Comparison of the clinical abrasion resistance of six commercially available denture teeth

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Purpose. Clinical abrasion of denture teeth has certain implications when dentures are worn in excess of the average useful lifetime. The purpose of this study was to evaluate clinical denture tooth wear over a period of 3 years.
Material and Methods. The wear of six commercially available denture teeth (Premierdent, Acrotone, Vitapan, Rx1, Duravite, and Ivoclar Orthosit) and a seventh combination of teeth was compared. Seventy patients with complete dentures were divided into seven groups of 10 each to form the study population.
Results. There were no significant differences among the commercial denture teeth. Porcelain/Vitapan teeth exhibited the highest amount of abrasion. Significant wear was also measured between the Ivoclar Orthosit and Porcelain/Vitapan teeth. (J Prosthet Dent 1997;77:23-7.)

CLINICAL IMPLICATIONS

In this study there were significant differences among the commercial denture teeth tested over the 3-year period. Clinical abrasion of denture teeth changes the occlusal contacts and contributes to the loss of vertical height and repositioning of the mandibular jaw in relation to the maxillary jaw. Wear resistance of acrylic resin denture teeth helps maintain the registered jaw relationship and prolongs the useful lifetime of the teeth.

Clinical abrasion of denture teeth has certain implications when dentures are worn in excess of the average useful lifetime. This average lifetime is dependent on the materials that are used. Porcelain has been reported to be the most durable material,[1] whereas microfilled resin is more resistant to wear than conventional acrylic resin is. In vitro testing[2] demonstrated that a modified high-strength resin tooth was 40% to 50% stronger than conventional acrylic resin. A study[3] that compared five brands of acrylic resin teeth concluded that newer formulations with supposed increased wear did not in fact display this superiority.

The ultimate tests of abrasion resistance are how these teeth perform clinically and how the various techniques, which include biostereometric evaluation of plaster casts of the denture teeth, for measuring abrasion resistance have been reported.[4-16]

The purpose of this clinical study was to compare the wear resistance of six commercially available acrylic resin denture teeth by use of biostereometric analysis of tooth material lost during a 3-year test period.

MATERIAL AND METHODS

Six commercially available brands of denture teeth and a porcelain/polymethyl methacrylate tooth combination were used for the study. A previously published report[17] advocated the use of porcelain maxillary posterior teeth opposing mandibular acrylic resin teeth, and it was decided to include a group with this tooth combination. The brands of denture teeth were Duravite (Titan Industries, Durban, South Africa), Premierdent (Premierdent, Cape Town, South Africa), Vitapan (Vita Zahnfabrik, Badsäckingen, Germany), Ivoclar Orthosit (Ivoclar AG, Schaan, Liechtenstein), Acrotone, (Wright Health Group, Dundee, Scotland) and Rx1 (Wright Health Group).

Seventy edentulous subjects whose ages ranged from 32 to 64 years were provided with complete dentures. A shortened occlusal table was used to exclude placement of denture teeth against an inclined plane.[18]

Occlusal remounts were performed at the time of denture insertion to provide bilateral posterior contacts and freedom of anterior or lateral occlusal interferences. After a period of time was allowed for habituation in the absence of any discomfort, baseline casts were made of the mandibular teeth with a poly siloxane silicone impression material (Xpress, 3M Dental Products, St. Paul, Minn.) and improved die stone (Fuijirock G.E., G-C Dental Corp., Tokyo, Japan).[16] Three round stainless steel

