the anterior region (the maximum consistent with tongue space) and placing a thin beading around the labial frenum to improve the seal.

Metals can be added in the form of wires, plates or fillers to increase the transverse strength of acrylic resin [13].

The reinforcement of acrylic resin with glass fibers in the form of a woven mat has been demonstrated to be a satisfactory way of producing a resin with improved mechanical properties [14].

Conclusion

An analysis of the potential cause of fracture in 320 repaired dentures has shown that, poor fit was the main cause of fracture, in upper dentures, whereas dropping was the main cause of fracture in lower dentures.

Upper dentures were repaired more than lower denture (ratio 2:1). Midline fracture was the commonest type of fracture and more than half of repaired dentures (58%) had previously been repaired.

Table I. Type of denture repairs at each hospital during the study period

Hospital name	Complete denture repairs	Replacement of teeth	Partial denture repairs	Total of repairs in each hospital	The time of survey
King Hussein Medical Center	91	19	43	153	From August until November 1997
Queen Alia Hospital	51	14	20	85	From December 1997 until March 1998
Marka Health Center	66	18	35	119	From April until July 1998
Prince Rashid Hospital	112	27	56	195	From August until end of November 1998
Total of repairs	320 (58%)	78 (14%)	154 (28%)	552 (100%)	

Table II. Number of upper and lower complete denture repairs in each hospital

Hospital name	Upper dentures	Lower dentures
King Hussein Medical Center	61	30
Queen Alia Hospital	33	18
Marka Health Center	44	22
Prince Rashed Hospital	74	38
Total	212	108

Table III. The number of fractured dentures in relation to denture age

Age-years	Number of dentures
0-3	61 (19%)
4-6	91 (29%)
7-9	62 (19%)
10-12	48 (15%)
13-15	30 (9%)
More than 15	28 (9%)
Total	320

Table IV. Differences in the site of fracture between upper and lower dentures*

Site of fracture	Upper denture	Lower denture
Midline fracture	139 (66%)	56 (52%)
Between the central and lateral	39 (18%)	7 (6.5%)
Canine area fracture	17 (8%)	35 (32%)
Premolar area fracture	5 (2%)	7 (6.5%)
Molar, tuberosity and retromolar pad area fracture	7 (4%)	3 (3%)
Other areas fractures	5 (2%)	-
Total	212	108

* X^2= 41.32 P<.001

Table V. Differences in the cause of fracture between upper and lower dentures*

Suggested cause of fracture	Upper denture	Lower denture	Upper &Lower denture
Poor fit	84 (40%)	32 (29%)	116 (36%)
Poor occlusion	40 (19%)	14 (13%)	54 (17%)
Dropping	12 (6%)	42 (39%)	54 (17%)
Defect in acrylic base (porosity, scratches)	38 (18%)	14 (13%)	52 (16%)
Material breakdown	22 (10%)	6 (6%)	28 (9%)
Setting the teeth out of the ridge	16 (7%)	-	16 (5%)
Total	212	108	320

* X^2= 61.40 P<.001

Table VI. Repetition of fractures in upper and lower dentures.

Repetition of repairs	Upper dentures	Lower dentures	Upper and lower dentures
Dentures had been repaired for the first time	83 (39%)	52 (48%)	135 (42%)
Dentures had been repaired once previously	44 (21%)	22 (20%)	66 (21%)
Dentures had been repaired twice previously	38 (17%)	19 (18%)	57 (18%)
Dentures had been repaired three times or more previously	47 (22%)	15 (14%)	62 (19%)
Total	212	108	320

References

1. **Beyli MS, Von Fraunhofer JA.** An analysis of causes of fracture of acrylic resin dentures. *J Prosthet Dent* 1981; 46: 238-241.
2. **Hargreaves AS.** The prevalence of fractured dentures, a survey. *Br Dent J* 1969; 126: 451-455.
3. **Darbar UR, Huggett R, Harrison A.** Denture fracture-a survey. *Br Dent J* 1994; 176: 342-345.
4. **Polyzois GA, Andreopoulos AG, Lagouvardos PE.** Acrylic resin denture repair with adhesive resin and metal wires: Effects on strength parameters. *J Prosthet Dent* 1996; 75: 381-387.
5. **Smith DC.** The acrylic denture, mechanical evaluation, Midline fracture. *Br Dent J* 1961; 110: 257-267.
6. **Stipho HD.** Reapir of acrylic resin denture base reinforce with glass fiber. *J Prosthet Dent* 1998; 80: 546-550.
7. **Stipho HD, Stipho AS.** Effectiveness and durability of repaired acrylic resin joint. *J Prosthet Dent* 1987; 58: 249-253.
8. **Barpal D, Curts DA, Finzen F, *et al.*** Failure load of acrylic resin denture teeth bonded to high impact acrylic resins. *J Prosthet Dent* 1990; 80: 666-671.
9. **Nitkin DA, Sponzo MT.** Simplified denture repair technique. *J Prosthet Dent* 1979; 41: 355-357.
10. **Hickey JC, Zarb GA, Bolender CI.** Boucher's prosthodontic treatment for edentulous patients 9th ed. St Louis: CV Mosby company 1985; 9-17.
11. **Beyli MS, Von Fraunhofer JA.** Repair of fractured acrylic resin. *J Prosthet Dent* 1980; 44: 497-503.
12. **Spratley MH.** An investigation of the adhesion of acrylic resin teeth to dentures. *J Prosthet Dent* 1987; 58: 389-392.
13. **Jameson WS.** Fabrication and use of a metal reinforcing frame in a fracture- prone mandibular complete denture. *J Prosthet Dent* 2000; 83: 476-479.
14. **Jagger DC, Harrison A, Jandt KD.** The reinforcement of dentures. A review. *J Oral Rehabil* 1999; 26: 185-194.