Bull. Tokyo Med. Dent. Univ., 24: 125–137, 1977.

A CLINICAL SURVEY OF REMOVABLE PARTIAL DENTURES

—ANALYSIS OF FOLLOW-UP EXAMINATIONS OVER A SIXTEEN-YEAR PERIOD—

BY

Isamu NAKAZAWA

ABSTRACT

In order to carry out the proper prosthetic treatment, it is necessary to select the method of treatment on the basis of accurate information concerning the prognosis of the prosthetic appliance. The oral structures are particularly proved to change when partial dentures are being used because the structures of the partial dentures are quite complex and they are easily broken. Therefore, in an attempt to analyze the changes that occur in the oral structures and partial dentures after insertion of the partial dentures, we conducted 3 series of follow-up examinations. The author sent out questionnaires and also conducted follow-up examinations of the patients. A summary of the major findings is as follows:

1) The percentage of those patients who came for their follow-up examinations, using metal based dentures, rose sharply over time. There were only 11.99% of the patients using the metal based dentures at the time the first study was conducted, but this rose to 58.13% at the time of the second study and 73.73% at the time of the third study.

2) The proportion of the patients who had anterior partial dentures declined over time from 9.36% at the time of the first study to 8.74% at the time of the second study and finally to 5.61% at the time of the third study.

3) The proportion of the partial dentures that had fractured was 23.15% at the time of the first study and 16.37% at the time of the second study and 16.67% at the time of the third study.

4) There was a striking difference in the fracture frequency of the acrylic resin based partial dentures dentures and that of the metal based partial dentures. The denture bases of the acrylic resin-based partial dentures fractured about four times as often as those of the metal based partial dentures.

5) In all three studies it was found that about 60% of the caries occurring on the abutment tooth occurred on the edentulous proximal side.

6) Changes in the mucous membrane, such as inflammation or development of ulcers, had occurred in 48.86% of the cases at the time of the first study. This proportion declined to approximately 47% at the time of the second study and finally to 43% at the time of the third study.

7) In examining the changes in the mobility of the abutment teeth, it was found that in all three studies approximately 20 to 30% of the abutment teeth demonstrated increased mobility, and about 10 to 20% showed decreased mobility while 55 to 65% showed no change.

* 中沢　勇: Department of Prosthetic Dentistry (Chief: Prof. I. NAKAZAWA), School of Dentistry, Tokyo Medical and Dental University (Tokyo Ika Shika Daigaku).
Received for publication, November 11, 1976.

Introduction

In order to promote the progress in the practice of dentistry, it is of utmost importance to conduct follow-up examinations on the various types of prosthetic appliances. There are two fundamental reasons for this. First, it is only after the patient has used the prosthetic appliance over a long period of time that one can determine the usefulness of a given academic theory, clinical technique, or prosthetic appliance by observing whether or not the prosthetic appliance has remained in harmonious balance with the remaining oral structures. Second, the follow-up examination is the foundation upon which further advances in technique must be based. These follow-up examinations are particularly important in the case of partial dentures which must remain in balance with both the residual ridges and the remaining teeth. The follow-up examination holds the key to the progress in the field of partial denture through a study of the changes which take place over time in the structure of the mouth.

Partial dentures are composed of artificial teeth, denture base, bar, and various types of retainers. Since partial dentures are removable it often becomes useless to the patient through either fracture or deformation. In addition, the condition of the mouth varies greatly from patient to patient. It is hardly an exaggeration to say that the remaining teeth and the residual ridges are different in each and every case. Therefore, the partial dentures must also differ in each and every case.

A number of follow-up studies have been done on partial dentures. For example, one may cite the works of G. Y. Hildebrand[1] (1937), J. N. Anderson and G. A. Lammie[2] (1952), E. Reichenbach and L. Kirchner[3] (1957), E. Reichenbach[4] (1953), G. Hansson[5] (1955), K. K. Koivumaa[6] (1956), R. Storer[7] (1958), J. N. Anderson and J. F. Bates[8] (1959), and the research of K. K. Koivumaa, B. Hedegård, and G. E. Carlsson,[9–11] which was based on a study of three sets of follow-up examinations carried out in 1960, 1961, and 1962. In addition, there is also the H. R. Tomlin and J. Osborne[12] study of 1961.

We have also conducted follow up examinations of wearers of partial dentures. The first time was a 1961 study of about 1,000 patients whose partial dentures were inserted between 1958 and 1960.[13–17] The second study was conducted in 1967 on some 2,000 patients whose dentures have been inserted between 1960 and 1965.[18–23] The third study, in 1975, examined some 2,500 patients whose dentures had been inserted between 1966 and 1973.