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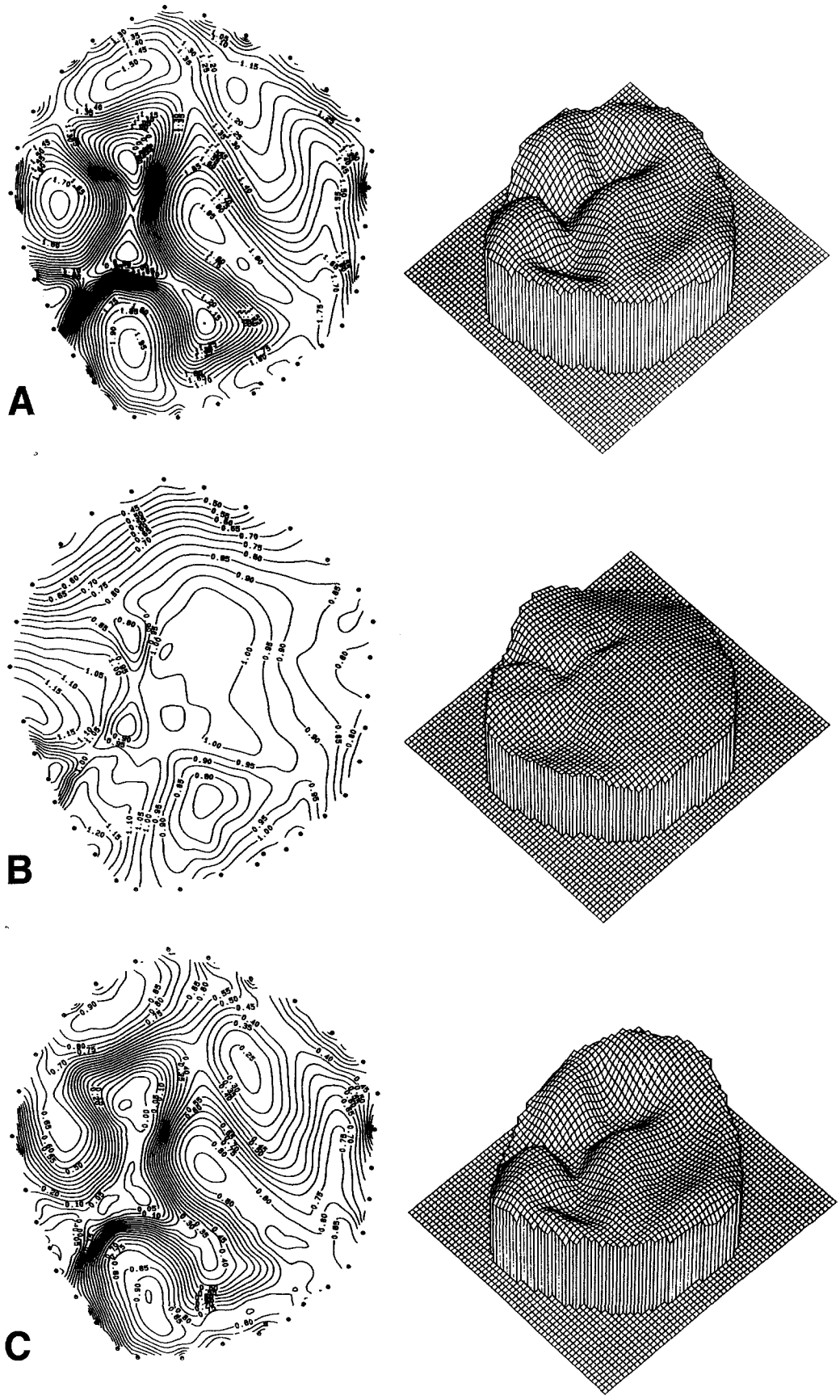

Fig. 1. *A through C,* Contour plots and three-dimensional representations of tooth surfaces for baseline (1986) and 1989 and difference between these two showing volumetric loss of tooth material over same area.

