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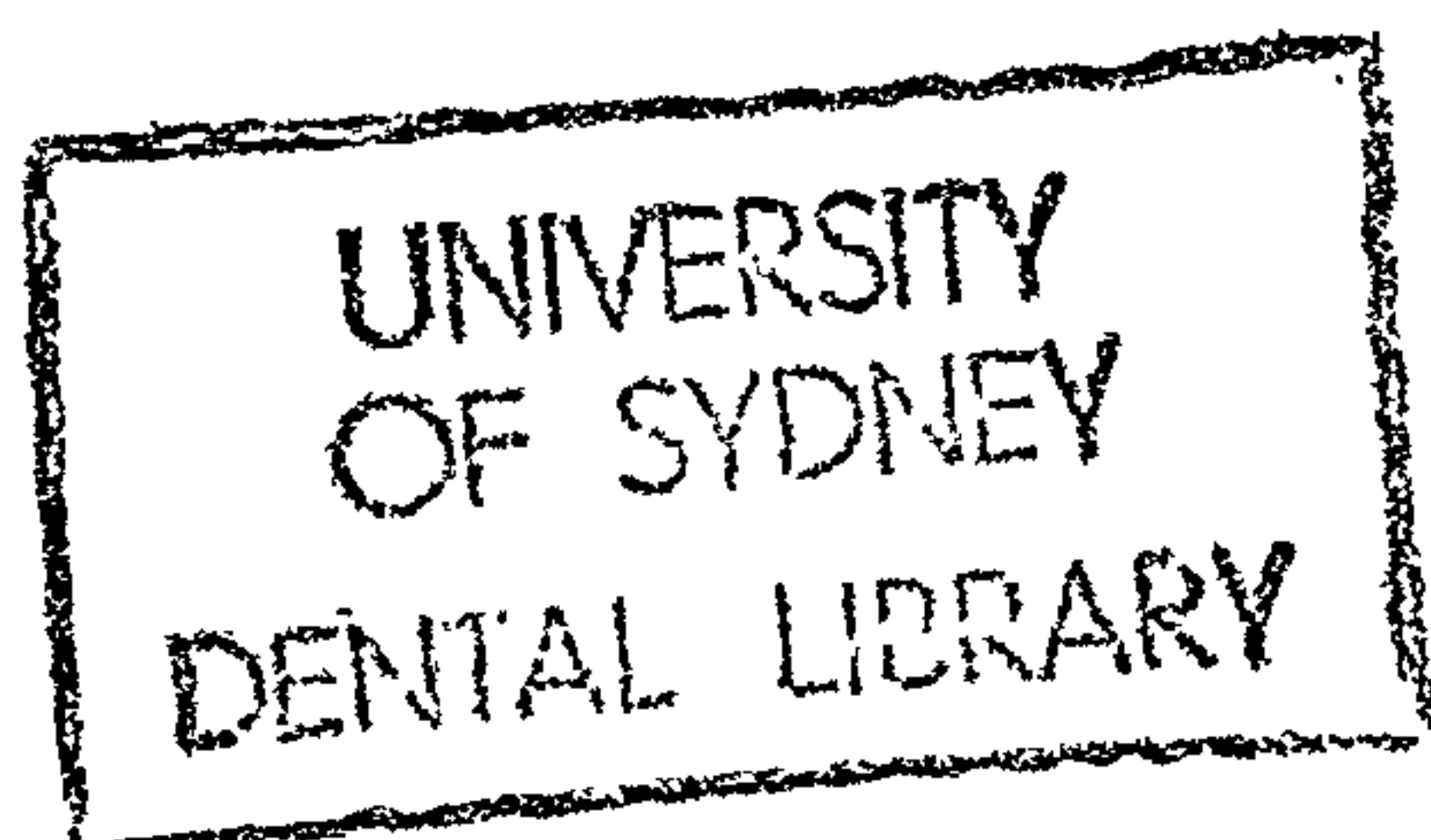
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A CLINICAL SURVEY OF REMOVABLE PARTIAL DENTURES  
AFTER 2 YEARS USAGE

BY  
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A thesis submitted in partial requirement  
for the degree of MASTER OF DENTAL SCIENCE

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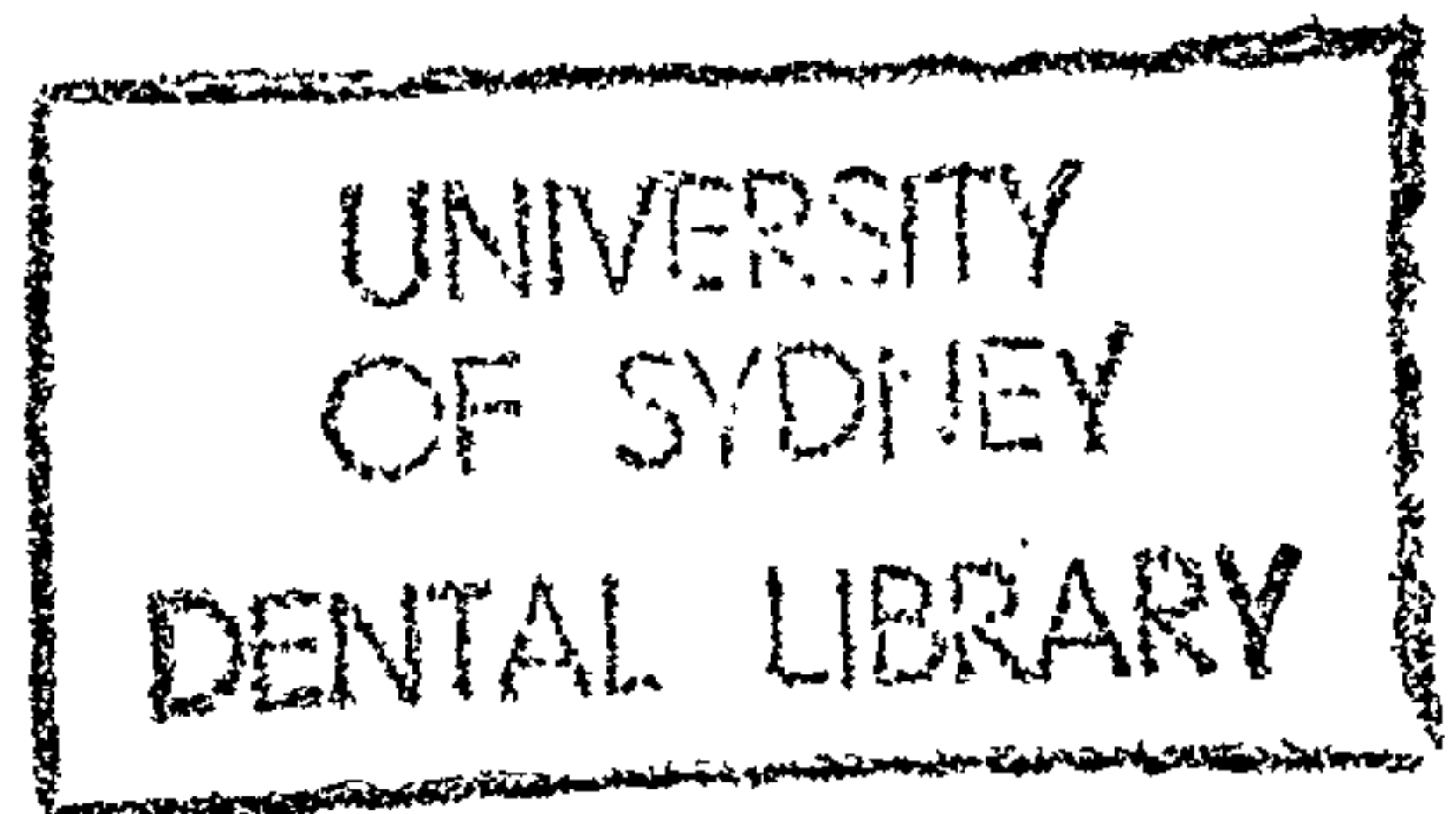
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Abstract



A 2-year clinical survey of 71 patients who had obtained removable partial dentures from the Department of Prosthetics, Dental School, University of Sydney was carried out to evaluate the results of prosthetic treatment. It was found that 80 per cent of the dentures were being used regularly. The incidence of dental caries and inflammatory lesions of mucosa appeared to be related to denture wearing habits. More than half of the dentures had lost active retention, stability and occlusal contacts in intercuspal jaw position. Fractures of some denture components were also observed. Despite that, patients examined appeared to be generally satisfied with their dentures they were unaware of the deterioration of denture and mouth conditions. It was also apparent that some of the denture wearing habits were due to lack of education and understanding on the part of the patient and that there was a definite need for a greater emphasis upon this aspect of prosthetic treatment, both during the professional education of the students and for the patients undergoing treatment in the hospital.

The results of this survey confirmed the findings of the many previous surveys in that the long-term success of removable partial denture treatment depends upon the awareness of the patients of the need for a regular service and maintenance of the appliance and to achieve this end, institution of some sort of a recall programme is essential.

## TABLE OF CONTENTS

|                                                                      | Page |
|----------------------------------------------------------------------|------|
| <u>Section I</u>                                                     |      |
| Introduction                                                         | 1    |
| <u>Section II</u>                                                    |      |
| Literature Review                                                    |      |
| 2.1 Effects upon denture usage                                       | 4    |
| 2.2 Effects upon the abutment<br>and non-abutment teeth              | 7    |
| 2.2.1 Caries                                                         | 7    |
| 2.2.2 Tooth mobility                                                 | 12   |
| 2.2.3 Periodontal conditions                                         | 14   |
| 2.3 Inflammation of supporting<br>tissues.                           | 16   |
| 2.4 Retention and stability of<br>denture.                           | 18   |
| 2.5 Fracture of abutment teeth<br>and denture components.            | 21   |
| <u>Section III</u>                                                   |      |
| Philosophy of Removable Partial<br>Denture Treatment and Indications |      |
| 3.1 Definitions and objectives                                       | 24   |
| 3.2 Consequences of loss of teeth                                    | 24   |
| 3.3 Types of partial dentures                                        | 25   |
| 3.4 Denture design                                                   | 27   |
| 3.4.1 Distribution of forces                                         | 28   |
| 3.4.2 Prevention of<br>undesirable movements                         | 31   |
| 3.4.3 Provision of stability<br>during function.                     | 32   |
| 3.4.4 Maintenance of health<br>of oral tissues.                      | 33   |

## TABLE OF CONTENTS

|                                                                    | <u>Page</u> |
|--------------------------------------------------------------------|-------------|
| 3.5 Denture components and their functions                         | 34          |
| 3.5.1 Saddle Areas                                                 | 34          |
| i) Denture base                                                    | 34          |
| ii) Occlusal surface                                               | 37          |
| 3.5.2 Supports                                                     | 40          |
| 3.5.3 Retention                                                    | 44          |
| i) Direct Retention                                                | 44          |
| ii) Indirect retention                                             | 45          |
| 3.5.4 Design of the retainer: locations, numbers and types, etc.   | 46          |
| 3.5.5 Major connector                                              | 55          |
| 3.5.6 The stress breakers                                          | 56          |
| <br><u>Section IV</u>                                              |             |
| Clinical Survey of Removable Partial Dentures after 2 Years Usage. |             |
| 4. Methods                                                         | 60          |
| 4.1 Patient Selection                                              | 60          |
| 4.2 Communication with the patients                                | 60          |
| 4.3 Examination and assessment of patients.                        | 61          |
| 4.3.1 Dentist's observation                                        | 61          |
| i) Mouth condition: caries and the inflammation of mucosa          |             |
| ii) Denture condition: retention, stability and occlusion.         | 62          |
| 4.3.2 Patient's assessment of the denture                          | 64          |
| 4.3.3 Assessment of examination forms.                             | 64          |

## TABLE OF CONTENTS

|                                                                                                                                 | Page |
|---------------------------------------------------------------------------------------------------------------------------------|------|
| 5. Observation and Results                                                                                                      |      |
| 5.1 Selection of patients                                                                                                       | 65   |
| 5.2 Assessment of the questionnaire                                                                                             | 65   |
| 5.3 Clinical assessment of patients.                                                                                            | 65   |
| 5.4 Assessments from examination forms.                                                                                         | 65   |
| 5.4.1 Distribution of denture patients and dentures as related to age and sex.                                                  | 66   |
| 5.4.2 Distribution of type of partial dentures.                                                                                 | 66   |
| 5.4.3 The opposing dentitions                                                                                                   | 67   |
| 5.4.4 Denture usage habits                                                                                                      | 67   |
| 5.4.5 Tooth loss after denture insertion                                                                                        | 68   |
| 5.4.6 Partial loss of tooth tissue                                                                                              | 68   |
| i) Caries                                                                                                                       | 69   |
| ii) Tooth fracture                                                                                                              | 70   |
| 5.4.7 Condition of the oral mucosa                                                                                              | 71   |
| 5.5 Patient's assessment of the dentures.                                                                                       | 72   |
| 5.6 Relationship between the denture base material and the design of the denture component for the different types of denture . | 73   |
| 5.6.1 Denture bases                                                                                                             | 73   |
| 5.6.2 Artificial teeth                                                                                                          | 73   |
| 5.6.3 Rests                                                                                                                     | 73   |
| 5.6.4 Retainers                                                                                                                 | 74   |
| 5.6.5 Major connector                                                                                                           | 74   |

## TABLE OF CONTENTS

|                                                                              | Page |
|------------------------------------------------------------------------------|------|
| 5.7 Denture fracture and deformation                                         | 75   |
| 5.8 Dentist's assessment of the denture.                                     | 76   |
| 6. Discussion                                                                |      |
| 6.1 Recall methods                                                           | 78   |
| 6.2 Method of examination                                                    | 79   |
| 6.3 Denture usage habits                                                     | 80   |
| 6.4 The effects of removable partial dentures on the remaining oral tissues. | 84   |
| 6.4.1 Further loss of teeth after denture insertion.                         | 84   |
| 6.4.2 Partial loss of tooth tissue.                                          | 85   |
| i) Caries                                                                    |      |
| ii) Fracture of remaining natural teeth.                                     |      |
| 6.4.3 Inflammation of oral mucosa.                                           | 86   |
| 6.5 Design of the partial dentures.                                          | 89   |
| 6.6 Patient education                                                        | 91   |
| 7. Conclusion                                                                | 93   |
| <u>Section V</u> References                                                  | 94   |

## SECTION I

### INTRODUCTION

## 1. INTRODUCTION

Removable partial dentures are removable appliances intended to restore a partial loss of teeth and tissues and the accompanying loss of function and aesthetics. The important objectives in constructing these appliances are, the re-establishment and maintenance of the patient's health and well-being, and the preservation of his remaining teeth and tissues.

According to Carlsson et al.<sup>(1)</sup> there is an increase in the demand for partial denture service. They attribute this increase to earlier and improved conservative treatment, improved periodontal treatment and man's increased life span.

Partial dentures being appliances imposed upon the remaining teeth and tissues are also liable to cause disruption in the normal physiological functions. They can create unhygienic conditions and even traumatize the remaining teeth and gingival tissues. They have been considered responsible for initiating carious lesions in the remaining natural teeth. DeVan has called partial dentures "A device for losing one's teeth slowly, painfully and expensively".<sup>(2)</sup> Evidently appliances that do not contribute towards the health and well-being of the patient and do not preserve the remaining oral structures will have to be considered a failure in Prosthetic treatment.

An increased demand in the partial denture service<sup>(1,2,3,4,5)</sup> necessitates investigation of the effects of these appliances on the remaining teeth and tissues. A considerable amount of research has already been done and the information gathered has led to improved treatment methods.

## 1.1 Types of Surveys

The clinical surveys carried out have been of two types:

### 1.1.1 Longitudinal surveys

These constitute a long-term study of a group of patients issued with partial dentures. They are examined periodically to progressively assess the response of the oral structures to the particular partial denture treatment. Previous surveys of this type were done by Carlsson et al.<sup>(6-9)</sup>, and Bergman et al.<sup>(10,11)</sup>. A similar survey is in progress at the University of Sydney. These surveys yield very valuable information but require a lot of time available to the surveyor.

### 1.1.2 Crossectional surveys

These represent surveys based on a single examination of a group of patients who have been issued dentures for a certain length of time. The existing conditions are compared with those recorded at the time the dentures were issued. Crossectional surveys can be accomplished in a much shorter time. Although the information gained is not as extensive as from the longitudinal surveys, it is valuable and worthwhile.

Many crossectional surveys have been carried out in other countries<sup>(12-19)</sup> but this present survey is the first of its type in Australia and constitutes a continuing effort to evaluate the result of denture treatment and investigate its effect on oral tissues.

## 1.2 Objective of Surveys

This survey was carried out on patients who had removable partial dentures made at the Dental Faculty of the University of Sydney by students in the year 1976. Seventy-one patients were examined. The objective of the survey was to evaluate the results of denture treatment according to the following specifications: (i) usage of denture, (ii) further tooth loss after denture insertion, (iii) relation of the appliance to caries, (iv) relation of appliance to health of mucosa, (v) patient's assessment of the denture and (vi) physical conditions of the denture.

It is hoped that results of this survey may lead to some improvement in future clinical treatment, particularly by dental students at the University of Sydney.

SECTION II  
LITERATURE REVIEW

## 2. LITERATURE REVIEW

Partial dentures have been labelled as devices for losing one's teeth slowly, painfully and expensively . Many surveys and investigations have been carried out to evaluate the actual effects of these appliances upon the remaining natural teeth and tissues and the patient as a whole. These investigations can be categorized under five major headings:

- (i) effects upon denture usage,
- (ii) effects upon the abutment and non-abutment teeth,
- (iii) effects upon supporting tissues,
- (iv) retention and stability of the dentures related to success,
- (v) fracture of abutment teeth and denture components.

### 2.1 Effects upon Denture Usage

Derry and Bertram<sup>(16)</sup> classified denture usage according to the daily use of dentures as: (i) denture worn always, (ii) denture worn only during the day, and (iii) denture never worn. They describe the reasons why patients do not use their dentures as: (i) fractured retentive component of the denture, (ii) additional loss of teeth, (iii) parts of the denture irritating the tissues and causing gagging, and (iv) instability of dentures. They made observations in patients treated according to certain specific guidelines.

Earlier, Anderson and Lammie<sup>(12)</sup> examined over 300 patients. They found that non-usage of dentures was also related to types of dentures. Thus, Kennedy's class I dentures (bilateral free-end saddles) showed the highest incidence of non-usage. They

also considered the patient's personal factors such as oral hygiene, intelligence, motivation and general health to be related to patients' successful usage of dentures. They found that patients of lower intelligence were unprepared to put up with any discomfort immediately after insertion of dentures. Such patients discarded their partial dentures without any attempt to accommodate or get the dentures adjusted. They further observed that if the motive was strong enough, the patients used the dentures even when these were fractured and lacking in retention etc.

Similar observations were made by Anderson and Bates<sup>(13)</sup>. They related the patients' successful usage of dentures to the location of saddles according to Kennedy's classification. They also suggested that maxillary partial dentures show a higher percentage of success than mandibular dentures.

According to Tomlin and Osborne<sup>(15)</sup>, the denture base material also affected the patient's denture wearing habits. According to them, cobalt-chromium dentures were worn more constantly than acrylic dentures.

Design of partial dentures also seems to influence denture usage. This is pointed out by Derry and Bertram<sup>(16)</sup>.

Roberts<sup>(17)</sup> describes denture usage as constant usage, usage only during the day, when eating, spasmodic usage and never. He also relates denture failure to denture design. According to him, a mandibular Kennedy's class I (bilateral free-end saddle) has a much higher chance of failure than other types and upper partial dentures have higher success rates than the lowers. To increase the success rate of denture usage, he suggests a need for stricter patient selection, proper denture

design, combined with more effective patient education and motivation. He states that the patients who have "poor dental interest" i.e., the dentures are not asked for, but are recommended by the dentist have a higher chance of denture failure.

Koivumaa et al <sup>(9,14)</sup> also confirm the findings of Tomlin and Osborne <sup>(15)</sup>, Derry and Bertram <sup>(16)</sup> and Roberts <sup>(17)</sup> and consider the type of partial dentures according to Kennedy's classification related to the incidence of denture failure. They have listed the reasons given by the patients for discarding the dentures and not renewing them as: (i) the patients could not get used to the dentures, (ii) the dentures did not fit, (iii) they interfered with normal function, or phonation, or (iv) that something had gone wrong with the dentures after a brief period of usage and the patients discovered that they could manage without the dentures.

Nakazawa <sup>(18)</sup> reported a progressive fall in the number of dentures being used over a sixteen-year period under survey. He attributes this fall to breakage of dentures, poor fit of dentures, caries and loss of abutment teeth and the pain associated with denture wearing. He also observed that some patients considered artificial dentures as foreign bodies.

Rantanen et al <sup>(19)</sup> investigated partial dentures retained by precision attachments and reported a success rate of 94 per cent, of which 23 per cent used the denture only during the day. The six per cent of patients who seldom wore the dentures considered some defects in the dentures such as wrong shade, sharp margins, nausea, premature contacts or even overextended peripheral and palatal margins and faulty fitting responsible for their inability to wear the dentures.

## 2.2 Effects upon the Abutment and Non-abutment Teeth

The effects have been studied under three headings:

- (i) carious involvement of abutment and non-abutment teeth,
  - (ii) mobility of abutment and non-abutment teeth, and (iii)
- periodontal condition of the remaining natural teeth.

### 2.2.2 Caries

The increased occurrence of caries associated with partial dentures has led to controversy regarding partial dentures being suitable prosthetic appliances. Though caries was high in denture wearers, many clinicians (8,10,13,15,16) did not believe that partial dentures themselves were the primary cause. They found that many other inter-related factors were involved such as denture wearing habits, oral hygiene habits, regularity of dental check ups, some denture designs and age and sex of the patient.

#### Denture Wearing Habits

Anderson and Bates<sup>(13)</sup> found that caries was rarely seen under occlusal rests or clasps and was noticed only in patients who habitually wore dentures at night. Makila et al<sup>(20)</sup> concurred with Anderson and Bates<sup>(13)</sup> and reported that caries developed more often in the direct than the indirect abutments and the indirect abutment teeth were carious more frequently among patients wearing dentures "always" than those wearing them only in the "day time".

### Oral Hygiene Habits

Seemann<sup>(21)</sup>, Addy and Bates<sup>(22)</sup> and Ghamrawy<sup>(23)</sup> found a significant increase in dental plaque deposition after patients had had their dentures for a period of time. In the survey by Koivumaa et al<sup>(9,14)</sup> caries was found in 41 of the 44 abutment teeth for bilateral free-end saddles, and 43 of the 74 for other denture types. Again, this was related to oral hygiene of the patient. In their thirteen-year follow-up survey, they confirmed that oral hygiene was the most important factor in preserving the remaining teeth. They conclude that when drastic changes occurred, these were most likely to be due to unsatisfactory oral hygiene with local periodontal and carious lesions as the end products.

Nakazawa<sup>(18)</sup> found that 60 per cent of caries occurred on the proximal sides of the abutment teeth adjacent to the edentulous saddles and pointed out that the dead space between the teeth and denture tended to trap food debris and plaque. He said: "When good oral hygiene was maintained the percentage of caries on abutment teeth was lower." In the survey by Bergman et al<sup>(10-11)</sup> five carious teeth were found in a total of 29 patients. In their survey, all patients were taught about dental care and how to maintain good oral hygiene which was checked at every clinical visit. Bergman et al<sup>(10-11)</sup> believed that with careful planning of the prosthetic treatment and with proper oral and denture hygiene followed by regular recall visits, the partial denture would cause very little damage to the remaining teeth.

### Regular Recall Programme

Regular recall programmes are recommended in most of the surveys so that the remaining teeth can be preserved as long as possible; good oral hygiene can be supervised and maintained and dentures adjusted when needed.

However, although these recommendations were made, only one survey actually dealt with this factor alone. In a longitudinal study by Bergman et al (10-11) after two years of denture usage only five carious teeth were found. Their patients were checked yearly and necessary instruction, scaling and prosthetic correction were being given. After six years of follow up, they reported that 21 of the 29 patients had not developed caries.

The other surveys were conducted over varying periods of time e.g., 1, 2, 4, 9 and 13 years but a regular recall programme was not included in the surveys.

Derry and Bertram<sup>(16)</sup> reported that after two years of denture usage, only 34 teeth (11% of all of the teeth) were severely decayed. On the other hand, Carlsson et al (6-9,14) reported that 41 of the 44 abutment teeth for free-end saddles, and 43 of the 74 abutments for other types of dentures were decayed after four years of denture wearing; thirteen years later, the same group of patients was investigated, and the result showed that most of the patients were in need of some dental treatment. Three who had not visited their dentist for a long time had deep caries in several of the residual teeth, while those who had visited their dentists during that period had only superficial caries.

Nakazawa<sup>(18)</sup> states, "...the longer a partial denture is used the higher the percentage of caries occurring on the abutment teeth becomes."

It is difficult to compare the results of these surveys as they did not follow the same criteria for teeth, patients and time of denture usage but generally after establishing that caries did increase, they all recommend regular recall appointments as a necessity.

#### Denture Design

The relation of partial denture design to caries has been discussed under three headings: (a) type of denture, (b) design of denture components, and (c) abutment and non-abutment teeth.

##### a. Type of denture

Tomlin and Osborne<sup>(15)</sup> and Carlsson et al<sup>(14)</sup> have indicated a greater incidence of caries in patients wearing Kennedy's class I type of dentures. Comparative studies on other types have not been done.

##### b. Denture components

Although Tomlin and Osborne<sup>(15)</sup> reported carious involvement of teeth under lingual plates, Schwalm et al<sup>(24)</sup> refute the contention and suggest that caries under the lingual plates was considerably less compared to surfaces of teeth contacted by other components of the removable partial dentures.

Nakazawa<sup>(18)</sup> observed that there was a greater incidence of caries under such complicated clasp designs as back action,

reverse back action, half and half clasp, etc., and that the incidence of caries was lower under cast clasps than wrought wire clasps.

c. Abutment and non-abutment teeth

Makila et al.<sup>(20)</sup> suggested that the incidence of caries is higher in direct abutment teeth than in indirect abutment teeth.

Derry and Bertram<sup>(16)</sup> also found a greater incidence of caries in teeth coming in contact with the denture and observed that exposed cementum was the commonest site of carious involvement.

Bergman et al.<sup>(10-11)</sup> also present similar views.

Rantanen et al.<sup>(19)</sup> observed that the abutment teeth that were crowned showed a much lesser incidence of caries than uncrowned teeth as reported by Carlsson et al.,<sup>(8)</sup> Derry and Bertram<sup>(16)</sup>, and Makila et al.<sup>(20)</sup>. Similarly Schwalm et al.<sup>(24)</sup> reported a noticeable lack of caries in crowned teeth in all Kennedy's classifications.

Nakazawa<sup>(18)</sup> also found a higher incidence of secondary caries on abutment teeth with amalgam or resin fillings.

Age and Sex

Only a few surveys mentioned age and sex as possible factors relating to the incidence of caries under dentures. Tomlin and Osborne<sup>(15)</sup> said that because the patients in their survey were in the age group 35-45, they found a lower incidence of caries. Nakazawa<sup>(18)</sup> reported that the percentage of caries occurring on abutment teeth increased until 49 years

of age, and decreased at 50 years and afterwards. However, he did not assert that age had any relation to the number of carious lesions on healthy abutment teeth.

Carlsson et al <sup>(14)</sup> found that 51 per cent of male and 23 per cent of the female denture wearers developed caries, but they believe that oral hygiene was the more important factor. In their survey 60 per cent of males were deficient in oral hygiene while only 30 per cent of females showed any neglect.

### 2.2.2 Tooth mobility

In a longitudinal study, Carlsson et al <sup>(6-8)</sup> found that after the first year of denture usage there was an increase in tooth mobility and it was greatest in the abutment teeth. In the second year, several abutments had axial as well as lateral mobility. The fourth year follow-up results showed a continued increase of tooth mobility. They further found that when a tooth showed more than second degree mobility, changes of alveolar bone margins became apparent in radiographs. They did not find any increase or change in tooth mobility in non-denture users. Their study was limited only in the free-end saddle patients.

On the other hand, Derry and Bertram <sup>(16)</sup>, Bergman et al <sup>(10-11)</sup> and Schwalm et al <sup>(24)</sup> reported no significant changes in abutment mobility. Their studies included all types of dentures.

Derry and Bertram <sup>(16)</sup> relate abutment mobility to inadequate rigidity of major connectors and insufficient support for the appliance against tissue-ward movements of the saddles resulting in non-uniform dispersion of masticatory stresses.

Bergman et al<sup>(10-11)</sup> and Schwalm et al<sup>(24)</sup> also relate tooth mobility to improper denture design and advocate the necessity of excellent oral hygiene.

Nakazawa<sup>(18)</sup> found that the increase in mobility of the abutment teeth varied according to age, number of remaining teeth, shape and type of the retainer used, denture cleaning habits, and stability and retention of dentures. Old age, fewer remaining teeth (1-6 teeth), cast clasps, resin base dentures, poor denture hygiene, and poor stability and retention caused an increase in abutment mobility. He found that prolonged use of partial dentures also increased abutment mobility.

The above surveys are difficult to compare because none have used the same criteria to measure tooth mobility and the examiners did not use a measuring device. They only made visual estimates. Therefore, differences in results could be due to differences in criteria, differences between the examiners of different surveys and inconsistency of human judgement over a period of time. Bergman et al<sup>(11)</sup> advised that their results be viewed with caution as the parameters were based on subjective evaluations.

The degree of tooth mobility also varied in different mouths and in the same mouth at different times of the day, with different general physical conditions of patients or physiochemical changes in the supporting structure from occlusal trauma<sup>(25)</sup>.

There were some clinical studies which measured tooth mobility by the use of special devices such as periodontometer by Muhlemann<sup>(26)</sup>, mobilometer by Plotnick et al<sup>(27)</sup> and an

electrical device by Goto<sup>(28)</sup>. Both Plotnick et al<sup>(27)</sup> and Goto<sup>(28)</sup> reported that there was an increase in mobility of abutment teeth following placement of removable partial dentures and a decrease after a period of wearing as teeth became stabilised by dentures. They did measure tooth mobility in individuals before denture insertion and used it as an individual mean, thus avoiding statistical error according to various degrees of tooth mobility in different mouths.

### 2.2.3 Periodontal conditions.

Periodontal tissue changes of denture patients are related to: (i) oral hygiene, (ii) denture usage, (iii) number of abutment and non-abutment teeth involved with the dentures, and (iv) number of remaining teeth and type of dentures according to Kennedy's classification and the morphological characteristics of maxillary and mandibular arches.

Seemann<sup>(21)</sup> found that the periodontal index was higher in teeth involved in the denture design than in those not involved. Ghamrawy<sup>(23)</sup> also found that wearing partial dentures increased the formation of plaque on all tooth surfaces. It is generally believed that wearing of partial dentures increases the opportunity for food lodgement and limits the natural cleansing action by tongue, lips and cheeks<sup>(21,29)</sup>. The increase in dental plaque leads to gingival inflammation and may progress to periodontal disease<sup>(21,23,30-32)</sup>.

Bergman et al<sup>(11)</sup> are of the opinion that introduction of a plaque control programme and its emphasis upon the patients, accompanied by a recall system results in no significant changes regarding plaque index, gingival index and periodontal pocket depth.

Poor oral hygiene is the most common cause of gingival inflammation. Before denture construction begins, good oral hygiene must be established to avoid further loss of teeth due to either periodontal disease or caries caused by wearing dentures. Carlsson et al <sup>(8)</sup> reporting on their longitudinal survey of 66 bilateral free-end saddle denture patients stated that; "On the basis of the high correlation between oral hygiene on the one hand and dental and periodontal lesions on the other, observed at the earlier follow-up and again confirmed after 4 years, it would seem justified to conclude that where a high standard of oral hygiene is observed, a partial denture can usually be well tolerated by the oral tissues without risk of pathologic alteration."

