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Clinical evaluation of failures in removable partial dentures

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Abstract: The aim of this clinical study was to evaluate the effects of removable partial dentures on the support tissues and changes occurring in lower tooth-supported and bilateral distal-extension dentures, 5 years after placement. The study involved analysis of a total of 53 patients who received prosthetic treatment for removable partial dentures. The patients were divided into two groups. In group 1, the patients had a completely edentulous maxilla and an edentulous area with natural teeth remaining in both the anterior and posterior regions. In group 2, the patients had a completely edentulous maxilla and partially edentulous mandible with preserved anterior teeth. Tooth mobility, prevalence of caries, fracture of the abutment teeth, fracture and/or deformation of the removable partial denture components and stability of the denture base were evaluated. The use of a removable partial denture increased tooth mobility, reduced the prevalence of caries, and did not cause loss or fracture of the abutments or damage to their components, when compared with the baseline. It was concluded that there was no difference between the groups as evaluated in terms of tooth mobility, prevalence of caries, loss and fracture of the abutments or damage to the components of the removable partial denture. (J Oral Sci 54, 337-342, 2012)

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Introduction

Although there are an increasing number of elderly dentate people in countries such as the USA and United Kingdom (1), survey data have indicated that at least one quarter of a million people under the age of 40 have removable partial dentures (2). Removable partial dentures should maintain the health of the remaining dentition and surrounding oral tissue. However, the factors determining the prognosis of removable partial dentures are still unclear.

Studies have shown that partial dentures in the mouth increase the formation of biofilm and, consequently, an increase in the occurrence of caries and periodontal disease (1-4). Other research has produced more favorable results, with moderate degrees of injury or practically no periodontal changes (5-7). Therefore, the existing results are inconclusive and sometimes contradictory.

The forces applied to the abutment teeth and their effects are very important considerations when designing and constructing removable partial dentures. Adequate planning of a partial denture requires an understanding of the forces generated during mastication and their distribution to supporting structures. If definite principles are followed when planning and constructing the prosthesis, it functions so that the stresses it produces are safely within the range of tissue tolerance, thus enabling it to contribute to periodontal health. Several long-term clinical studies have shown that correctly designed removable partial dentures do not have any detrimental effects on abutment teeth (8-10). However, some investigations have shown that a higher level of oral hygiene is

needed for removable partial denture patients and that the denture design should be as simple as possible, covering only the essential hard and soft tissues (11). There was a strong correlation between the presence of local pathologic alterations accompanying the use of partial dentures and poor oral hygiene.

The distal extension removable partial denture does not have advantages over tooth support, since the residual ridge must be used for both support and retention. Biomechanically, a partial denture is a prosthetic restoration that derives its support principally from the tissues underlying its base, and only to a minor degree from the abutments. The distal extension removable partial denture has a tendency for lateral movement during function. Moderate intermittent forces exerted on the bony ridge by a prosthesis may be stimulating and help preserve, rather than destroy, the bony ridge (12). On the other hand, excessive force causes resorption of the residual ridge (13). As the ridges resorb and tissue contact is lost, the result is a tissueward migration of the denture bases. It is assumed that horizontal and lateral stress on abutment teeth may cause, or favor, the breakdown of periodontal structures and increase tooth mobility.

Therefore, the aim of this clinical study was to evaluate the effects of removable partial dentures on the support tissues and the changes occurring in lower tooth-supported and bilateral distal-extension dentures, 5 years after placement. These changes included tooth mobility, prevalence of caries, fracture of the abutment teeth, fracture and/or deformation of the removable partial denture components and stability of the denture base.

