A 15-year clinical evaluation of fixed prosthodontics

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The purpose of the present study was to examine failures of fixed prosthodontics during a period of 15 years and to evaluate the quality of those bridges remaining after this period of time. The study group consisted of 102 patients who received 108 bridges made by the senior students at the Dental Faculty, University of Oslo, in 1967/68. All bridges were made of type-3 casting gold and heat-cured acrylic veneering. The mean age of the patients at the beginning of the study was 48 years. Of the original group of 102 patients, 88 attended the clinical examination after 5 years, 71 after 10 years, and 55 after 15 years. Of the 343 abutment teeth 25% were root-filled and restored with post and core. During the 15 years' observation period 26 bridges were lost or had to be remade because of failures. The mean time of service for these bridges were 10.5 years. The failure rate was 4% after 5 years, 12% after 10 years and 32% after 15 years. A modification of the CDA rating system was used for evaluation of the clinical quality of the restorations after 15 years. Between 5% and 14% of the units were recorded as 'not acceptable' for the different characteristics evaluated. □ *Clinical study; failure; fixed partial dentures; quality*

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Restoring and replacing teeth with fixed prosthodontics still represent major activities of the dental profession, mainly because of the high prevalence of caries and periodontitis experienced by the adult and elderly population. Despite a generally declining caries incidence in industrialized countries, this tendency is likely to remain in the foreseeable future in these countries.

Dental bridges may fail for various reasons, including material wear with time. It is therefore of interest for the patient, the dental profession, and the health authorities to be able to estimate the longevity of this type of dental restoration. Several authors have reported on the frequency and reasons for failures and then estimated the life span of fixed partial dentures (1–10). The quality of fixed prosthodontics has also been examined in longitudinal studies by some authors (11, 12).

Kantorowicz (1) reexamined 149 bridges made in 138 patients, cemented by the teaching staff and students in the period 1959–65. The mean age of the bridges in this study was 3.3 years. During this period 15% of the bridges had failed, and the main reason for failure was caries. Caries as the main reason for 'unserviceable' crowns and bridges has also been reported by others (3, 6, 8). Schwartz et al. (3) examined the reasons for crown and bridge failure in patients who attended a dental school clinic in 1964–67. During this period 406 patients were registered, with 721 'unserviceable' single crowns and retainers. The mean life span for restorations registered as 'unserviceable' was found to be 10.3 years. Caries accounted for 37% of the failures and insufficient retention for 12%. However, failures caused by caries occurred on an average after 11.1 years, compared with a life span of only 6.8 years for crowns with insufficient retention.

Glantz et al. (11) examined the quality of fixed partial dentures after 5 years, using the CDA quality-evaluating system (13, 14). They rated 90% of the restorations as satisfactory. Few studies have, however, been done on the failure and quality of fixed partial dentures in patients who have been receiving regular oral hygiene checks (15, 16).

The purpose of this study was, in a group of patients, to (1) examine failures of fixed

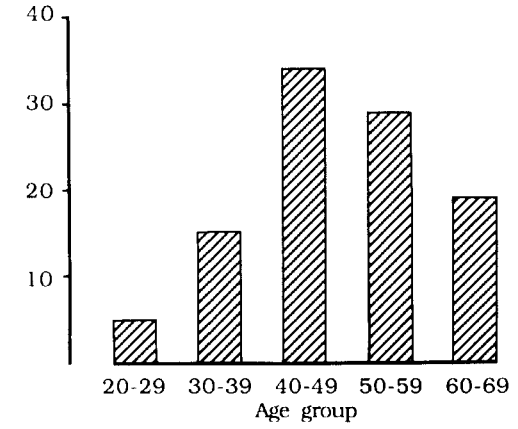

Fig. 1. Age distribution of patients at the basis observation.

partial dentures during a period of 15 years, and (2) evaluate the clinical quality of the restorations remaining after this period of time.

Materials and methods

The study group consisted of 102 patients (73 women and 29 men) after exclusion of those patients who could foresee that they would not be able to attend reexamination after 5 years and those who were more than 70 years old. The age distribution of the patients at the beginning of the study is shown in Fig. 1. The youngest patient was 25 years and the oldest 69 years, and the mean age was 48 years. The patients received 108 bridges, including 343 retainers and 259 pontics. Eighty-nine of the bridges were made for the maxilla and 19 for the mandible. Seventy-seven per cent of the retainers were made in gold–acrylic, 12% were partial crowns, and 11% were full crowns in gold. Of all the 343 abutment teeth

