From the Department of Prosthetic Dentistry,
(Head: Professor *Björn Hedegård*,
D. Odont.)
the Royal Schools of Dentistry Stockholm and Umeå, Sweden.

STUDIES IN PARTIAL DENTAL PROSTHESIS. II

AN INVESTIGATION OF MANDIBULAR PARTIAL DENTURES WITH DOUBLE EXTENSION SADDLES*

by

GUNNAR E. CARLSSON
BJÖRN HEDEGÅRD
KALERVO K. KOIVUMAA

INTRODUCTION

The prosthetic reconstruction in cases with posteriorly lost teeth (Kennedy Class I) presents intricate and difficult problems to the prosthodontist. Unfortunately, the use of bridgework — proved to be the most suitable reconstructive replacement from most points of view — is highly limited in such cases. Instead, various types of removable appliances have to be utilized.

The main problem facing the prosthodontist in such cases is how to distribute the masticatory stresses on the denture between the two supporting tissue structures, the tooth with its periodontal structures and the edentulous area. The periodontium can withstand heavy forces in axial directions without any damaging effect, while considerably smaller lateral forces on the teeth may cause periodontal breakdown as has been shown in experimental studies on animals as well as in clinical studies

* Financial aid was obtained in the form of a grant from Sigrid Juselius' Foundation, Finland.

(*Hildebrand* 1937, 1956; *Kronfeld* 1931, 1940; *Orban* 1928, *Bhaskar & Orban* 1955, *Wentz et al.* 1958). The alveolar bone is considered to be able to withstand stress more easily in the form of tension than as pressure.

The inevitable difference in resilience between the mucosa covering the edentulous alveolar ridge and the periodontal structures of the teeth is the main problem, and will cause the dentogingivally supported denture to rotate around an axis through the hindmost occlusal rests when stress is placed upon the saddle parts. Such a rotation may induce unfavourable horizontal and sheering forces on the abutment teeth.

The dental literature presents a rich variety of constructions of partial dentures. Many authors try to solve the problem of stress distribution due to the said difference in resilience of the abovementioned tissues. According to their opinions, these authors can grossly be divided into two groups, viz.

(1) those who prefer a rigid connection between the retentive elements and the saddles and

(2) those who prefer stress-breaking connection between the two parts.

The advocates of the rigid appliance hold the view that this type of dentures makes possible a broader distribution of stresses upon the denture onto remaining teeth and edentulous ridges. Experimental studies have proved that a more even distribution of horizontal forces on the natural teeth can be obtained through the use of as many of the teeth as possible as direct or indirect abutments and through keeping the connection rigid between retentive and saddle parts. (*Frechette* 1956, *Kaires* 1956, 1958; *Weinberg* 1956).

The followers of the stress-breaking theory claim that there is necessity of a stress-breaking device between the retaining elements and the saddles due to the difference in compressibility of the supporting tissues under stress. A device of such design compensating for the difference is that of *Steiger,* 1952. A resilient connection would allow for the saddles to sink when under load without unfavourable forces on the abutment teeth. Several complicated types of construction with resilient joints have been proposed by Swiss schools (e.g. *Müller* 1948, *Biaggi-Elbrecht* 1951,

Steiger 1952), while others prefer more simple types of resilient connections (*Hirschtritt* 1957, *Jones* 1952, *Neill* 1958, *Wilson* 1955).

Yet other authors have use for both types of construction; the appliance of preference depending on the individual case. Thus for instance *Osborne & Lammie* (1954) propose stress-breaking in cases with long saddles and periodontally impaired remaining teeth. *Spreng* (1956) who strongly advocates rigid partial dentures recommends, however, a resilient connection between skeleton and saddles where the soft denture-supporting tissues are highly compressable.

In spite of the many suggestions to solve the problems of partial dentures of the double extension saddle type through numerous designs and in spite of the intense discussions in the literature concerning the superiority of the different methods, clinical research reports supporting the individual statements are very rare, and comparative investigations on various partial denture designs still remain to be published.

Those few clinical longitudinal and follow-up investigations that present material and methods of investigation correctly, give evidence of local tissue injury following wearing of partial dentures. Mostly the periodontal tissues are traumatized, and the changes can mainly be seen as gingival inflammations and retraction of the gingiva, but also as increased mobility of abutment teeth (*Anderson & Lammie* 1952, *Koivumaa* 1956, *Reichenbach & Kirchner* 1952, *Wannenmacher* 1954). Inflammatory reactions of the mucosa supporting the denture base as well as resorptive changes of the edentulous alveolar ridge are fairly often seen (*Koivumaa,* 1956). Carious lesions of the tooth surfaces in contact with the dentures are not uncommon.

Injuries of the abovementioned types are reported mainly associated with simple, mostly gingivally supported partial dentures, while the dental literature gives an impression of a far less damaging effect from more complicated dento-gingivally supported partial dentures, although factual data are lacking.