Carlsson et al <sup>(6-8)</sup> also reported the incidence of inflamed margins around abutments to be higher with full-time denture wearers than with day-time wearers. According to them, gingival inflammation of the abutment teeth increased distinctively in the first year and remained at the same high level throughout subsequent years.

Makila et al <sup>(20)</sup> state that deepening gingival pockets were more frequent when the dentures had been worn for more than 18 months, than with a wearing time of 6-18 months. The gingiva surrounding the direct abutments showed more inflammation than that around the indirect abutment teeth.

The number of teeth remaining in the mouth was also related to gingival inflammation. Nakazawa <sup>(18)</sup> found that all abutments in patients with 2-5 remaining teeth showed gingival deterioration but only 58 per cent of patients with 6 or more remaining teeth showed any deterioration of the abutments.

Gingivitis was more frequent in Kennedy's class I patients than in Kennedy's class II; and was more in the lower than in the upper jaw.

### 2.3 Inflammation of the Supporting Tissues

According to Razek and Shaaban<sup>(33)</sup>, changes in the denture bearing oral mucosa following the insertion of a removable denture prosthesis may be histopathological and/or histochemical in nature despite the normal clinical appearance of the tissue. They conclude that, "A denture stimulates the underlying mucosa for the first 3 years. A healthy mucosa results, showing slight hyperkeratinization and increased enzymatic activity. After 3 years there are atrophic changes which can lead to inflammatory changes. There is also a reduction in enzyme activity associated with wearing dentures for more than 3 years. Remaking the dentures after 3 years increases the enzymatic activity of the alveolar mucosa."

Carlsson et al<sup>(6)</sup> reported that after a period of one year, 11 per cent of the saddle areas in denture wearers showed inflammatory reactions and some patients showed denture ulceration, whereas no inflammation could be found in non-denture wearers. Inflammation was more frequently seen in patients wearing dentures day and night than in those using them during the day-time only. They also found that the denture supporting mucosa of the maxillary denture was inflamed more frequently than the mandibular mucosa.

Nakazawa<sup>(18)</sup> also made similar observations. He found that inflammation on the maxillary mucosa was twice as common as that on the mandibular mucosa.

Roberts<sup>(17)</sup> reported that only 67 of the 224 subjects in his survey had normal soft tissues. Others had either painful or reddened saddle areas, or showed irritation from connectors or inflammation associated with food impaction. Stability of dentures in the surveys was described as poor and some dentures had broken occlusal rests. In examining patients with palatal inflammation, Derry and Bertram<sup>(16)</sup> also found that poor stability was associated with every case of inflammation.

Carlsson et al<sup>(1,8)</sup> found that in bilateral free-end saddles, rotation about the occlusal rests followed resorption of the saddle areas and caused inflammation of mucosa and the gingival margins around the indirect abutment teeth. It also caused the lingual bar to exert pressure on the mucous membrane on the lingual aspect of the alveolar ridge.

Tomlin and Osborne<sup>(15)</sup> explained the inflammation of the mucosa under a linguoplate in Class I lower dentures, in terms of bone resorption under the saddles, causing the lower part of the linguoplate to move forward and to apply pressure to the underlying mucosa resulting in inflammation. In their survey, they found that 35 per cent of dentures of this type needed rebasing.

Another possible factor relating to the inflammation of the supporting tissue is denture cleanliness. Nakazawa<sup>(18)</sup> reported that 36 per cent of patients had inflamed soft tissues and 31 per cent had physical changes in the supporting tissues. Poorly cleaned dentures were claimed to cause a higher incidence of physical change and inflammation than well cleaned dentures. He also found that where a denture border contacted the gingival margins of remaining teeth, physical changes occurred.

Mucous membrane responds differently to different dental materials. The studies by Bissada et al <sup>(30)</sup>, Anderson and Bates <sup>(13)</sup>, and Nakazawa <sup>(18)</sup> found that the quality of tissue response to metal base dentures was superior compared with resin bases. However, gingival areas not covered by the denture base showed the least degree of inflammation.

A study by Plotnick et al <sup>(27)</sup> showed that the resorption of supporting bone and loss of mucous membrane occurred when lower removable partial dentures were worn; and the amount of resorption varied according to the type of opposing dentition, and it increased with time.

#### 2.4 Retention and Stability of Denture

When first issued, all partial dentures are retained directly by active retaining components. Over a period of time the direct active retention is lost. This loss of retention is related to not only the length of the period of usage of dentures but also to metal fatigue and fracture of retainers and other denture components <sup>(13,14,15,16)</sup>.

Koivumaa et al <sup>(14)</sup> found that wrought gold alloy retainers showed a lower incidence of loss of activity than retainers of cast cobalt-chromium alloys and wrought stainless steel. They also indicate that differences in the form of the retainers did not influence the loss of this activity, and that after four years of usage 30 per cent of the dentures lost their active retention.

Roberts <sup>(17)</sup> found that only 43 per cent of the dentures examined had good active retention, while in the rest of the dentures although adaptation of the clasps was classified as

good there was no active retention. Bergman et al<sup>(11)</sup> found that the loss of clasp retention was more common in the lower partial dentures than in the upper.

Bates<sup>(34)</sup> suggests four possibilities for the partial denture clasps to lose their active retention: (i) a polishing or abrading action of the metal against the tooth, eliminates some of the frictional resistance; (ii) clasps abrade the surfaces of the teeth and eliminate the undercuts into which they were placed; (iii) the patient may not insert or remove the denture along the planned path of insertion and may therefore cause a greater deflection on the clasp arms than was intended; and (iv) the teeth move due to migration and/or mobility whilst wearing partial dentures. However, his investigations showed that deflection of clasps occurred when the path of insertion of a partial denture was changed, and that migration and mobility of the clasped teeth were likely to be the causes of lost retention. He found that abrasion of enamel or loss of friction of the clasps was too little to affect denture retention.

Most patients do not complain about the loss of active retention, because the function is taken over by the oral and jaw muscles, which have learnt to hold the dentures in place<sup>(13-16)</sup>. Koivumaa et al<sup>(14)</sup> in their survey reported that after one year, 44 per cent of the retaining clasps exhibited no active retention, but only 18 per cent of dentures showed unsatisfactory retention.

Tomlin and Osborne<sup>(15)</sup> examined 123 dentures that were being worn constantly. They found inadequate retention even though the patients felt the retention was good. They also considered reflex muscular control an important influence in partial denture retention.

Derry and Bertram<sup>(16)</sup> suggest that, "Perhaps active retention is helpful in the early phase of denture use as the patient learns to adjust to his prosthesis, but factors such as stability, saddle extension and muscle function become increasingly important." They found that for the patient, stability of partial dentures was more important than active retention.

The loss of stability of dentures is considered to be the result of ridge resorption, mucosal changes and changes in occlusion. In the clinical survey carried out by Derry and Bertram<sup>(16)</sup>, twenty-three per cent of dentures had poor stability. This in combination with constant usage was claimed to be the cause of inflammation under the palatal elements of the dentures.

Alveolar bone resorption is claimed to be higher in patients wearing dentures. During the six-year period of survey, Bergman et al<sup>(11)</sup> rebased or relined the lower removable partial dentures of 12 patients nineteen times because of changes and injuries to the oral tissues. They support the recommendation that patients wearing removable partial dentures should be checked regularly to allow for the necessary prosthetic adjustments to be made.

Changes in the shape of the alveolar ridge in denture wearers were reported by Carlsson et al<sup>(1)</sup>. They found a rapid bone resorption and reduction in the height of the edentulous mandibular ridge in denture wearers. No such changes were seen in patients without dentures. The resorption of alveolar bone was considered to be due to: (i) partial dentures exerting direct pressure on underlying bone, and (ii) the dentures causing deterioration of the abutment periodontium. They indicated that resorption of alveolar ridges led to the loss of retention and stability, loss of balanced occlusion and articulation, and produced inflammation of the denture bearing mucosa due to the consequent traumatic effects of dentures.

## 2.5 Fracture of Abutment Teeth and Denture Components

Derry and Bertram<sup>(16)</sup> found amalgam restorations that had fractured during a 24-month period of partial denture usage. They believe that the preparation of occlusal rests in the amalgam fillings weakened the restorations and led to fractures under masticatory force.

Fracture of denture components: Derry and Bertram<sup>(16)</sup> and Carlsson et al<sup>(6)</sup> have reported fractures of occlusal rests. Carlsson et al<sup>(6)</sup> suggest that the fracture rate was lowest in wrought gold wire and highest in wrought stainless steel wire. They suggested the reason for fracture as ridge resorption which resulted in excessive movement of the denture leading to fatigue failure of the rest.

Anderson and Bates<sup>(13)</sup> have reported fractures of white gold wire retainers that were soldered to cast occlusal rests. They suggest the cause of fracture as faulty soldering technique (over-heating).

Nakazawa<sup>(18)</sup> reported 22 per cent of fractures in his first survey, 16 per cent in the second and 16 per cent in the third survey in three different groups of patients. The difference in the percentage incidence of fractures in the first survey and that in the second and third surveys may be due to the fact that there were more cobalt-chromium denture bases in the later surveys than in the former. He also found that fractures of the resin denture bases were four times more frequent than the metal denture bases.

According to Bates<sup>(35)</sup>, cobalt-chromium alloys have become a popular material for partial denture bases because of high qualities and reasonable price, but fracture failure is still

high compared to gold alloy. He considers the fracture of cobalt-chromium dentures to be due to: (i) defects in the casting such as air bubbles; (2) physical properties of the alloys used; (3) the improper shaping of highly stressed sections of the casting; and (4) fatigue of the cobalt-chromium alloy.

Harcourt<sup>(36)</sup> examined 160 fractures of cobalt-chromium dentures and explained that defects and weakened structure of the alloy at the fracture site, were responsible for the failure.

Bates<sup>(37)</sup> studied the character of stresses occurring in the retentive arms of clasps and in the lingual bars. He found that the stress in a retentive clasp arm was at the proportional limit and very near to the fatigue limit. Therefore, fracture could occur in badly designed clasps. In a lingual bar, on the other hand, the stress level was roughly half that of the proportional limit, and much below that of the fatigue limit but according to him the greater frequency of application of stress on the lingual bar could still cause fracture.

Apart from the properties of the alloy itself, shape, size and length of denture components also influences fractures<sup>(35,37,38)</sup>.

Earnshaw<sup>(38)</sup> studied the fatigue stress of alloys and demonstrated the fracture of struts attaching a clasp unit to the lingual bar. His explanation for the failure was that the struts were improperly shaped; they were thinned where they crossed the gingival margin of the abutment teeth, and this

resulted in fatigue fractures. He explained fatigue fracture as the result of repeated loads which though not high enough to produce observable distortion, can cause fracture after a period of time.

SECTION III

PHILOSOPHY

OF

REMOVABLE PARTIAL DENTURE TREATMENT

AND

INDICATIONS

### 3. PHILOSOPHY OF REMOVABLE PARTIAL DENTURE TREATMENT AND INDICATIONS.

#### 3.1 Definitions and Objectives

A partial denture is introduced to aid in the preservation of oral health and the maintenance of adequate oral function. The philosophy of this treatment has been abused by the patients, through lack of understanding, and by the dentist through carelessness<sup>(39-42)</sup>. S. Francis Fish<sup>(43)</sup> presents this very eloquently. He states, "To the patient, the denture is an assemblage of items each of which is intended to replace one natural tooth. To the dentist the denture is one part of the treatment of the mutilated dentition, one of a number of measures to protect the patient from the consequences of the loss of the teeth".

#### 3.2 Consequences of Loss of Teeth

Fish<sup>(43)</sup> tabulates the consequences of the loss of teeth as: (i) migration of teeth in mesio-distal direction, (ii) depression of teeth into the alveolar bone due to heavy stress concentration on a few remaining teeth, (iii) deviation of mandible, laterally and antero-posteriorly to secure the most efficient occlusal contact when missing teeth result in loss of normal intercuspation, (iv) localised attrition due to concentration of functional load on only a part of the arch, (v) gross disorientation of occlusal relationship due to over-eruption of teeth, and (vi) loss of alveolar bone following tooth extraction. He also makes the

comments that changes in relationship of teeth affect the functional and dynamic relationship between mandible and maxilla or the masticatory system as a whole; also preservation of teeth in partially edentulous patients has the same significance as preservation of the so called "basal" bone in edentulous patients and results in the postponement of the edentulous state particularly in young patients.

These views are also supported by Koivumaa (41) Osborne et al (44) and Steffel (42).

### 3.3 Types of Partial Dentures

The partial denture prostheses may be: fixed partial dentures, e.g. crowns and bridges, or removable partial dentures. According to Koivumaa et al (4) the type of prosthesis to be constructed depends chiefly upon the condition and numbers of the remaining natural teeth, the condition of alveolar process and mucosa, and the amount of functional force anticipated on the appliances in the particular patient.

#### Indications of Fixed and Removable Partial Dentures

Clarke (45) suggests that before any appliance can be loaded onto the remaining natural teeth, they should be subjected to careful radiographic, occlusal and periodontal assessment, also examined should be inter and intra-arch relationship, and the direction and magnitude of occlusal forces. It is generally regarded that with fixed partial

dentures the axial and non-axial forces can be counteracted more adequately than with removable partial dentures.

However, there are some specific indications for using removable partial dentures (46). Some of these are:

- 1) unilateral or bilateral free-end saddles which would require impracticable cantilever fixed appliances. The functional stresses on such appliances would produce tilting forces on abutment teeth and would need abutments with supernatural anchorage to counteract this leverage. Removable appliances are the only satisfactory alternative;
- 2) a long edentulous span where total available tooth support is inadequate for satisfactory dispersion of functional stresses resulting from the large occlusal table;
- 3) aesthetics, in the anterior region where a number of anterior teeth are missing or where better tooth arrangement, contour, and shading are possible only through the use of removable partial dentures;
- 4) excessive loss of residual bone where a removable partial denture permits the location of the artificial teeth in a more favourable position to the lip and the opposing dentition regardless of the shape of the residual ridge;
- 5) after recent extraction where changes in the residual ridge are expected and subsequent rebasing will be required;
- 6) some patients may be averse to cutting and shaping of the natural teeth for the abutment crown, etc.;
- 7) need for bilateral bracing where the removable denture can act as a periodontal splint and provide effective across the arch support for the weakened teeth;
- 8) economic consideration or a temporary appliance for future treatment.

Carlsson et al <sup>(1)</sup> state that in patients with few remaining teeth a removable partial denture is needed for:  
(i) stabilising the mandible against the maxilla by restoring molar support and improving the balance of the whole masticatory apparatus; and (ii) distributing load over the occlusal area and possibly promoting a more efficient masticatory function.

Plotnick et al <sup>(27)</sup> reported achievement of 50 per cent chewing efficiency when lower removable partial dentures were worn.

Furthermore, partial dentures prevent migration or drifting of the adjacent teeth, depression of the teeth by heavy stress, localised attrition or traumatogenic occlusion, gross disorientation of occlusal relationship by over-eruption of the opposing tooth/teeth, and loss of alveolar bone due to atrophy. According to Graham <sup>(47)</sup>, migration and tilting of teeth adjacent to the edentulous space results in loss of tooth contacts and so develops food impaction areas.

McLane <sup>(48)</sup> prefers removable partial dentures to fixed bridge because according to him the former are less expensive and restore the masticatory function and aesthetic appearance as adequately as the latter.

### 3.4 Denture Design

Denture design is based upon an accurate assessment of conditions existing in the mouth such as the number, condition and position of remaining teeth, state of gingival health, amount and shape of the residual alveolar bone, tooth mobility, activity of oral muscles and occlusion <sup>(3-5, 49-57)</sup>.

Aesthetics also influences denture design and is generally the principal concern of the patient. The mouth conditions vary in every patient, and accordingly the design of different components of the denture can be varied as long as sound general principles are followed.

An appropriate partial denture design should:

1. Produce an equitable distribution of forces on the remaining teeth and tissues.
2. Prevent undesirable movement of the denture.
3. Provide stability during function.
4. Contribute towards the maintenance of health of the remaining oral tissues.

#### 3.4.1 Distribution of Forces

Henderson and Seward (58) state, "Preservation, the primary objective of a removable partial denture service, can be realized only when forces are optimally distributed." In the mouth, the natural teeth are subjected to vertical forces acting along the long axes of the teeth and horizontal forces acting in mediolateral, anteroposterior and oblique directions.

Teeth are naturally equipped to dissipate the stresses of mastication throughout the skeletal frame of the masticatory system. The forces acting in the different parts of the dental arch differ in direction and magnitude. Accordingly natural teeth have varying numbers of roots and so the system of anchorage in different parts of the mouth is different. The periodontal membrane acts as a shock

absorber and helps the teeth to withstand forces of mastication as well as any excessive occlusal stresses, lateral pressures and axial rotation (52, 59).

In partially edentulous patients, if the stresses acting on a long saddle replacing many teeth are brought to bear upon only a few remaining natural teeth, the magnitude of the stresses will exceed the physiological limit of tolerance of the teeth and will result in their breakdown and failure of the treatment (60).

Maxfield et al (61) found that during normal mastication of food, the individual abutment teeth could be subjected to loads as high as 2 kg or even more. Considering this possibility, care must be exercised to select very healthy abutment teeth.

In partial denture patients, the masticatory stresses are also borne by the residual alveolar ridges and the maxillary and mandibular oral surfaces. These areas consist of cancellous bone covered by a varying quality and quantity of soft displaceable mucoperiosteum and are not naturally equipped to take masticatory stresses (62). The areas absorb the stresses of mastication through the cushion effect of the covering mucoperiosteum. The physiological limit of tolerance of these tissues is lower than the teeth. In properly designed partial dentures, the remaining natural teeth take up most of the masticatory forces acting on the artificial teeth in the edentulous spaces. If these forces were transmitted to only the alveolar ridge spaces vacated by the lost natural teeth, the forces will exceed the physiological limit of tolerance of the mucoperiosteum and

the alveolar bone and will produce trauma, discomfort and failure of the appliance.

Korber as quoted by Osborne et al<sup>(44)</sup> found that the capacity of the denture foundation to carry loads was directly proportional to the length of its circumference rather than its area.

Equitable dispersion of masticatory forces also depends on the amount of biting force. This in turn is influenced by such factors as age, sex and muscle activity. Christidou et al<sup>(63)</sup> found that males or young patients had greater biting force than females or older patients.

Both the remaining natural teeth as well as the residual alveolar ridges and the maxillary and mandibular foundation surfaces can be used for stress distribution. The greater the magnitude of forces, the greater should be the number of remaining natural teeth sharing the forces and more extensive should be the tissue contact surfaces.

Partial dentures may be:

(i) entirely tooth supported in which case the stresses are distributed only on the remaining natural teeth,

(ii) entirely tissue supported when the stresses are transmitted only through the maxillary and mandibular denture foundation areas, and

(iii) mixed support dentures in which case some parts of the appliance rest on the mucoperiosteum and other parts on the remaining natural teeth.

In the first two types of dentures, that is the entirely tooth-supported and the entirely tissue supported, the consistency of the supporting tissues being more or less

uniform, the equitable distribution of stresses is simple; but in mixed support dentures, the difference in the consistency of the teeth and tissues requires the establishment of a balance between the support gained from the teeth and the support gained from the tissues. Failing this, there will be undesirable movements of the denture.

Shohet<sup>(25)</sup> draws attention to this by saying, "To control these stresses and to distribute them intelligently between mucosa and supporting teeth requires the careful consideration of: 1) the condition of teeth and mucosa, 2) the impression techniques, 3) denture design, and 4) the distribution of stress between the mucosa and as many supporting teeth as possible."

#### 3.4.2 Prevention of Undesirable Movements

Removable partial dentures move during function because they are not rigidly attached to abutment teeth and also because of the dissimilarity of the supporting structures, i.e. teeth and mucoperiosteum. Excessive movement of the denture can damage supporting tissues<sup>(29,58,64-65)</sup>.

Carlsson et al<sup>(1)</sup> described a consistent vertical movement in the bilateral free-end saddle dentures during chewing. This vertical movement may be directed towards the tissues or away from them. The occlusal rests would be required to limit vertical movement towards the tissues and retentive clasps to counteract the movement away from the tissues.

Henderson and Steffel<sup>(66)</sup> describe three possible movement patterns in the bilateral free-end saddle dentures. These are:-

- (i) A rotation about an axis formed by the two principal occlusal rests. (Fig. 1A)
- (ii) A rotation about a longitudinal axis as the individual free-end saddle moves in a rotary direction about the residual ridge. (Fig. 1B)
- (iii) A rotation of the appliance about an imaginary perpendicular axis located near the centre of the dental arch. (Fig. 1C)

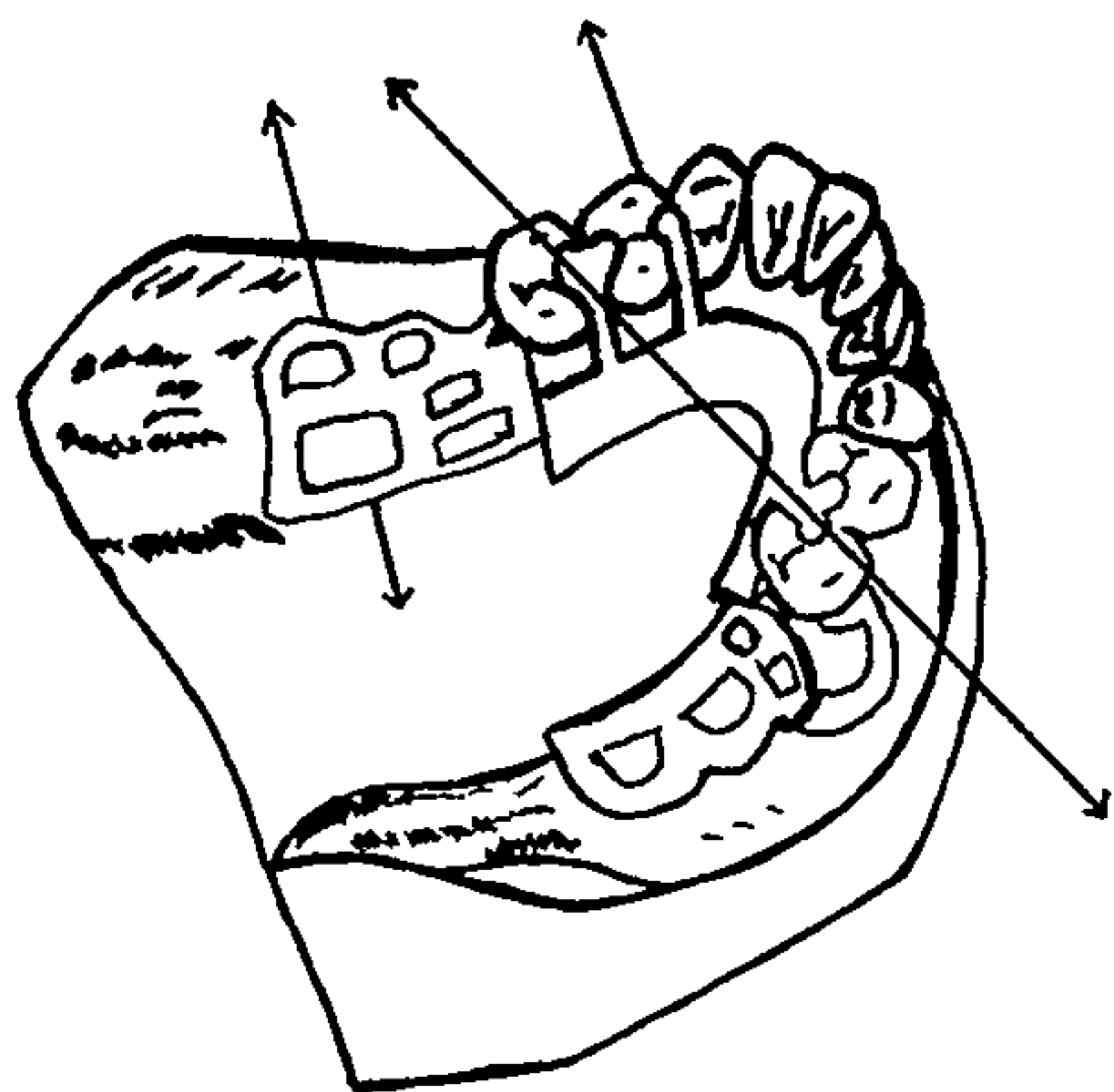
These movements cause the denture to act as a lever which tilts the abutment teeth. Tilting and twisting forces or torque may cause severe damage to the abutment teeth and periodontal tissues producing rapid resorption of the alveolar bone.

#### 3.4.3 Provision of Stability during Function

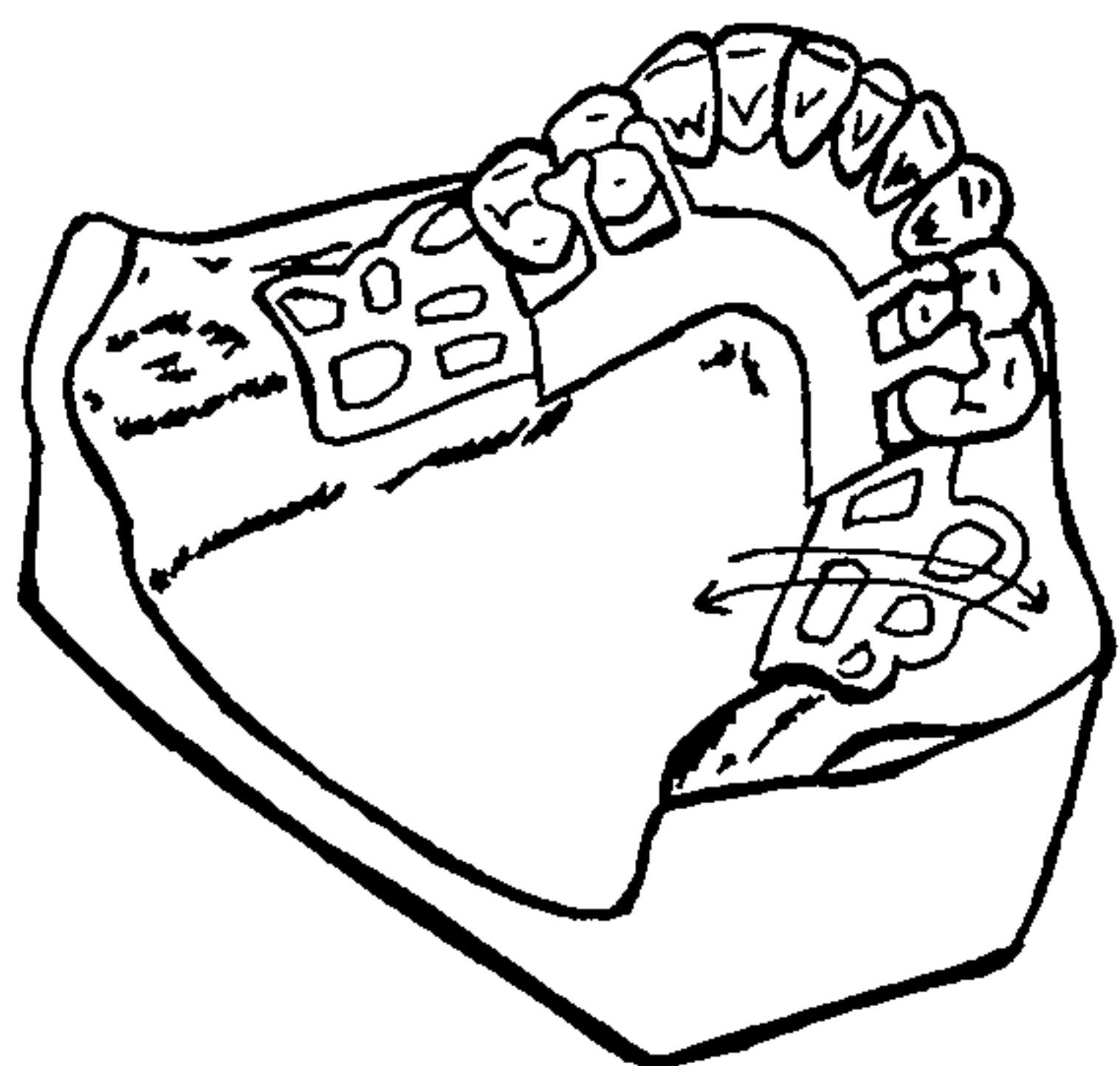
Non-uniform distribution of forces on the denture may result in certain parts of the denture moving towards the tissue and others away from the tissue. These movements may be such that they may either result in trauma to the remaining teeth and tissue or displacement of the denture from its seat forcing an interruption of function. Derry and Bertram<sup>(16)</sup> state that most of the patients examined in their survey were unaware of the lack of active retention and were using the denture successfully, but those patients who were unable to use the denture invariably complained of denture instability.

The movement of the denture towards the tissues can be prevented by suitably located occlusal rests in tooth-borne dentures and by increasing the foundation surface area covered by the dentures in tissue-borne dentures. In cases with mixed support such as free-end saddles, the saddle coverage would have to be sufficiently

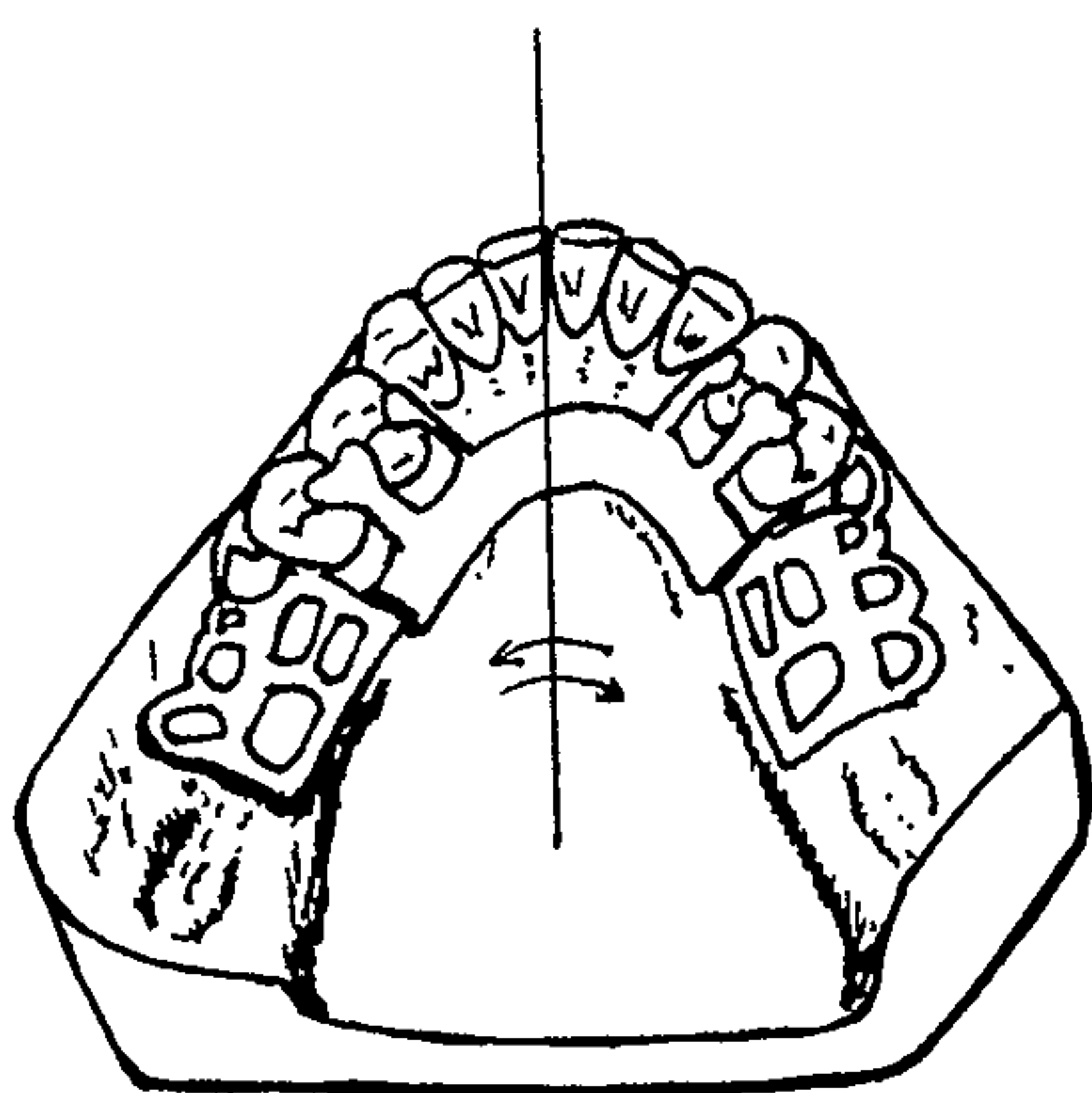
Fig. 1. Three possible movements of a distal extension partial denture.