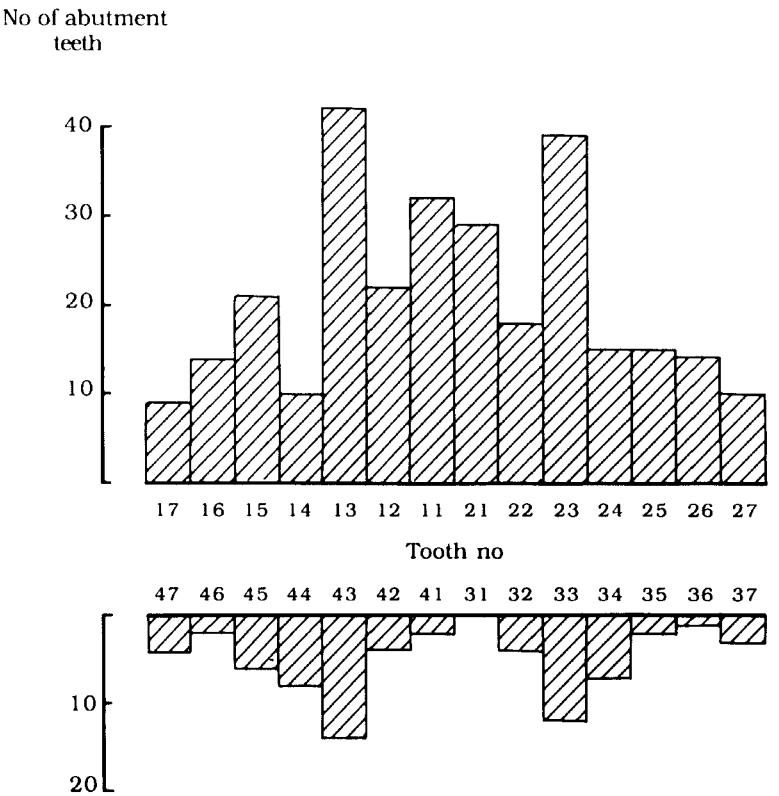

Fig. 2. Number and location of abutment teeth in 102 patients at the basis observation.

Table 1. Number of patients, bridges, and abutments and ratio of abutment to pontic at the different times of examination

No. of years	No. of patients	No. of bridges	No. of abutments	Ratio of abutment to pontic
Basis observation	102	108	343	1.3:1
5th year	88	92	282	1.3:1
10th year	71	77	236	1.3:1
15th year	55	59	187	1.2:1

25% were root-filled and restored with post and core made in type-3 casting gold. The location of the abutment teeth at the initial observation is shown in Fig. 2.

The bridges were made by the senior students at the Dental Faculty, University of Oslo, in the academic year 1967/68. Before the prosthodontic treatment the patients received periodontal treatment including motivation, instruction in oral hygiene, and scaling. Periodontal surgery was also received by 32 of the patients before the prosthodontic treatment.

All bridges were made of type-3 casting gold (Gamma gold, K. A. Rasmussen, Hamar, Norway) and heat-cured acrylic veneering (Hue-lone, L. D. Chaulk Co., Toronto, Canada) and cemented with zinc phosphate cement (de Trey Zinc Phosphate Cement), following standard procedure. All the bridges were made at the same dental laboratory (A/S Dental-laboratoriet, Oslo, Norway), using the same type of material and the same technique.

Table 1 shows the number of patients, bridges, abutments and the ratio of abutments to pontics at the initiation of the study and at the different observation periods. The bridges examined at the different observation periods are shown in Table 2. About half of the restorations were three- and four-unit bridges. Most of the bridges were made for the front of the upper jaw. The ratio of retainers to pontics was 1.3 to 1 at the initial observation and 1.2 to 1 at the 15-year examination (Table 1).

During the first 10 years the patients received oral hygiene prophylaxis by a dental hygienist every 6 months, and a clinical examination was done once a year by me. Intra-oral roentgenograms were taken of all patients before the treatment started, after cementation, and after 5, 10, and 15 years. Failure of bridges requiring removal or replacement was recorded during the observation period. The data related to periodontal condition, caries lesions, changes in bone level, and root-filled teeth will be published separately.

The clinical evaluation of the quality of the bridges in those patients who attended the reexamination after 15 years was done with a modification of the California Dental Association (CDA) Evaluation System for Dental Care (17). I underwent calibration during a 2-day seminar in 1983 and made all

Table 2. Number of bridges by size at the different observation periods

		No. of bridges				
	No. of patients	2–4 units	5–7 units	8–10 units	11–14 units	Total
Initial observation	102	59	25	11	13	108
5th year	88	48	23	9	12	92
10th year	71	41	17	7	12	77
15th year	55	28	16	6	9	59

Table 3. Reasons for not attending the clinical examination at the different observation periods

Reasons	No. of patients			
	5th year	10th year	15th year	Total
Died	4	4	8	
Illness		2		
Moved	5	2		
Not interested		2		
No response	1		3	
Bridge failure	4	7	5	
Total	14	17	16	47

the recordings. The following four characteristics were evaluated: color, surface structure, shape, and margin integrity. In this rating system *R* represents range of excellence, *S* represents range of acceptability, *T* represents replace or correct for prevention, and *V* represents replacement or removal. Color, surface structure, shape (anatomic form), and margin integrity were evaluated for each unit and given the score of the worst surfaces examined. When evaluating color, surface structure, and shape, only the units with acrylic veneering were included. When recording the marginal integrity, all the abutment teeth were included.