In a longitudinal investigation of dento-gingivally supported partial dentures, the present authors (*Koivumaa, Hedegård, Carlsson* 1960) observed, however, that fairly extensive local tissue injuries appear already after so short an observation period

as one year. The 108 partial dentures observed represent various types of dento-gingivally supported design. From this point of view the material can be considered fairly heterogeneous and the investigation should therefore be looked upon as an extensive pilot study with the aim of searching information about types and location of tissue changes associated with the denture. Many factors could not be systematically accounted for in the abovementioned report, such as the influence of various denture designs, of the number of remaining teeth, the classification according to Kennedy etc. It would therefore be of interest to analyse a more homogeneous material in order to find out if definite information could be obtained, as in the former material the heterogeneity might have masked the influence of factors of importance. As dentures of the double free-end type present the most difficult problems, a closer study of a patient material consisting solely of such cases would be of interest.

The data in our original study comprises a fairly large number of cases fitted with mandibular partial dentures of the double extension saddle type (Kennedy Class I with or without modifications). Most of them were also fitted with full maxillary dentures during the same period of treatment. As these cases — fitted with full upper and partial lower dentures — form an homogeneous group from the point of view of partial denture design as well as masticatory stresses and original occlusion and articulation contact, they form an ideal group for further analyses. The present paper accounts for the latter study material.

PRESENT STUDY

Material

The patient material for the present study consists of 54 persons in good health, who had been provided with full maxillary dentures and mandibular partial dentures of the double extension type at the Royal School of Dentistry, Umeå, Sweden, during the period March to June 1959.

The collecting of the patients, their treatment and the principles followed in construction of the partial dentures are accounted for in detail in the *Proceedings of the Finnish Dental*

Association (Suomen Hammaslääkäriseuran Toimituksia) 1960 by the present authors in "Studies in Partial Dental Prosthesis. I".

In June of 1960, that is to say 12—15 months after completion of the prosthetic treatment, all patients were recalled for re-examination. Forty-eight (90 %) appeared for this examination. Four of the six patients who did not appear, contacted the school and explained why they did not come; one was ill during the re-examination, one was temporarily away, one could not attend because of his work, and one informed us that she had had all her teeth extracted in the meantime. The remaining two patients could not be contacted.

Twenty-two of the re-examined patients were women and twenty-six were men. The mean age was 48 years, 46 years being the mean for the females and 49 years for the males. The distribution by age and sex is given in Table 1.

Table 1

Distribution of re-examined series of patients by age and sex.

Age group Years	Males	Females	Total	
			N	%
—29	1	1	2	4
30—39	4	5	9	19
40—49	10	9	19	40
50—59	5	4	9	19
60—	6	3	9	19
Total	26	22	48	100

The 48 re-examined partial dentures were all dento-gingivally supported, i.e. supported by the teeth by means of occlusal rests, continuous clasps etc. and by edentulous alveolar ridges through the saddle base. The specific construction varied slightly with the individual case. Thirty-two of the dentures were pure free-end appliances, i.e. without any modifications. The remaining sixteen dentures were constructed with one or two additional bounded saddles (Kennedy Class I modifications 1 and 2). The distribution of the types of dentures and the patients wearing habits are accounted for in Table 2.

Table 2

Distribution of partial denture type within the patient material and of denture wearing habits.

Dentures worn	Kennedy Class I				Kennedy Class I mod.				Total	
	Males	Females	Total		Males	Females	Total			
	N	N	N	%	N	N	N	%	N	%
All the time	7	7	14	44	10	3	13	81	27	56
Day time ..	1	6	7	22	1	2	3	19	10	21
Never	7	4	11	34	—	—	—	—	11	23
Total	15	17	32	100	11	5	16	100	48	100

Of the 16 dentures with bounded saddles 12 had one and 4 had two such saddles. In 12 of these 16 dentures the bounded saddle replaced one or more lower incisors. This might be the real explanation for the fact that all of the modified partial dentures were worn, while 34 % of the pure free-end saddle dentures were not used by the patients. Lost incisors are naturally a serious esthetic disadvantage, and it seems obvious that patients fitted with dentures replacing front teeth have greater patience in enduring the initial discomforts and thus in getting used to the new appliance than have partial denture patients with all natural front teeth left.

The distribution of the partial dentures according to the denture materials used is accounted for in Table 3.

Table 3

Distribution of dentures according to type (Kennedy Classification) and denture material.

Denture material	Dentures worn		Dentures not worn		Total
	Kennedy I°	Kennedy I$^{mod.}$	Kennedy I°	Kennedy $^{mod.}$	
Cast cobalt-chromium skeleton; acrylic saddle base	18	9	10	—	37
Clasps and bars in wrought alloy; acrylic denture base	3	7	1	—	11
Total	21	16	11	—	48

The denture skeletons cast in cobalt-chronium alloy were all made at a laboratory in Stockholm certified by Austenal, and thus the alloy used was Austenal Vitallium®. All the skeletal dentures were constructed so that relining and rebasing could be carried out. Clasps and bars in wrought alloy (stainless steel and wrought gold alloy wires) were manufactured in the Umeå Dental School by skilled technicians. All the acrylic work in the appliances was done by the same technicians in the laboratory of the School. The acrylic material Stellon (Amalgamated Dental Co., London) was used throughout. From a technical point of view the partial dentures in the present series can therefore be considered as being equal to those used in routine clinical work in the Scandinavian countries.