- A. Rotation around the fulcrum line passing through the two principal occlusal rests when the denture base moves toward the supporting residual ridges.



- B. Rotation around a longitudinal axis formed by the crest of the residual ridge.



- C. Rotation around a vertical axis located near the center of the arch.

increased to match the support gained from the teeth. The principle of selective compression of mucoperiosteum may also be used to achieve balance between teeth and tissue supports.

The horizontal and oblique forces also produce undesirable mediolateral and antero-posterior movements of the denture.

An equitable distribution of forces and control over the movements can also be affected by providing adequate contact between the axial surfaces of the teeth and the denture<sup>(67-68)</sup>.

#### 3.4.4 Maintenance of Health of the Oral Tissue

The principal objectives of a removable partial denture are to restore the lost components of the masticatory organ, re-establish continuity of the dental arches and recreate a state of functional harmony among the different parts of the remaining masticatory system and the dentures. The achievement of these objectives is dependent upon proper design.

Most of the clinical surveys establish the necessity of oral hygiene as a fundamental finding<sup>(6-24)</sup>. Tomlin and Osborne<sup>(15)</sup> consider increased incidence of caries and gingival inflammation under wide lingual plates due to poor oral hygiene. Nakazawa<sup>(18)</sup> has related complex clasp design to increased incidence of caries for similar reasons. However, some surveys have actually shown healthy gingival tissue and mucosa in partial denture patients where oral hygiene was given proper importance in denture design and during denture usage<sup>(10-11, 24)</sup>.

The philosophy and the involved principles as summarised above are generally accepted and incorporated in the teaching programmes of this institution.

### 3.5 Denture Components and their Functions

Removable partial dentures consist of:

1. Saddles carrying the artificial teeth in a suitable denture base.
2. Means of support
3. Means of retention
4. Connectors.

#### 3.5.1 Saddles

These are parts of the denture that occupy the edentulous spaces. They consist of (i) the denture base which comes in contact with the surface of the edentulous space and also reproduces the labial, buccal and lingual alveolo-gingival contours and (ii) the inciso-occlusal surfaces which occlude with the opposing artificial or natural dentition and take part in the restoration of aesthetics and lost function.

##### (i) Denture Base:-

Denture bases are supported by the edentulous ridge and their shape and size depend essentially upon the number of teeth missing, the location of teeth missing, and the magnitude of masticatory stresses active in the particular area. In tooth-borne dentures, they transmit masticatory forces acting on the artificial teeth to the abutment teeth but contribute very little directly towards the dissipation of these forces. Whereas in tissue-borne dentures, the entire masticatory force is transmitted to the basal bone through the denture base. In tooth-tissue-supported dentures e.g. free-end saddles, the displaceability of the mucoperiosteum

and the comparative rigidity of the teeth creates possibility of undesirable movements of the partial denture around a fulcrum line passing through the major tooth support areas (49).

These movements produce a destructive torque on the abutment teeth and also uneven force distribution on the saddle area. In the last two situations i.e. entirely tissue supported dentures and tooth-tissue-supported dentures, denture bases have to be so designed that they provide maximum coverage of the saddle areas, thus reducing the amount of force acting per unit area.

This concept is supported by Applegate and Nissle (46), Krough-Poulsen (48) and also by Holmes (69).

The actual dissipation of forces from the saddle area to the basal bone is dependent upon the nature of contact between the denture base and the denture foundation. As pointed out by Razeq and Shabaan (33), accurate adaptation of the denture base is important in the prevention of undesirable and possibly pathological changes of the denture bearing mucosa, local irritation and the consequences. Similarly, Maxfield et al (61) indicate that good adaptation of the denture base to the residual ridge in free-end saddles, is an excellent means of providing maximum support, increasing comfort and decreasing stress on the abutment teeth.

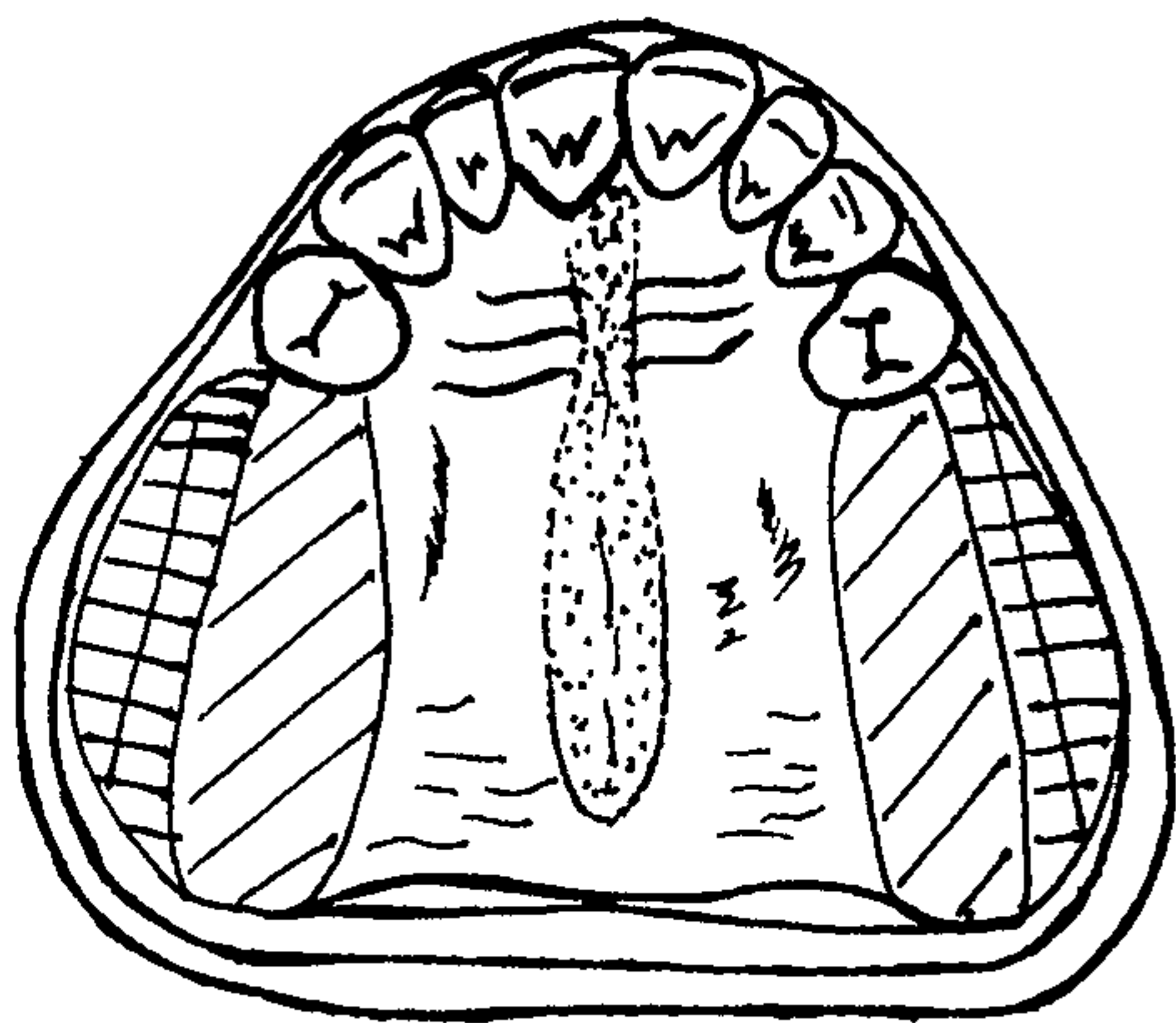
In accordance with the principles of hydraulics, mucoperiosteum being mostly composed of fluids is not compressible although due to the inherent variations of

consistency of the submucous and the suprapariosteal tissues, there are variations in the displaceability of the mucoperiosteum in different parts of the mouth. This also results in undesirable movements of the denture base (70-71).

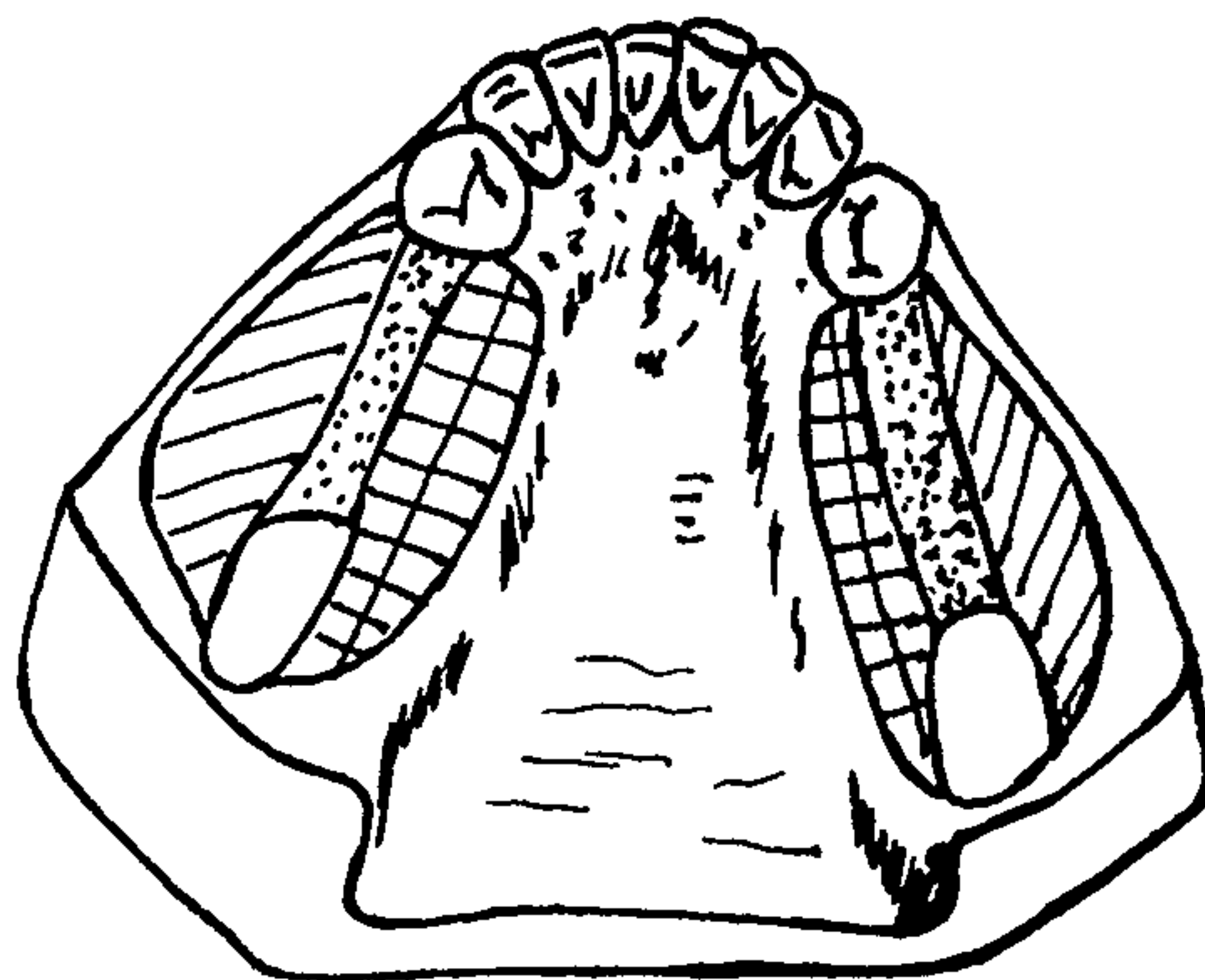
Generally two concepts (71-72) are presented as explanation and solution of the problem: (i) mucostatic concept and (ii) mucocompressive concept. According to the mucostatic concept, impression of the oral mucosa is taken in such a manner and with such an impression material that there is least amount of displacement of the mucoperiosteum. The dentures constructed from such impressions fit the foundation area accurately, so that the mucoperiosteum is confined between the underlying bone structure on one side and the denture base on the other, so theoretically, there is no place for these tissues to escape to and they are expected to act rigidly.

This concept is refuted by advocates of the mucocompressive technique. Maxfield et al (61) presented blanching of the mucosa under clear denture base as an evidence to the effect. Similarly, Hindels (72) found various degrees of movement of partial dentures constructed from mucostatic impression.

In the mucocompressive concept, impressions are taken under functional stresses in such a manner that the stresses acting on the denture foundation are distributed uniformly between the displaceable and non-displaceable tissues. In the primary impression, relief is provided on extremely displaceable and non-displaceable tissues and contact on the



A



B

Fig. 2.

A. Crest of the maxillary residual ridge (herringbone pattern) is the primary supporting region for the maxillary distal extension denture base. Buccal and lingual slopes may furnish a limited amount of vertical support of the denture base. It seems logical that their primary role is to counteract horizontal rotational tendencies of the denture base. The dotted portion outlines the incisive papilla and median palatal raphe. Relief must be provided these regions, especially if the tissues covering the palatal raphe are less displaceable than those covering the crest of the residual ridge.

B. Dotted portion outlines the crest of the residual ridge, which should be recorded in its anatomic form in impression procedures. Similarly, the retromolar pads should not be displaced by the impression. The buccal shelf regions are outlined by the herringbone pattern and selected additional pressures may be placed on these regions for vertical support of the denture base. Lingual slopes of the residual ridge (cross-hatched) may furnish some vertical support of the restoration; however, these regions principally resist horizontal rotational tendencies of the denture base and should be recorded by the impression in an undisplaced form.

so called normal tissue. When the final impression is taken under the functional stress, the normal tissues take the functional forces and are slightly displaced whereas the relieved areas are recorded in their undisturbed forms. The finished denture will come in contact with the normal tissue and take the brunt of the stresses of the mastication. The non-displaceable tissues come in contact with the denture surface only after the normal areas have been displaced.

There are several techniques<sup>(70) (73-75)</sup> that can be followed, but altered case technique as presented by Leupold<sup>(70)</sup>, Hindels<sup>(73)</sup> and Leupold and Kratochvil<sup>(75)</sup> is advocated because it meets all the requirements of denture base.

Leupold and Kratochvil<sup>(75)</sup> claimed this procedure to be a definite step towards the preservation of oral structures. They found that this technique provided: 1) remarkable stability particularly in free-end saddles, 2) a positive occlusion which will be maintained for a long period of time, 3) reduced stress on the abutment teeth and 4) reduced post insertion adjustment. This technique is also advocated by Thompson et al<sup>(76)</sup> and Tebrok et al<sup>(77)</sup>.

(ii) Occlusal surface:-

For the restoration of aesthetics the artificial teeth have to match the remaining natural teeth in form, size and colour to the satisfaction of the patients<sup>(75)</sup>.

For restoration of lost functions, the dentures require a harmonious tooth contact between the natural and the artificial teeth in the different border and functional maxillo-mandibular relationships. Osborne et al<sup>(44)</sup> point out three clinical aspects of occlusion, "First, its

equilibration prior to denture construction by means of tooth grinding, conservation or extraction. Second, the recording of centric occlusion and the development of balanced occlusion and articulation. Third, the maintenance of these conditions during the life of the denture by rebasing and possible tooth grinding".

In establishing a good relationship of denture teeth and the remaining natural teeth, there are three measures to be considered: (a) the vertical dimension and free-way space, (b) the horizontal relationship and (c) the balanced occlusion.

The vertical dimension: Vertical dimension may be maintained by the remaining natural teeth particularly when the number of teeth lost is limited and there are adequate posterior tooth contacts and the jaws have normal function. The artificial denture can be easily incorporated in the natural relationship. There may be situations when the measure of vertical dimension is completely lost due to loss of occlusal contact between the remaining maxillary and mandibular teeth. It may also have changed due to depression or movement of the remaining natural teeth resulting from concentration of masticatory forces on a limited number of natural teeth. Determination of vertical dimension in such cases will be guided by the establishment of adequate free-way space and aesthetic requirements (79-80).

An attempt to increase the vertical dimension may endanger the remaining teeth. This is pointed out by Lamnie et al<sup>(81)</sup> who reported tooth depression resulting from

wearing partial dentures that obliterated free-way space. The increased vertical dimension may also result in severe ridge resorption due to heavier loading of the alveolar ridge<sup>(80)</sup>.

The Horizontal Relationship: Similar to the vertical dimension, the horizontal relationship may be indicated by a stable contact between the maxillary and mandibular teeth in the intercusped position. In such cases the partial dentures are constructed in the maximum intercusped relationship between the remaining natural teeth. There may be situations when a definite horizontal relationship is lost due to loss of a great number of teeth. The mandible reaches occlusal contact with the maxilla in abnormal protrusive and/or lateral relationships. Horizontal maxillo-mandibular relationships should be re-established prior to construction of partial denture with an interim or temporary removable treatment denture<sup>(82)</sup> and occlusal adjustments<sup>(83)</sup>. The denture should be constructed so that the intercusped position coincides with the maximum retruded position of the mandible<sup>(83-84)</sup>.

The Balanced Occlusion: Balanced occlusion is described as simultaneous contact between upper and lower natural and/or artificial teeth bilaterally and in maximum retruded and also in functional positions of the mandible<sup>(84)</sup>. The balanced occlusion influences the stability of the denture and according to Koivumaa et al<sup>(4)</sup> increases the masticatory efficiency by as much as 20 per cent. Henderson<sup>(84)</sup> has given a very interesting table detailing the occlusal contacts in different situations (Table No. 1).

Table 1: Contact relationships of opposing posterior teeth to be sought

when treating patients with removable partial dentures

| Restorations                                                                                        | Centric<br>relation | Centric<br>occlusion | Working<br>side | Balancing<br>side | Protrusive |
|-----------------------------------------------------------------------------------------------------|---------------------|----------------------|-----------------|-------------------|------------|
| 1) Lower bilateral distal extension denture opposed by natural teeth or fixed partial dentures      | X                   | X                    | X               |                   |            |
| 2) Lower unilateral distal extension denture opposed by natural teeth or fixed partial dentures     | X                   | X                    | X               |                   |            |
| 3) Maxillary bilateral distal extension denture opposed by natural teeth or fixed partial dentures  | X                   | X                    | X               | X                 |            |
| 4) Maxillary unilateral distal extension denture opposed by natural teeth or fixed partial dentures | X                   | X                    | X               |                   |            |
| 5) Opposing bilateral distal extension removable partial denture                                    | X                   | X                    | X               | X                 |            |
| 6) Class IV (only anterior teeth replaced)                                                          |                     | X                    |                 |                   |            |
| 7) Lower bilateral distal extension denture opposing by maxillary complete denture                  | X                   | X                    | X               | X                 | *<br>X     |

X = positions where contacts are required

\* = when appearance, phonetics and a favorable occlusal plane are not compromised

(From Henderson, D. - Occlusion in removable partial prosthodontics  
J. Prosthet. Dent., 27:157 (Feb.) 1972)

In the posterior teeth, the area of occlusal contact between the denture teeth and the opposing teeth also plays an important role in the selection of the form and material of the posterior teeth. Henderson<sup>(84)</sup> suggests the use of porcelain teeth against porcelain, gold occlusal surfaces against natural or restored natural teeth and gold occlusal surfaces to oppose fixed partial dentures. According to him, occlusal surfaces of plastic teeth abrade rapidly, resulting in changes in vertical dimension as well as in the horizontal relationship. The form of occlusal contact is also an important consideration. Wide surface to surface contacts induce greater horizontal and oblique stresses that are more traumatic to the basal bone than ridge and point contacts (47-48, 85).

### 3.5.2 Supports

Support in respect to partial denture can be defined as a means (i) to counteract tissueward movement of the denture during function and (ii) to uniformly transmit the masticatory forces active on the appliance to the remaining teeth.

Anderson and Lammie<sup>(12)</sup> stressing the importance of occlusal rests state that, partial dentures without occlusal rests or insufficient number of rests cause stripping of the gingiva and periodontal membrane from the remaining teeth and produce inflammatory reactions in the saddles. Similarly, Ward<sup>(86)</sup> states that the removable partial denture is a destructive appliance unless it is designed with adequate vertical stops.

Kabcenell<sup>(87)</sup> states that a tooth can successfully resist 17 times as much force in the axial direction as it can in transverse direction. He further suggests that the walls of the occlusal rest can be utilised to reinforce the unity of tooth and denture when lateral stresses are directed against it. DeVan<sup>(2)</sup> has reported that a transverse force of one pound produces the same amount of displacement of periodontal tissue as an axial force of 61 pounds.

Non-uniform distribution of masticatory stresses on different parts of an appliance results in undesirable traumatic movements or instability. Chick<sup>(88)</sup> suggests that the rests contributing towards indirect retention and stability should be placed as far away from the saddle as possible. McDowell<sup>(89)</sup> also found reduction of stresses at the apices of the primary abutment teeth in patients where indirect retention was gained through auxilliary rests on teeth away from the saddle.

The number and location of rests depend upon the number, location and type of saddle areas. Both ends of the bounded saddles as in Kennedy class III types need to be supported. The greater the magnitude of stresses on the appliance, the greater should be the number of rests distributing the stress to the remaining teeth. In free-end saddles (Kennedy class I and II), the occlusal rests have to be located on the mesial abutment only. Kratochvil<sup>(90)</sup> demonstrated the reduction of strain on abutment teeth in free-end saddle patients when rests were located on the mesial instead of the distal aspect of the last standing teeth. He found that rests on the distal side tended to produce a greater tipping of the

denture and distal pulling of the abutment teeth, resulting in bone loss and abutment mobility (Fig. 3).

The retainers have also to be provided with occlusal rests so that different parts of the retainer are maintained in correct relationship to one another on the surfaces of the teeth.

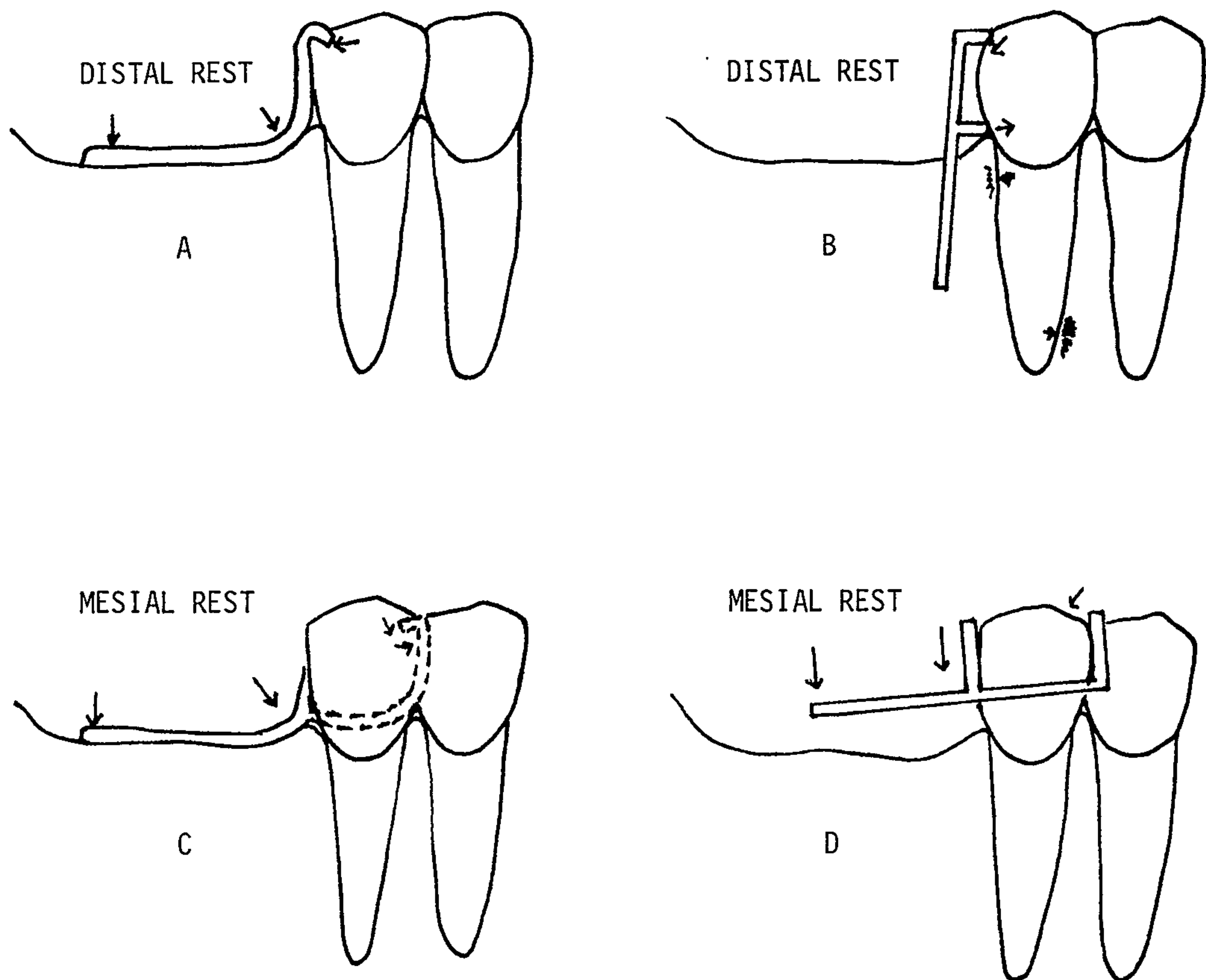


Fig. 3.

- A. An abutment tooth with a metal casting having the occlusal rest on the side adjacent to the edentulous region. The arrows indicate the direction of forces when the denture moves downward.
- B. The "wrench" effect exerted on an abutment tooth by a metal framework with a disto-occlusal rest.
- C. A mesio-occlusal rest on the metal casting on an abutment tooth. The arrows show the direction of movement when the base moves.
- D. The wrench effect on an abutment tooth by a metal framework with a mesio-occlusal rest is minimized.

From Kratochvil, F.J. - J. Prosthet. Dent., 13: 116-117, 1963.

Rests:

Support is gained by: (i) extending parts of the denture on occlusal, lingual or incisal surfaces of the teeth at right angle to the long axis. These extensions are referred to as occlusal rests, lingual rests, or incisal rests depending upon their location on the tooth. These rests are located in rest seats prepared on the particular surfaces of the teeth.

There are primary and auxilliary rests. The primary rests are located immediately next to the edentulous spaces and are responsible for prevention of the tissue-ward movement of the denture. The auxilliary rests are located on teeth away from the saddle as in the case of continuous clasp and indirect retainers. They transmit the masticatory forces acting on the appliance to teeth other than the abutments thus reducing the stresses on the abutments. They also prevent undesirable movement of different parts of the appliance, giving it a greater stability<sup>(49)</sup>.

The type of support gained from the rests can be varied by varying the shape of the rest seat. Semicircular base of the rest seats allows semi-rigid support, i.e. the denture is able to have limited independent movement which assists in dissipation of the masticatory forces within the appliances. A spoon-shaped form of the floor of the rest seat (slightly deeper towards the centre of occlusal surface and shallow in the marginal area) can be used to prevent the distal displacement of the saddle<sup>(39)</sup>. Similarly, cingulum rests that dip into the pits in front of the cingulum prevent

distal movement of the denture. Occlusal rest seats may also be box-shaped as in some precision attachments<sup>(91)</sup>. These can be used to limit independent mobility of the denture making the appliance a rigid extension of the remaining natural teeth.

(ii) support can also be provided by resting parts of the denture on the axial surfaces of the teeth occlusally to their relative maximum convexity (survey line)<sup>(87)</sup>.

### 3.5.3 Retention:

Retention: Retention can be defined as counteraction of forces displacing the denture away from its foundation. There are two basic forms of retention:

- i) direct retention
- ii) indirect retention

#### Direct retention:

According to DeVan<sup>(2)</sup>, direct retention can be gained from three sources:

a) surface adhesion - resulting from the intermolecular attraction between the denture foundation surfaces of the mouth and the corresponding surfaces of the denture. It is proportional to the surface area of the denture covered by the appliance, the greater the coverage the greater the retention<sup>(49)</sup>.

b) friction - friction between axial surfaces of the teeth and the corresponding contacting surfaces of the denture also produce retention. The amount of retention through friction is proportional to the vertical height of the contacting surfaces between the teeth and the denture.

The greater the vertical height of the contacting surfaces, the greater will be the retention<sup>(68)</sup>.

c) tensofriction - parts of the appliance are brought into passive contact with the axial surfaces of the remaining natural teeth in the region of cervical convergence of the crown or on suitably located undercuts in restoration etc. These parts are referred to as "the retainers". When there is movement of the appliance, the retainers are forced occlusally towards the maximum convexity of the axial surfaces of the teeth or the undercuts. This activates the retainers which exert horizontal pressure on the surfaces of the teeth or restorations, resulting in increased friction between the opposing surfaces and resistance to further occlusal movement of the appliance. This horizontal pressure on the teeth should be reciprocated by a bracing action from other parts of the appliance.

DeVan<sup>(2)</sup> and Blatterfein<sup>(92)</sup> consider the retainers most detrimental to the health of abutment periodontal membrane and are most important during denture design.

Indirect retention:

In situations such as free-end saddles or the maxillary appliances with long saddles, the saddle areas are apt to move away from the tissues either due to gravity or just due to adhesiveness of the sticky food during mouth opening. This movement of the appliance generally takes place around the transverse axis passing through the mesial abutments. This can be prevented by providing occlusal stops on remaining natural teeth anterior to the transverse fulcrum and is referred to as indirect retainers<sup>(49)</sup>.

#### 3.5.4 Design of the Retainer

Design of partial denture for retention involves:

(i) location of retainers, (ii) the numbers of retainers required and (iii) the type of retainers.

Location of retainer:

The location of retainer is determined by the site of the greatest activity of displacing forces, which is usually in the region of the saddles. Whenever possible, both ends of the saddle should be retained<sup>(88)</sup>. This is not very practicable in the unilateral and bilateral free-end saddles and it is not necessary for very small single tooth saddles and usually not desirable in the anterior segment of the arch for reasons of the aesthetics<sup>(78)</sup>. In unilateral saddle dentures, parts of the appliance extending to the opposite side of the arch also require active retention<sup>(93)</sup>. In Kennedy class IV type patients, the anterior tipping of the saddle has to be counteracted by active retention to posterior extension of the appliance<sup>(88)</sup>.

The number of retainers:

The number of retainers required depends upon the magnitude of the displacing forces. As mentioned, DeVan<sup>(2)</sup> and Blatterfein<sup>(92)</sup> consider the retainers most dangerous to the health of the abutment teeth and suggest that the number of retainers used should be as few as possible. On the other hand, Heintz<sup>(95)</sup> prefers too many retainers to too few in the light of force distribution onto abutment teeth rather than their purely retentive effects.