Results

The reasons for not attending the examinations are listed in Table 3. An additional 10 bridges had to be remade among those patients who attended the 15-year clinical examination.

During and including the 15-year observation 26 bridges had been lost or had to be remade because of failure, and the mean time of service for these bridges was 10.5 years. The reasons for the failures are indicated in Table 4. The patients who did not attend the different examinations, except for those with bridge failures, were not included in this estimate. Insufficient retention, caries, and esthetics were the commonest reasons for failures. The mean time of service for those bridges registered as failure because of insufficient retention was 9 years, whereas those that failed because of caries or for esthetic reasons had served an average of 12 and 14 years, respectively.

Replacements for esthetic reasons included wear, discoloration of the acrylic facing, and retraction of the gingiva.

The results of the CDA rating after 15 years is shown in Table 5. Between 86% and 94% of the units were given scores of *R* or *S*

Table 4. Reasons for failure of fixed bridges during a period of 15 years

Reasons	No. of bridges			
	0–5 years	6–10 years	11–15 years	Total
Insufficient retention	2	2	3	7
Caries		1	4	5
Perio./mobility			2	2
Fracture of root	2	1		3
Fracture of material		1		1
Esthetics			6	6
Unknown		2		2
Total	4	7	15	26

Table 5. Quality of bridges after 15 years of use in accordance with the CDA rating system

	No. of units	Score (%)			
		R	*S*	*T*	*V*
Color	294	20	66	13	1
Surface	294	45	49	4	1
Shape	294	58	36	4	3
Margin	187	50	41	5	5

(satisfactory) for the different characteristics evaluated.

Discussion

Analyses of failures and deterioration of dental restoration are important to ascertain what might improve clinical procedures and also for the selection of materials. From the available data on the longevity of fixed prosthodontics there is variation both in the manner in which the data are collected and in the results. This is to be expected, since the information is collected at different times during the past two to three decades and since the availability for treatment, the materials used, the economic situation, and the interest in dental care have changed during this period of time.

The patients included in this study were regular patients seeking treatment at a dental school. The adult population in Norway has to pay the full cost for dental treatment at a regular rate. However, the treatment at the Dental School is subsidized so that the cost is reduced by 40–60%, and this is probably the main reason for most of them to seek treatment there. Most patients in this study belonged to the middle- and low-income groups, and women and pensioners are overrepresented. The age and sex distributions were about the same as for all patients who had fixed prosthodontics made at the same department in the period 1967–73 (18) and in public and private clinics in Scandinavia (11, 12, 15). The effect of selection bias due to absentees is considered to be small in this study, and there is no reason to suspect that the present group of patients should differ essentially from other patients receiving treatment in the department at that time (18).

Only a few studies have been carried out on dental school patients examining the longevity and failures of fixed partial dentures (1, 3, 15), and there is hardly any study in which data were collected for such restorations placed by dental students. It might be argued that dental students are inexperienced in advanced clinical work. However, every step during the treatment had to be checked and accepted by an experienced teacher, and there is no reason to believe that the treatment on an average was of a lower quality than what patients would receive in general practice (3, 5, 6).

The mean time of service for the bridges that failed was about the same as observed by Schwartz et al. (3) and Kerschbaum et al. (6). The patients included in their studies were, however, 10 to 15 years younger than the patients in the present study. The age distribution of the patients and the results agree with those reported by Karlsson (12), who examined fixed bridges made by general practitioners in a major community in Sweden.

Bridges with heat-cured acrylic facing were generally used for fixed bridges at the time when the treatment was done, whereas porcelain bound to metal was used for single crowns (18). The bridges included in this study were checked and accepted by me before the cementation, and the oral hygiene and periodontal condition were registered (19). Since the bridges also were made at the same dental laboratory, one would assume that the quality and the dimensions of the material would be of the same standard for all bridges.