In the present series of cases, the average numbers of remaining teeth in the denture-fitted lower jaw were as follows,

	Denture-wearers	Non-denture-wearers
Average number of mandibular teeth	6.5	8.0

The teeth examined were divided into three groups, viz. direct abutment teeth, indirect abutment teeth, and other teeth. The average numbers of mandibular teeth in these groups were as follows,

	Abutment teeth	Indirect abutment teeth	Other teeth
Denture-wearers	2.5	3.1	0.9
Non-denture-wearers	2.1	5.2	0.5

(In the group of non denture-wearers the corresponding classifications of remaining teeth were used although the teeth were not actually serving as "direct" or "indirect" abutments.)

Methods of investigation

The choice of the methods of investigation, their description in detail and the conduct of the investigation are fully accounted for in the aforementioned publication. A short summary will be given here.

In the present paper the investigation will be restricted to certain clinical observations which are deemed important to the clinician.

On the completion of the patient's treatment the primary ex-

amination was carried out. The re-examination took place at the School one year later by the same two observers that carried out the primary registrations.

In addition to the effect of oral hygiene, special attention was given to the periodontal tissues. In assessing the condition of those tissues, tooth mobility, the exposure of the cemento-enamel junction, the depth of the gingival pocket and the condition of the gingival margin were considered as being valuable objects of study. Evaluation of the state of the oral mucosa supporting and surrounding the denture was also incorporated in the study as an important observation. Furthermore, obvious carious lesions on abutment and other teeth were recorded.

To enable correlation of the findings of tissue changes with changes in the function of the denture, and to obtain an idea of the changes in the denture itself, its fit to the supporting tissues, its occlusion contact and articulation, as well as its stability and retention, were regarded as essential points and thus objects for examination. In addition, any gross deficiencies such as obvious deformations, fractures, and breakage were noted.

Record was also made of the patient's opinions of the comfort and function of the denture.

The checking of the reliability of the observations through double determinations proved the errors of the classification system to be of so small a magnitude, that the data obtained at the clinical examinations could be deemed sufficiently accurate and reliable for the purpose of the present investigation.

In the statistical treatment of results recorded, the methods and formulae accounted for in the paper previously mentioned have been adopted for the present study also.

Results

The results of the investigation are presented in Tables 4—9 and in Figs. 1 and 2.

Observations on the oral tissues

Mobility of the Teeth (Table 4, Fig. 1)

On initial examination, 9—13 per cent of the abutment teeth and 20 per cent of the indirect abutment teeth were found to be mobile.

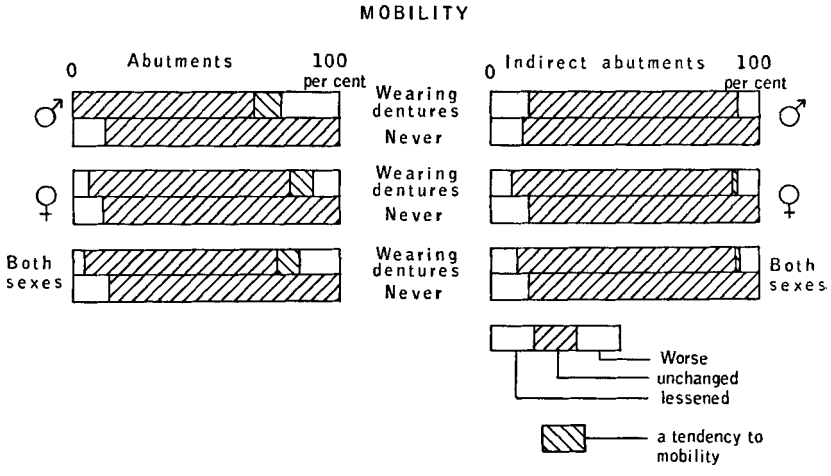

Fig. 1.

Table 4

Distribution of the material according to the trend of the change occuring in the mobility of the teeth after one year.

Sex	Dentures worn	Number of cases	Number of teeth			Mobility of teeth (per cent of cases)								
						Abutments			Indir. abut.			Other teeth		
			A	In	O	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased
Males	worn	19	47	59	11	21^{11}	67	0	7	79	14	0	100	0
Females	worn	18	50	57	21	10^{8}	76	6	7^{2}	84	7	0	95	5
Both		37	97	116	32	15^{9}	72	3	7^{1}	83	10	0	97	3
Males	not worn	7	15	33	6	0	87	13	0	88	12	0	100	0
Females	not worn	4	9	25	—	0	89	11	0	84	16	—	—	—
Both		11	24	58	6	0	87	13	0	86	14	0	100	0

A = abutment teeth; In = indirect abutments; O = other teeth.

Indices indicates incidence of tendeney to mobility.