Materials and Methods

Selection of patients

The study population comprised 75 patients who, between March and December 2007, were fitted with complete upper and lower removable partial dentures. The mean age of the patients was 68.6 years and none had general health complications. Two types of arch were selected for this investigation: a bilateral edentulous area with abutment corresponding to the first premolar and second molar on each side (Kennedy Class III, mod. 1) and a bilateral distally extended lower with six natural anterior teeth (Kennedy Class I). For the abutments of tooth-supported removable partial dentures, a clasp design with a cast circumferential buccal retentive arm, a rigid reciprocal clasp arm and a rest adjacent to the edentulous ridges was selected (Group 1). In cases with bilateral distal-extension, a clasp design including the T clasp of a Roach retentive arm, a rigid reciprocal arm and a mesial rest were used (Group 2). The undercuts engaged by the retentive arms were limited to 0.25 mm. The framework casts were made in cobalt-chrome alloy (Wironit - Bego - Bremer Goldschlägerei Wilh. Herbst GmbH & Co., Bremen, Germany). All biological and mechanical principles of removable partial denture design and construction were followed to minimize the forces transmitted to the supporting tissues or to decrease the movement of the prostheses in relation to them. The altered-cast impression technique was used to provide adequate support. Acrylic resin anatomic posterior teeth were set in balanced occlusion and the denture bases were constructed in acrylic resin. Prior to prosthetic treatment, all the other necessary dental treatments such as periodontal and restorative were carried out. Prosthodontic and periodontal data were recorded immediately after insertion of the partial dentures (baseline). On examination of these patients, each abutment tooth was evaluated for the presence of mobility and caries. The mobility was rated from 0 (76% in Group 1 and 68% in Group 2) to 1 (24% in Group 1 and 32% in Group 2) and none of the abutments presented carious lesions. Oral examinations were carried out by one of two previously calibrated clinicians whose inter- and intra-examiner variability was not significant. All dentures were seated in the mouth before the start of the experiment and checked for accuracy of fit and stability. Some adjustments were made, and affected areas were polished. Patients received oral hygiene instructions and a self-educational manual. Oral instructions included mechanical tooth cleaning three times daily using a soft toothbrush, interproximal flossing and interspace toothbrushing. The cleaning of removable dentures included mechanical cleaning with a soft toothbrush and dentifrice. After 5 years, all patients were contacted either by mail or telephone. Each patient was offered a free examination if they participated in the study, but only 53 of them attended (70 per cent of the original sample). The study was approved by the Human Research Ethics Committee of Araraquara Dental School, and informed consent was obtained from each patient.

Clinical measurement parameters

The parameters listed below were carefully recorded at the baseline and five years after the prostheses had been inserted:

1) Tooth mobility: the abutment tooth mobility was graded clinically by placing a tooth between two metal instrument handles and moving the tooth in as many directions as possible. The following scores were used: (0) no mobility, (1) < 1 mm movement in the horizontal plane, (2) > 1 mm movement in the horizontal plane, (3)

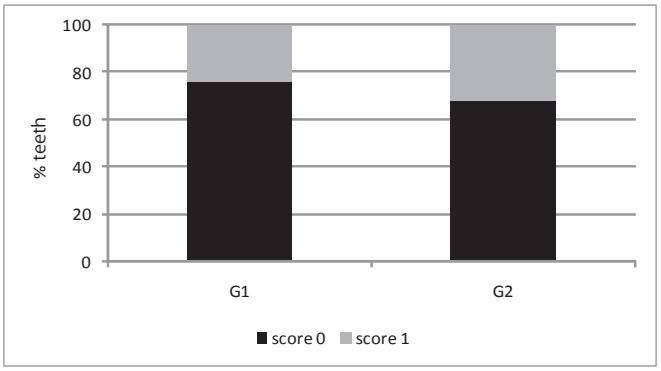

Fig. 1 Degree of mobility of removable partial denture abutment teeth at the baseline..

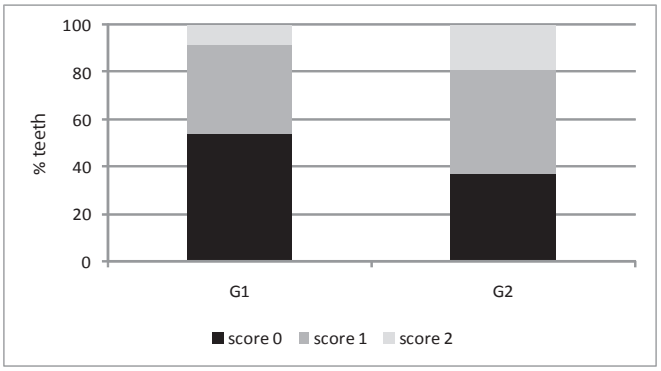

Fig. 2 Degree of mobility of removable partial denture abutment teeth after 5 years.

movement in an apical direction.