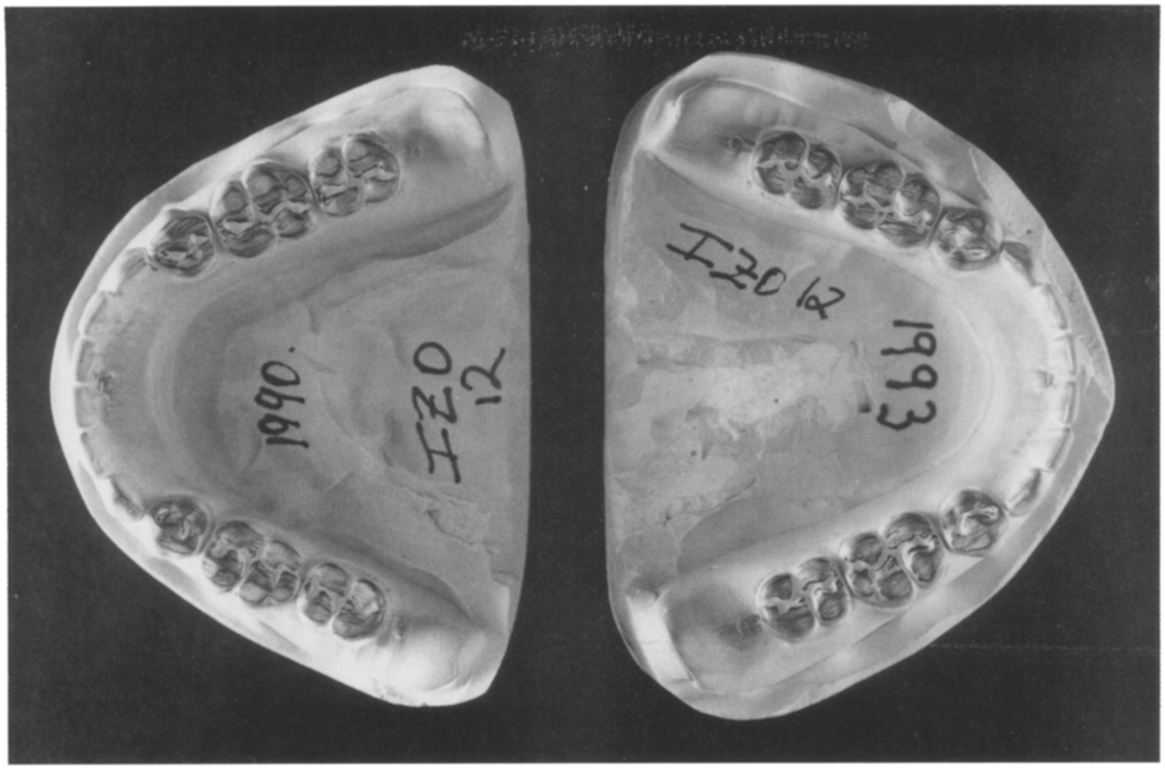

Fig. 2. Casts of baseline and 3-year follow-up of lowest degree of wear.

Fig. 3. Casts of baseline and 3-year follow-up of highest degree of wear.

metal markers were inserted in the mandibular dentures, two posterior to the molars on either side and one behind the central incisors. These markers were placed to act as baseline beacons to which the contour plots of occlusal surfaces of the mandibular teeth at the start and at the end of the study could be related.[14]

Table I. Mean abrasion (in cubic millimeters divided by square millimeters) and SD of the different denture teeth

Type	Mean	SD
Porcelain/Vitapan	0.259	0.173
Premierdent	0.242	0.148
Acrotone	0.201	0.100
Vitapan	0.169	0.114
Rx1	0.168	0.111
Duravite	0.108	0.101
Ivoclar Orthosit	0.094	0.059

Table II. Highest and lowest abrasion (in cubic millimeters divided by square millimeters) in each group

Type	Highest	Lowest
Porcelain/Vitapan	0.623	0.036
Premierdent	0.528	0.084
Acrotone	0.374	0.071
Vitapan	0.376	0.029
Rx1	0.415	0.062
Duravite	0.369	0.034
Ivoclar Orthosit	0.237	0.027

The allocation of subjects for each tooth type was randomly performed. After 3 years of denture use a second cast was made of the mandibular teeth. These casts were subjected to biostereometric analysis to determine the amount of clinical abrasion each mandibular denture had undergone during the trial period. The reflex microscope, developed by Scott, and its use for abrasion measurement has been described.[14] The accuracy of the method has been demonstrated to be ± 2 μm for the x and y coordinates and between 4 and 8 μm for the z coordinates.[15] A software program with the ability to verify the baseline markers before and after surveying was used and it ensured the repeatability of the measurements. The accuracy of the replication system of models used for the measurements has also been reported.[16] Figure 1 illustrates the computer-generated contour plots and three-dimensional images of a denture tooth that demonstrates surface changes at the beginning *(A)* and end *(B)* of the 3-year period as well as the difference between the two measurement data *(C)*.