After an observation period of one year an increase of mobile abutment teeth of 15 per cent was noted in the group of patients wearing their dentures. A tendency towards increased mobility, without its being pathological, was registered in a further 9 per cent of these teeth. In 3 per cent a decrease of mobility was found.

In the group of patients not wearing their dentures a decrease of 13 per cent in the incidence of mobile abutment teeth was found.

For the indirect abutments an increase of mobility of 7 per cent and a tendency to mobility of 1 per cent was noted as well as a decrease of mobility in 10 per cent for these teeth. In patients who did not wear their dentures at all, the increase and decrease of mobility incidence were 0 and 14 per cent, respectively. As regards "other teeth" no appreciable changes were registered.

Exposure of cemento-enamel junction (Table 5)

Exposed cemento-enamel junction of the various tooth groups were found to an extent of 35—52 per cent at the initial examina-

Table 5

Distribution of the material according to the trend of the change occurring in the exposure of the cemento-enamel junction after one year.

Sex	Dentures worn	Number of cases	Number of teeth			Exposure of cemento-enamel junction (per cent of cases)								
						Abutments			Indir. abut.			Other teeth		
			A	In	O	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased
Males	worn	19	47	59	11	21	77	2	8	92	0	36	64	0
Females	worn	18	50	57	21	18	74	8	23	74	4	5	90	5
Both		37	97	116	32	20	75	5	16	83	2	16	81	3
Males	not worn	7	15	33	6	7	93	0	7	93	0	0	100	0
Females	not worn	4	9	25	—	44	56	0	24	76	0	—	—	—
Both		11	24	58	6	21	79	0	16	84	0	0	100	0

A = abutment teeth; In = indirect abutments; O = other teeth.

tion. A higher incidence was observed for indirect abutment teeth and "other teeth".

After the observation period of one year, an increase in the junction exposure was noted, in denture wearers as well in patients not wearing their dentures. The increase amounted to about 20 per cent in abutment teeth and to 16 per cent in indirect abutment teeth. No significant differences could be found between the different groups of teeth or between patient groups.

Depth of the gingival pockets (Table 6)

In the various groups of teeth deepened gingival pockets were found to an extent of 30 per cent. During the observation period a deepening of the gingival pockets was found at 7 per cent of the abutment teeth, while shallowing of the pockets occured at 19 per cent of these teeth. In non-denture-wearers, shallowing was not noted. Instead, a deepening of the pockets at 13 per cent of the abutment teeth occurred. At the indirect abutment teeth the changes were few, viz. deepened pockets in 4—5 per cent of the denture-wearing patients and in 12 per cent of the non-denture-wearers.

Table 6

Distribution of the material according to the trend of the change occurring in the depth of the gingival pockets after one year.

Sex	Dentures worn	Number of cases	Number of teeth			Depth of gingival pockets (per cent of cases)								
						Abutments			Indir. abut.			Other teeth		
			A	In	O	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased	Increased	Unchanged	Decreased
Males	worn	18	47	59	11	6	69	23	7	86	7	—	82	18
Females	worn	19	50	57	21	8	78	14	2	95	4	5	67	29
Both		37	97	116	32	7	74	19	4	90	5	3	72	25
Males	not worn	7	15	33	6	13	87	0	18	82	0	0	100	0
Females	not worn	4	9	25	—	11	89	0	4	96	0	—	—	—
Both		11	24	58	6	13	87	0	12	88	0	0	100	0

A = abutment teeth; In = indirect abutments; O = other teeth.

Significant differences between the different groups of teeth could not be established, although a tendency towards higher incidence of pocket deepening appeared with indirect abutment teeth in non-denture patients.

Changes in the oral mucosa

a) *Gingival margins (Table 7, Fig. 2)*

On initial examination the incidence of inflammatory gingival margins at the abutment teeth amounted to 18—20 per cent. At indirect abutments the incidence of gingival inflammation was found to be 35—40 per cent.

At the end of the observation period there was an increase in inflammatory reaction around the abutment teeth of denture-wearing patients of 58 per cent, a decrease in 4 per cent. Regarding patients who did not wear their appliances, increase and decrease both amounted to 4 per cent. The difference between the two patient groups proved statistically significant.

At indirect abutments increase and decrease in inflamed gingival margins amounted to 26 and 16 per cent respectively in patients not wearing their dentures.

Table 7

Changes in the inflammation of gingival margins (per cent).

Sex	Dentures worn	Number of cases	Number of teeth			Gingival margins inflammation (per cent of cases).								
						Abutments			Indir. abut.			Other teeth		
			A	In	O	Aggravated	Unchanged	Lessened	Aggravated	Unchanged	Lessened	Aggravated	Unchanged	Lessened
Males	worn	19	47	59	11	66	32	2	29	39	32	9	91	0
Females	worn	18	50	57	21	50	42	8	23	77	0	5	71	24
Both		37	97	116	32	58	37	5	26	58	16	6	78	16
Males	not worn	7	15	33	6	7	87	7	3	67	30	0	100	0
Females	not worn	4	9	25	—	0	100	0	24	56	20	—	—	—
Both		11	24	58	6	4	92	4	12	62	26	0	100	0

A = abutment teeth; In = indirect abutments; O = other teeth.