The type of retainers:

The selection of type of retainers depends upon:

(a) the anatomical and relative configuration of the abutment teeth, (b) the amplitude of denture movement expected during function, and (c) the health of the abutment teeth.

#### Configuration of the Abutment Teeth

According to Blatterfein<sup>(92)</sup>, axial contours of the teeth converge toward occlusal surface and also toward the cervical margin from a "neutral zone" that represents the maximum convexity of the contour. (Fig. 4). The area of occlusal convergence is considered the non-undercut zone and the area of cervical convergence the undercut zone. Generally partial dentures require more than one retainer. Due to the difference in the axial inclination of the different abutment teeth instead of the anatomical contours, relative contours of the different abutment teeth and the remaining natural teeth have to be considered to establish a path of insertion and removal for the appliance. This is achieved by comparing the axial surfaces of different abutment teeth to a common vertical so that we can determine the position for relative "neutral" and occlusal cervical convergence zone (Fig. 5A). The side of the common vertical (the analysing rod of the surveyor) forms a triangle with the cervical convergence part of the tooth (Fig. 5B). The apex of the triangle is located at the "neutral zone" and the base towards the cervical margin of the tooth. This triangle can be referred to as the undercut triangle. The horizontal depth of the undercut is

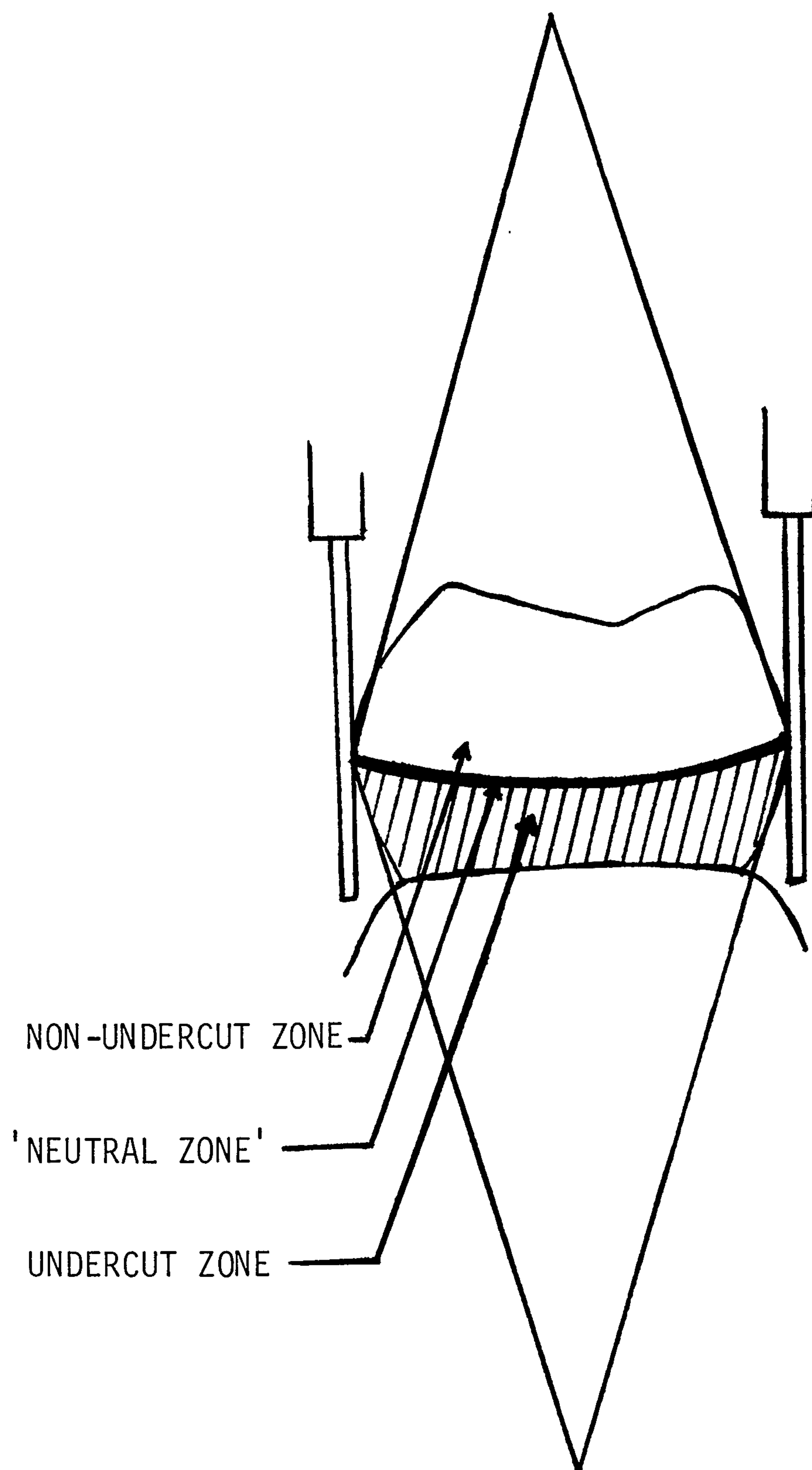
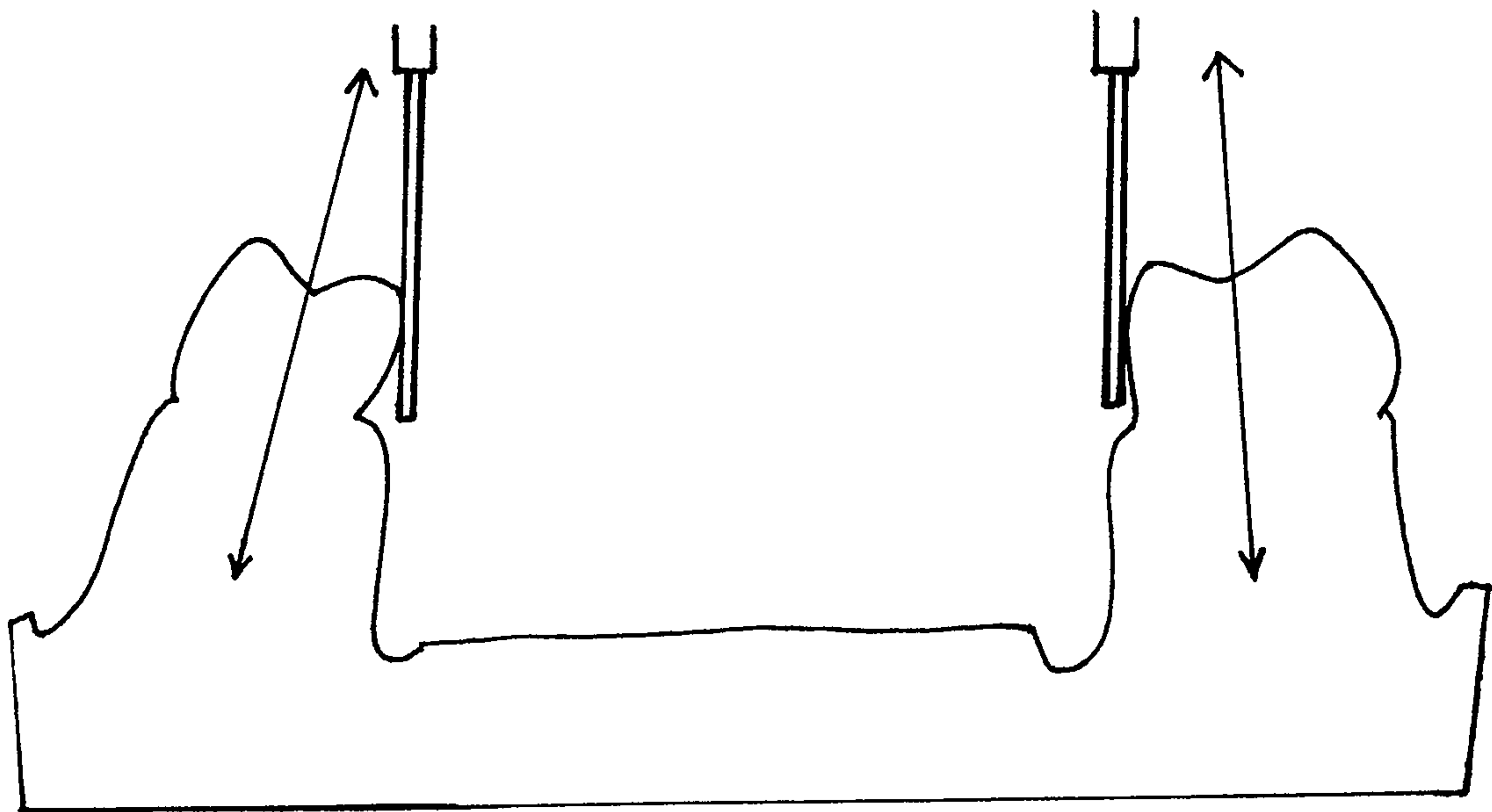


Fig. 4. Segregation of basic tooth contours.



A

B

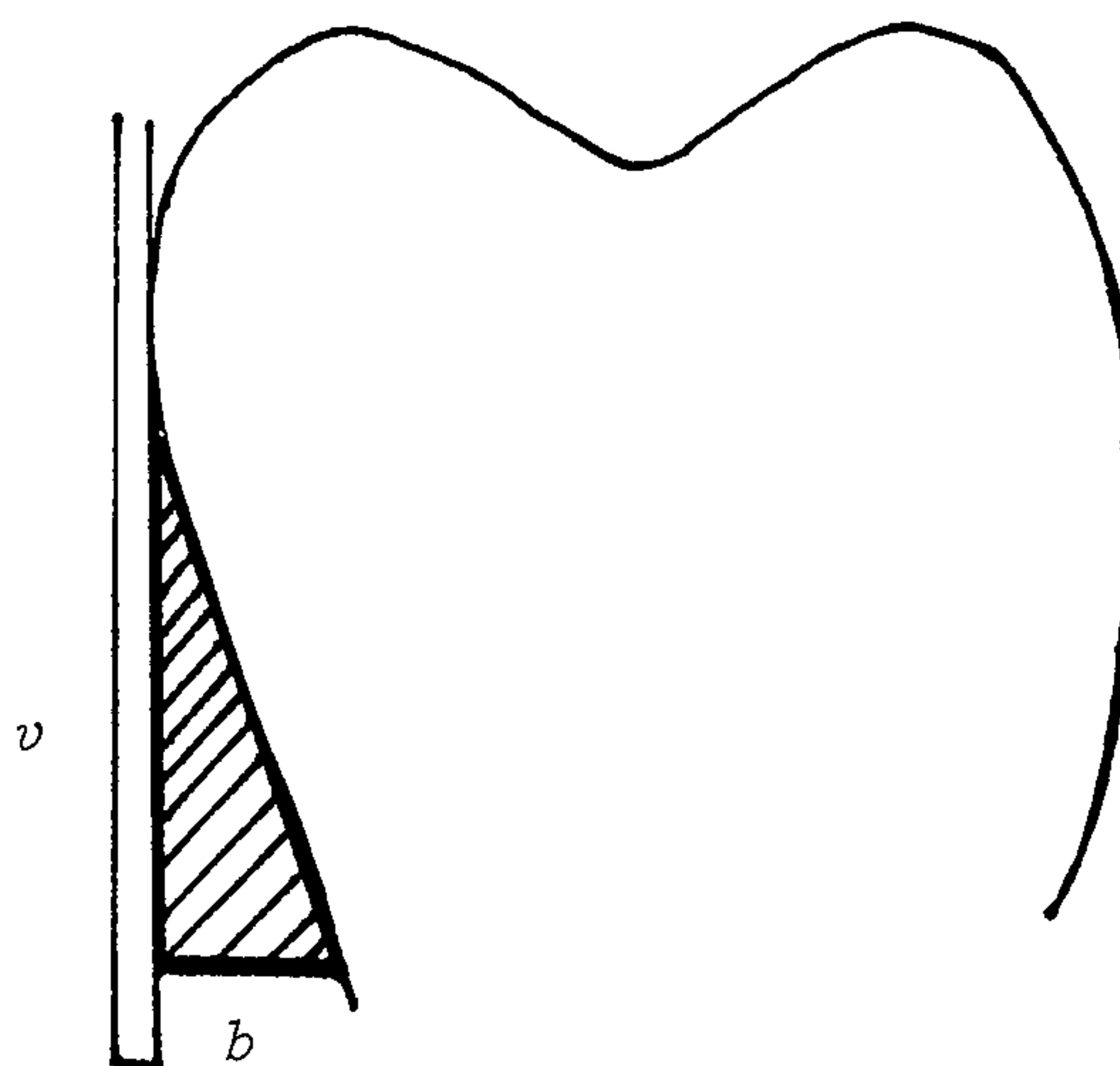


Fig. 5.

A. Differences of relative undercut areas due to the different inclination of the abutment teeth.

B. Undercut triangle.  $b$  - base,  $v$  - vertical height.

represented by the width of the base of the triangle and the height by the distance between the base and the apex.

#### Parts of Conventional Retainers:

Direct retention is gained by extending parts of the retainer into the relative undercut in the cervical convergence areas. A conventional retainer consists of:

- (i) a retentive arm - that engages the undercut.
- (ii) a reciprocating arm - that braces the abutment on the side opposite the retentive arm.
- (iii) the occlusal stop - which prevents further sinking of the appliance and maintains proper relationship between the retainer and the reciprocator on the surfaces of the tooth.
- (iv) a minor connector - that connects the above three parts to one another and the rest of the appliance.

#### Retentive arm

Retentive arm essentially consists of two parts, (a) the tooth contacting part - that actually comes into passive contact with the surface of the tooth and (b) the flexible part - which connects the tooth contacting part to the rigid part of the retainer or the appliance and due to its flexibility, allows the tooth contacting part to pass over the maximum convexity and reach the designated undercut.

Design for the retentive arm: The fundamental principles involved are that;

- (i) the retentive arm should rest passively in the cervical convergence area of the tooth and become active only when there is a movement of the denture. If the retentive

arm is continuously exerting active pressure on the surface of the abutment tooth even when the denture is firmly seated and is free of displacing forces, the retentive arm may exert orthodontic force that may contribute to deterioration of the abutment tooth. This is supported by Kabcenell<sup>(87)</sup> Steffel<sup>(39)</sup> and Blatterfein<sup>(92)</sup>. Blatterfein<sup>(92)</sup> further suggests that the degree of active force produced during movement of the appliance should be uniform in all retainers on the appliance. He observed deterioration of abutment teeth when there were differences in tension in the different retainers.

(ii) The lateral pressure consequent to the movement of the denture should be within the physiological limit of the tolerance of the abutment teeth. This depends upon (a) the location, depth and height of undercuts on the different abutment teeth, (b) length of the clinical crown and crown/root ratio of the abutment teeth and (c) conditions of health of the supporting tissue of the abutment teeth<sup>(49)</sup> <sup>(87)</sup>.

The design of the retentive arm involves

- (i) determination of the extent of areas of tooth contact.
- (ii) determination of the location of the tooth contact in the undercut.
- (iii) flexibility of the retentive arm.

The extent of surface area of passive contact between the retentive arm and the tooth surface should be minimum for reasons of oral hygiene, prevention of caries and preservation of tooth tissue. This is supported by Nakazawa<sup>(18)</sup>.

The horizontal depth of undercut engaged by the retentive arm: the deeper the undercut the greater will be the horizontal pressure exerted by the retainer on the abutment tooth during movement of the appliance<sup>(92)</sup>. Therefore, for preservation of the abutment the retentive arm will have to be located as close to the relative maximum convexity (survey line) on the abutment tooth as possible. When the undercut is not deep enough the horizontal pressure exerted will be smaller and there will be less retention. To compensate, the retentive arm should be located at some distance from the survey line on the cervical convergence area of the tooth surface, so that the retainer will have to move over a greater distance vertically to disengage the undercut and so lose retention.

The distance of the desirable undercut from the occlusal surface of the abutment tooth depends on the anatomical configuration of the tooth. This will influence both the retainer type and the area of engagement of the undercut in relation to the survey line (Fig. 6).

The retentive arm can be connected to the body of the denture in different ways. It can be connected with a short connector through the occlusal rest, in which case it will have limited resiliency and will be able to gain retention from shallow undercuts. But, as the depth of horizontal undercut increases, the retentive arm will need a greater amount of resiliency to stretch over the maximum convexity of the tooth without causing any traumatic effect<sup>(96)</sup>.

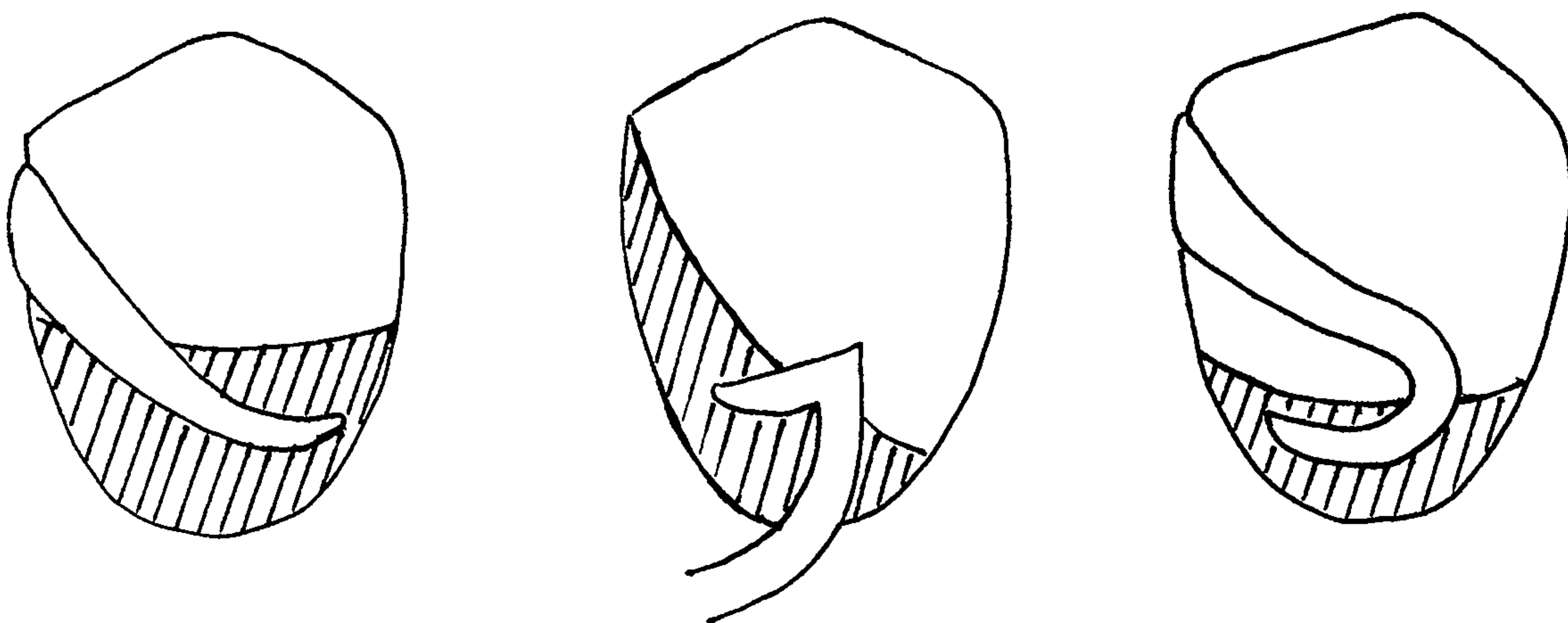


Fig. 6. Differences in configuration of abutment teeth influencing the design for retention.

in stability". The reciprocating arm must reach as close to the gingival margin as possible so that lateral stress in the denture will have the shortest possible torque action. The retainer elements should be on the same level in different parts of the mouth<sup>(87) (92)</sup>. Reciprocation may be gained from special reciprocating arms or any parts of the denture contacting on the side opposite to the retentive arms.

#### The occlusal stop

Occlusal stops fix the relationship between the retentive arm and the reciprocating arm on the tooth surface<sup>(88)</sup>. They are generally located on the proximal aspect of the occlusal surface. Additional occlusal stops may have to be provided for such composite forms as ring retainers and "half and half" retainers.

#### The minor connector

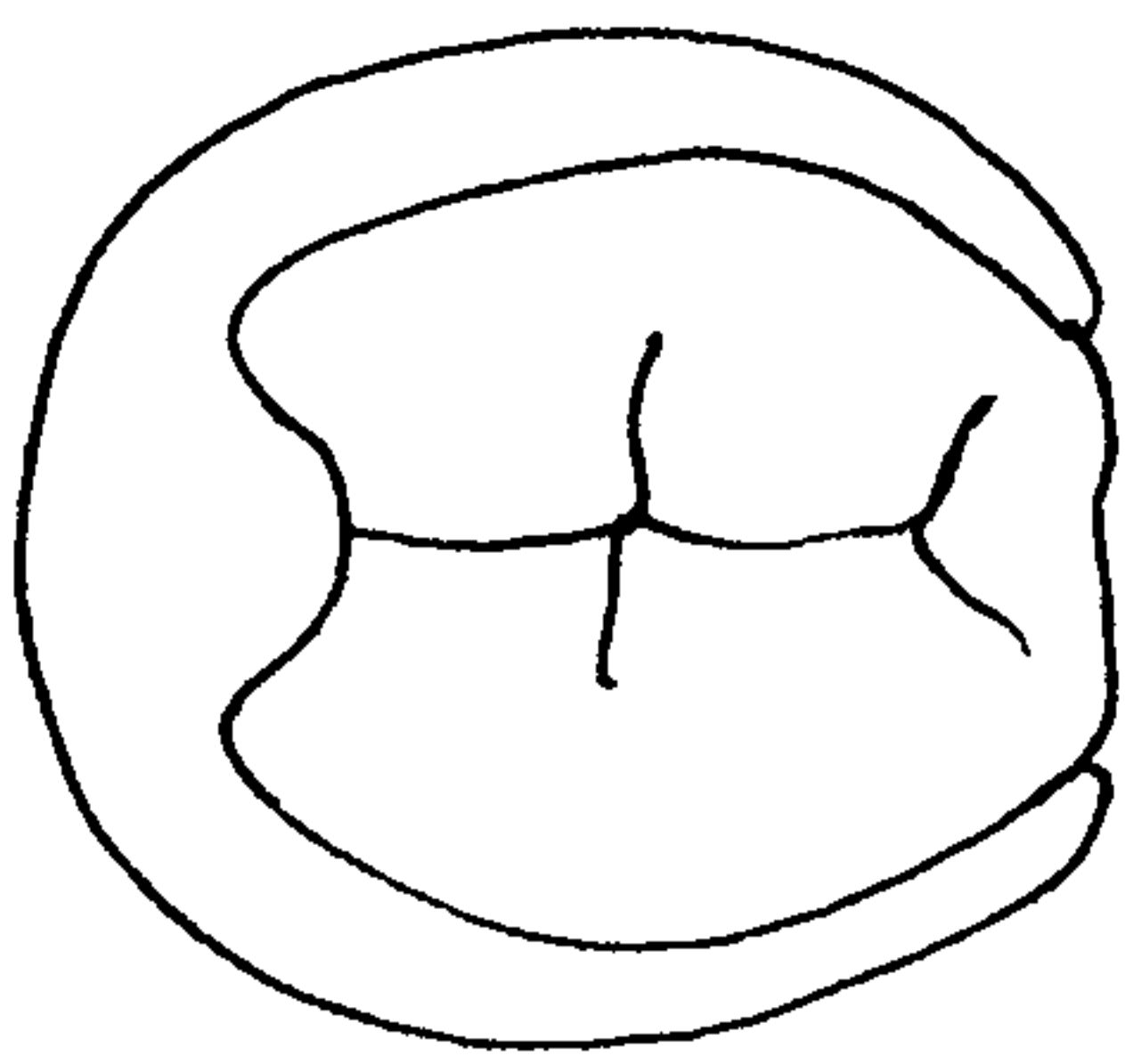
The different parts of the retention unit, i.e. the retentive arm, the reciprocating arm and the occlusal stop may join together into one rigid body which also acts as a minor connector between the retainer and the rest of the appliance as in the case of conventional circumferential retainers (Fig. 7A). The different parts of the retainer may also be connected to the body of the denture independently through their own minor connector (Fig. 7B). Such connectors may be flexible or rigid depending upon the requirement of the particular component of the retention unit. Occlusal rests and reciprocators will require rigid connectors whereas retentive arms will require varying degrees of flexibility as in the case of different bar type retainers. In ring-type

The flexibility of the retentive arm is different in different materials - gold, stainless steel or cobalt-chromium alloys. According to Bates<sup>(96)</sup>, wrought gold wire has the greatest resiliency and cast cobalt-chromium alloys the least. The choice of material will again depend upon the anatomical configuration of the teeth and the physical status of the supporting structures of the abutment.

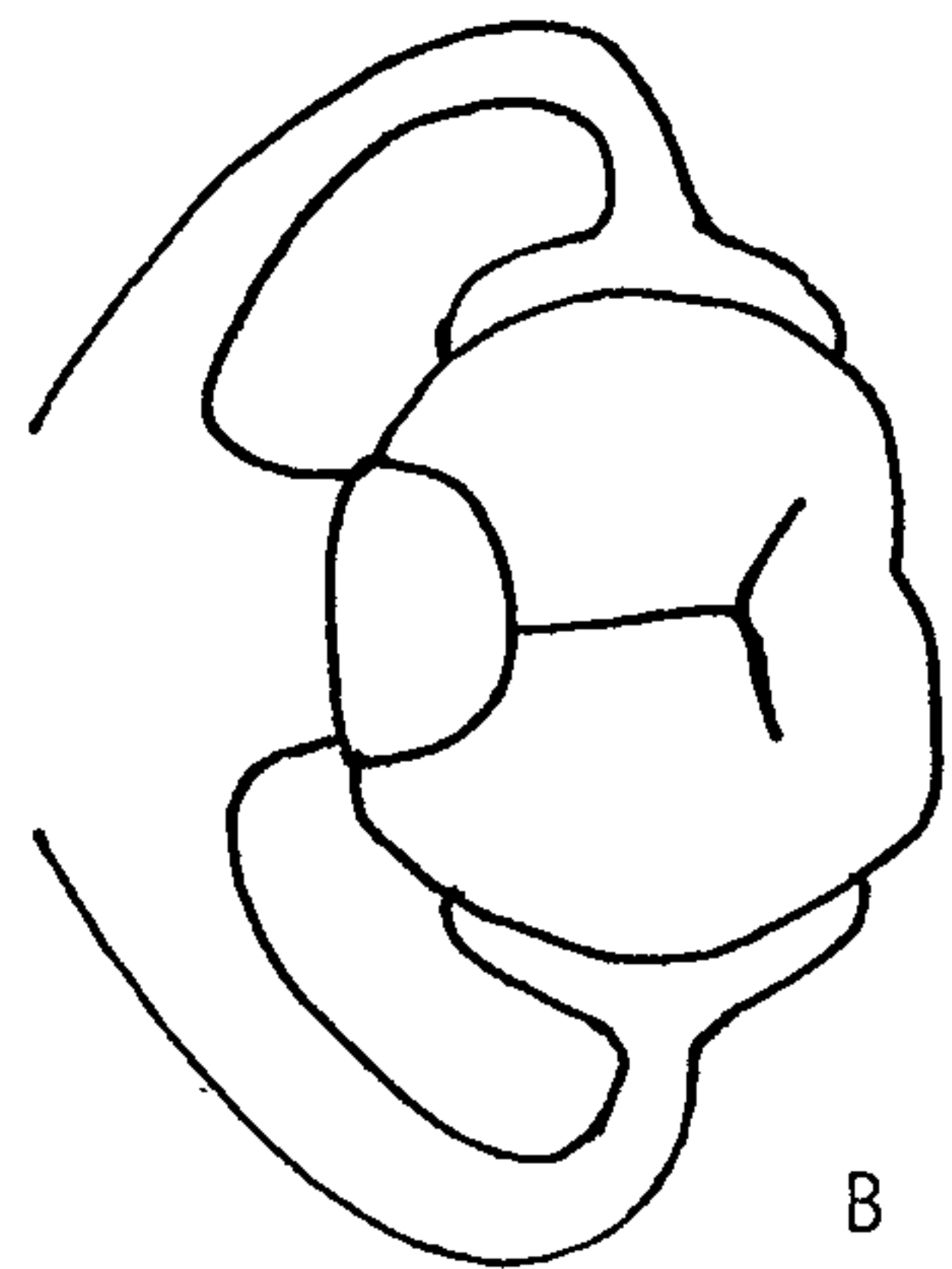
The dimensions of the retentive arm will be influenced by the properties of the material of choice. For cast cobalt-chromium, Bates<sup>(97)</sup> recommends a ratio of 2:1 of width: thickness of the retentive arm. Excessive increase in thickness will make the retainer more rigid and susceptible to fracture.