RESULTS

Table I presents the mean abrasion (in cubic millimeters divided by square millimeters) and SD for each group of denture teeth. Table II presents data for the highest and lowest abrasion measurements found for the different denture teeth. Figures 2 and 3 illustrate the baseline casts and 3-year casts of the highest and lowest measurements of tooth abrasion.

The Tukey pairwise method of comparison revealed that the Ivoclar Orthosit teeth were significantly different ($p < 0.05$) from the porcelain/Vitapan teeth, whereas there were no statistically significant differences between Premierdent, Acrotone, Vitapan, Rx1, Duravite, and Ivoclar Orthosit teeth.

DISCUSSION

No statistically significant differences were found between the wear of the different tooth groups except for the Porcelain/Vitapan and Ivoclar Orthosit teeth. Ivoclar Orthosit teeth demonstrated the lowest degree of wear (0.094 mm^3/mm^2) followed, in order, by Duravite, Rx1, Vitapan, Acrotone, Premierdent and Porcelain/Vitapan (0.259 mm^3/mm^2) (Table I).

The denture wearers in this study represented a group of vegetable farmers with a similar diet and socioeconomic status. All the patient groups except Ivoclar Orthosit exhibited denture tooth wear of more than 0.350 mm^3/mm^2 (Table II), which could be considered clinically excessive. Figure 2 shows baseline cast and 3-year follow-up of the lowest amount of wear found (0.0265 mm^3/mm^2). Figure 3 demonstrates the highest amount of wear (0.6234 mm^3/mm^2).

Subjective evaluation of wear by independent observers revealed that five dentures made with the Porcelain Vitapan teeth exhibited excessive wear. Three dentures made with Premierdent teeth and single casts in the remaining groups with Orthosit Ivoclar teeth were the exception, where all the dentures exhibited slight wear.

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Noteworthy Abstracts of the Current Literature

The effect of speed, pressure, and time on bone temperature during the drilling of implant sites.
Brisman DL. Int J Oral Maxillofac Implants 1996;11:35-7.

Purpose. Bone necrosis may occur if bone is heated to 47° C for 1 minute. Necrosis may interfere with or prevent the osseointegration process. This in vitro study was performed to determine the effect on temperature within bone caused by changes in drilling speed and pressure.
Material and Methods. Cortical bovine femoral bone was used. Four study groups were created with various drilling speeds (1800 or 2400 rpm) and pressures (1.2 or 2.4 kg). External irrigation was conducted during preparation of 7 mm osteotomy sites by use of new 2 mm pilot, 2.5 mm spade, and 3.25 mm spade drills. Temperature was recorded with a shielded thermocouple positioned 0.5 mm from and parallel to the preparation sites. Drilling time and time to reach maximum temperature were recorded.
Results. Bone preparation required significantly less time when high speed (2400 rpm) and high pressure (2.4 kg) were applied. No significant differences in preparation time were seen with other combinations of speed and pressure. Temperatures achieved with the three different burs did not demonstrate a significant difference between the low speed/low pressure and high speed/high pressure combinations. The combinations of increased pressure with low speed or increased speed with low pressure resulted in significantly increased heat.
Conclusion. Excesssive heat generation may be avoided by using low drilling speed and pressure. Efficient drilling may not always be possible with this combination, resulting in increased pressure when dense bone is encountered. If pressure is increased, it should be associated with an increase in drilling speed to prevent excessive heat generation through a more efficient drilling process. *10 References. SE Eckert*