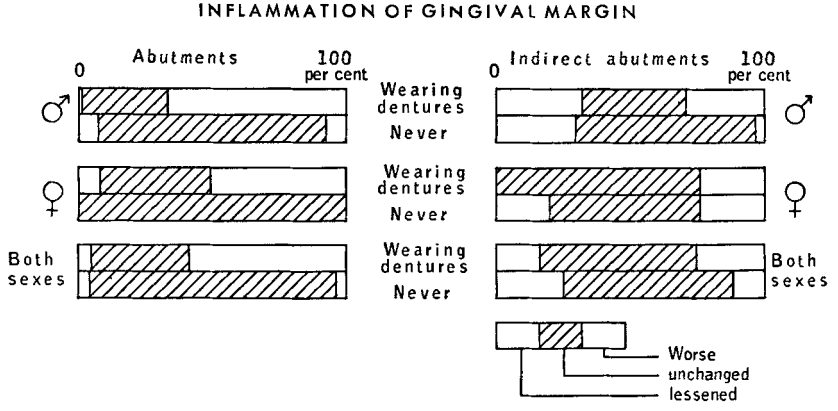

Fig. 2.

b) *Edentulous areas (Table 8)*

At the initial examination of the edentulous ridges the mucous membranes were found clinically normal throughout. After the one year observation period 14 per cent of the 94 saddle areas in denture wearers showed inflammatory reactions, whereas no inflammations could be found in non-denture-wearers.

Table 8

Changes of the inflammation of saddle-areas under dentures (per cent).

Denture wearing habits	Sex	Number of cases	Number of saddles	Edentulous ridges		
				Aggravated	Unchanged	Lessened
Wearing dentures	Males	19	54	11	89	0
	Females	18	40	18	82	0
	Both	37	94	14	86	0
Not wearing dentures	Males	7	14	0	100	0
	Females	4	8	0	100	0
	Both	11	22	0	100	0

Occlusion and articulation (Table 9)

Central habitual occlusion and articulation could be considered to be good in all the cases at the initial examination. At the end of the observation period a deterioration of occlusal contacts was observed in 16 per cent and of articulation contacts in no less than 70 per cent of the cases.

Table 9

Changes of habitual centric occlusion and articulation balance, in denture wearers (per cent).

Sex	Number of cases	Contacts in habitual centric occlusion		Contacts in lateral movements	
		Deteriorated	No change	Deteriorated	No change
Males	19	16	84	84	16
Females	18	17	83	56	44
Both	37	16	84	70	30

Discussion

In the present patient material it is obvious that selection bias was not present. The attendance at the re-examination was high (90 %), and those not attending gave good reasons for being absent.

All the patients in the present series enjoyed good general health, as judged from their case histories and the findings on both examinations. A general medical examination had, however, not been arranged for these patients.

The individual periodontal tolerance to forces can obviously not be taken into consideration, as no accurate method of evaluating force-tolerance has been developed. The same can be said for tissue endurance at different ages. However, as the age distribution is within definite limits, the authors are of the opinion that its effect is of minor importance in evaluating the results of this investigation. Instead, the material is divided according to sex, as it has been shown that women are more sensitive than

men with respect to inflammatory reactions of the mucosa (*Kutzleb* 1957).

In assessing the results, the increase in mobility of the abutment teeth is probably the most interesting phenomenon, and it is of great clinical importance. In denture-wearers the increase of mobile abutment teeth was comparatively great considering the short observation time of one year. It seems obvious that the mobility increase is caused by the forces introduced through the dentures. In patients not wearing their partial dentures, the "abutment teeth" did not show any mobility increase in spite of the fact that they are subject to more than normal masticatory forces, being the most distal ones in the reduced tooth arch. Of indirect abutment teeth both an increase and decrease of mobility were registered. It is, of course, possible that the forces on these teeth vary with the various designs of the dentures, but it must be remembered that this group of teeth includes a great many lower incisors that already at the initial examination had a prevalence of increased mobility of 20 per cent.

The abutment teeth were all canines or premolars. The tendency to increased mobility was higher with premolars than with canines. This might be due to the fact that the force on the premolars can be higher because of the occlusal rests. In addition to this, the larger root area of the canines may be considered of importance for better withstanding the forces.

In the present patient material no differences could be demonstrated in the depth of the gingival pockets or the exposure of the cemento-enamel junction during the observation period or between denture-wearers and non-denture-wearers. In connection with wearing dentures the problem of understanding such results is a rather complex one. An inflammatory reaction caused by the denture may produce swelling of the gingival margin deepening the pocket even though a pathologic reaction in the fundus part of the gingival pocket is lacking. On the other hand, the denture may press the margin in an apical direction and thus shallow the pocket, although the pocket tissue at its fundus may be pathologically changed. This makes it difficult to evaluate the findings unless the changes are distinct and in the same direction. This was not the case in this series of observations. In this connection attention should be paid to the animal experi-

ments showing that increased tooth mobility does not necessarily presuppose gingival changes (*Kronfeld* 1940, *Wentz et al.* 1958).