The author checked the patients for any signs of tooth decay, periodontal disease, inflammation, movement, and fracturing. We also inquired as to whether the patients were using their partial dentures. Thereupon, the results of these three sets of data were compared, which yielded some interesting conclusions.

Materials and Methods

All three studies were carried out in the following manner: Questionnaires (Fig. 1) were sent to the patients with two purposes in mind. First, the patient was encouraged to come for his follow-up examination asked if he would be able to come for his appointment. Second, a number of simple questions concerning the patient's use of his partial denture were asked. The responses to this questionnaire formed the basis of our analysis of the patients who did not come for their follow-up examinations.

The patients who came for their examination were checked for caries, changes in the

Please circle the appropriate response and return this questionnaire.

1) Can you come for your follow-up examination? Yes No
2) Are you presently using the partial dentures which we inserted? Yes No

Yes

a) Can you chew with your partial dentures? Yes No
b) Are you satisfied with the appearance of the partial dentures? Yes No
c) Can you speak clear with the partial dentures inserted? Yes No
d) Does the tooth which the denture clasp fastens on wiggle? Yes No
e) Does the partial denture more about too easily? Yes No
f) Have the dentures broken? Yes No

No

I. The reason for not using the partial dentures is that
a) it is broken
b) it hurts
c) cannot chew even if it is in
d) it doesn't fit
e) the teeth that the dentures fastens onto have fallen out
f) it is troublesome

II. Are you using a different partial denture?

Address:

Phone Number:

Name:

Fig. 1. Questionnaire

Record of follow-up examination of partial denture

No._____

Patient's Name:		Sex: M.	F.
Present Address:		Phone Number:	
Date of Birth:		Age:	
Denture Inserted Date			
Date of Follow-up Exam.			
Doctor in Charge of Follow-up Exam.:			
Classification of Partial Denture			
Upper	Anterior	Free-end	Unilateral
	Posterior	Tooth-supported	
Lower	Ant. & Post.	Combined	Bilateral
Antagonistic Teeth	Previous Use of Denture		Denture Material
Complete Denture	Yes		Metal Based Denture (Chromium-Cobalt Alloy)
Partial Denture			
Natural Teeth	No		Acrylic Resin Based Denture

I) Question for the patient

A) Are you presently using our partial denture? Yes No

B) Approximate Length of time it took to become accustomed to the partial denture Months Days

C) Present condition of the partial denture
a) Mastication Good Poor
b) Appearance Good Poor
c) Pronunciation Good Poor

D) Do you sleep with the partial denture out at night?
Yes No

E) How many times a day to you brush your teeth?
0, 1, 2, 3, more than 4

F) How many time a day do you clean the partial denture?
0, 1, 2, 3, more than 4

G) What part of the partial denture was most difficult become accustomed to?

H) Which foods are hard to chew with the partial denture?
Peanuts Fish-paste Dried-octopus Nougat candies

I) Does food get stuck under the partial denture?
Yes No

II) Check the patient for the following:

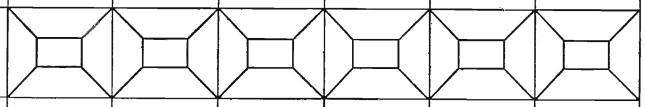
A) Stability of partial denture Good Poor

B) Hygiene of partial denture Excellent Good Poor

C) Tissue condition under & around partial denture (Mark the site of problems on chart on next page)

	Tissue Site	Compression	Inflamation	Ulcer	Pain
Around Partial Denture	Buccal Side				
	Labial Side				
	Attaching to Cervcal Margin				
	Away From Cervical Margin				
	Palatal Side; Anterior				
	Palatal Side; Posterior				
Under Partial Denture	Anterior Side				
	Posterior Side				
	Palatal Side				

D) Abutment tooth (Mark caries & mobility of all remaining teeth on chart on next page)

Site						
Caries (C_1-C_4)						
Rest						
Clasp body						
Clasp arm						
						
Degree of mobility (m_0-m_4)						
Periodontal disease (+ −)						
Hypersensitivity (+ −)						

E) Fractures and deformations of partial denture (Indicate site on chart on next page)

	Denture Base	Artifical Teeth	Clasp	Bar	
Fracture					Red Line
Deformation					Blue Line
Repair					Red Dotted Line

Tissue Condition Under Partial Denture
- Inflamation .....Red line
- Ulcer .....Red dotted line
- Compression .....Blue line
- Pain.....Blue dotted line

Please mark clearly the site of the prosthetic appliances and all caries of the remaining teeth.