Tooth-colored polymeric restorative material for veneering of crowns has been criticized for its lack of color stability and resistance against wear (20, 21). When the color of the acrylic facings was evaluated after 15 years, only 14% of the units were recorded as 'not acceptable', which seems to be a reasonable percentage for this type of material. The chemical and light-cured composite resins have not yet been found to have a better color stability than the conventional heat-cured veneer material (21). However, the resistance against wear for the heat-cured material is less than that of porcelain. Most of the *T* and *V* ratings for margins were given because of secondary caries or wear of the root apical to the crown margin.

A bridge that has served for 15 years may not rightly be called a failure, since the quality of the abutment teeth, the oral condition, and the patient's health will, among many other conditions, to a large extent influence the longevity of a dental restoration. How-

ever, to reduce the problems of periodontitis and caries among patients who receive fixed prosthodontics, it is important that an optimal program for prophylactic dentistry procedures be instituted for these patients. The use of fluoride as a prophylactic measure towards root caries has also been demonstrated to be effective and should therefore be strongly recommended for these patients (22, 23).

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References

1. Kantorowicz GF. Bridges, an analysis of failures. Dent Pract 1968;5:176–8.
2. Roberts DH. The failure of retainers in bridge prostheses. An analysis of 2000 retainers. Br Dent J 1970;128:117–24.
3. Schwartz NL, Whitsett LD, Berry TG, Steward JL. Unserviceable crowns and fixed partial dentures: life-span and causes for loss of serviceability. J Am Dent Assoc 1970;81:1396–1401.
4. Reuter JE, Brose MO. Failures in full crown retained dental bridges. Br Dent J 1984;157:61–3.
5. Leempoel PJB, Eschen S, De Haan AFJ, Van'T Hof MA. An evaluation of crowns and bridges in a general dental practice. J Oral Rehabil 1985;12: 515–28.
6. Kerschbaum T, Voss R, Thie BM. Kronen und Brückenzahnersatz. Eine Erhebung über den Funktionsverlust in Klinik und Praxis. ZWR 1986;95: 494–509.
7. Margniuk GA, Kaplan SH. Longevity of restorations: survey results of dentists' estimates and attitudes. J Am Dent Assoc 1986;112:39–45.
8. Randow K. On the functional deformation of extensive fixed partial dentures. An experimental clinical and epidemiological study. Swed Dent J 1986; 13(suppl 34).
9. Walton JN, Gardner FM, Agar JR. A survey of crown and fixed partial denture failures: length of service and reasons for replacement. J Prosthet Dent 1986;56:416–21.
10. Karlson S. Failures and length of service in fixed prosthodontics after long-term function. A longitudinal clinical study. Swed Dent J 1989;13:185–92.
11. Glantz P-O, Ryge G, Jendresen MD, Nilner K. Quality of extensive fixed prosthodontics after five years. J Prosthet Dent 1984;52:475–8.
12. Karlsson S. A clinical evaluation of fixed bridges, 10 years following insertion. J Oral Rehabil 1986;13:423–32.
13. Ryge G, Snyder M. Evaluating the clinical quality of restorations. J Am Dent Assoc 1973;87:369–77.
14. Ryge G, Jendresen MD, Glantz P-O, Mjør I. Standardization of clinical investigators for studies of restorative materials. Swed Dent J 1981;5:235–9.
15. Nyman S, Lindhe J. A longitudinal study of combined periodontal and prosthetic treatment of patients with advanced periodontal disease. J Periodontol 1979;50:163–9.
16. Bentley C. Longevity of restorations in a dental school clinic. J Dent Educ 1986;50:594–600.
17. California Dental Association CDA Quality Evaluation for Dental Care. Guidelines for the assessment of clinical quality and professional performance. Los Angeles: The Californian Dental Association, 1977.
18. Valderhaug J, Karlsen K. Frequency and location of artificial crowns and fixed partial dentures constructed at a dental school. J Oral Rehabil 1976; 3:75–81.
19. Valderhaug J. Periodontal conditions and carious lesions following the insertion of fixed prostheses: a 10-year follow-up study. Int Dent J 1980;30:296–304.
20. Ekfeldt A. Incisal and occlusal tooth wear and wear of some prosthodontic materials. An epidemiological and clinical study. Swed Dent J 1989; 16(suppl 65).
21. Ruyter IE, Nilner K, Møller B. Color stability of dental composite resin materials for crown and bridge veneers. Dent Mater 1987;3:246–51.
22. Saxegaard E, Valderhaug J, Rølla G. Deposition of fluoride on dentine and cementum after topical application of 2% NaF. In: Thylstrup A, Leach SA, Qvist V, eds. Dentine and dentine reactions in the oral cavity. Oxford, England: IRL Press Ltd, 1989:199–206.
23. Øgaard B, Arends J, Rølla G. Action of fluoride on initiation of early root surface caries in vivo. Caries Res 1990;24:142–4.

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