The increase of a marginal inflammatory reaction in denture wearers is quite apparent in the present material. One cause for this may be deficient oral hygiene. In this respect the material is inhomogeneous, in that good oral hygiene was found in only 30 per cent of the male patients, while 75 per cent of the female patients kept up their oral hygiene. The importance of good hygiene for the status of the mucous membrane has been proved by *Lövdal et al.* (1959) and *Schei et al.* (1959) among others. To this may be added the fact that some of the teeth in our patient material were crowned. It has been shown by *Waerhaug* (1954) and by *Koivumaa et al.* (1959, 1960) that marginal inflammatory changes are not infrequent in connection with crown restorations.

By grouping the abutment teeth according to the status of oral hygiene and to the type of crowns, it was found that inflammatory gingival reactions appeared more frequently with deficient oral hygiene and artificially crowned teeth. In those cases the increase was 84 per cent in denture wearers. Even with good oral hygiene the crowned abutment teeth had an inflammatory increase as high as 64 per cent. Corresponding figures for abutment teeth with natural crowns were 74 and 54 per cent, respectively. This demonstrates the important role of oral hygiene in keeping the inflammatory reaction down and the possible risk of marginal changes with artificial crowning. On the other hand this risk must be put in relation to the great risk of carious lesions at the uncrowned abutment teeth. The present results, however, still indicate a high tendency to inflammatory reactions at teeth used as abutments for partial dentures.

Marginal inflammatory changes at indirect abutment teeth, to a high degree present in our material, may partly be due to the fact that they mainly consisted of incisors, on which calculus frequently forms. Similar changes were found at other non-contacting teeth as well.

Inflammatory reactions of the mucous membrane under the saddles appeared to a small extent. It is also likely that resorptive processes had taken place. This is indicated by the great decrease of articulation contacts and also of decrease in occlusion

contacts. Contact at articulating movements remained only in 30 per cent of the cases during the short observation time of one year. It should be pointed out, however, that the highest difference (8 %) in the double determinations appeared at this registration. In spite of that, the observation results indicate that resorption is the main factor in losing contact at articulation.

During the observation period three clasps and two lingual continuous clasps broke. One denture was relined and one was remade. Some of the patients not wearing their dentures complained of irritation in the saddle areas and a few of bad retention. Half of them did not give any reason for not having worn their dentures. The denture wearers were all happy about their dentures and had not noticed any changes whatsoever during the observation time.

Conclusions

On the basis of the findings in this study, the authors consider themselves justified in expressing the following opinion:

Dento-gingivally supported partial dentures may cause changes at the abutment teeth in such a way that marginal inflammatory reactions and mobility increase. The inflammations are more frequent with deficient oral hygiene, and crowning of the abutment teeth may increase this reaction. At indirect abutments such changes can also appear but seem to be less frequent.

Under the denture saddles resorption takes place which after a short time impairs the articulation.

The patients do not seem to be aware of the changes or do not notice them during the first year of wearing the abovementioned types of dentures.

Tissues changes at abutment teeth of mandibular "Kennedy Class I" cases proved more frequent and severe than at abutment teeth of the more heterogeneous material published in Study I.

The investigation does not give any indication of future changes. The question whether these changes continue without stopping or whether they reach a certain level after a certain period of time, after which they slow down or the condition stabilizes, is a very important one. It is the intention of the authors to follow the patient material here dealt with for several

years in order to obtain further data that might help to answer to these questions.

SUMMARY

In order to evaluate the effect on the oral tissues of dento-gingivally supported mandibular partial dentures (Kennedy Class I), the authors made a study of 54 partial denture cases during a specified period of time. 48 of the patients appeared for re-examination one year subsequent to the original examination and prosthetic treatment.

Of the patients re-examined 22 were women and 26 men. The mean age was 48 years. All the patients had been fitted with a full upper and a partial lower denture. Eleven of them did not wear their mandibular dentures.

The study was restricted to certain clinical observations deemed to be important. Apart from oral hygiene, special attention was devoted to the periodontal tissues. In assessing the condition of these tissues, the mobility of the teeth, the exposure of the cemento-enamel junction, the depth of the gingival pockets, and the condition of the gingival margins were considered valuable objects of investigation. An estimation of the state of the oral mucosa supporting and surrounding the dentures was also made.

The changes in the function of the denture, its occlusion contacts and articulation were regarded as essential points and hence subjected to examination.

Records were also kept of the opinions expressed by the patients as to the comfort and the function of their dentures.

All registrations of the above factors were made at the time of the fitting of the dentures, and once again about one year later, by two observers making separate examinations in accordance with detailed instructions.

An estimation of the reliability of the observations showed that the results obtained were sufficiently accurate and reliable for the purpose of the present study.

The results of the investigation are summarized in the Conclusions.

RÉSUMÉ

ÉTUDES SUR LA PROTHÈSE PARTIELLE II.

Étude sur les appareils partiels du maxillaire inférieur avec doubles selles en extension.