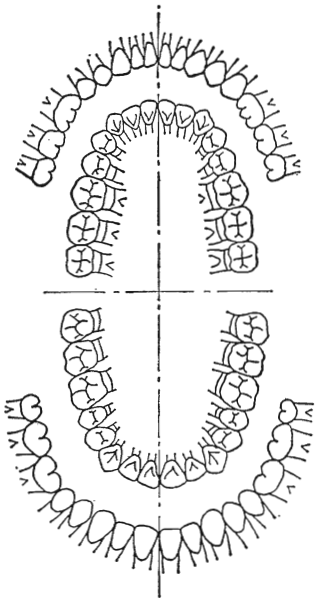


Fig. 2. Record of follow-up examination of partial denture

mucous membrane, fractures of the partial dentures, and to see whether or not tooth mobility had increased since the partial dentures were inserted in accordance with the items in the check list (Fig. 2). In order to check the occlusion, the patients were told to bite into wax, and the measurements were compared in an attempt to analyze changes over time. In addition, we checked the general condition of the mouth and took X1ray.

Since there were many patients and more than one dentist involved, the author felt that there was a need to minimize individual inconsistencies in judgements. In order to analyze the patients more consistently and objectively, the dentists consulted with each other beforehand on which standards to use.

For purposes of analysis, the retention and stabilization of the partial denture were defined as "good" in those cases where no relining was necessary, and "poor" in those cases where relining or a new partial denture proved to be necessary.

Caries were checked through use of a dental mirror and explorer and recorded on the check list on a scale of C_1–C_4 in accordance with the Shimada method.[28]

Tooth mobility was checked by grasping the crown of a tooth with pincers and by attempting to move it. The degree of tooth mobility was then graded on a scale of M_0 to M_4. Tooth mobility was classified as M_0 in those cases where there was no perceptible labio-lingual movement. If there was some slight movement, mobility was classified as M_1. Where there was pronounced labio-lingual movement, tooth mobility was said to be M_2. In those cases where pronounced labio-lingual movement was combined with

mesio-distal movement, tooth mobility was recorded as M_3. If the tooth sank vertically in addition to labio-lingual and mesio-distal movement, tooth mobility was said to be M_4. In addition, the abutment tooth was checked for hypersensitivity, and the area around it was examined for any evidence of periodontal disease.

We also checked the tissue condition around and under the partial dentures to see if there was any sign of inflammation, ulcers, compression, or pain. We then recorded the results and the site of any complications on the follow-up examination check list. Simultaneously, we recorded the site of any fractures, deformations or repairs. We then recorded the information contained in the check-list on a data punch card for each patient.

Results

I) *Long-term observations on clinical effects of wearing partial dentures*

1) Seven-one point nine seven per cent of all the cases investigated continued to use the same partial dentures after their placement. However, the percentage was markedly affected by the procedure of constructing dentures, the conditions of missing teeth and the period of dentures employed; it was 78.22% for metal base dentures and 67.43% for resin base dentures. The chronological percentage of dentures used was about 90% within a year and three months after their insertion, 70% after three years and three months, 60% between three years and three months and four years and 9 month, and 40% after five years and three months.

2) The following six items were surveyed regarding the dentures in use: mastication, appearance, phonetics, mobility of abutment teeth, retention of dentures, and breakage of dentures. About 10% of these dentures insufficiently functioned in each item of mastication, appearance, phonetics, mobility of abutment teeth, and retention of dentures. Breakage of dentures was also seen in some 20% of the cases, especially in aged patients. In a comparison between metal base dentures and resin base dentures, poor cases in the former were about a half as many as those in the latter as regards the above-mentioned five items with the exception of mastication. The mobility of abutment teeth increased as the period of dentures used was prolonged.

3) Shown below are the causes of stopping employment of partial dentures in order of their frequency:

breakage of dentures	29.32%
poorly-fitting dentures	24.43%
carious or lost abutment teeth	22.48%
pain associated with dentures	10.75%

The other factors listed with 10% or less were feeling of a foreign body and temporary prosthetic appliances. In comparing these factors of metal base dentures with those of resin base dentures, breakage of dentures was the major reason in the former and poorly-fitting dentures in the latter.

Dentures tended to be discarded because of the following factors in connection with the period of dentures used: 1) pain and feeling of a foreign body associated with a denture in the group were one or two years had passed since their insertion, and 2) carious or lost abutment teeth in the group were three to five years had passed.