#### The reciprocating arm

The retentive arm when active exerts lateral pressure on the surface of the abutment tooth. According to Kabcenell<sup>(87)</sup> this transverse force can be 17 times more traumatic than an axial force of the same magnitude. To counteract these transverse forces, the abutment teeth need to be braced by a reciprocator on the side opposite the retainer. The reciprocator must be completely rigid and maintain contact with the abutment tooth in all situations where the retentive arm becomes active. Kabcenell<sup>(87)</sup> suggests. "The rigid elements of the clasp must be completely rigid in construction, rest passively against the tooth occlusal to the height of contour, and encircle more than 180 degrees of the circumference of the tooth - ..... - to attain the utmost



A



B

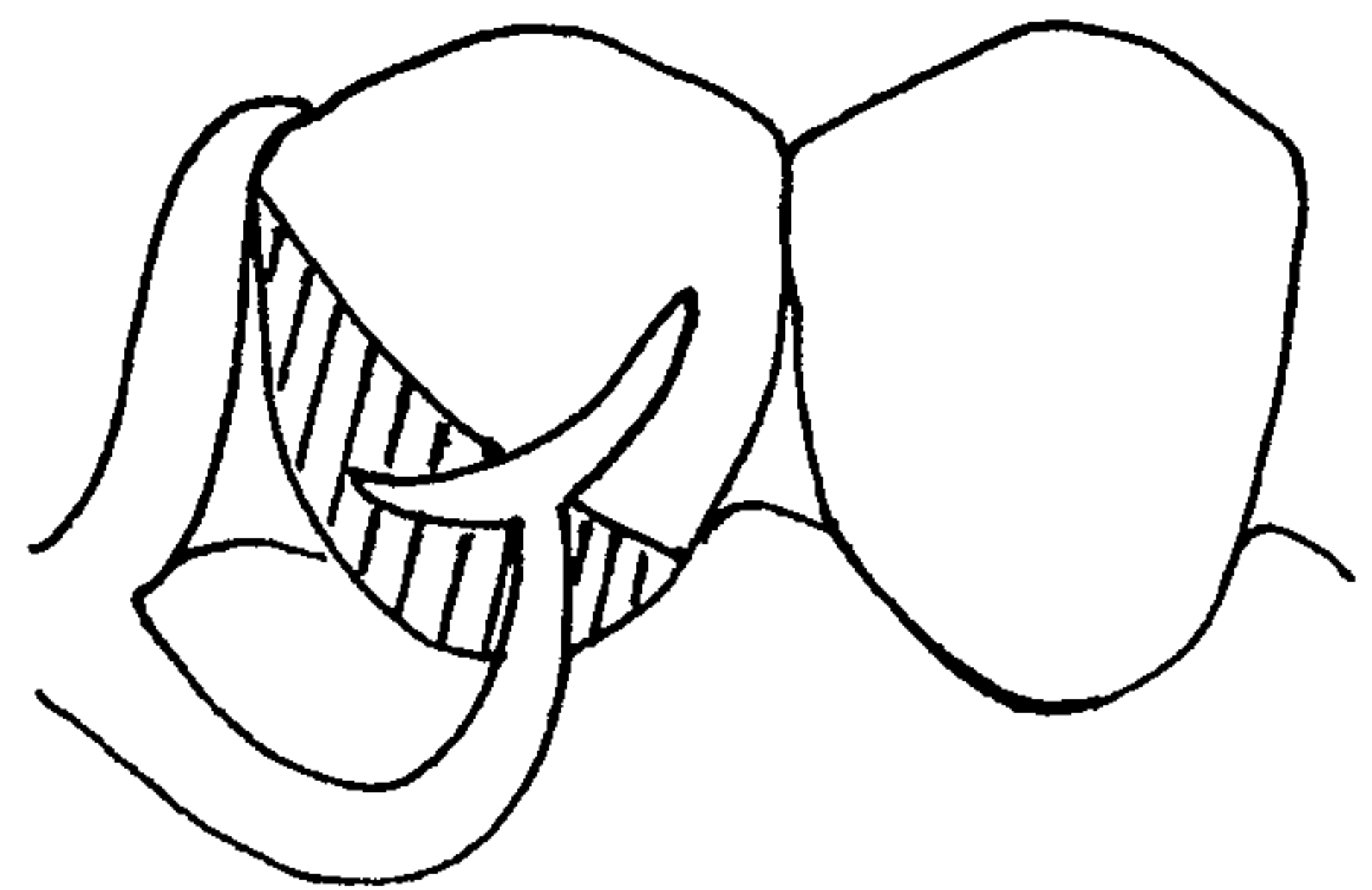
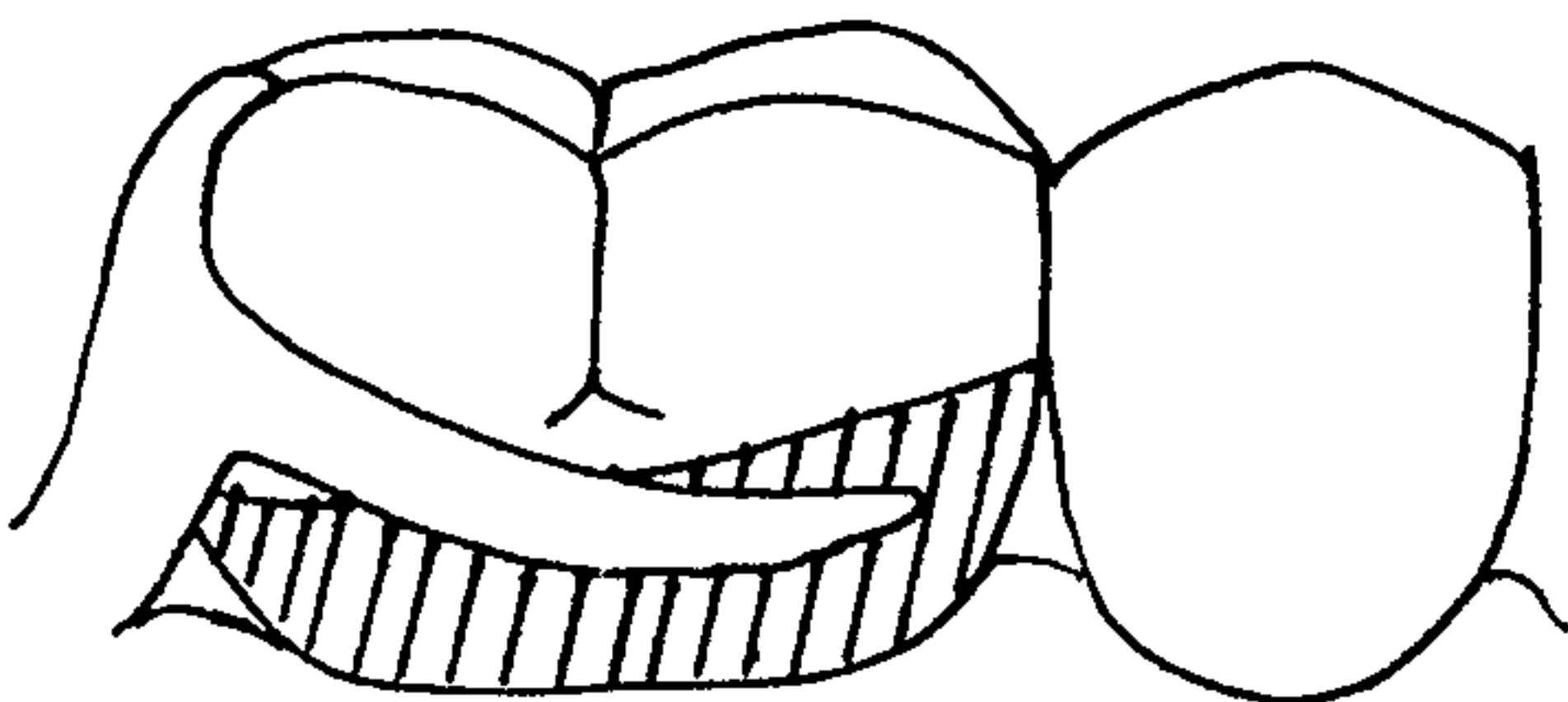


Fig. 7.

- A. The occlusal approach retainer - a conventional circumferential.
- B. The gingival approach retainer - a bar-type retainer.

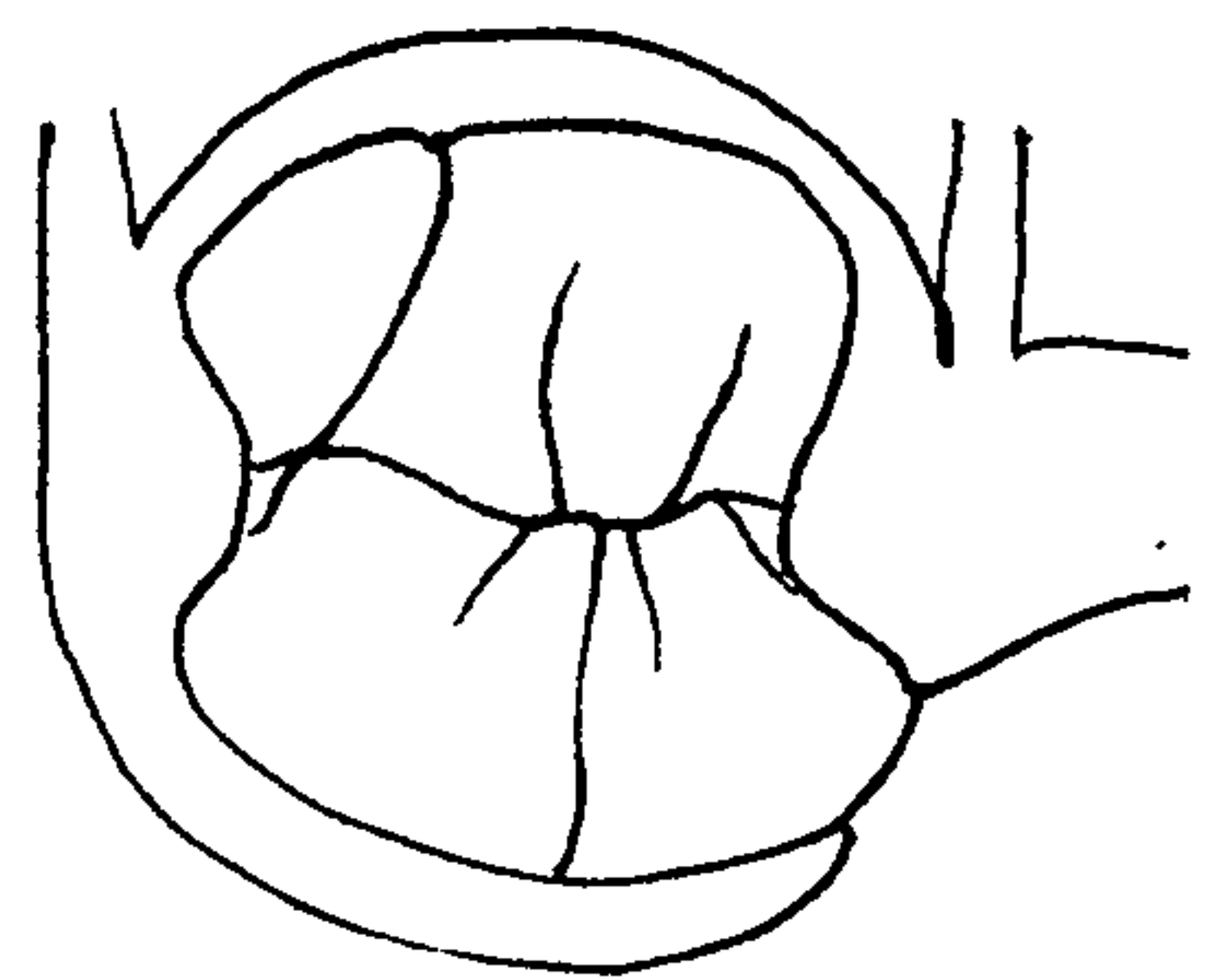
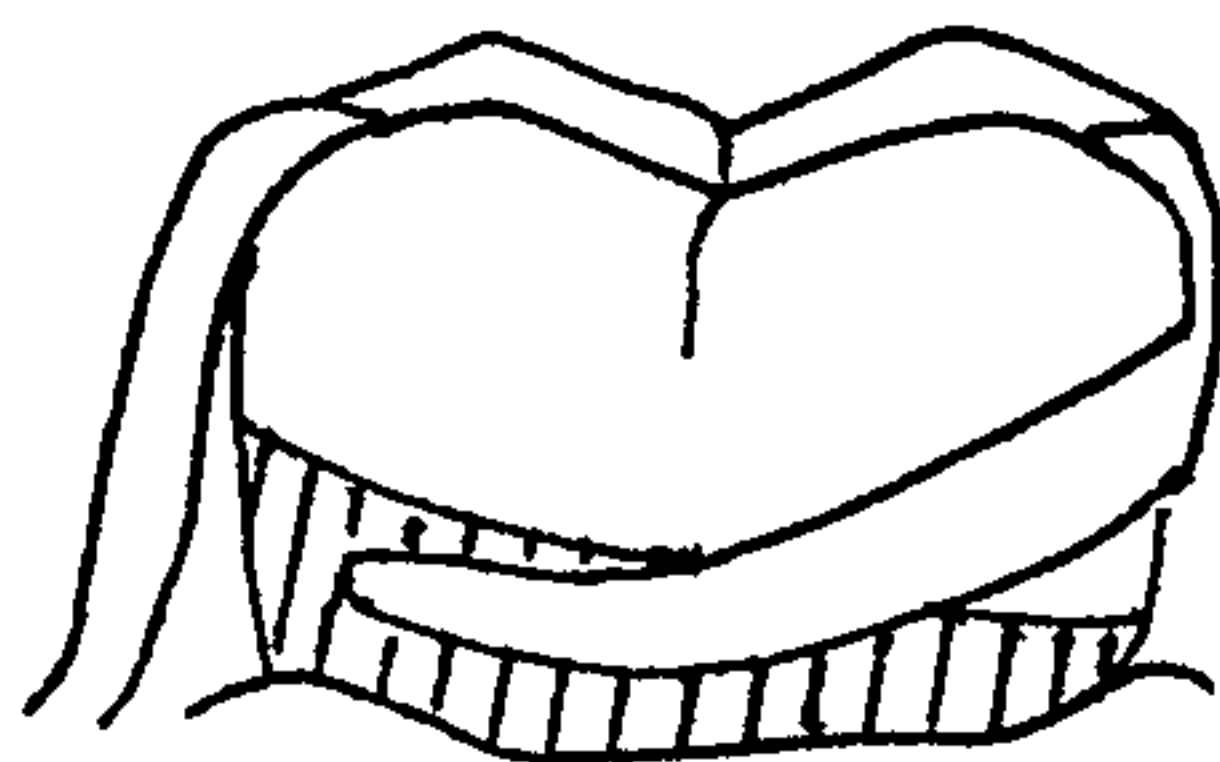
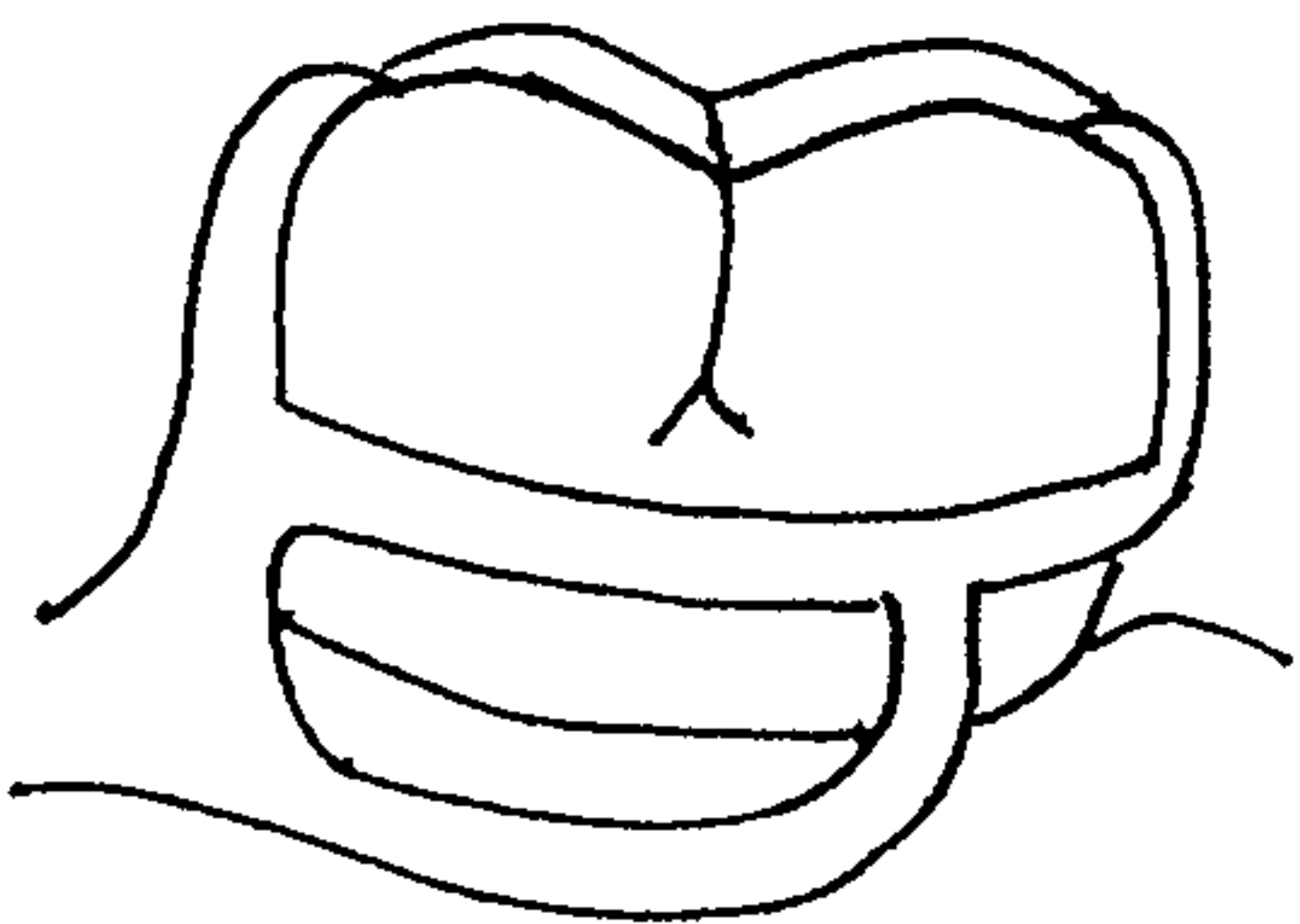


Fig. 8. A ring retainer requiring additional rest.

retainers, the retentive arm joins the body of the denture through the reciprocator, which in addition to acting as a reciprocator also acts as a connector (Fig. 8).

#### Classification of retainers and their modifications

Retainers are classified according to (i) their direction of approach to the undercut area, (ii) their general shape and form and (iii) the technique used for their construction<sup>(2)</sup>. Thus, as suggested by Riley<sup>(98)</sup>, there will be occlusally approaching retainers and gingivally approaching retainers. There are circumferential retainers and bar-type retainers and there are wrought retainers and cast retainers.

In the occlusally approaching retainer, the retaining arm reaches the undercut area from the occlusal direction and its connector remains above the survey line so that contact between the retentive arm and the tooth surfaces is maintained during further tissue-ward movement of the appliance. The examples are conventional circumferential retainer and its modifications (Fig. 9).

In the gingivally approaching retainers (Fig. 10), the connector of the retaining arm approaches the undercut from a gingival direction so that during a further tissue-ward movement, the retentive arm loses all contact with the tooth surface. Contact is resumed only when the denture is displaced from its foundation in the occlusal direction. Further, occlusal movement of the denture results in a tripping action of the retainer against the maximum convexity of the tooth before it expands and slips above, thus providing the required retention.

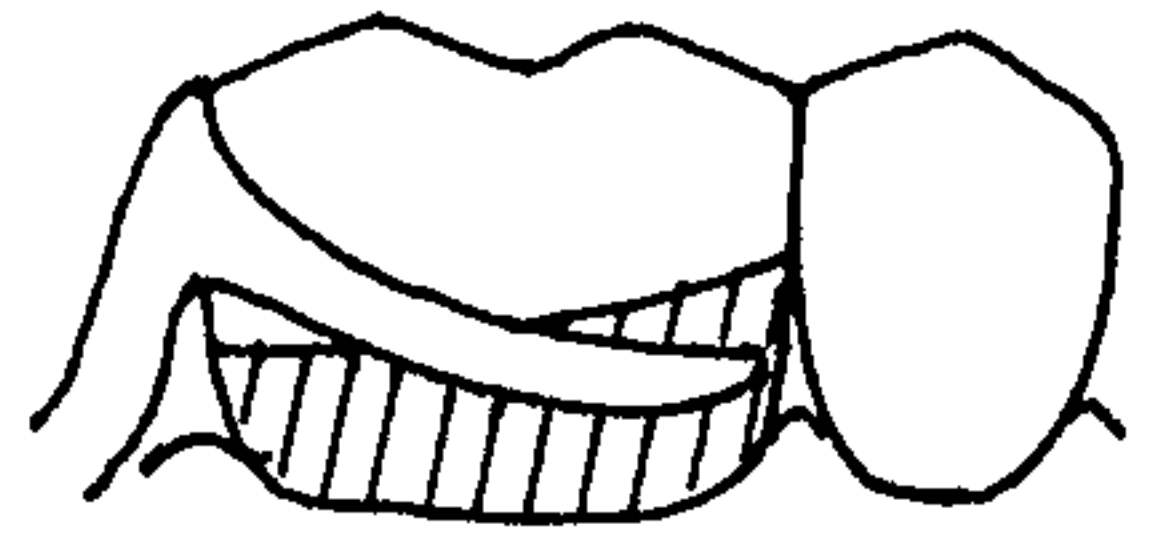
In a circumferential retainer, the entire retainer comes in contact with the tooth and at least 180 degrees of its circumference, and is comparatively rigid. In the bar retainers, the different components i.e. the retentive arm, the reciprocator and the occlusal rest, approach the tooth independently through their own connectors so that the rigidity or flexibility of the retainer can be controlled by suitable modifications of the connectors<sup>(87,98)</sup>.

The cast retainers are comparatively rigid and have a closer adaptation to the surface of the tooth compared to the wrought retainers which are more flexible<sup>(87)</sup>.

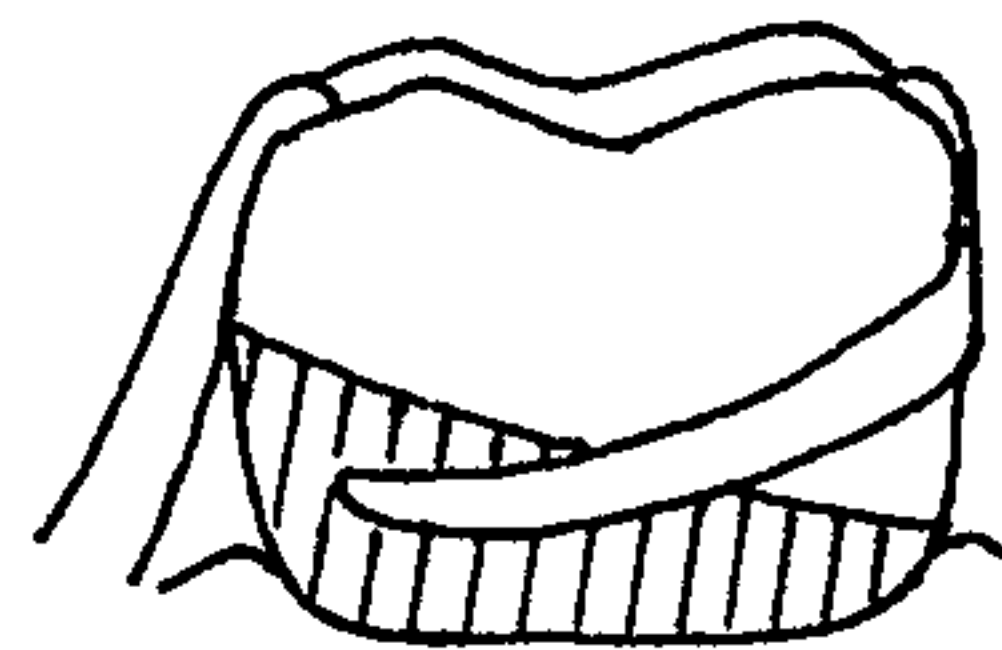
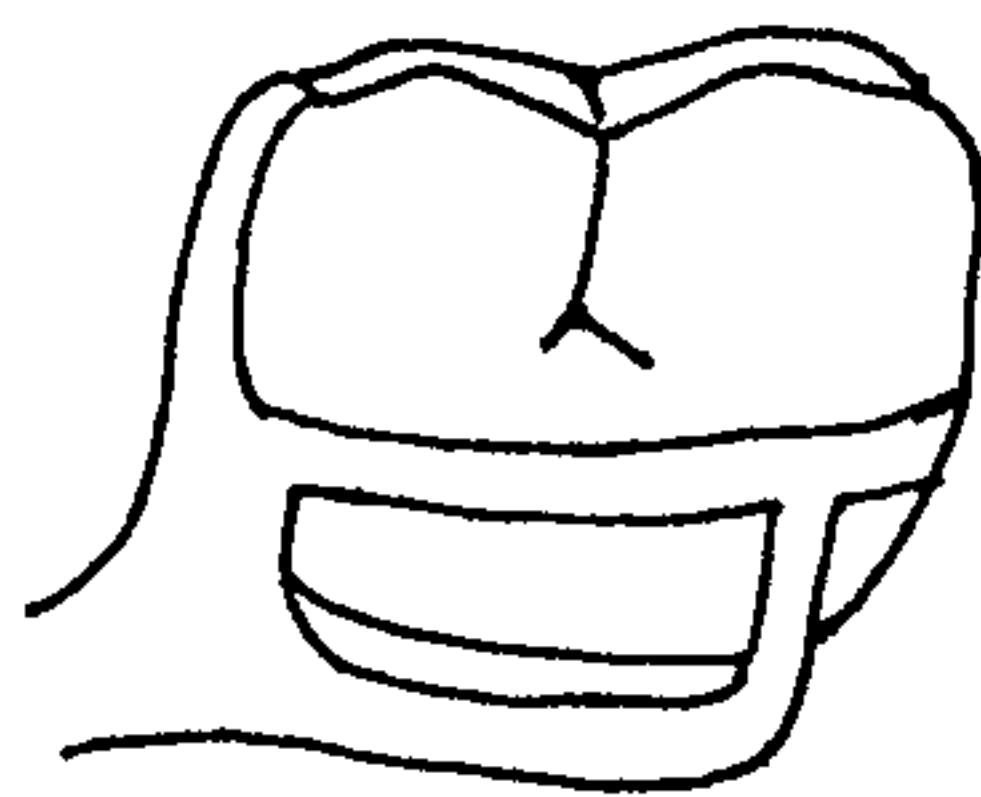
#### Selection of Retainer for a particular Appliance

According to Firtell<sup>(99)</sup>, there are many criteria that must be considered in retainer selection, such as amount of retention required, location of existing undercuts, tooth form and position, the flexibility of clasp arms and biology of tooth and its supporting tissues. According to McCracken<sup>(100)</sup>, the abutment teeth on either side of the arch should be considered in relation to the anticipated amount of denture movement. Johnston and Bates<sup>(53)</sup> have recommended the use of as many retainers as necessary, so that the abutment teeth are not subjected to lateral forces in excess of their physiologic tolerance. In unfavourable conditions they recommend the use of auxilliary measures such as multiple clasping, stress breakers and even fixed splinting. On the other hand, retainers have been criticised as the most controversial and seemingly contradictory phase of partial denture design. Blatterfein<sup>(92)</sup> describes the basis of the

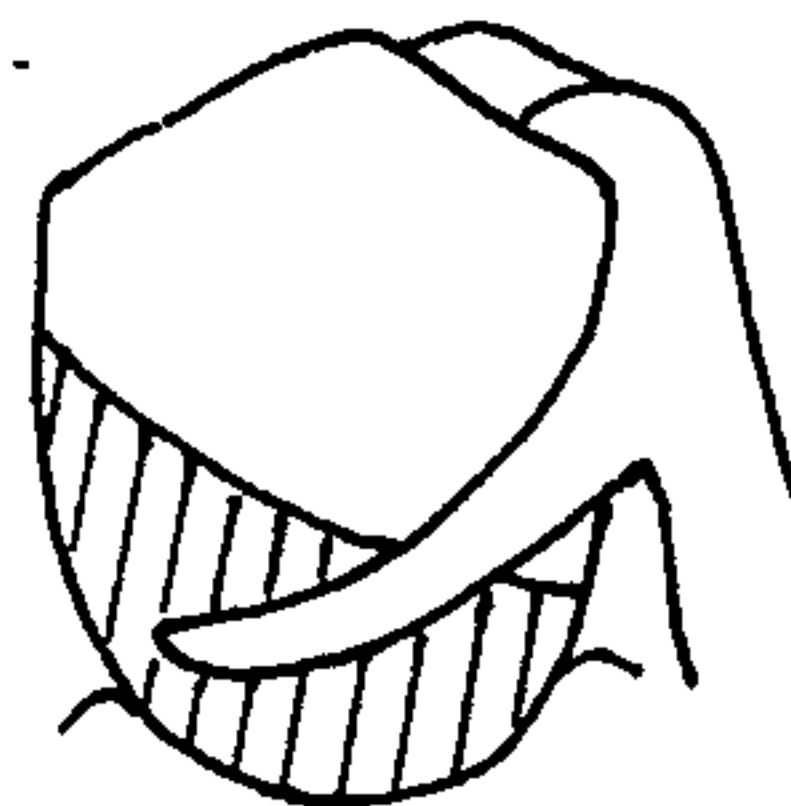
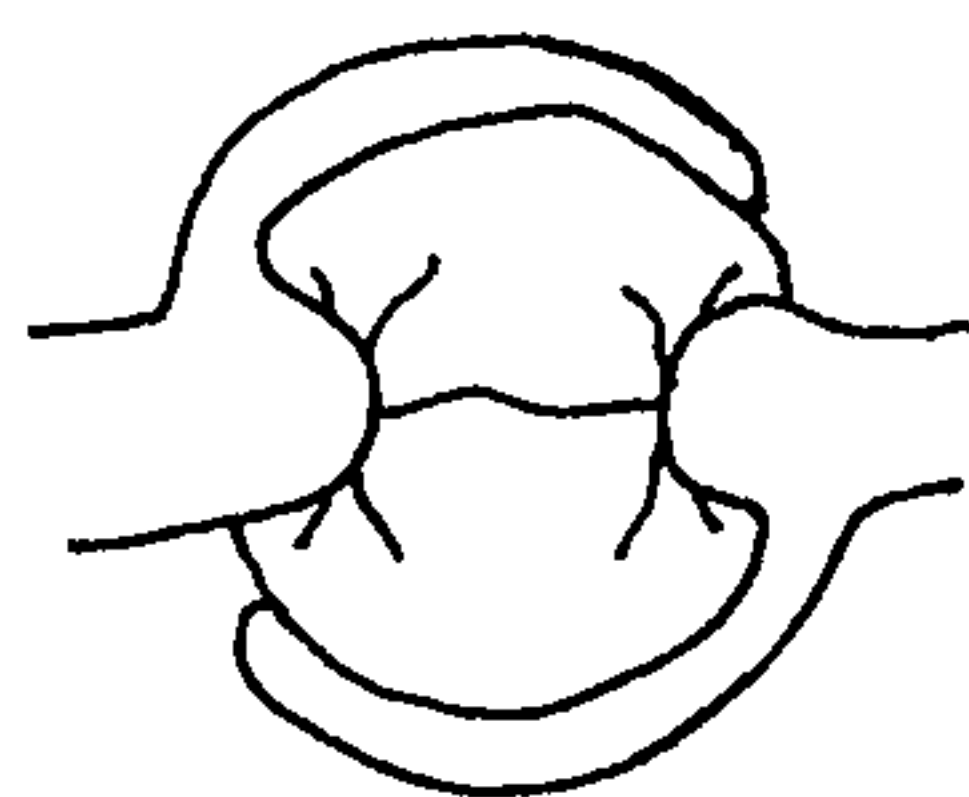
Fig. 9. Circumferential retainers and their modifications.



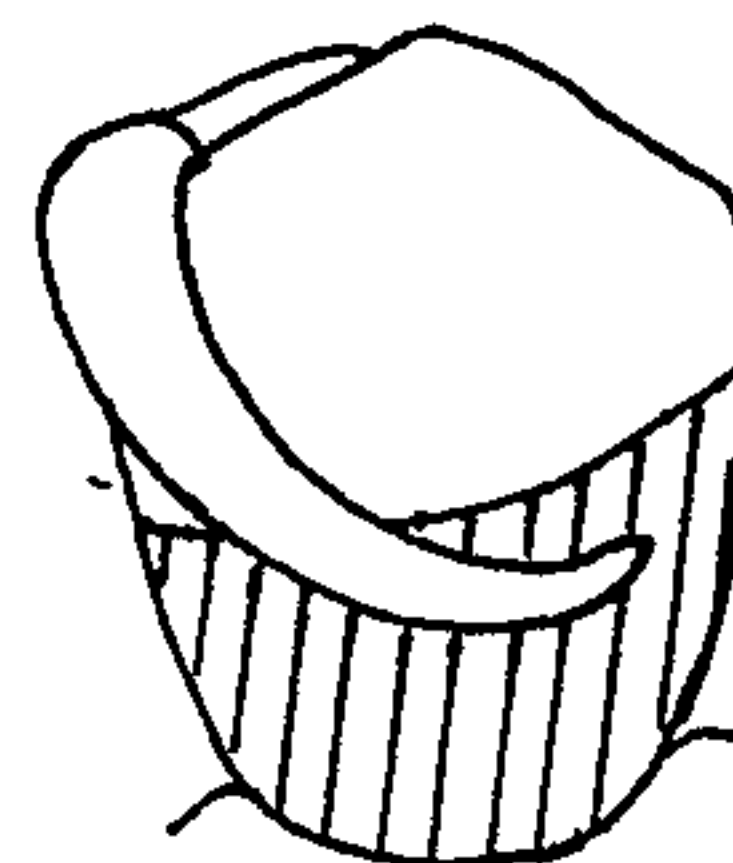
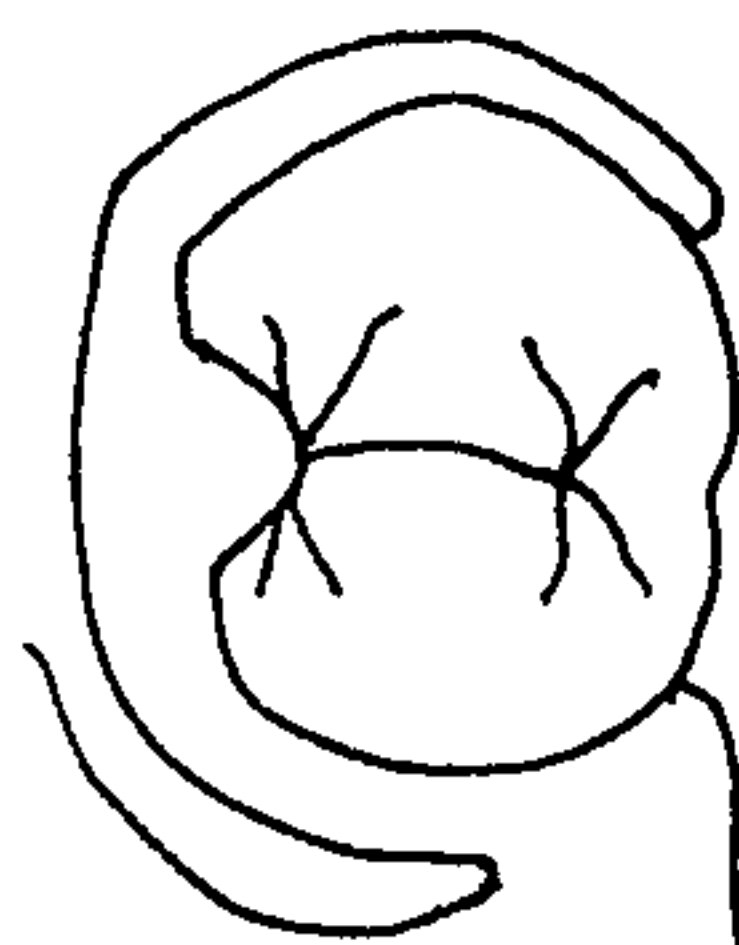
A. A conventional circumferential.