Dans le but d'évaluer l'action sur les tissus buccaux des appareils de prothèse partielle du maxillaire inférieur à appui gingivo-dentaire, les auteurs ont examiné 53 cas de prothèse partielle pendant une période déterminée. 48 des patients se sont présentés à un examen complémentaire un an après l'examen du début et le traitement prothétique.

Parmi ce patients ayant subi l'examen complémentaire, il y avait 22 femmes et 26 hommes. L'âge moyen était de 48 ans. Tous les patients avaient reçu un appareil complet du haut et un appareil partiel du bas. Douze d'entre eux ne portaient pas l'appareil du bas.

L'étude s'est limitée à certaines observations cliniques jugées importantes. En dehors de l'hygiène buccale, l'attention a en particulier été portée sur les tissus périodontaux. Pour l'évaluation de l'état de ces tissus, l'examen de la mobilité des dents du dénudement de la jonction émail-cément, de la profondeur du cul-de-sac gingival et de l'état du liseré gingival a été considére comme précieux. Une estimation de l'état de la muqueuse buccale supportant et entourant les appareils a aussi été incluse dans cette étude.

Les changements dans le fonctionnement de l'appareil lui-même, ses contacts d'occlusion et d'articulation ont été considérés comme des points essentiels et devant être examinés.

On a aussi enregistré les opinions exprimées par les patients sur le fonctionnement et le confort des appareils.

L'enregistrement de tous les facteurs ci-dessus a été fait au moment de l'appareillage et de nouveau à peu pres un an plus tard par deux observateurs faisant leurs examens séparément suivant des instructions détaillées.

Une estimation de la sécurité des observations a montré que les résultats obtenus étaient suffisamment précis et sûrs pour servir à la présente étude.

Les résultats de cette étude sont résumés dans les conclusions.

ZUSAMMENFASSUNG

UNTERSUCHUNGEN ÜBER PARTIELLE PROTHESEN II.

Die dento-gingival gestützen partiellen Freiendprothesen im Unterkiefer.

Um Aufschlüsse u.a. über mögliche Veränderungen des Gebisses im Zusammenhang mit dento-gingival gestützten partiellen Unterkiefer — Freiendprothesen (Kennedy — Klasse I) zu erhalten, wurde eine longitudinale klinische Untersuchung durchgeführt.

Das Patientenmaterial bestand aus 53 Fällen mit totalen Prothesen im Oberkiefer und partiellen Freiendprothesen im Unterkiefer, die im Zahnärztlichen Institut in Umeå behandelt worden waren. Die primäre Untersuchung erfolgte im Zusammenhang mit der Behandlung. 12—15 Monate später wurden die Patienten zu einer neuen Untersuchung bestellt. 48 (91 %) der 53 Patienten haben der Aufforderung Folge geleistet, u.zw. 22 Frauen und 26 Männer. Das mittlere Alter derselben war 48 Jahre.

37 der erschienenen Patienten trugen ihre Unterkieferprothesen, während die übrigen 11 aus verschiedenen Gründen ihre Partialprothesen während der Beobachtungszeit nicht angewendet hatten. In diesen Fällen handelte es sich ausschliesslich um reine Freiendprothesen, d.h. ohne Frontzahnersatz.

Die registrierten Beobachtungen über eingetretene Gewebsveränderungen und die Funktion der Prothesen lassen sich folgendermassen zusammenfassen:

Dento-gingival gestützte Freiendprothesen im Unterkiefer verursachen eine verhöhte Frequenz von Beweglichkeit der Stützzähne und marginale Entzündungen an denselben. Erhöhte Frequenz von Entzündungen tritt im Zusammenhang mit schlechter Mundhygiene auf, sowie bei künstlichen Kronen. Die Frequenz der genannten Veränderungen weist eine steigende Tendenz auch bei indirekten Stützzähnen auf.

Unter den Freiendsätteln der Partialprothesen tritt wahrscheinlich eine Resorption ein, die sich u.a. als bedeutliche Verschlechterung von Artikulationskontakten äussert.

Die Prothesenträger waren hauptsächlich positiv zu der Behandlung eingestellt. Die Mehrzahl derselben empfand eine Verbesserung des Kauvermögens. Diese Patienten waren sich jedoch

nicht der Gewebsveränderungen, die während der Observationszeit aufgetreten waren, bewusst.

Die Untersuchung gibt keinen Anhalt zur Beurteilung ob die beobachteten Veränderungen fortschreiten werden oder ob nach einer gewisser Zeit eine Stabilisierung zu erwarten ist. Um diese Frage eingehender zu klären, sind weitere Untersuchungen von diesem Patientenmaterial geplant.

REFERENCES

Anderson, J. N. & Lammie (1952): A clinical survey of partial dentures. Brit. dent. J. *92:* 59.

Bhaskar, S. & B. Orban (1955): Experimental occlusal trauma. J. Periodont. *26:* 270.

Biaggi, A. & H. J. Elbrecht (1951): Gelenkige Prothesen und ihre Indikation. Verlag Zahnärztliche Welt, Konstanz 1951.