4) Forty-two point three seven percent of the cases who discarded partial dentures have not had newly constructed dentures. This percentage was 26.55 for maxillar

dentures and 47.75 mandibular dentures.

II) *Effects of partial dentures on the mucous membrane*

Four hundred and seventy persons (590 cases) were subjected to investigation of the effects of partial dentures on the soft tissues and the mucous membrane. The results were as follows:

1. The changes in the condition of the soft tisues and the mucous membrane were observed in 277 out of 590 cases (47%). About 36% of them were scars and 31% showed findings with suspension of physical changes.
2. The scars on the maxilla were twice as many as those on the mandible.
3. There was an extremely highly occurance of physical changes and scars in poorly-cleaned dentures than in well-cleaned dentures.
4. In the case of the edentulous opposing jaw, scars had the lowest occurance.
5. In a comparison between the two different denture base materials, there was a remarkably higher occurance of physical changes in resin base dentures than in metal base dentures.
6. The occurance of physical changes was likely to increase according to the number of remaining teeth.
7. Physical changes were notably seen in the areas where a denture border was in contact with the cervix of remaining teeth in both upper and lower jaws.

III) *Changes of occlusion of partial dentures*

Five hundred cases out of 2,100 patients were subjected to the recording of their occlusions with a wax bite method and a statistical analysis was made on the changes of occlusion of partial dentures.

1. The occlusion of partial dentures was outstandingly affected by the type of dentures, i.e., a bounded saddle denture, a free-end saddle denture or a combined denture of the two, and by the relation with the opposing teeth, namely, the ramianing teeth or artificial teeth.
2. The thickness of wax bite clearly indicated time elapsed variations; in particular, it was notable in the case of bilateral free-end saddle dentures in both the maxilla and mandible along with the natural opposing teeth.
3. The time elapsed variations in the occlusion of partial dentures were minimum in bounded saddle dentures and were the highest and were the highest in free-end saddle dentures were three to four years had passed since their insertion.
4. There was 0.10–0.20 mm of difference in the thickness of wax bite between the remaining teeth and the remaining teeth, the remaining teeth and artificial teeth.

IV) *Fractures*

1) Frequency

There were 61 fractures in 267 cases in the first survey, yielding a percentage of 22.8%. The results of the second survey showed that there were 96 fractures in 596 cases (16.3%), and the third survey indicated that there were 131 fractures in 786 cases (16.7%).

2) Sex

In the first two surveys, twice as many as women fractured their partial dentures. However, there was little discernible differences between men and women in the third survey, both having fracture rats of approximately 16%. We no longer had detailed records from the first survey, so we compared the results of the second and third surveys. The second survey indicated that the denture base was fractured in 10.0% of the cases, and that the artificial teeth were fractured 5.8% of the

time. However, the results of the third survey showed that the denture base was fractured in 3.77% of the cases and the artificial teeth in 30.8% of the cases.

3) Upper and Lower Partial Dentures

The first survey demonstrated that an upper partial denture was twice as likely to break as a lower one, but in analyzing the results of the second and third surveys, there was no significant difference between the percentage of fractures that occurred in the upper partial dentures and the percentage of fractures that occurred in the lower dentures. If one compares the fractures in the second survey according to the site of the fracture, one discovers that although fractures of the lower partial dentures outnumbered those of the upper partial dentures in the second survey, the results were precisely the reverse in the third survey, with fractures of the upper partial dentures outnumbering those of the lower.

4) Metal Partial Dentures and Resin Dentures

The fracture rate for metal partial dentures in the first survey was 25%. This, however, can be explained by the fact that the sample was too small to yield an accurate percentage. It is therefore impossible to compare the results of the first survey with those of the second and third surveys.

The most striking difference between resin partial dentures and metal partial dentures was the percentage of fractures which occurred in the denture base. Fractures occurred in the resin denture bases four times as often as in the metal denture bases.

In comparing the fracture rate of artificial teeth, it was found that the teeth set in a metal denture base fractured a bit more often than did those set in a resin denture base.