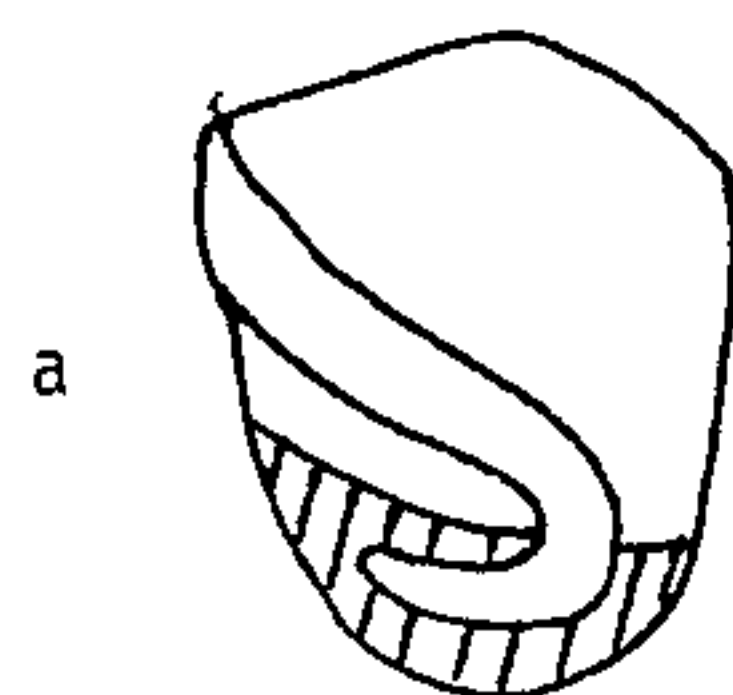
B. A ring retainer.



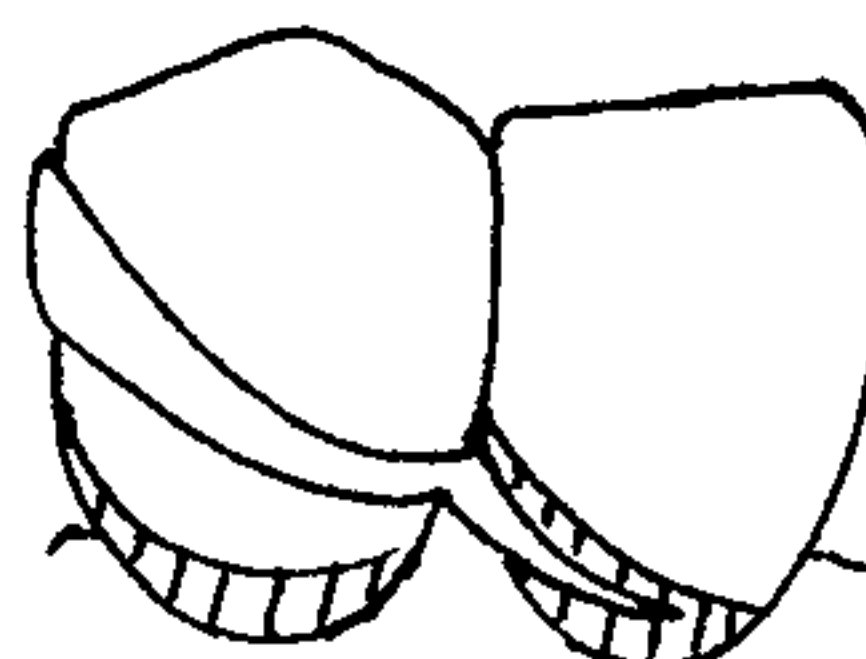
C. A half and half retainer.



D. A back-action retainer.



b



c



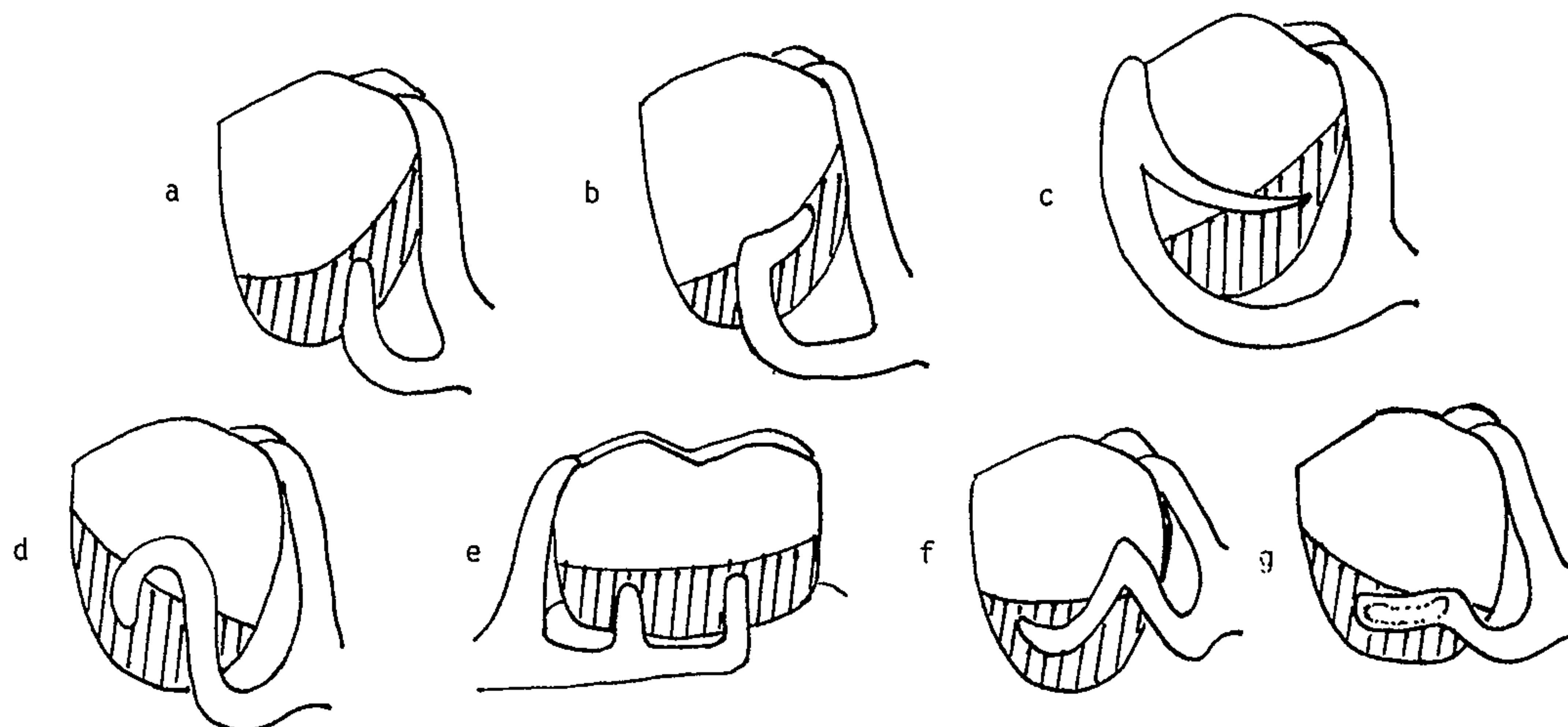
E. Other modifications.

a. hairpin retainer

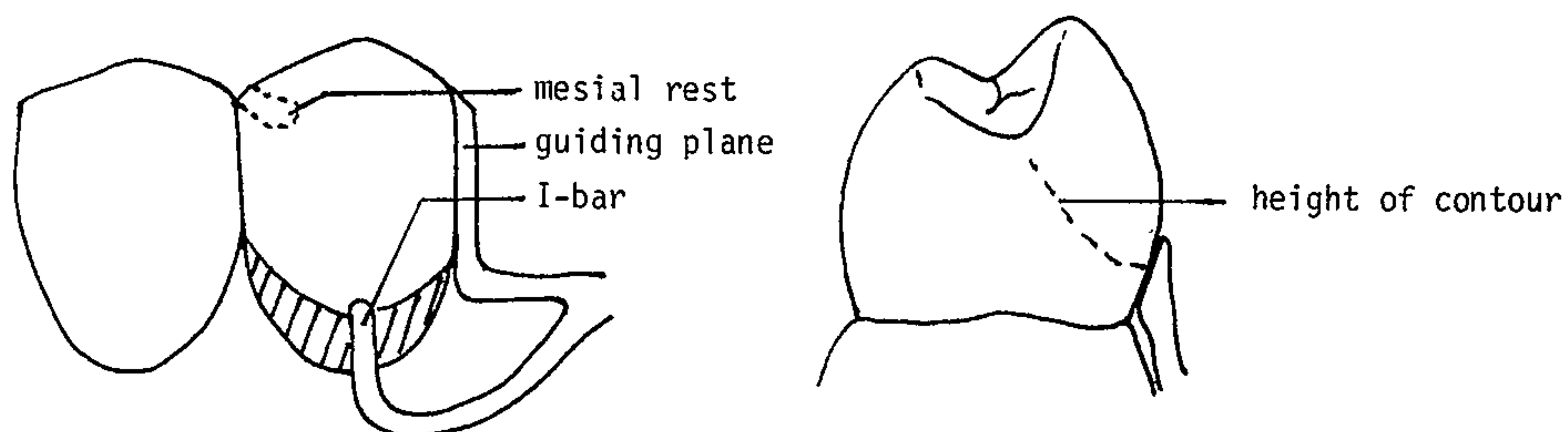
b. circumferential retainer by Blatterfein  
J. Amer. Dent. Assoc., 43:185, 1951.

c. circumferential retainer by Looë.  
Brit. Dent. J., 88:67, 1950.

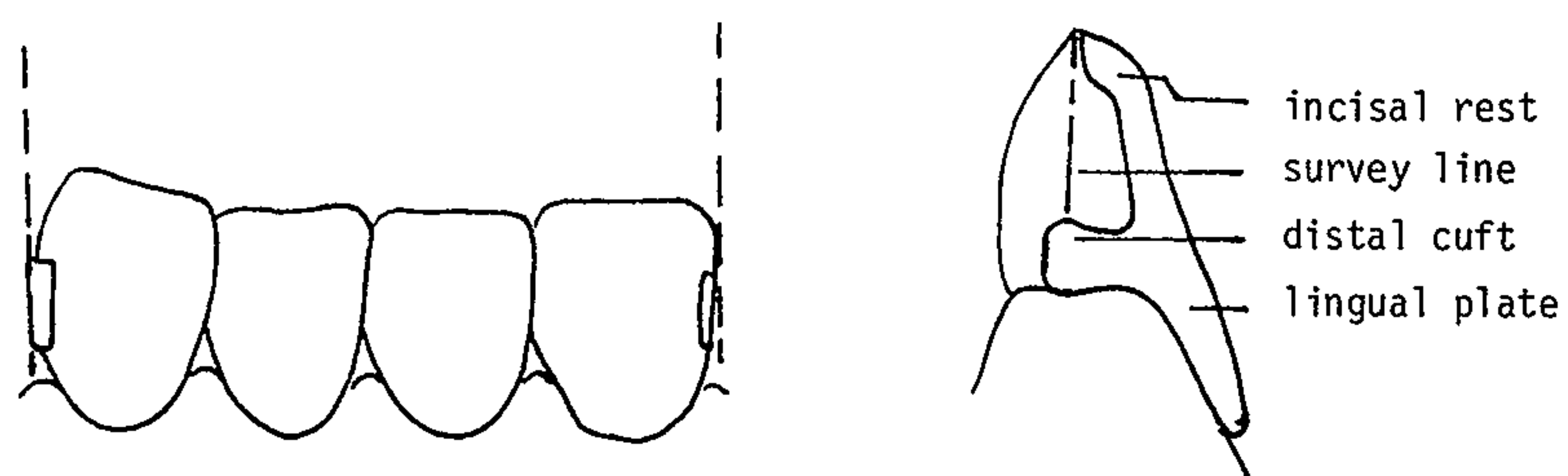
Fig. 10. The Bar-type Retainer.



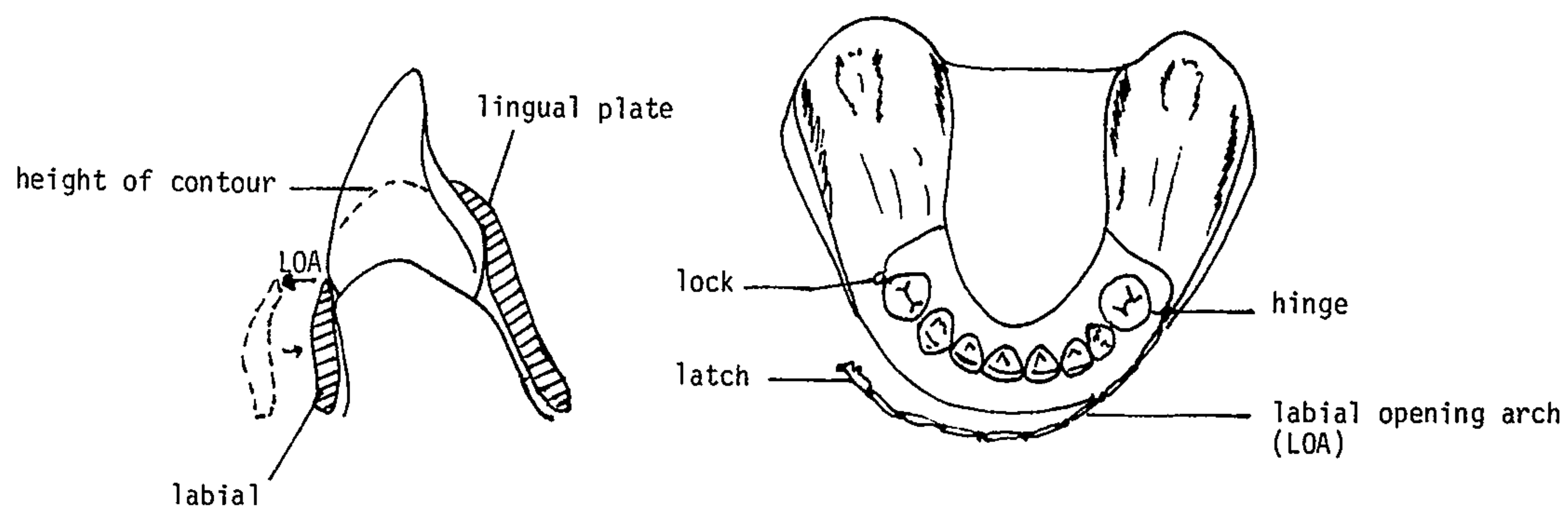
- A. a,b,c,d,e - I,L,R,S,U - bar retainers.  
f,g - bar retainer designed by Looë (Brit. Dent. J. 88:67, 1950).



- B. RPI retainer.



- C. Double distal cufts designed by Murray & Cock (N.Z. Dent. J. 73:29, 1977).



- D. The swing-lock ( J. Prosthet. Dent. 40: 257 , 1978 )

design as irreconcilable and unscientific. DeVan<sup>(2)</sup> considers them as most injurious and objectionable. But retention is a basic requirement for the proper functioning of prosthetic appliances. The advocates of different types of retainers claim specific properties for their favourite design<sup>(2,87,90,101-107)</sup>. Many studies<sup>(25,76-77,99,108-112)</sup> have been carried out concerning retention, stress on abutment teeth, tooth mobility and denture movement due to different retainer designs. Most of the studies were prepared and measured in the laboratory and the biologic conditions of the mouth were not closely simulated, therefore the results may be different to actual occurrence<sup>(25)(113)</sup>. However, they provide some understanding that can be used in selection of suitable retainers for particular patients. The ultimate selection of retainers for a particular patient will depend upon the existing mouth conditions, the amount of retention required and technical facilities available.

### 3.5.5 Major Connector

A major connector unites the isolated parts of the appliance. McCracken<sup>(114)</sup> states, "No component of a removable partial denture should be added arbitrarily or conventionally. Each component should be added for a good reason and to serve a definite purpose."

According to Henderson<sup>(115)</sup>, a major connector should be (i) of a material compatible with the oral tissue, (ii) it should be rigid so as to uniformly distribute masticatory stresses, (iii) it should not cause excessive alteration of surface contours so as to cause interferences

or irritations to the movable tissues around the appliance, e.g. tongue, lips and/or cheeks, (iv) it should not cause any impingement of the soft tissues during the removal and insertion of the appliance or during function, (v) it should cover the oral tissues only as much as is absolutely necessary, and (vi) it should not create any food traps or unhygienic conditions.

Essentially, the major connector may be in the form of bars as palatal, lingual or sublingual bars; or plates covering the palatal or lingual surfaces of the teeth and tissues. The choice between the bars and the plates depends upon the conditions existing in the mouth, requirements of strength, requirement of support and patient's acceptability<sup>(115-121)</sup>.

### 3.5.6 The Stressbreaker

According to Krough-Poulsen<sup>(50)</sup>, stress breakers are resilient connectors or joints between the tooth-borne and the tissue-borne parts of the denture. These permit small independent movements between the two parts of the appliances and allow them to settle independently of one another when subjected to occlusal loads. Such appliances are thought to provide a more even distribution of occlusal forces and a reduction of tilting stress on the abutment teeth due to the lever action of free-end saddles as they sink into the tissues.

Theoretically, stress-breaking has sound principles, but practical value is limited or doubtful<sup>(122)</sup>. The

"stress breaker dentures" lack stability in all directions and have complicated designs which require special techniques and procedures<sup>(31)</sup>. The stress breakers give a faulty feeling of security regarding effectiveness of the design. They require more frequent clinical assessment and adjustment and the trend appears to be towards alternative methods of ensuring that neither of the two support elements - teeth and tissues - are overloaded.

During the design and construction of a removable partial denture for a patient, any of the following practices may be adopted:

(i) the dentist makes the impressions and casts, and sends them to the laboratory, expecting the laboratory to design and cast the framework. When the castings are received, the dentist makes a few alterations and adjustments in the teeth involved with the casting and/or the opposing teeth and cusps to accommodate the thickness of the occlusal rests, etc. In other words, the designing and construction of the appliance is left entirely to the commercial laboratory.

(ii) the dentist may examine the patient, prepare occlusal rests following some very generalised rules, take an impression and make a cast and request the laboratory to design the rest of the appliance.

or (iii) the dentist may make correctly articulated study casts, examine the patient clinically as well as radiographically, survey the casts, and make a definite overall plan of treatment; for the oral cavity. The design of the partial denture is only one part of the overall treatment plan and the dentist prepares himself, or makes

arrangements for the completion of any pre-prosthetic treatments. This may include a general prophylaxis, periodontal and operative treatments, orthodontic treatment or even oral surgery.

As part of this, he carries out pre-impression mouth preparation such as occlusal rest seat preparation, modification of axial contours etc. Then the final impressions are made and master casts poured and a detailed prescription prepared for the commercial laboratory to follow in minute detail.

Many surveys are on record investigating these three modes of operation. McCracken<sup>(100)</sup> considered that the practice of delegating the design of denture framework to the laboratory technician deserved condemnation. Biologically acceptable partial denture service is possible only when the design of the partial denture is determined by the dentist at the time of treatment planning. Adequate mouth preparation is accomplished with a specific overall treatment plan in mind.

Graham and Beckett<sup>(123)</sup> and also Frantz<sup>(124)</sup> pointed out that there are many variations in design of a partial denture framework for identical casts when carried out by different commercial laboratories or different dentists.

Frantz<sup>(125)</sup> also found that variations in design that were unacceptable when considering biologic and mechanical requirements were more common in the commercial laboratory designs than in designs prepared by dentists.

Sykora<sup>(126)</sup> points out that the most revealing response to his survey was the complaint from a commercial dental

laboratory about the lack of detailed instructions (work authorisation orders) from dentists for the fabrication of removable partial denture framework. The laboratories complained that 50-80 per cent of all work authorisation forms received were incomplete. Although, during the undergraduate course, dental students were trained in giving specific work authorisation orders, Sykora<sup>(126)</sup> observed that the habit does not seem to carry over into dental practice.

SECTION IV

RESULTS OF THE CLINICAL SURVEY

FROM

UNIVERSITY PROSTHETIC CLINIC

DENTAL FACULTY

UNIVERSITY OF SYDNEY

AUSTRALIA

#### 4. Clinical Survey of Removable Partial Dentures after 2 Years Usage

##### Methods

4.1 Patient selection: From the archives of the Prosthetic Dentistry Department of the Faculty of Dentistry in the University of Sydney, the treatment records of 109 partial denture patients were selected using the following criteria:

i) The patients had obtained removable partial dentures from the department of Prosthetic Dentistry, Dental Faculty, University of Sydney made by fourth and fifth year dental students, between July and October, 1976.

ii) The partial dentures opposed natural dentitions, removable partial dentures or complete dentures.

iii) The completed removable partial dentures at the time of final issue were graded as B+ or higher, that is satisfactory or better. The different patients were assessed by different demonstrators, who did not follow any prescribed rules of assessment other than generally acceptable standards of workmanship, biomechanics and patient's comfort and satisfaction. No preference was given to the higher grades.

4.2 Communication with the patients: The following attempts were made:-

1st attempt: The routine-departmental-appointment cards (Fig. No. 11) were mailed to the patients, giving appointments within the next five weeks.

2nd attempt: To the patients who did not respond, the departmental appointment cards were mailed again.

3rd attempt: Of the patients who still did not respond, thirteen had their telephone numbers recorded on the charts and the author tried to contact them. Those who could be contacted were given a brief introduction to the survey and the value of periodic clinical check up appointments. They were given appointments and were requested to co-operate.

4th attempt: Those patients who did not respond to the above or who could not be contacted on the telephone, were sent a letter from the head of the department explaining the importance of the survey and requesting their co-operation. (Fig. No. 12). A questionnaire (Fig. No. 13) and a stamped and addressed envelope also accompanied the letter. The patients were requested to ring for an appointment or return the completed questionnaire.

5th attempt: A reminder (Fig. No. 14) was sent to the patients requesting the return of the questionnaire.

6th attempt: To complete the means of communication, a final attempt was made by visiting the patients at their recorded addresses.

4.3 Examination and assessment of patients: Clinical examination was conducted and recorded in accordance with the forms shown in Fig. No. 15A,B,C,D.. The dentist's as well as patient's observations were recorded.

4.3.1 Dentist's observations

i) Mouth conditions: For the detection of caries, only the visual and digital methods were used. The guides for the visual methods were: 1) evidence of loss of tooth tissue

**UNITED DENTAL HOSPITAL OF SYDNEY**

1/AP200

2 CHALMERS STREET, SURRY HILLS, N.S.W. 2010 (Near Central Railway)

Phone: 211-4322

211-2120 (After Hours)

Reg. No.....

With reference to University Prosthetics .....

AN APPOINTMENT has been made with.....

Department, at..... on.....

**PLEASE PRESENT THIS NOTICE TOGETHER WITH YOUR  
BLUE REGISTRATION CARD**

Secretary

Fig. 11.

TELEPHONE: 211-4322



**The University of Sydney**  
FACULTY OF DENTISTRY

DEPARTMENT OF PROSTHETIC DENTISTRY  
DENTAL HOSPITAL  
CHALMERS STREET  
SURRY HILLS.  
NEW SOUTH WALES. 2010

Dear

The Department of Prosthetic Dentistry needs your help.

One of our postgraduate students, Miss Pimtip, is completing a survey on partial dentures. She wishes to assess their effectiveness after two years use and is particularly interested in knowing your opinion of your dentures.

Recently two appointments have been made for you, but unfortunately you failed to attend. I would be grateful if you would telephone for another appointment by ringing:

211 4322      Ext. 255 or 256

If you are unable to attend the Prosthetic Dentistry clinic at the United Dental Hospital, would you please complete the attached form and return it in the enclosed envelope, as soon as it is possible.

Your co-operation in this matter would be greatly appreciated, and you will be helping us provide the most appropriate denture treatment.

Yours sincerely,

Iven Klineberg,  
Professor and Head,  
Department of Prosthetic Dentistry

Attach.

NAME..... AGE..... SEX.....

Tick correct answer:

1. Reason for not attending the survey:

- Not in Sydney
- Working
- Ill-health
- Other.....

2. Do you wear the partial denture made at the Dental Hospital?

- |               |     |    |
|---------------|-----|----|
| Upper denture | Yes | No |
| Lower denture | Yes | No |

Remarks.....  
.....

3. How often do you see the dentist?

- Every 6 months
- Every year
- Not since receiving the denture(s)

Fig. 13.

TELEPHONE: 211-4322



**The University of Sydney**  
FACULTY OF DENTISTRY

DEPARTMENT OF PROSTHETIC DENTISTRY  
DENTAL HOSPITAL  
CHALMERS STREET  
SURRY HILLS.  
NEW SOUTH WALES. 2010

Dear

Recently you were sent a questionnaire about the dentures you had constructed at the Dental Hospital and to date we have not received your reply.

In order to come to valid conclusions from the survey we are carrying out, it is desirable that we contact everyone in the group we have chosen. As your name is in the survey group, we urge you to return the questionnaire as soon as possible. If it has been mislaid, please contact Miss Pimtip or Mrs. Harradine, telephone number 211 4322.

Thanking you in anticipation,

Yours sincerely,

Iven Klineberg,  
Professor and Head,  
Department of Prosthetic Dentistry

A CLINICAL SURVEY OF REMOVABLE PARTIAL DENTURES AFTER 2 YEARS USAGE.