2) Prevalence of caries: the presence or absence of pit and fissure caries was determined with a mirror and explorer. The clinical examination was supplemented by intra-oral radiographs to detect interproximal and recurrent caries. The radiographic examination evaluated the caries status by means of interproximal bitewing radiographs.

3) Abutment loss: abutment tooth losses and extractions were evaluated, based on data collected at the baseline.

4) Fracture of the abutment teeth: fracture of the abutment teeth was assessed clinically and examination was supplemented by intra-oral radiographs to detect root fractures.

5) Fracture and/or deformation of the removable partial denture components: any visible fracture in the following components was observed: rests, clasps, major connector, minor connectors, guiding planes, indirect retention, basal saddle and artificial teeth.

6) Stability of the denture base: stability was tested clinically by applying alternate finger pressure over the extension base in a tissueward direction.

Statistical analysis

Differences between the baseline and 5-year values were compared in terms of percentages. The chi-squared or Fisher test was used to examine the distribution of fracture and/or deformation of the removable partial denture components, instability of the base and prevalence of caries and fracture of the abutment teeth. Abutment mobility was evaluated using the Mann-Whitney test. Student's *t*-test was conducted to evaluate bone loss. The statistical analyses were performed at a 0.05 level of significance.

Results

Assessment of clinical parameters at the baseline

In Groups 1 and 2, most of the abutments (76% and 68%, respectively) had a score of 0 for mobility (Fig. 1). As described previously, none of the abutments showed carious lesions, or fractures of the abutment teeth and roots.

Assessment of clinical parameters in Group 1 and 2 after 5 years

Figure 2 presents data for tooth mobility. The results revealed no significant changes in tooth mobility between the groups 5 years after insertion. However, there was a decrease in the frequency of teeth with a mobility score of 0 compared to the baseline. The prevalence of caries ($P = 0.9$), fracture of the abutment teeth ($P = 0.704$) and roots ($P = 1.0$) are shown in Table 1. The results revealed no significant changes between Groups 1 and 2. There was no significant difference in the incidence of abutment loss between the groups (Table 1).

Table 2 summarizes the prevalence of fracture and/or deformation of the removable partial denture components. There were no differences in the prevalence of failure between the types of removable partial dentures (Groups 1 and 2). All the prosthesis failures were fractures, and there were no cases of deformation. The failure rate for artificial teeth was low (Table 3), being less than 5%, and there were no significant differences in incidence between Groups 1 and 2. The proportion of prostheses with instability of the base is also shown in Table 3. Although 23% of prostheses showed displacement in Group 1 and 48% did so in Group 2, the difference was not significant ($P = 0.057$).

Table 1 The prevalence of caries, abutment tooth and root fractures, and incidence of tooth loss in Groups 1 and 2

Group	Caries	Fracture	Root fracture	Abutment lost
G1 (n = 26)	12 (46%)	4 (15%)	0 (0%)	1 (4%)
G2 (n = 27)	12 (44%)	3 (11%)	0 (0%)	2 (7%)
χ^2	0.900			
Fisher		0.704	1.000	0.514

Table 2 The prevalence of removable partial denture component fractures in Groups 1 and 2

Groups	Component Fractures						
	Rest	Reciprocal clasp	Retentive clasp	Major connector	Saddle	Minor connector	Guiding plane
G1 (n = 26)	0 (0%)	2 (8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
G2 (n = 27)	0 (0%)	1 (4%)	0 (0%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)
Fisher	1.000	0.610	1.000	1.000	1.000	1.000	1.000

Table 3 The prevalence of fracture or displacement of artificial teeth and the denture base in Groups 1 and 2

Groups	Artificial teeth		Denture base	
	Fracture	Displacement	Fracture	Displacement
G1 (n = 26)	0 (0%)	1 (4)	0 (0%)	6 (23%)
G2 (n = 27)	0 (0%)	0 (0%)	0 (0%)	13 (48%)
χ^2				0.057
Fisher	1.000	0.491	1.000	

Discussion

In comparison with the baseline, the results of this study showed that values of the clinical parameters studied increased in both Groups 1 and 2, except for fracture of the root and abutment loss. Clinical findings after 5 years showed that almost half of the abutment teeth, in both groups, presented some degree of mobility. However, the present study was not designed to demonstrate any differences between the groups (extension base and tooth-supported base).