V) *Variation in mobility of abutment teeth*

Two hundred and twenty-nine cases (622 abutment teeth) were two years had elapsed after insertion of dentures were selected for the first survey, and 573 cases (1,739 abutment teeth) were five years had passed after placement of dentures, for the second survey. The results are summarized as follows:

1. Variation in mobility of all the abutment teeth

The non-variation group in mobility of abutment teeth was 62.5% in the first survey and 57.3% in the second survey, the increased mobility group was 25.9% and 23.9%, and the decreased mobility group was 10.9% and 18.8%, respectively; similar results were obtained in both surveys. It was noted that the percentage of the decreased mobility group rose in the second survey in spite of the long period of the survey. The group with comparatively small variations in mobility between +1 and −1 was 92.4% in the first survey and 91.3% in the second survey. It was judged by the examination of mobility with palpation that more than 90% of all the abutment teeth had very slight variations. Less than only 10 percent showed large variations in mobility (Fig. 1 and 2).

2. Variation in mobility of abutment teeth by maxilla or mandible

Almost no significant difference was noticed. The mobility of abutment teeth in the mandible, however, tended to be a little larger than that of the abutment teeth in the maxilla.

3. Variation in mobility of abutment teeth by age

The number of abutment teeth with mobility increased as the patients became older; 35 to 50% of abutment teeth showed mobility in the 60's or over.

4. Variation in mobility of abutment teeth by the period of dentures used

In the first survey, the rate of mobility increased with prolongation of the period of dentures used: it was 22.9% in a half year, 18% in a year and 36.2% in two years. In the second survey, the rate was not as high as that in the first survey: it was 33.3% in a half year, some 20% in one to two years and some 30% in three years or more. This is due to lower rate of mobility in metal base dentures than that of resin base dentures as described later; resin base dentures were employed in 88% of the subjects of the first survey, while in 51% of those of the second survey.

5. Variation in mobility of abutment teeth by the number of remaining teeth

The fewer the number of remaining teeth is, the higher the rate of mobility becomes. In the cases where one to six teeth remained, mobility was seen in 40–60% of abutment teeth; it was less than 30% in the cases where seven teeth or more remained.

6. Variation in mobility of abutment teeth by the shapes of clasps and materials utilized

In the first survey, the rate of mobility of abutment teeth was 25.8% in wire clasps and 34.3% in cast clasps. A comparison was made between resin base dentures and metal base dentures in the second survey; this can be regarded as a comparison between wire clasps and cast clasps. The rate was 42.5% in the former cases and 25.2% in the latter. There was a completely opposite relationship between the results of the two surveys. The following factors are considered:

i) The number of cast clasps investigated was extremely different in the two surveys; 11.7% in the first survey and 65.3% in the second survey.

ii) Better design was made in the second survey with rapid advances in metal base dentures.

7. Variation in mobility of abutment teeth by cleaning of dentures, stability and retention of dentures and relation with the opposing jaw.

A study was made with regard to these items in the second survey only.

Significant difference in the variation in mobility of abutment teeth by the extent of cleaned dentures was markedly observed in the group showing an increase of two degrees or more; increased mobility was seen in 3.8% of the well cleaned cases, 6.2% of fairly well cleaned cases and 15% of poorly cleaned cases. Twelve point eight percent of the dentures investigated showed the best stability and retention, and twenty-nine point six percent were fairly good, 48.4% being poor.

Increased mobility was noted in about a half of poorly stabilized and retained dentures. There was no significant difference in the increase rate of mobility of abutment teeth between the opposing jaws with partial dentures and with natural dentition; the rate was 20%. In the case of the opposing jaw with a full denture, the rate increased to 35%.

VI) *The percentage of caries occurring on abutment teeth*

The percentage of caries occurring on abutment teeth had a tendency to become lower at every clinical survey conducted after the insertion of partial dentures, notably at the third survey, showing an eight percent decrease as compared with the previous survey. The trend was remarkable especially with intact clasped teeth; the percentage was 35.46% at the second survey and 22.02% at the third survey. This is probably because more and more metal base dentures have been used year after year; the percentage of metal base dentures used was 58.14% at the second survey and 73.7% at the third survey. It was found that at every survey that treated clasped teeth were less

attacked by caries than intact clasped teeth, indicating the necessity for the preventive restorations of clasped teeth.

1) The percentage of caries occurring on abutment teeth in relation to restoration

The percentage of caries occurring on abutment teeth was investigated from the standpoint of abutment teeth treated by the fitting of crowns, inlays, amalgams, some other filling materials including resins and silicate cements As a results, it was clear that the incidence of secondary caries on abutment teeth after the filling of amalgam and resin was higher at the first and second survey, while it was lower at every survey when crowns were chosen for the treatment of abutment teeth. A crown is considered to have prevented abutment teeth from producing caries by covering all the areas frequently attacked by caries.