Patient's name \_\_\_\_\_ Reg. No. \_\_\_\_\_  
Address \_\_\_\_\_ Phone \_\_\_\_\_  
Date of Birth \_\_\_\_\_ Sex \_\_\_\_\_  
Date of Denture Issue \_\_\_\_\_  
Date of Examination \_\_\_\_\_

Denture History

First denture? Yes ☐ No ☐  
If no, previous denture experience Good ☐ Poor ☐

Use of Denture

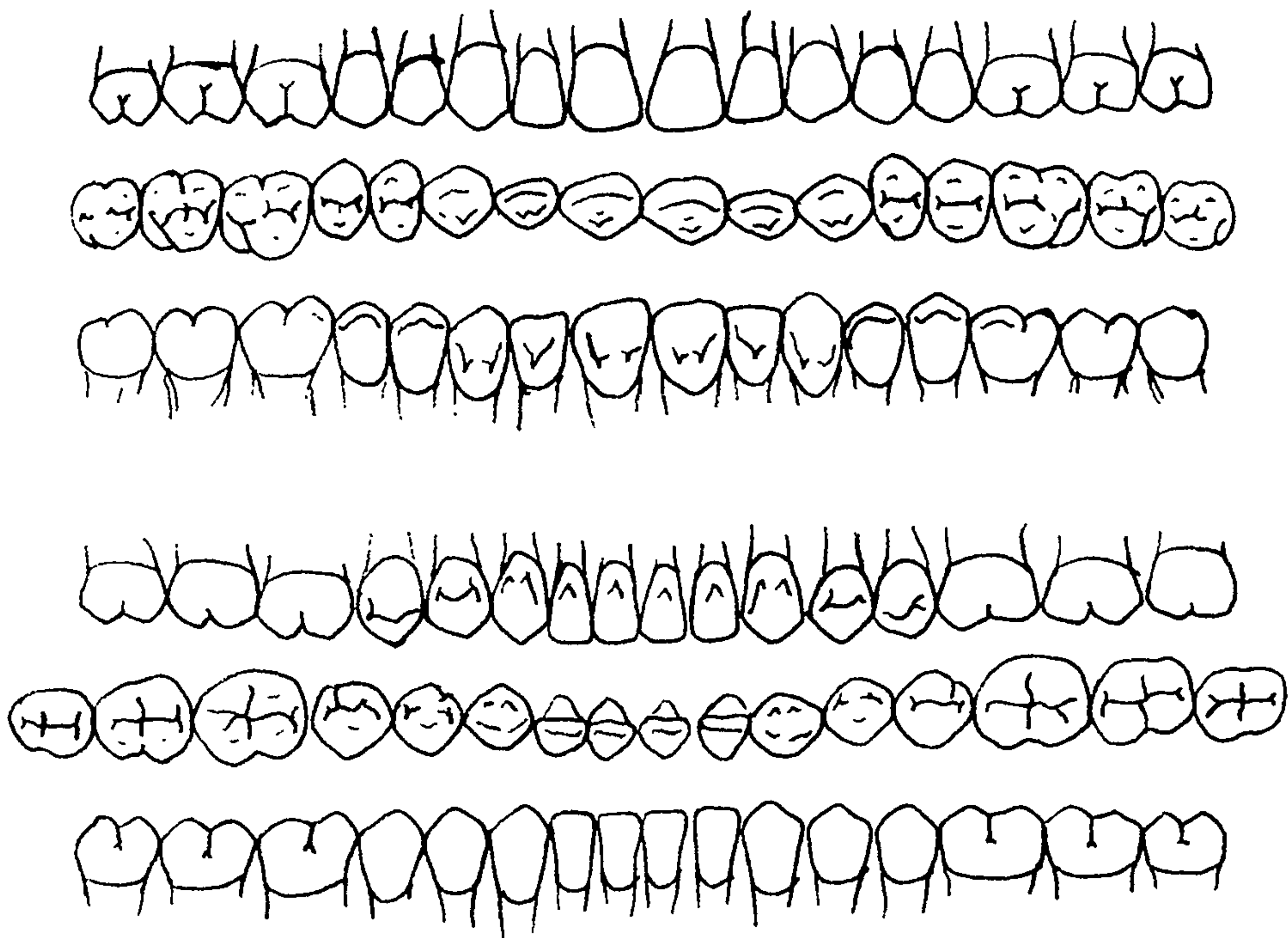
|              | <u>Maxillary</u>      | <u>Mandibular</u>     |
|--------------|-----------------------|-----------------------|
| Always       | <input type="radio"/> | <input type="radio"/> |
| Day only     | <input type="radio"/> | <input type="radio"/> |
| Meals only   | <input type="radio"/> | <input type="radio"/> |
| Occasionally | <input type="radio"/> | <input type="radio"/> |
| Never        | <input type="radio"/> | <input type="radio"/> |

Tooth loss after Denture Insertion Yes ☐ No ☐  
If yes, Abutment ☐ Periodontitis ☐  
Involved in denture design ☐ Caries ☐  
Not involved in denture design ☐ Does not know ☐

Dental Caries

Yes ☐ No ☐  
If yes, Abutment ☐ Rest ☐ Clasp ☐  
In contact with denture ☐  
Not in contact with denture ☐

Fig. 15A



Condition of Mucosa

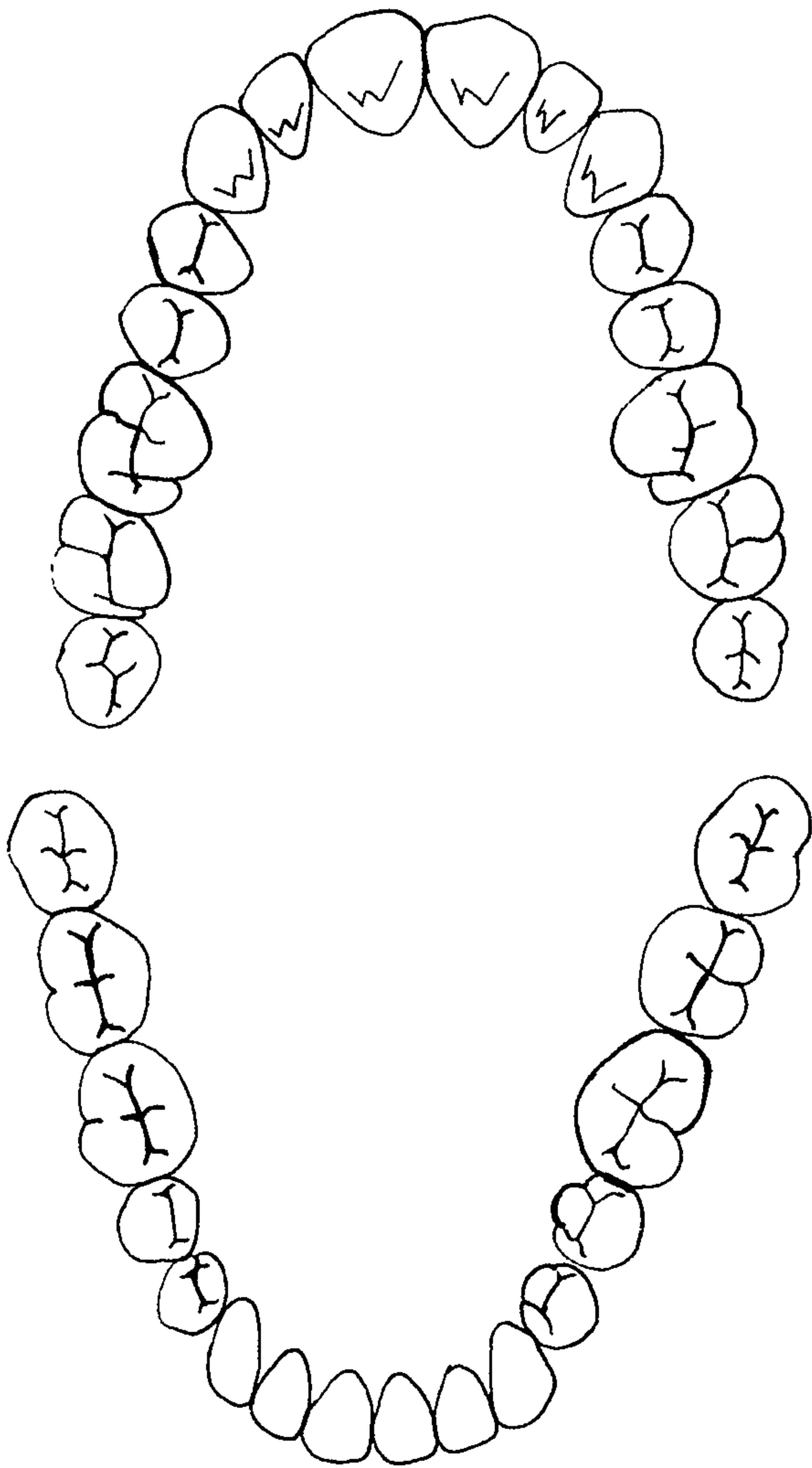
|                   | <u>Maxillary</u>      | <u>Mandibular</u>     |
|-------------------|-----------------------|-----------------------|
| Trauma-ulceration | <input type="radio"/> | <input type="radio"/> |
| Hypertrophy       | <input type="radio"/> | <input type="radio"/> |
| D.S.M.            | <input type="radio"/> | <input type="radio"/> |

Patient's Assessment of Dentures

|                         | <u>Maxillary</u>      | <u>Mandibular</u>     |
|-------------------------|-----------------------|-----------------------|
| Appearance              | <input type="radio"/> | <input type="radio"/> |
| Comfort                 | <input type="radio"/> | <input type="radio"/> |
| Stability and Retention | <input type="radio"/> | <input type="radio"/> |
| Chewing efficiency      | <input type="radio"/> | <input type="radio"/> |

Poor - 1      Satisfactory - 2      Good - 3

Fig. 15B



|                |                | <u>Maxillary</u>      | <u>Mandibular</u>     |
|----------------|----------------|-----------------------|-----------------------|
| <u>Base:</u>   | Cast Co/Cr     | <input type="radio"/> | <input type="radio"/> |
|                | Acrylic Resin  | <input type="radio"/> | <input type="radio"/> |
| <u>Rests:</u>  | Cast Co/Cr     | <input type="radio"/> | <input type="radio"/> |
|                | Wrought S.S.W. | <input type="radio"/> | <input type="radio"/> |
| <u>Clasps:</u> | Cast Co/Cr     | <input type="radio"/> | <input type="radio"/> |
|                | Cast Gold      | <input type="radio"/> | <input type="radio"/> |
|                | Wrought S.S.W. | <input type="radio"/> | <input type="radio"/> |
|                | Wrought Au.W.  | <input type="radio"/> | <input type="radio"/> |
| <u>Teeth:</u>  | Acrylic Resin  | <input type="radio"/> | <input type="radio"/> |
|                | Porcelain      | <input type="radio"/> | <input type="radio"/> |
|                | Cast Co/Cr     | <input type="radio"/> | <input type="radio"/> |

Fig. 15C

Denture Examination

|                     |                 | <u>Maxillary</u>      | <u>Mandibular</u>     |
|---------------------|-----------------|-----------------------|-----------------------|
| <u>Retention:</u>   | Good            | <input type="radio"/> | <input type="radio"/> |
|                     | Fair            | <input type="radio"/> | <input type="radio"/> |
|                     | Poor            | <input type="radio"/> | <input type="radio"/> |
| <u>Stability:</u>   | Good            | <input type="radio"/> | <input type="radio"/> |
|                     | Fair            | <input type="radio"/> | <input type="radio"/> |
|                     | Poor            | <input type="radio"/> | <input type="radio"/> |
| <u>Occlusion:</u>   | Tooth contact   | <input type="radio"/> | <input type="radio"/> |
|                     | Saddle 1        | <input type="radio"/> | <input type="radio"/> |
|                     | Saddle 2        | <input type="radio"/> | <input type="radio"/> |
|                     | Saddle 3        | <input type="radio"/> | <input type="radio"/> |
| <u>Fracture:</u>    | Major connector | <input type="radio"/> | <input type="radio"/> |
|                     | Minor connector | <input type="radio"/> | <input type="radio"/> |
|                     | Rest            | <input type="radio"/> | <input type="radio"/> |
|                     | Clasps          | <input type="radio"/> | <input type="radio"/> |
|                     | Teeth           | <input type="radio"/> | <input type="radio"/> |
| <u>Deformation:</u> | Major connector | <input type="radio"/> | <input type="radio"/> |
|                     | Minor connector | <input type="radio"/> | <input type="radio"/> |
|                     | Clasps          | <input type="radio"/> | <input type="radio"/> |

Fig. 15D

such as cavities, 2) change of tooth colour and 3) accumulation of food debris. Digital examination was carried out with probe #6 and surface roughness or catching of the probe was considered as carious involvement. Attempt was made to relate the carious lesions to abutment teeth, occlusal rests, retainers and other parts of the denture.

For examination of the mucosa, surface congestion, inflammation and ulceration in some way generally associated with the denture was recorded. The conditions of the mucosa were classified as: 1) Traumatic inflammation - Localised areas of congestion on denture foundation with or without evidence of ulceration, 2) Hypertrophic mucosa - Mucosa appearing to be growing over the margin of the skeletal design of the appliance 3) Denture sore mouth - Chronic generalised inflammatory mucosa covering the denture foundation area including the gingival margins and the periphery of the saddles. No attempt was made to relate the inflammation to any particular component of the denture.

ii) Dentist's assessment of denture:

This was based upon denture conditions including retention, stability and occlusion at the time of clinical assessment. It has to be recorded here that we can only assume from the standard of student work assessment in this school that at the time of issue of the dentures the condition of the occlusal contacts was adequate and if any discrepancy was observed, it was the result of denture usage after issue. The same assumption applied to retention and stability.

For the assessment of retention, an attempt was made

to dislodge the denture with one finger moving one of the principle retainer in the occlusal direction. If the denture offered active resistance it was considered well-retained. If the denture came off easily but was not falling off by itself, the retention was considered fair. If the denture was floating about in the mouth the retention was considered poor.

For the assessment of stability, vertical pressure in the direction of the foundation was applied to the right, left, anterior and posterior parts of the appliance alternatively. The absence of any rocking movement indicated good stability. The presence of very small rocking movements indicated a fair degree of stability. When the rocking movements were of such amplitude that the occlusal rests completely lifted out of their seats, the stability was considered poor.

For the assessment of occlusion, contacts of the partial denture and the opposing dentition was examined in the intercuspal jaw position and was assessed as good, fair or poor depending upon how tightly a piece of articulating paper of 0.02 mm. thickness (Ainsworth<sup>®</sup>) was held between the opposing teeth. If the articulating paper could not be pulled out without tearing, the occlusal contact was considered to be good. The occlusal contact was considered fair when the articulating paper was pulled out with slight difficulty. The occlusal contact was considered poor when there was no contact at all between the denture and the teeth and the articulating paper made no mark on the artificial teeth.

The designs of the partial dentures were also recorded on the prescribed forms and were assessed from the dentist's point of view.

#### 4.3.2 Patient's assessment of the denture

The patient's assessment of the denture was recorded by asking him the following questions:

Appearance: "Do you like the look of your denture?"

Comfort: "Do you feel comfortable with the denture?"

Stability & Retention: "Do you feel that the dentures move when you are chewing?"

"Do the dentures ever lift off completely?"

Chewing Efficiency: "Do you chew better with the denture, and can you chew without the dentures?"

The patients were encouraged to grade their answers to the questions as good, satisfactory or poor and these were recorded as 3, 2, 1 respectively. Those patients who scored 12 in answers to all the four questions were grouped as completely satisfied. Those who scored 4 for all the questions were grouped as completely dissatisfied while those patients who scored between 5 and 11 were considered as having some reservations.

#### 4.3.3 Assessment of examination forms:

The assessment of the forms was carried out under the following 10 headings:-

1. Distribution of the denture patients as related to age and sex.
2. Distribution of the types of dentures examined according to Kennedy's classification in relation to type of opposing dentition.

3. Denture usage habits.
4. Tooth loss related to denture.
5. Partial loss of tooth tissue related to denture.
6. Condition of mucosa related to denture.
7. Patient's assessment of the denture.
8. Relationship of design of denture components to Kennedy's classification.
9. Denture fracture and deformation.
10. Dentist's assessment of the appliance.

## 5. Observations and Results

5.1 Selection of patients: From examination of the departmental charts and records in accordance with the basic criteria, 109 patients were selected. Different methods of communication shown in Table No. 2 were tried as a result of which a total number of 71 patients presented for clinical examination. Out of the remaining thirty-eight, twelve patients responded by only returning the questionnaires, two patients declined to take part in the survey due to lack of interest or time, one patient had passed away, one was in ill-health, and two could not be contacted at home at the time of the author's visit. The remaining 20 patients either could not be contacted at all or had changed their address.

5.2 Assessments of the questionnaire: The assessments of the questionnaire are shown in the Table No. 3. Most of the patients did not join the survey because of ill-health.

5.3 Clinical assessment: The seventy-one patients - 65 per cent of the total group - were clinically examined during

Table 2: Patient's response to each communication method

| COMMUNICATION METHOD                     | TOTAL PATIENTS INVOLVED | PATIENTS REPORTING FOR CLINICAL EXAMINATION | PATIENTS RESPONDING ONLY BY QUESTIONNAIRE | PATIENTS NOT PARTICIPATING IN THE SURVEY AND THEIR REASONS                                                             |
|------------------------------------------|-------------------------|---------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 1. ROUTINE APPOINTMENT CARD              | 109                     | 54                                          | -                                         |                                                                                                                        |
| 2. REMINDER APPOINTMENT CARD             | 55                      | 10                                          | -                                         |                                                                                                                        |
| 3. TELEPHONE                             | 13                      | 5                                           | -                                         | 1 patient : too busy<br>1 patient : disinterest<br>5 patients: not in Sydney or moved<br>1 patient : unable to contact |
| 4. DEPARTMENTAL LETTER AND QUESTIONNAIRE | 32                      | 1                                           | 8                                         | 1 patient : died<br>7 patients: returned letters                                                                       |
| 5. REMINDER DEPARTMENTAL LETTER          | 15                      | -                                           | 3                                         | 1 patient : ill-health<br>2 patients: returned letters                                                                 |
| 6. PERSONAL VISIT                        | 9                       | 1                                           | 1                                         | 2 patients: not at home the day of the visit<br>5 patients: moved                                                      |
| TOTAL                                    |                         | 71                                          | 12                                        | 26                                                                                                                     |

Table 3: Assessment of the 12 questionnaires

| QUESTION                                                        | REASON                            | RESULT |    |       |
|-----------------------------------------------------------------|-----------------------------------|--------|----|-------|
| 1. Reason for not attending the survey                          | Not in Sydney                     | 3      |    |       |
|                                                                 | Working                           | 1      |    |       |
|                                                                 | Ill-health                        | 7      |    |       |
|                                                                 | Considered unnecessary            | 1      |    |       |
| 2. Do you wear the partial denture made at the dental hospital? |                                   | Yes    | No | Total |
|                                                                 |                                   | 2      | 2  | 4     |
|                                                                 | Upper denture                     | 6      | 5  | 11    |
|                                                                 | Lower denture                     |        |    |       |
| 3. How often do you see the dentist?                            | Total                             | 8      | 7  | 15    |
|                                                                 | Every 6 months                    |        | 3  |       |
|                                                                 | Every year                        |        | 1  |       |
|                                                                 | Never since receiving the denture |        | 8  |       |

Note: Reasons for not using the dentures were: discomfort, ulcer, loose denture and preference for fixed partial denture. One patient never wears both dentures together but wears the upper denture for aesthetics and the lower denture for mastication.

one-half hour appointment per patient. The examination and recordings were carried out by the author. Although 94 partial dentures were issued only 88 dentures could be examined. Six dentures were not available for assessment, because for one reason or another, the patients had discarded them.

5.4 From the examination records, the following data was collected.

5.4.1 Distribution of denture patients and dentures as related to age and sex: Table No. 4.

Of the total 71 patients surveyed, 25 per cent were males and 75 per cent females. Their ages ranged from 32 to 73; the average age of the sample being 57.8 years. The greatest incidence of denture patients examined was in the 60-69 year age group, of which 71 per cent were females.

5.4.2 Distribution of type of partial dentures:

The dentures were divided into maxillary and mandibular, and cast cobalt-chromium or acrylic resin as shown in Table No. 5. The distribution of dentures was also examined in respect to position of saddle according to Kennedy's classification and also according to the opposing dentition and is shown in Tables No. 6 and 7.

Out of the 94 dentures examined 77 per cent belonged to female patients and 23 per cent to males. The incidence of Kennedy's class I type was the highest and class IV type the lowest. Sixty-three per cent of dentures represent unilateral

Table 4: Age-sex distribution of patients and dentures

| Age    | 30-39   |         | 40-49   |         | 50-59   |         | 60-69   |         | 70 and over |         | Total    |          |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|-------------|---------|----------|----------|
|        | Patient | Denture | Patient | Denture | Patient | Denture | Patient | Denture | Patient     | Denture | Patient  | Denture  |
| Female | 5       | 9       | 8       | 11      | 11      | 15      | 22      | 27      | 7           | 10      | 53 (75%) | 72 (77%) |
| Male   | 2       | 3       | 2       | 2       | 1       | 2       | 9       | 9       | 4           | 6       | 18 (25%) | 22 (23%) |
| Total  | 7       | 12      | 10      | 13      | 12      | 17      | 31      | 36      | 11          | 16      | 71       | 94       |

Table 5: Distribution of dentures in relation to denture base materials

| Denture base material<br>Denture | Cast Cr-Co |            | Acrylic resin |            | Total %              |
|----------------------------------|------------|------------|---------------|------------|----------------------|
|                                  | Maxillary  | Mandibular | Maxillary     | Mandibular |                      |
|                                  | 37         | 51         | 2             | 4          | 39 (41%)<br>55 (59%) |
| Total                            | 88 (94%)   |            | 6 (6%)        |            | 94 (100%)            |

Note: Six of the 94 dentures were lost and could not be examined clinically. They were included in the survey because for one reason or another the dentures were failures. Their details were collected from the prosthetic charts.

and bilateral free-end saddles and 37 per cent bounded saddles.

5.4.3 The opposing dentition was complete denture, partial denture or natural dentition. (Table No. 7). The incidence of partial dentures opposing partial dentures was the highest. Thirty-four per cent of the partial dentures opposed complete dentures and 81 per cent of these represented Kennedy's class I type dentures.

5.4.4 Denture usage habits:

Table No. 8 shows the seven variations of denture wearing habits and their relationship to the location and type of the appliance.

It was found that 51 per cent of the dentures were used only during the day time and 29 per cent were used always, i.e. day and night. The remaining dentures for one reason or another can be assumed as failures because the patient could not use them for all functional requirements. Of these, one per cent were used only during meals; two per cent were used either all the time or only during the day but were removed during meal times; three per cent of the dentures were used occasionally and generally for aesthetics only; and 14 per cent of the dentures were never used because patients either did not use them at all from the time of issue or were not using them during the past 6 months.

The failure of dentures was related to the location and type of the dentures. Mandibular dentures showed a much

Table 6: Distribution of types of dentures in female and male patients

| Denture type<br>Sex | Kennedy's<br>class I | Kennedy's<br>class II | Kennedy's<br>class III | Kennedy's<br>class IV | Total    |
|---------------------|----------------------|-----------------------|------------------------|-----------------------|----------|
| Female              | 33                   | 14                    | 23                     | 3                     | 73 (78%) |
| Male                | 7                    | 4                     | 8                      | 1                     | 21 (22%) |
| Total (%)           | 41 (44%)             | 18 (19%)              | 31 (33%)               | 4 (4%)                | 94       |

Table 7: Dentures and the opposing dentition

| Opposing<br>dentition<br>Denture type | Complete<br>denture | Partial<br>denture | Natural<br>dentition | Total |     |
|---------------------------------------|---------------------|--------------------|----------------------|-------|-----|
|                                       |                     |                    |                      | No.   | %   |
| Kennedy's class I                     | 26 (81%)            | 15 (31%)           | -                    | 41    | 44  |
| " " II                                | 3 (9%)              | 10 (21%)           | 5 (36%)              | 18    | 19  |
| " " III                               | 3 (9%)              | 20 (42%)           | 8 (57%)              | 31    | 33  |
| " " IV                                | -                   | 3 (6%)             | 1 (7%)               | 4     | 4   |
| Total (%)                             | 32 (34%)            | 48 (51%)           | 14 (15%)             | 94    | 100 |

Table 8: Distribution of dentures related to denture usage habits

| Denture type*<br>Denture usage habits | Maxillary |    |     |    |       | Mandibular |    |     |    |       | Total |     |
|---------------------------------------|-----------|----|-----|----|-------|------------|----|-----|----|-------|-------|-----|
|                                       | I         | II | III | IV | Total | I          | II | III | IV | Total | No.   | %   |
| Always                                | 3         | 1  | 8   | 1  | 13    | 7          | 2  | 4   | 1  | 14    | 27    | 29  |
| Day only                              | 2         | 5  | 12  | 1  | 20    | 19         | 7  | 2   | -  | 28    | 48    | 51  |
| Always except meals                   | -         | -  | -   | -  | -     | 1          | -  | -   | -  | 1     | 1     | 1   |
| Day only except meals                 | -         | -  | -   | -  | -     | 1          | -  | -   | -  | 1     | 1     | 1   |
| Meals only                            | -         | -  | -   | -  | -     | 1          | -  | -   | -  | 1     | 1     | 1   |
| Occasionally                          | -         | -  | 1   | -  | 1     | 1          | 1  | -   | -  | 2     | 3     | 3   |
| Never                                 | 1         | 1  | 2   | 1  | 5     | 5          | 1  | 2   | -  | 8     | 13    | 14  |
| Total                                 | 6         | 7  | 23  | 3  | 39    | 35         | 11 | 8   | 1  | 55    | 94    | 100 |

\* Kennedy's classification

higher incidence of failure than the maxillary dentures. Also, there was a higher incidence of failure in free-end saddle dentures than in bounded saddle dentures.

Denture wearing habits were also related to denture experience prior to the present appliance. Table No. 9. Forty-three per cent of the dentures were the first dentures experienced by the patients and 57 per cent of the dentures were issued to patients who had previously used some appliance with good or poor experience. It was found that dentures prepared for the first time showed a 68 per cent failure i.e. they were "never used"; whereas 31 percent of failure was in the patients who had previous denture experience and regardless of the quality of past denture experience.

Patients gave different reasons for different wearing habits. Some of the reasons given by patients who were using the dentures "always" were: 1) they were not told to take the dentures out at night; 2) they were not fully convinced of the advantages of leaving dentures out at night and felt it unnecessary to do so; and 3) one patient said that she bit her lower lip if she left the dentures out at night. The reasons for not using the denture are presented in the "patient's assessment of the denture".

5.4.5 Tooth loss after denture insertion: There were three patients who lost teeth after partial denture insertion. A total number of 4 teeth were lost. Three of these were abutment teeth related to two different dentures. The fourth tooth lost was located in the opposite arch and was

Table 9: Denture experience related to denture usage habits

| Denture experience                                                        | Successful denture |            |          | Unsuccessful denture |            |          | Total |     |
|---------------------------------------------------------------------------|--------------------|------------|----------|----------------------|------------|----------|-------|-----|
|                                                                           | Maxillary          | Mandibular | Total    | Maxillary            | Mandibular | Total    | No.   | %   |
| First denture                                                             | 9 (12%)            | 18 (24%)   | 27 (36%) | 5 (26%)              | 8 (42%)    | 13 (68%) | 40    | 43  |
| Patient with previous denture experience                                  |                    |            |          |                      |            |          |       |     |
|                                                                           | 18 (24%)           | 13 (17%)   | 31 (41%) | 1 (5%)               | 4 (21%)    | 5 (26%)  | 36    | 38  |
| - Good                                                                    |                    |            |          |                      |            |          |       |     |
| - Poor                                                                    | 7 (9%)             | 10 (13%)   | 17 (23%) | -                    | 1 (5%)     | 1 (5%)   | 18    | 19  |
| Total no. of dentures issued to patients with previous denture experience | 25 (33%)           | 23 (30%)   | 48 (64%) | 1 (5%)               | 5 (26%)    | 6 (31%)  | 54    | 57  |
| Total                                                                     | 34 (45%)           | 41 (54%)   | 75       | 6 (31%)              | 13 (68%)   | 19       | 94    | 100 |

Table 10: Denture usage related to denture types

| No. of denture             | Free-end saddle denture Class I & II |    |            |    |       | Bounded saddle denture Class III & IV |    |            |    |       |
|----------------------------|--------------------------------------|----|------------|----|-------|---------------------------------------|----|------------|----|-------|
|                            | Maxillary                            |    | Mandibular |    | Total | Maxillary                             |    | Mandibular |    | Total |
|                            | No.                                  | %  | No.        | %  | No.   | No.                                   | %  | No.        | %  | No.   |
| Successful denture         | 11                                   | 19 | 35         | 59 | 46    | 22                                    | 63 | 7          | 20 | 29    |
| Unsuccessful denture       | 2                                    | 3  | 11         | 19 | 13    | 4                                     | 11 | 2          | 6  | 6     |
| Total - out of 94 dentures | 13                                   | 14 | 46         | 49 | 59    | 26                                    | 28 | 9          | 10 | 35    |
|                            |                                      |    |            |    | 63    |                                       |    |            |    | 37    |

Table 11: Distribution of number of the remaining teeth related to denture usage

|                      | No. of remaining teeth |     |     |     |       | Total<br>no. of<br>denture | Total<br>no. of<br>remaining<br>teeth | Average<br>of teeth<br>per arch |
|----------------------|------------------------|-----|-----|-----|-------|----------------------------|---------------------------------------|---------------------------------|
|                      | 2-3                    | 4-5 | 6-7 | 8-9 | 10-11 | 12-13                      |                                       |                                 |
| Successful denture   | 1                      | 10  | 25  | 23  | 11    | 5                          | 578                                   | 7.7                             |
| Unsuccessful denture | -                      | 2   | 3   | 6   | 6     | 3                          | 177                                   | 9.3                             |
| Total                | 1                      | 12  | 28  | 29  | 17    | 8                          | 755                                   |                                 |

Table 12: Denture success rate and the locations of artificial teeth  
in the dental arch

| No. of denture       | Location of artificial teeth |                           |               | Total |
|----------------------|------------------------------|---------------------------|---------------|-------|
|                      | Posterior only               | Posterior and<br>anterior | Anterior only |       |
| Successful denture   | 48 (76%)                     | 24 (89%)                  | 3 (75%)       | 75    |
| Unsuccessful denture | 15 (24%)                     | 3 (11%)                   | 1 (25%)       | 19    |
| Total                | 63 (67%)                     | 27 (29%)                  | 4 (4%)        | 94    |

not directly involved in the partial denture design. It was extracted because of coronal fracture.

Two patients who lost abutment teeth described that they felt pain and the attending dentist advised extraction. The exact reason for pain and extraction of the teeth could not be determined. The patients said that the teeth were "sound". Periodontitis seemed unlikely because the patients showed good oral hygiene and the remaining teeth were found to be healthy. In one patient, the cause of further loss of teeth may have been proximal caries.

5.4.6 Partial loss of tooth tissue: This may be due to i) caries or ii) fractures.

i) Dental caries: Table No. 13 shows incidence of caries related to the type of involvement of the teeth with the denture. The teeth either acted as abutment teeth for the appliance or came in contact with some parts of the appliance or were located in the opposing arch and came into occlusal contact with the denture. Thirty-two per cent of patients examined showed carious lesions. In all, 24 cavities were detected. It was found that 66 per cent of the lesions were in abutment teeth and the highest incidence was related to the retainers. The lesions were seen slightly gingivally to the arms of the retainers. Nine per cent of the carious lesions were found in the occlusal rest on the abutment teeth; 21 per cent of the lesions were found on other teeth making contact with the denture.

Table 13: Distribution of caries in the 30 per cent patients showing carious lesions

| Total number of carious lesions | Abutment |          |               |                                 | In contact with other denture components | Not in contact with any denture components | Opposing arch |
|---------------------------------|----------|----------|---------------|---------------------------------|------------------------------------------|--------------------------------------------|---------------|
|                                 | Rest     | Retainer | Lingual plate | Not contacting by any component |                                          |                                            |               |
| 24                              | 2        | 12       | 1             | 1                               | 5                                        | 2                                          | 1             |
| In percentage(%)                | 8        | 50       | 4             | 4                               | 21                                       | 8                                          | 4             |
| Total(%)                        | 66       |          |               |                                 | 21                                       | 8                                          | 4             |

Table 14: Distribution of caries related to Kennedy's classification of dentures

| Caries<br>Denture type | Abutment |          |                     |       | In contact with denture |                           |       | Not in contact with denture |
|------------------------|----------|----------|---------------------|-------|-------------------------|---------------------------|-------|-----------------------------|
|                        | Rest     | Retainer | Under lingual plate | Total | Lingual plate           | Rests and other component | Total |                             |
| Kennedy's class I      | 1        | 4        | 1                   | 6     | -                       | 3                         | 3     | 1                           |
| " II                   | 1        | 1        | -                   | 2     | -                       | -                         | -     | -                           |
| " III                  | -        | 7        | -                   | 7     | 1                       | 1                         | 2     | 2                           |
| " IV                   | -        | -        | -                   | -     | -                       | -                         | -     | -                           |
| Opposing dentition     | -        | -        | -                   | -     | -                       | -                         | -     | 1                           |
| No.<br>Total %         | 2        | 12       | 1                   | 15    | 1                       | 4                         | 5     | 4                           |
|                        | 8        | 50       | 4                   | 63    | 4                       | 17                        | 21    | 17                          |

The location of caries was also related to the type of partial denture according to Kennedy's classification (Table No. 14). It was found that class I and class III showed a higher incidence of caries than class II and class IV and class III type dentures showed a greater number of lesions located under rests other than on the abutment teeth.

Caries was also related to denture usage habits (Table No. 15). It was found that patients wearing dentures day and night showed the highest incidence of caries and out of these, the incidence was greatest in class III type dentures.

Two patients did not use the dentures, but still had caries involving the abutment teeth. One of these patients was using a previously made partial denture instead of the appliance included in the survey. These patients have not been included in the Table.

ii) Tooth fracture: This included fractures of tooth tissue itself and also the restorations already present in the teeth. In one patient the incisal edge next to the incisal rest was chipped. Another patient had a fractured MO-amalgam restoration related to an occlusal rest, apparently weakened due to the preparation of the rest seat. Three patients also reported fractures of the teeth after denture insertion. The site of fracture did not appear to be involved with the denture design.

Table 15: Distribution of caries related to denture usage habit

| Denture usage<br>habit<br>Denture type | Always | Day only | Always<br>except<br>meals | Day only<br>except<br>meals | Meals<br>only | Occasionally | Never | Total |     |
|----------------------------------------|--------|----------|---------------------------|-----------------------------|---------------|--------------|-------|-------|-----|
|                                        |        |          |                           |                             |               |              |       | No.   | %   |
| Kennedy's class I                      | 4      | 3        | -                         | 1                           | -             | -            | -     | 8     | 38  |
| " II                                   | -      | 2        | -                         | -                           | -             | -            | -     | 2     | 10  |
| " III                                  | 7      | 2        | -                         | -                           | -             | 1            | -     | 10    | 48  |
| " IV                                   | -      | 1        | -                         | -                           | -             | -            | -     | 1     | 5   |
| No.<br>Total                           | 11     | 8        | -                         | 1                           | -             | 1            | -     | 21    | 100 |
|                                        | 52     | 38       | -                         | 5                           | -             | 5            | -     |       |     |

Note: 1. Twenty-one patients showed 24 carious lesions.  
2. Three patients developed two carious lesions in the same arch.

5.4.7 Condition of the oral mucosa: The assessment of inflammatory involvement of the mucosa included denture foundation areas and gingival tissues.