Frechette, A. R. (1956): The influence of partial denture design on distribution of force to abutment teeth. J. pros. Dent. *6:* 195.

Hildebrand, G. Y. (1937): Studies in dental prosthetics. Svensk tandläk.-Tidskr. *30:* Suppl.

—»— (1956): Om axialbelastningens kliniska betydelse. Svensk tandläk.-Tidskr. *49:* 749.

Hirschfritt, E. (1957): Removable partial dentures with stressbroken extension bases. J. pros. Dent. *7:* 318.

Jones, R. R. (1952): The lower partial denture. J. pros. Dent. *2:* 219.

Kaires, A. K. (1956): Effect of partial denture design on bilateral force distribution. J. pros. Dent. *6:* 373.

—»— (1956): Effect of partial denture design on unilateral force distribution. J. pros. Dent. *6:* 526.

—»— (1956): Partial denture design and its relation to force distribution and masticatory performance. J. pros. Dent. *6:* 672.

—»— (1958): A study of partial denture design and masticatory pressures in a mandibular bilateral distal extension case. J. pros. Dent. *8:* 340.

Koivumaa, K. K. (1956): Changes in periodontal tissues and supporting structures connected with partial dentures. Finska Tandläk.-Sällsk. Förh. *52:* Suppl. I.

Koivumaa, K. K. & K. Mattila (1959): Histologiska undersökningar av förändringar i den marginala gingivan vid richmondkronor med akrylfasad. Odont. Tidskr. *67:* 48.

Koivumaa, K. K. (1960): Untersuchungen über klinisch beobachtete Veränderungen des Zahnfleisches bei Richmondkronen mit Kunststoffassaden. Dtsch. Stomat. *10:* 481.

Koivumaa, K. K. & A. Wennström (1960): A histological investigation of the changes in gingival margins adjacent to gold crowns. Odont. Tidskr. *68:* 373.

Koivumaa, K. K., B. Hedegård & G. E. Carlsson (1960): Studies in partial dental prosthesis I. Finska Tandl.-Sällsk. Förh. *56:* 248.

Kronfeld, R. (1931): Histologic study of the influence of function on the human periodontal membrane. J. Amer. dent. Ass. *18:* 1242.

——»—— (1940): Clinical study of the periodontal pocket. J. Amer. dent. Ass. *27:* 499.

Kutzleb, H. J. (1957): Erkrankungen des Zahnfleisches: Einfluss von Pubertät, Menstruation, Schwangerschaft und Klimakterium (Umschau *57:* 371), cit. according to Dental Abstracts *3:* 291, 1958.

Lammie, G. A. & J. Osborne (1954): The bilateral free-end saddle lower denture. J. pros. Dent. *4:* 640.

Lövdal, A., O. Schei, J. Waerhaug & A. Arnulf (1959): Tooth mobility and aveolar bone resorption as a function of occlusal stress and oral hygiene. Acta odont. scand., *17:* 61.

Müller, B. (1948): Das Resilienzgelenk nach Beat Müller für abnehmbare partielle Zahnprothesen. Neuchâtel, 1948.

Neill, D. J. (1958): The problem of the lower free-end removable partial denture. J. pros. Dent. *8:* 623.

Orban, B. (1928): Tissue changes in traumatic occlusion. J. Amer. dent. Ass. *15:* 2090.

Reichenbach, E. & L. Kirchner (1952): Ein weiterer Beitrag zur partiellen Prothese in der Sozialpraxis. Dtsch. zahnärztl. Z. *7:* 521.

Schei, O., J. Waerhaug, A. Lövdal & A. Arnulf (1959): Alveolar bone loss as related to oral hygiene and age. J. Periodont. *30:* 7.

Spreng, M. (1956): Die Beziehungen der zahnärztlichen Prothese, der Kronen und Brücken zum lebenden Gewebe. Die Zahn-, Mund- und Kieferheilkunde 4:e Band. Verlag von Urban & Schwarzenberg, München/Berlin, 1956.

Steiger, A. A. (1952): Progress in partial denture prosthesis. Int. dent. J. *2:* 542.

Waerhaug, J. (1953): Tissue reactions around artificial crowns. J. Periodont. *26:* 107.

Wannenmacher, E. (1954): Die Prothese als schädigender Faktor durch Reizwirkung auf die Schleimhaut. Dtsch. Zahnärztl. Z. *9:* 89.

Weinberg, L. (1956): Lateral force in relation to the denture base and clasp design. J. pros. Dent. *6:* 785.

Wentz, F. M., J. Jarabak & B. Orban (1958): Experimental occlusal trauma imitating cuspal interferences. J. Periodont. *29:* 117.

Wilson, J. H. (1955): Partial dentures, a manual for students and practitioners of dentistry. Angus & Robertson, Sydney, 1955.

Addresses:

Carlsson
Royal School of Dentistry
Lasarettet
Umeå, Sweden

Hedegård
Royal School of Dentistry
Box 3207
Stockholm, Sweden

Koivumaa
Oltermannintie 6
Vanha-Käpylä
Helsinki, Finland