Movement of the base of an entirely tooth-borne partial denture toward the edentulous ridge is prevented primarily by rests placed on the abutment teeth located at each end of each edentulous space. As a result, rotation of the tooth-borne partial denture is relatively nonexistent. However, a slight increase of tooth mobility was noted for this group. It has been reported that tooth mobility increases during the life of removable partial dentures. This increased mobility might be attributable to the physiological aging process and concomitant changes in the periodontal structures (14). According to Svanberg et al. (15), tooth mobility may increase as a result of adaptive, non-pathological change in the absence of any inflammatory symptoms. Physiological processes of ageing with associated reduction of the periodontal tissues might possibly explain the increase of mobility in the abutment teeth.

Although no significant difference was found between the two groups, the extension-base removable partial dentures showed a tendency for abutments to have more mobility. Considering that forces directly parallel to the long axis of a tooth are better tolerated than tipping or torquing forces (16,17), changes in abutment tooth mobility with time are expected to be more pronounced in distal extension than in tooth-supported removable partial dentures. Bilateral distal extension removable partial dentures share their support between the abutment teeth and the edentulous ridge (18). Differences in resilience between these supporting elements affect the distribution of force on the abutment teeth and residual alveolar ridges. In addition, alveolar resorption is a continuous process, with resulting loss of fit in local areas (19). The fit of the denture base to the alveolar ridge declines progressively as the alveolar ridge is resorbed. The compromised fit of the denture adversely affects the retention, stability and support of the remov-

able prostheses. Consequently, this can result in mobility of abutment teeth. These results are contrary to several reports that showed moderate-to-severe damage to the periodontium (20,21). Carlsson et al. (3) also reported an increase of mobility in the abutment teeth when a partial denture (distal extension) was worn by the patient and a decrease in abutment mobility when a partial denture was not worn. When interpreting the results presented in Fig. 2, the percentage of abutments with a mobility degree of 0 was approximately 55% for Group 1 and 38% for Group 2. In addition, the great majority of the abutments in both groups exhibited a mobility degree of 0 or 1. These favorable results could be attributed to planned prosthetic treatment. Properly designed removable partial dentures may provide a homogeneous distribution of occlusal forces, create regular adaptation of periodontal tissue and a decrease in tooth mobility. The results of this study are in agreement with those of Jorge et al. (10), who found no significant changes in tooth mobility between two types of design (extension base and tooth-supported base) during six months of follow-up.

In general, in this study, the removable partial denture itself appeared to affect caries status (44% to 46%). Insertion of removable partial dentures has been shown to be associated with a quantitative increase of *Streptococcus mutans* in saliva, thereby contributing to the increased risk of caries in removable partial denture wearers (22,23). If a poor oral hygiene habit is apparent, then educational and motivational efforts to improve self-care skills are in order. A recent study demonstrated the importance of patient education, good oral self-care and regular professional recall for people who wear removable partial dentures (24).

There was no significant difference in the incidence of loss and fracture of the abutments for the two groups (Table 1). The results of this study are in agreement with Saito et al. (25), Kratochvil et al. (26) and Chandler and Brudvik (27), who reported that the incidence of abutment tooth loss with removable partial dentures was generally low. On the other hand, this finding is in contrast to the results of Vanzeveren et al. (28), who observed that the number of abutments lost was significantly higher in the presence of free-end edentulous areas as compared with bounded edentulous areas.

In this study, the incidence of fracture of the removable partial denture was less than 5% and there were no significant differences in incidence between Groups 1 and 2. Indeed, the fracture percentages of removable partial dentures can be considered low considering the high number of casting defects and inaccuracies mentioned in several studies (29). Vermeulen et al. (24) reported a fracture percentage of 17% after 5 years, increasing to 35% after 10 years. Korber et a1. (30) found a repair percentage of 40% after 5 years, of which 15% was caused exclusively by fractures of metal parts.

Because of the small number of prostheses available, the results must be judged carefully. However, the negative effects of removable partial dentures on the support tissues can be diminished by home-care procedures and professional biofilm control recall appointments.

Within the limitations of this study, it was concluded that there was no difference between the groups when evaluated in terms of tooth mobility, prevalence of caries, loss and fracture of the abutments, or damage to the components of removable partial dentures.

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