2) The percentage of caries occurring on abutment teeth in relation to age

It was observed at the first survey that the percentage of caries occurring on abutment teeth increased until 49 years of age and it decreased at 50 years of age and afterwards. The second and third surveys also showed to a significant degree that age influenced the percentage of caries on all abutment teeth. However, it was not observed that age had anything to do with the percentage of caries on healthy abutment teeth. Therefore, no clear cut consulsion was reached concerning the relationship between age and the percentage of caries occurring on abutment teeth.

3) The percentage of caries occuring on abutment teeth in relation to maxilla and mandible

A high percentage of caries occurred on abutment teeth in the upper jaw than in the lower jaw. Especially at the third survey, there was a significant difference between the upper and lower jaws.

4) The percentage of caries occurring on abutment teeth in relation to the period of denture use

It is commonly believed that the longer a partial denture is used the higher the percentage of caries occurring on the abutment teeth becomes. This was also true of our surveys except that the percentage on and after three and half years of the placement of partial dentures was not very high.

5) The percentage of caries occurring on abutment teeth in relation to clasp construction procedure.

The percentage of caries occurring on abutment teeth with cast clasps was markedly lower than that of caries on abutment teeth with wire clasps.

6) The percentage of caries occurring on abutment teeth in relation to types of clasps used

It appeared that the percentage of caries occurring on abutment teeth was higher when complicatedly constructed clasps such as back action clasps, reverse back action clasps, and half and half clasps were used. On the other hand, double Aker's clasps and two-arm clasps with rests showed a lower percentage of carious teeth. It was clear that a rest played a very important role in protecting an abutment tooth from caries by preventing the impaction of food.

7) Areas frequently attacked by caries

It was found that about 61% of caries on abutment teeth were seen on the cervix of the proximate surfaces in contact with dentures, the next most frequently attacked areas being on the occlusal surfaces. It appears that this was caused by dead spaces at the cervix where some food debris and plaque tend to remain. In ad-

dition when a resin base denture is used, the percentage of caries occurring on abutment teeth may be high, because a P.M.M.A. in contact with abutment teeth tends to get dirty.

8) The relation with frequency of brushing, cleaning of dentures and wearing dentures at night

It was observed that when good oral hygiene was maintained the percentage of caries occurring on abutment teeth was lower. The percentage was higher when a denture was kept in at night than when it was removed for the night. There was a significant difference between the two cases.

VII) *Accumulation of food debris and plaque on partial dentures*

A study was carried out to clarify the relationship between the condition of dentures colored with 10% of neutral red and the change in a patient's oral tissues.

The following results were obtained:

1. The denture border (the contact area of the remaining teeth with the denture base) was most highly stained.
2. Periodontal disease and injury on the underlying mucosa of the plate increased markedly according to the extent of the stained denture border.
3. Caries produced on abutment teeth have some relation with the degree of clasp bodies stained with the neutral red rather than that of rests.
4. Dentures were highly stained as the period of the denture used was prolonged, especially in resin base dentures.
5. A highly significant correlationship between the degree of dentures stained and the condition of oral hygiene was seen.

General Discussion

The purpose of the investigation was to make clear the changes occuring in the occuring in the periodontal tissues, residual ridge, other denture bearing soft tissue, occlusal conditions and the partial denture themselves.

And also the clinical results of the removable partial dentures in the condition of periodically changing supporting oral structures. There was loss of function of mastication, esthetic satisfaction, and phonetics which results in occurance of changing supporting conditions and also broken dentures.

In general conclusion, the success of partial denture treatment depends to considerable extent on the patient's cooperation and practice of oral hygiene and these serial findings indicate that the partial denture treatment should be undertaken only when absolutely necessary, and should be planned so as to minimize the risk of damage of the oral tissues.

Conclusion

1) The percentage of those patients who came for their follow-up examinations who were using metal-based dentures rose sharply over time. There were only 11.99% of the patients using the metal-based dentures at the time the first study was conducted, but this rose to 58.13% at the time of the second study and 73.73% at the time of the third study.

2) The proportion of the patients who had anterior partial dentures declined over time from 9.36% at the time of the first study to 8.74% at the time of the second study and finally to 5.61% at the time of the third study.

3) The proportion of the partial dentures that had fractured was 23.15% at the time of the first study and 16.37% at the time of the second study and 16.67% at the time of the third study.

4) There was a striking difference in the

fracture frequency of the resin-based partial dentures and that of the metal-based partial dentures. The denture bases of the resin-P.Ds fractured about four times as often as those of the metal-based P.Ds.

5) In all three studies it was found that about 60% of the caries occuring on the abutment tooth occured on the edentulous proximal side.

6) Changes in the mucous membrane such as inflammation or the development of ulcers, had occured in 48.86% of the cases at the time of the first study. This proportion declined to approximately 47% at the time of the second study and finally to 43% at the time of the third study.

7) In examining changes in the mobility of the abutment teeth, it was found that in all three studies approximately 20–30% of the abutment teeth demonstrated increased mobility, and about 10–20% of them showed decreased mobility while 55–65% showed no change.

8) A highly significant correlationship between the degree of dentures stained and the condition of oral hygiene was seen.

Acknowledgement

The author thanks Prof. Jinichi Obana, Dr. Katsuya Mizuno, Dr. Shunzo Kobayashi, Dr. Hiroshi Amemori, Dr. Ryuji Kawasaki, Dr. Tadamasa Goto, Dr. Hiroshi Mizutani and Assistant Prof. Makoto Matsumoto for their constant interests and helps in these studies. His thanks are due to all staffs of Department of the First Prosthodontics in Tokyo Medical and Dental University.

References

1) Hildebrand, G. Y.: Studies in dental prosthetics, Svensk tandläk.-tskr., 30: Suppl., 1937, cit. by Koivumaa, K.K., in Suom. hammaslääk. seur. toim., 52: Suppl. 1, 1956.
2) Anderson, J. N., and Lammie, G. A.: A clinical survey of partial dentures. Brit. Dent. J., with partial dentures. Suom. hammaslääk.-seur. toim., 52: Suppl. I, 1956.
7) Storer, R.: Variation in tolerance and partial denture design. The Dental Practitioner, 9: 35–40, 1958.
8) Anderson, J. N., and Bates, J. F.: The cobalt-chromium partial denture. A clinical survey. Brit. Dent. J., 107: 57–62, 1959.
9) Koivumaa, K. K., Hedegard, B., and Carlsson, G. E.: Studies in partial dental prosthesis I. An investigation of dentogingivally supported partial dentures. Sumon. hammaslääk.-seur. toim., 56: 249–306, 1960.
10) Carlsson, G. E., Hedegard, B., and Koivumaa, K.K.: Studies in partial dental prosthesis II. An investigation of mandibular partial dentures with double extension saddles. Acta odont. scand., 19: 215–237, 1961.
11) Carlsson, G. E., Hedegard, B., and Koivumaa, K. K.: Studies in partial dental prosthesis III. A longitudinal study of mandibular partial dentures with double extension saddles. Acta odont. scand., 20: 95–119, 1962.
12) Tomlin, H. R., and Osborne, J.: Cobalt-chromium partial dentures. A clinical survey. Brit. Dent. J., 109: 307–310, 1961.
13) Obana, J., Mizuno, K., Kobayashi, S., Sato, T., Jibiki, H., Kamura, T., Kawahara, T., Matsumoto, M., and Amemori, H.: A clinical survey of partial dentures (I) Part 1 Materials and methods (in Japanese). Hotetsushi (J.J.P.S.), 5: 207–212, 1961.
14) Mizuno, K., Sato, T., Jibiki, H., Kamura, T., Matsumoto, M., and Amemori, H.: A clinical survey of partial dentures (I), Part 2. Fractures of partial dentures (in Japanese). Hotetsushi (J.J.P.S.), 5: 213–218, 1961.
15) Kobayashi, S., Sato, T., Kawahara, T., and Matsumoto, M.: A clinical survey of partial dentures (I). Part 3. Caries in abutment teeth (in Japanese). Hotetsushi (J.J.P.S.), 6: 82–90, 1962.
16) Obana, J., Mizuno, K., Jibiki, H., Kawahara, T., and Sato, Y.: A clinical survey of partial dentures (I). Part 4. Changes in the mobility of the abutment teeth (in Japanese). Hotetsushi (J.J.P.S.), 7: 148–155, 1963.
17) Obana, J., Kamura, T., Kawakami, M., and Amemori, H.: A clinical survey of partial dentures (I). Part 5. Changes in the condition of the gingival margin and the mucous membrane covered by partial dentures (in Japanese). Hotetsushi (J.J.P.S.), 8: 116–123, 1964.
18) Obana, J., Matsumoto, M., Amemori, H., Kawakami, M., Sato, Y., Kajii, T., Hoshino,

92: 59–67, 1952.
3) Reichenbach, E., und Kirchner, L.: Ein weiterer Beittrag zur partiellen Prothese in der Sozialpraxis. Dsch. zahnärztl. Zschr., 7: 521–524, 1952.
4) Reichenbach, E.: Vergleichende Therapie des unteren Lückengebisses mit Endlücken. Zahnärztlische Rundschau, 62: 621–627, 1953.
5) Hansson, G.: Partiella mandibulära friändsproteser. En efterkontroll. Svensk tandläk.-tskr., 48: 223–229, 1955.
6) Koivumaa, K. K.: Changes in periodontal tissues and supporting structures connected K., and Okuno, M.: A clinical survey of partial dentures (II). Part 1. Materials and methods (in Japanese, English abstract). Hotetsushi (J.J.P.S.), 12: 146–154, 1968.
19) Amemori, H., Okuno, M., Gunji, K., Kawasaki, R., Oyama, T., Hosoi, T., Oka, H., Hotta, H., and Goto, T.: A clinical survey of partial dentures (II). Part 2. Long-term observation on clinical effects of wearing partial dentures (in Japanese, English abtract). Hotetsushi (J.J.P.S.), 12: 155–171, 1968.
20) Obana, J., Sato, T., Kawakami, M., Okuno, M., Oyama, T., and Oka, H.: A clinical survey of partial dentures (II). Part 3. Fractures of partial dentures (in Japanese, English abstract). Hotetsushi (J.J.P.S.), 12: 236–244, 1968.
21) Amemori, H., Hoshino, K., Hosoi, T., Kawasaki, R., Hirabayashi, Y., and Goto, T.: A clinical survey of partial dentures (II). Part 4. Changes in the condition of the gingival margin and the mucous membrane covered by partial dentures (in Japanese, English abstract). Hotesushi (J.J.P.S.), 13: 61–71, 1969.
22) Amemori, H., Kajii, T., Hoshino, K., Kawasaki, R., Gunji, K., and Morita, K.: A clinical survey of partial dentures (II). Part 5. Caries in abutment teeth (in Japanese, English abstract). Hotetsushi (J.J.P.S.), 13: 72–82, 1966.
23) Amemori, H., Hosoi, T., Ishiwata, Y., and Mizutani, H.: A clinical survey of partial dentures (II). Part 6. Changes in the mobility of the abutment teeth (in Japanese, English abstract). Hotetsushi (J.J.P.S.), 15: 134–143, 1971.
24) Nakazawa, I., Matsumoto, M., Kawasaki, R., Goto, T., Okusa, H., Ishikawa, Y., Mizutani, H., Endo, Y., Tajirika, T., Takahashi, K., Ishii, E., Koshihara, H., Ninomiya, H., Igarashi, Y., Shibuya, T., Ishihata, N., Ogino, A., Manabe, A., Sato, T., and Shinohara, J.: A clinical survey of partial dentures (III). Part 1. Materials and methods (in Japanese). Hotetsushi (J.J.P.S.), 19: 238–246, 1975.
25) Kashikura, A., Matsumoto, M., Kawasaki, R., Goto, T., Okusa, H., Ishiwata, Y., Mizutani, H., Endo, Y., Takahashi, K., Igarashi, Y., Shibuya, T., Ishihata, N., Ogino, A., Manabe, A., Shinihara, J., and Ono, K.: A clinical survey of partial dentures (III). Part 2. Occlusion (in Japanese). Hotetsushi (J.J.P.S.), 19: 375–384, 1975.
26) Shibuya, T., Matsumoto, M., Kawasaki, R., Goto, T., Okusa, H., Ishiwata, Y., Mizutani, H., Endo, Y., Takahashi, K., Igarashi, Y., Ishihata, N., Ogino, A., Manabe, A., Shinohara, J., and Ono, K.: A clinical survey of partial dentures (III). Part 3. Fractures of partial dentures (in Japanese). Hotetsushi (J.J.P.S.), 20: 24–30, 1976.
27) Ishiwata, Y., Matsumoto, M., Kawasaki, R., Goto, T., Okusa, H., Mizutani, H., Endo, Y., Takahashi, K., Igarashi, Y., Shibuya, T., Ishihata, N., Ogino, A., Manabe, A., Shinohara, J., and Ono, K.: A clinical survey of partial dentures (III). Part 4. Caries in abutment teeth (in Japanese). Hotetsushi (J.J.P.S.), 20: 31–37, 1976.
28) Shimada, Y., *et al.*: Shoka-rekko ushoku no shindan no konnansei ni kansuru kenkyu (A study of diagnosis on pit and fissure caries) (in Japanese). Kokueseikaishi, 8: 165–168, 1958.