Out of 94 dentures, 37 per cent showed pathological involvements of the mucosa. Table No. 16 represents a distribution of different conditions of the mucosa in maxilla and mandible related to types of dentures according to Kennedy's classification. It was found that class I and II type of dentures showed the greatest number of lesions and the incidence was again greater under the mandibular than the maxillary dentures. The incidence of denture sore mouth was highest under class I mandibular dentures. Denture sore mouth was the most common lesion seen in maxillary dentures and its incidence was highest in class III type dentures.

Table No. 17 shows distribution of the different conditions of the mucosa in relation to the denture base material in the maxillary and mandibular dentures. The table does not represent a valid comparison between the materials themselves but acrylic dentures being generally used as temporary dentures, requiring a wider surface area coverage and lacking in other finer points of denture design, caused a relatively greater incidence of denture sore mouth.

Table No. 18 represents the relationship between conditions of the mucosa and the degree of retention and stability of the dentures. The poorer the retention and stability, the higher was the incidence of inflammation



Table 17: Inflammation of mucosa related to base materials

| Total number of dentures:<br>Cast Cr-Co/Acrylic = 77/4* | Maxillary  |         | Mandibular |         |
|---------------------------------------------------------|------------|---------|------------|---------|
|                                                         | Cast Cr-Co | Acrylic | Cast Cr-Co | Acrylic |
| Trauma-ulceration                                       | 2          | -       | 5          | -       |
| Hypertrophy                                             | -          | -       | 2          | -       |
| Denture sore mouth                                      | 9          | 1       | 11         | 1       |
| Total No.<br>%                                          | 11         | 1       | 18         | 1       |
|                                                         | 14         | 25      | 23         | 25      |

\* Note: 7-dentures not being used were not included.

Table 18: Inflammation of mucosa related to  
denture retention and stability

Total number of dentures examined = 88

|                          | Retention |          |         | Stability |         |         |
|--------------------------|-----------|----------|---------|-----------|---------|---------|
|                          | Good      | Fair     | Poor    | Good      | Fair    | Poor    |
| No. of dentures examined | 50        | 26       | 12      | 57        | 11      | 20      |
| Trauma-ulceration        | 4 (8%)    | 2 (8%)   | 1 (8%)  | 4 (7%)    | 1 (9%)  | 2 (10%) |
| Hypertrophy              | 2 (4%)    | -        | -       | -         | 2 (18%) | -       |
| Denture sore mouth       | 10 (20%)  | 8 (31%)  | 4 (33%) | 11 (19%)  | 4 (36%) | 7 (35%) |
| Total                    | 16 (32%)  | 10 (39%) | 5 (41%) | 15 (26%)  | 7 (63%) | 9 (45%) |

Table 19: Inflammation of mucosa related to denture usage habits

|                          |        |          |                     |                       |            |               |       |
|--------------------------|--------|----------|---------------------|-----------------------|------------|---------------|-------|
| No. of dentures involved | 27     | 48       | 1                   | 1                     | 1          | 3             | 13    |
| Denture usage habit      | Always | Day only | Always except meals | Day only except meals | Meals only | Occasion-ally | Never |
| Trauma-ulceration        | 4      | 3        | -                   | -                     | -          | -             | 2     |
| Hypertrophy              | 1      | 1        | -                   | -                     | -          | -             | -     |
| Denture sore mouth       | 9      | 14       | -                   | -                     | 1          | -             | -     |
| Total No.<br>%           | 14     | 18       | -                   | -                     | 1          | -             | 2     |
|                          | 52     | 38       | -                   | -                     | 100        | -             | 15    |

of the mucosa, of denture sore mouth, and of gingival inflammation.

The inflammatory conditions of the mucosa related to denture use (Table No. 19). Fifty-three per cent of the dentures that were used all the time showed pathological changes in the underlying mucosa, whereas 38 per cent of dentures used only during the day time showed little inflammatory changes.

#### 5.5 Patient's Assessment of the Dentures: (Table No. 20)

Fifty-six per cent of the dentures scored 12 and were completely satisfactory. Only two per cent scored 4 and were completely unsatisfactory. The patients were not using the unsatisfactory denture at all. About 42 per cent of the dentures scored between 5 and 11 and patients had some reservations about their use; some dentures were never used, while others were used regularly or occasionally.

Table No. 21 shows the distribution of the reasons given by the patients for dissatisfaction with their maxillary and mandibular dentures. Some patients had more than one reason for dissatisfaction. The objections against the mandibular dentures were more common than the maxillary dentures and discomfort and lack of chewing efficiency were the most repeated objections. Table No. 22 is a detailed tabulation of the patient's reactions.

Table 20: Patients' assessment of the dentures

|                 | Completely satisfied | Some reservations | Completely dissatisfied | Total |
|-----------------|----------------------|-------------------|-------------------------|-------|
| No. of dentures | 53                   | 39                | 2                       | 94    |
| %               | 56                   | 41                | 2                       | 100   |

Table 21: Distribution of patient's reasons for dissatisfaction

| Reason for dissatisfaction | Maxillary | Mandibular | Total     |
|----------------------------|-----------|------------|-----------|
| Appearance                 | 6         | 5          | 11 (17%)  |
| Comfort                    | 8         | 14         | 22 (34%)  |
| Retention and stability    | 6         | 8          | 14 (22%)  |
| Chewing-efficiency         | 5         | 13         | 18 (28%)  |
| Total                      | 25 (38%)  | 40 (62%)   | 65 (100%) |

Table 22: Patient's reservation for the dentures

| Assessment              | No. of patients | Reason                                                                                                |
|-------------------------|-----------------|-------------------------------------------------------------------------------------------------------|
| Appearance              | 1               | Too big anterior denture teeth                                                                        |
|                         | 2               | Dislike visible clasps                                                                                |
|                         | 1*              | Dislike denture as a whole                                                                            |
| Comfort                 | 3*              | Pain                                                                                                  |
|                         | 1               | Trapping food particles                                                                               |
|                         | 2               | Inability to speak properly                                                                           |
|                         | 2               | Feeling of full mouth and<br>inability to chew and/or speak                                           |
|                         | 1               | Irritating soft tissue (cutting)                                                                      |
|                         | 2*              | Too tight dentures and feeling premature<br>contact                                                   |
|                         | 1*              | Nausea                                                                                                |
|                         | 1*              | Unable to get used to the denture                                                                     |
|                         | 1               | Feeling tired on supporting tissue after a<br>period of wearing                                       |
| Stability and retention | 2*              | Feeling of denture moving during mastication                                                          |
|                         | 2               | Loose denture                                                                                         |
|                         | 1               | Dropping of denture during speaking                                                                   |
|                         | 1*              | Too tight denture                                                                                     |
| Chewing efficiency      | 1               | Pain                                                                                                  |
|                         | 2               | Denture did not increase masticatory<br>efficiency and prefer not to wear the<br>denture for function |
|                         | 1               | Loose denture                                                                                         |
| Other assessment        | 1*              | Broken denture                                                                                        |
|                         | 1*              | Patient was not convinced of the usefulness                                                           |

\* the reason for the denture not being used

5.6 Relationship between the denture base material and the design of the denture component for the different types of dentures:

The design of the denture components involves the choice of material, and shape and form of the components. Table No. 23 represents the distribution of the materials generally used for the construction of the different components of the dentures.

5.6.1 Denture bases: (Table No. 24) Cast cobalt-chromium appears to be the material of choice. Acrylic was used only when there were fewer remaining natural teeth or the appliance was an immediate or temporary denture.

5.6.2 Artificial teeth: Table No. 23. Porcelain appears to be the material of choice for the artificial teeth. Acrylic teeth were also used and in very few patients both acrylic and porcelain teeth were used. The use of acrylic teeth was generally for some specific reason such as insufficient vertical or antero-posterior space. The following seem to be the rules generally followed:

- 1) opposing artificial appliances had the artificial teeth of the same material: porcelain or acrylic, 2) if the opposing dentition was natural, the appliance could have acrylic or porcelain teeth, and 3) in limited spaces or single tooth replacements, acrylic teeth were generally preferred.

5.6.3 Rest: All the rests in all the dentures were cast cobalt-chromium. These either formed a part of the rest of the

Table 23: Distribution of material used for denture base, rests, clasps and teeth

| Denture component | Material            | Maxillary | Mandibular |
|-------------------|---------------------|-----------|------------|
| Base              | Cast Cr-Co          | 37        | 51         |
|                   | Acrylic             | 2         | 4          |
| Rests             | Cast Cr-Co          | 39        | 55         |
|                   | Wrought S.S.W.      | -         | -          |
| Clasps            | Cast Cr-Co          | 35        | 47         |
|                   | Cast gold alloy     | -         | -          |
|                   | Wrought S.S.W.      | 4         | 4          |
|                   | Wrought Au.W.       | 3         | 3          |
| Teeth             | Acrylic             | 16        | 14         |
|                   | Porcelain           | 17        | 35         |
|                   | Cast Co-Cr          | -         | -          |
|                   | Acrylic & Porcelain | 5         | 3          |

Table 24: Frequency of denture base material used and the denture types

| Material used | Maxillary         |                    |                     |                    | Mandibular        |                    |                     |                    | Total    |
|---------------|-------------------|--------------------|---------------------|--------------------|-------------------|--------------------|---------------------|--------------------|----------|
|               | Kennedy's class I | Kennedy's class II | Kennedy's class III | Kennedy's class IV | Kennedy's class I | Kennedy's class II | Kennedy's class III | Kennedy's class IV |          |
| Cast Cr-Co    | 6                 | 5                  | 24                  | 2                  | 33                | 11                 | 6                   | 1                  | 88 (94%) |
| Acrylic       | -                 | 1                  | -                   | 1                  | 2                 | 1                  | 1                   | -                  | 6 (6%)   |
| Total         | 6                 | 6                  | 24                  | 3                  | 35                | 12                 | 7                   | 1                  | 94       |

Table 25: Different designs of maxillary major connector related to denture types

|                       | Kennedy's class I | Kennedy's class II | Kennedy's class III | Kennedy's class IV | Total     |
|-----------------------|-------------------|--------------------|---------------------|--------------------|-----------|
| Single strap          | -                 | -                  | 10 (45%)            | -                  | 10 (28%)  |
| Single broad strap    | -                 | -                  | 2 (9%)              | 1 (33%)            | 3 (8%)    |
| Full palatal coverage | 2 (40%)           | 1 (17%)            | -                   | -                  | 3 (8%)    |
| Antero-posterior bar  | 3 (60%)           | 5 (83%)            | 9 (41%)             | 1 (33%)            | 18 (50%)  |
| U-shape               | -                 | -                  | 1 (5%)              | 1 (33%)            | 2 (6%)    |
| Total                 | 5                 | 6                  | 22                  | 3                  | 36 (100%) |

Note: Two acrylic dentures and one lost denture were not included in this table.

Table 26: Different designs of mandibular major connector related to denture types

|                                   | Kennedy's class I | Kennedy's class II | Kennedy's class III | Kennedy's class IV | Total     |
|-----------------------------------|-------------------|--------------------|---------------------|--------------------|-----------|
| Lingual bar                       | 6 (19%)           | 5 (45%)            | 3 (60%)             | -                  | 14 (29%)  |
| Lingual bar with continuous clasp | 1 (3%)            | 1 (9%)             | -                   | 1 (100%)           | 3 (6%)    |
| Lingual plate                     | 25 (78%)          | 5 (45%)            | 2 (40%)             | -                  | 32 (65%)  |
| Total                             | 32                | 11                 | 5                   | 1                  | 49 (100%) |

Note: Four mandibular acrylic dentures and two lost dentures were not included in this table.

Table 27: Distribution of denture rests and their positions

| Anterior teeth |               | Posterior teeth |              | Total |
|----------------|---------------|-----------------|--------------|-------|
| Incisal rest   | Cingulum rest | Occlusal rest   | Overlay rest |       |
| 49             | 46            | 110             | 7            | 212   |
| 23             | 22            | 52              | 3            | 100%  |
| 95 (46%)       |               | 117 (53%)       |              |       |

Table 28: Distribution of retainer design related to  
saddle type and material used

|                                                    | Tooth-borne saddles |                   |                  | Free-end saddles |                   |                  | Total |      |
|----------------------------------------------------|---------------------|-------------------|------------------|------------------|-------------------|------------------|-------|------|
|                                                    | Cast<br>Cr-Co       | Wrought<br>S.S.W. | Wrought<br>Au.W. | Cast<br>Cr-Co    | Wrought<br>S.S.W. | Wrought<br>Au.W. | No.   | %    |
| <u>Circumferential<br/>retainers</u>               |                     |                   |                  |                  |                   |                  |       |      |
| Conventional<br>circumferential                    | 74                  | 10                | 1                | 3                | 1                 | 3                | 92    | 39.0 |
| Short<br>circumferential<br>retainer               | 5                   | -                 | 2                | 1                | -                 | -                | 8     | 3.4  |
| Double<br>(butterfly)<br>retainer                  | 7                   | -                 | -                | -                | -                 | -                | 7     | 3.0  |
| Half and half<br>retainer                          | 1                   | -                 | -                | -                | -                 | -                | 1     | 0.4  |
| Double distal<br>cuft retainer                     | 2                   | -                 | -                | -                | -                 | -                | 2     | 0.8  |
| Mesio-distal<br>retainer                           | 3                   | -                 | -                | -                | -                 | -                | 3     | 1.3  |
| Ring retainer                                      | 6                   | 1                 | -                | -                | -                 | -                | 7     | 3.0  |
| Back-action<br>retainer                            | 1                   | -                 | -                | 1                | -                 | -                | 2     | 0.8  |
| Total                                              | 99                  | 11                | 3                | 5                | 1                 | 3                | 122   | 51.7 |
|                                                    | 113 (75%)           |                   |                  | 9 (11%)          |                   |                  |       |      |
| <u>Bar type<br/>retainer</u>                       |                     |                   |                  |                  |                   |                  |       |      |
| T,C bar<br>retainer                                | 16                  | 1                 | 1                | 61               | 4                 | 2                | 85    | 36.0 |
| I-bar retainer                                     | 8                   | -                 | 1                | 3                | -                 | 1                | 12    | 5.1  |
| Total                                              | 24                  | 1                 | 1                | 64               | 4                 | 3                | 97    | 41.1 |
|                                                    | 26 (17%)            |                   |                  | 71 (84%)         |                   |                  |       |      |
| <u>Combination<br/>retainer</u>                    |                     |                   |                  |                  |                   |                  |       |      |
| Bar retentive<br>arm and<br>circumferential<br>arm | 12                  | -                 | -                | 4                | 1                 | -                | 17    | 7.2  |
| Total                                              | 12 (8%)             |                   |                  | 5 (6%)           |                   |                  | 17    | 7.2  |
| Grand Total                                        | 135                 | 12                | 4                | 73               | 6                 | 6                | 236   | 100  |
|                                                    | 151 (100%)          |                   |                  | 85 (100%)        |                   |                  | 236   |      |

cobalt-chromium framework or were anchored in acrylic bases as individual units. The rests used showed considerable variations of shape and form. The distribution is shown in Table No. 27. Essentially, both ends of all bounded saddles were supported on the proximal aspects of the abutment teeth facing the saddles. In free-end saddle dentures, the rests were located on the mesial aspects of the abutment teeth away from the saddle. In some dentures the occlusal rests formed onlays reproducing the whole occlusal anatomy of the teeth. This was to rectify occlusal discrepancies.

5.6.4 Retainers: As shown in Table No. 23, cast cobalt-chromium was the material of choice for the retainers although one denture had Dalla Bonna precision attachments. This appliance was not included in the table.

The different types and variations of retainers: Means of retention used in the dentures are shown in Table No. 28. Circumferential retainers and their variations were the most commonly used means of retention particularly for tooth-borne saddles. The conventional circumferential was the most common type used. Forty-one per cent of retainers used represented different bar types, T-bar design being the most common. These forms were also preferred for free-end saddles. In some dentures the retention units consisted of a combination of circumferential and bar type of retainer components. Most of these combination retainers were seen in tooth-borne saddles. Wrought gold wire retainers

were used more commonly in free-end saddles than in tooth-borne saddles.

5.6.5 Major connector: Table No. 25 shows the variations in the design of maxillary major connectors as related to the type of denture according to Kennedy's classification. The antero-posterior bars appear to be most commonly used and for all types of dentures. Single strap major connectors appear to be more common for Kennedy's class III type of dentures when only small saddles needed to be connected. For single or bilateral free-end saddles, there appears to be a preference for a wider palatal coverage.

Table 26 shows the distribution of variations of form of the mandibular major connectors. A lingual plate design appears to be the overall favourite and the most commonly used connector for bilateral or unilateral free-end saddles. Single lingual bars appear in about one-third of the total number of dentures. In only a few dentures the double lingual bars (lingual bars with continuous clasps) were used. In one denture, a combination of lingual bar and lingual plate was used. The plate covered the lingual surface of the incisor teeth and was connected to the posterior saddle with two bars. The plate was intended to serve as an indirect retainer.

5.7 Denture fracture and deformation: (Table No. 29)

Out of 94 dentures 16 showed fractures which involved

Table 29: Distribution of fractured denture components

|                 | Maxillary | Mandibular | Total |
|-----------------|-----------|------------|-------|
| Major connector | 2         | -          | 2     |
| Rest            | 1         | 1          | 2     |
| Retainer        | 3         | 2          | 5     |
| Teeth           | 3         | 5          | 8     |
| Total           | 9         | 8          | 17    |

major connectors, retainers, occlusal rests and artificial teeth. Two fractured acrylic dentures were grouped with fractured major connectors. Out of these, one was discarded by the patient and according to his description, the anterior saddle repeatedly fractured transversely due to deep over-bite. The second denture was a Kennedy class II type and the fracture line passed along the mid-line antero-posteriorly.

A number of dentures had fractured retainers. These included cast cobalt-chromium, wrought gold or stainless steel arms of different shapes and forms.

Only two dentures showed fractured rests.

Fractures of artificial teeth occurred mostly in single teeth or narrow saddles. Some chipping of porcelain teeth was also observed.

Only one denture showed deformation of wrought stainless steel retainers located on the sides of the bounded saddles.

#### 5.8 Dentist's assessment of the denture:

Out of 94, only 88 dentures could be assessed. Six dentures were discarded or lost by the patients. The assessment of retention and stability of maxillary and mandibular dentures as related to the condition of occlusal contacts is shown in Table No. 30.

It is evident from Table No. 30 that there is no direct relation between occlusal contacts, retention and stability. A greater number of dentures showed loss of occlusal contacts after usage of two years. Those dentures that showed poor retention and poor stability also showed poor occlusal contacts and most of these were mandibular dentures.

Table 30: Relationship of denture occlusion to retention and stability

|          | Occlusion | Retention |          |         |           | Stability |         |          |           |
|----------|-----------|-----------|----------|---------|-----------|-----------|---------|----------|-----------|
|          |           | Good      | Fair     | Poor    | Total     | Good      | Fair    | Poor     | Total     |
| Maxilla  | Good      | 9         | 2        | 1       | 12 (32%)  | 9         | -       | 3        | 12 (32%)  |
|          | Fair      | 3         | 2        | -       | 5 (14%)   | 3         | 1       | 1        | 5 (14%)   |
|          | Poor      | 10        | 8        | 2       | 20 (54%)  | 13        | 1       | 6        | 20 (54%)  |
|          | Total     | 22 (59%)  | 12 (32%) | 3 (8%)  | 37 (100%) | 25 (68%)  | 2 (6%)  | 10 (27%) | 37 (100%) |
| Mandible | Good      | 10        | 7        | 4       | 21 (41%)  | 13        | 6       | 2        | 21 (41%)  |
|          | Fair      | 2         | 2        | -       | 4 (8%)    | 2         | 1       | 1        | 4 (8%)    |
|          | Poor      | 16        | 5        | 5       | 26 (51%)  | 17        | 2       | 7        | 26 (51%)  |
|          | Total     | 28 (55%)  | 14 (27%) | 9 (18%) | 51 (100%) | 32 (63%)  | 9 (18%) | 10 (20%) | 51 (100%) |

The retention and stability were also compared to denture usage habits. It appears (Table No. 31) that the patients wearing dentures "always" showed better retention and stability than patients wearing dentures during the day time only. It also appears that most of the patients showing poor retention used the dentures during the day time only, whilst most of the patients showing poor stability used the dentures all the time.

Table 31: Retention and stability of dentures related to denture usage

| Denture<br>usage |       | Always    | Day only  | Always<br>except<br>meals | Day only<br>except<br>meals | Meals only | Occasionally | Never    | Total |     |
|------------------|-------|-----------|-----------|---------------------------|-----------------------------|------------|--------------|----------|-------|-----|
|                  |       |           |           |                           |                             |            |              |          | No.   | %   |
| Retention:       | Good  | 17 (63%)  | 23 (48%)  | 1                         | -                           | 1          | 3            | 5 (71%)  | 50    | 57  |
|                  | Fair  | 8 (30%)   | 17 (35%)  | -                         | -                           | -          | -            | 1 (14%)  | 26    | 30  |
|                  | Poor  | 2 (7%)    | 8 (17%)   | -                         | 1                           | -          | -            | 1 (14%)  | 12    | 14  |
|                  | Total | 27 (100%) | 48 (100%) | 1                         | 1                           | 1          | 3            | 7 (100%) | 88    | 100 |
| Stability:       | Good  | 18 (67%)  | 29 (60%)  | 1                         | 1                           | 1          | 3            | 4 (57%)  | 57    | 65  |
|                  | Fair  | 2 (7%)    | 8 (17%)   | -                         | -                           | -          | -            | 1 (14%)  | 11    | 13  |
|                  | Poor  | 7 (26%)   | 11 (23%)  | -                         | -                           | -          | -            | 2 (29%)  | 20    | 23  |
|                  | Total | 27 (100%) | 48 (100%) | 1                         | 1                           | 1          | 3            | 7 (100%) | 88    | 100 |

DISCUSSIONS  
AND  
CONCLUSIONS

6. Discussions

6.1 Recall Methods:

According to the criteria cited, the records of 109 patients were selected. Four different means and six attempts were made to communicate with these patients for clinical appointments. As a result, 65 per cent of the patients presented for clinical assessment, 11 per cent could be assessed only from the questionnaires returned by them, 24 per cent of the patients for one reason or another did not reply.

Out of the patients who attended the clinical survey, 90 per cent had responded to postal appointments, 7 per cent to the telephone calls, one to the personal letter and one to the personal visit. Although the result was not 100 per cent successful, the postal appointments proved to be the simplest and most satisfactory method.

Although Schwalm et al<sup>(24)</sup> have reported very successful results from the telephone appointments, the present survey showed a very poor response; possibly due to the fact that some of the patients treated in this hospital did not have this means of communication available. It may also be possible that phone numbers of every patient were not recorded due to oversight.

Out of the 47 personal letters, only one patient came for clinical examination and the results from the returned questionnaires suggest that as high as 67 per cent of the

denture patients did not visit their dentist regularly despite the failure of denture treatment and/or the need for oral health care and some denture adjustments.

To personally visit a patient is a time-consuming method and is neither practicable nor effective.

It was found that in this Dental School, there was no regular recall programme in operation. It is possible that due to the enormous number of students and patients involved and the limited time available to the students for follow up of their work that this type of programme may not be practicable. However, it is equally important that both the patients and dental students should be educated about the benefits and needs for such a programme. In the survey only 50 per cent of patients responded to the first effort; with a subsequent attempt only another 15 per cent of the patients could be motivated.

Thus a recall programme is not completely successful. The responsibility for subsequent examination and servicing of the appliances can be the responsibility of the patients. and this should be explained to them by the students.

## 6.2 Method of examination

Efforts were made to limit the appointments to about half an hour duration and for the same reason the methods of examination and recording were kept very brief and simple. Caries was assessed only by visual and probe examination. A radiographic assessment required extra time and arrangements

and so was not used. Assessment of the health status of the mouth was also kept very simple for the reason that detailed records of tissue conditions at the time of issue of the denture were not available for comparison. Only such conditions were observed as were most apparent.

### 6.3 Denture usage habits

The subjects in this survey showed 7 variations of denture wearing habits (Table No. 8). Twenty-nine per cent of dentures were used day and night and 51 per cent only during the day. Six per cent of the dentures were used spasmodically either for aesthetic reasons or during meals or for other similar occasions. Fourteen percent of dentures were never used. According to these habits, dentures can be classified as: 1) successful dentures - dentures which the patient could use for all activities of the masticatory system without any discomfort. These dentures were worn day and night or only during the day; and 2) unsuccessful dentures which the patient either could not use at all or was obliged to wear under certain circumstances only and with some reservations. According to this classification, 80 per cent of the dentures in this survey were successful and 20 per cent unsuccessful. Out of the unsuccessful dentures, 14 per cent were never used and 6 per cent were used only for some particular functions. On their face value these figures appear to be alarmingly high but compared to the observations by Derry and Bertram<sup>(16)</sup> and considering that they used controlled clinical and technical procedures and

the patients in this survey were selected at random without any particular regard to the methods and skills involved in the construction of dentures, the observation appears to be reasonable.

From a study of previous surveys, there appears to be a relationship between the duration of denture usage and the percentage of success at the time of assessment. Koivumaa et al<sup>(14)</sup> reported a success rate of 91 per cent in dentures that had been in use for a period of one year. Schwalm et al<sup>(24)</sup> reported a success rate of 78 per cent in dentures that had been worn for a period of 1 to 2 years. Roberts<sup>(17)</sup> assessed the dentures that had been in use from 1 to 9 years and reported a success rate of 60 per cent. Carlsson et al<sup>(8-9)</sup> in selected patients reported a success rate of 77 per cent after 4 years of denture usage and 34 per cent after 13 years of denture usage in the same group of patients. There appears to be a progressive decline in the success rate of partial dentures as the duration of usage increases. In this respect, the observations of the present survey fit into the general pattern presented by all the other surveys.

Denture usage habits also appear to be related to such factors as previous denture experience, location of the denture - Maxillary and mandibular, type of denture according to Kennedy's classification, number of remaining natural teeth and patient's appraisal of denture for comfort, chewing efficiency, retention and stability and aesthetic effect.

1. Previous denture experience: As it is evident from Table No. 9, 43 per cent of dentures belonged to patients who

did not have any previous denture experience, 38 per cent were issued to patients who had good previous denture experience and 19 per cent to those who had poor denture experience. The incidence of successful dentures in patients who had previous denture experience was higher than the patients who were wearing their first dentures. Although the number of patients is too small there are indications that the quality of previous denture experience is not related to the degree of success or failure of the present dentures.

2. Location of dentures - Maxillary or mandibular. It is also evident from Table No. 9 that mandibular dentures showed a greater incidence of failure than the maxillary dentures. Similar observations were made by Koivumaa et al<sup>(14)</sup> and Nakazawa<sup>(18)</sup>.

3. Types of denture according to Kennedy's classification (Table No. 10). Essentially Kennedy's classification distinguishes unilateral and bilateral free-end saddles from bounded saddles. In the survey, 59 dentures represented unilateral and bilateral free-end saddles. Out of these, 22 per cent of the dentures were failures and the incidence of failure was higher in the mandibular dentures than in the maxillary dentures. The numbers of dentures examined is too small to draw any definite conclusions but there are indications that success rate was higher in bounded saddles than in free-end saddles. The results of the present survey are in general agreement with Carlsson et al<sup>(8)</sup>, Anderson and Bates<sup>(13)</sup> and Anderson and Lammie<sup>(12)</sup>.

4. Number of remaining natural teeth and the location of artificial teeth in the dental arch also appears to influence the success or failure of the denture. Table No. 11. In patients who had 12 to 13 remaining teeth in the arch the failure rate was higher than 50 per cent and it decreased progressively as the number of the remaining teeth decreased. This confirms the observation by Anderson and Lammie<sup>(12)</sup> who pointed out, "...that if some natural masticatory efficiency remains, the patient is less tolerant of a denture."

Table No. 12 shows the distribution of dentures in respect to the location of the artificial teeth in the dental arch. The percentage of success is notably higher in the appliances that restored posterior as well as anterior teeth. This suggests that aesthetics has a noticeable influence in the success rate of denture usage.

5. Denture wearing habits as related to patient's appraisal of the denture: The particular method of assessment was adopted for the reason that it gave a more precise indication of the patient's subjective opinion about the dentures. Fifty-six per cent of dentures scored 12 and were completely satisfactory. Two per cent scored 4 and were completely unsatisfactory and the dentures were never worn. About 41 per cent of the dentures, the patients had some reservations. Some of these dentures were being used regularly, and some were used only at certain times or never. Table No. 22 gives some idea of the principal complaints of the patients about their dentures. It appears that discomfort was the most common factor influencing denture wearing habits. Lack of stability and retention was the

next common complaint. Very few patients complained about inadequate chewing efficiency and aesthetics. In the overall picture, the patients gave importance to comfort, retention and stability, aesthetics and chewing efficiency, and in that order.

6.4 The effects of removable partial dentures on the remaining oral tissues:

Removable partial dentures come into contact with the remaining oral tissues, i.e. the remaining natural teeth, alveolar ridges and other associated structures and may produce some changes in the tissues. They may cause a further loss of teeth or a further partial loss of tooth tissue due to caries or fractures. Changes of the residual ridge commonly found were the inflammation of covering mucosa and resorption of alveolar bone. In this survey only inflammation of covering mucosa could be clinically examined as the comparative assessment of bone resorption required pre-denture issue records, radiographs and extra time and arrangements.

6.4.1 Further loss of teeth after denture insertion:-

Out of 71 patients, a further loss of teeth was observed only in 3 patients and a total number of 4 teeth were lost. Three of these were directly related to dentures and one was located in the opposing arch. The information available from the patients did not give any definite indication of the actual cause of loss of teeth such as caries or periodontal

disease. According to Carlsson et al<sup>(8)</sup>, further loss of teeth is due either to direct traumatic effect of the appliance on the abutments and the remaining natural teeth or a deterioration in the state of oral hygiene related to the artificial appliances. In the present survey, although there was some evidence of traumatic influence, deterioration of oral hygiene and the consequent carious involvement of teeth, no definite conclusion can be drawn because: 1) the total sample of patients examined was too small; and 2) the duration of use of the dentures was not long enough to fully reveal traumatic influences of the appliances.

#### 6.4.2 Partial loss of tooth tissue:

i) Caries: Twenty-four carious lesions were observed. Out of these, 66 per cent were related to abutment teeth, 21 per cent came into contact with some parts of the dentures, 8 per cent were in the same dental arch but not involved with dentures in any way, and 4 per cent were in the opposing arch (Table No. 13). The incidence of carious lesions was higher in Kennedy's class I and class III than in class II and class IV dentures and was again higher in patients who used the dentures day and night than in patients who used them during the day only (Table Nos. 14-15). Similar observations were made by others such as Tomlin and Osborne<sup>(15)</sup>, Anderson and Bates<sup>(13)</sup>, Makila et al<sup>(20)</sup>, Carlsson et al<sup>(8)</sup>, Bergman et al<sup>(10-11)</sup>, Derry and Bertram<sup>(16)</sup> and Nakazawa<sup>(18)</sup>. All these studies have indicated lack of oral hygiene either due to a lack of education of the patients, or the fact that dentures do disrupt the natural cleansing mechanism of the mouth.

Bergman et al <sup>(11)</sup> made special efforts to educate the patients in this respect and claims to have very successful results. They <sup>(8,10-11,13,15,16,18,20)</sup> further suggested that crowning abutment teeth would increase the protection of these teeth against caries. In the present survey although pre- and post-prosthetic treatment condition of oral hygiene were not recorded and compared, there was ample evidence of accumulation of plaque and food debris where associated with the removable partial denture.

ii) Tooth fracture - Only in one denture a fractured incisal edge was related to an incisal rest. The fracture seemed to be due to unsupported enamel rods being chipped away by pressure from the contact of the incisal rest. In another subject, a fractured amalgam restoration was related to an occlusal rest resulting in recurrence of caries. In both instances, the preparation of the rest seats seems to have weakened the incisal edge and the restoration. Derry and Bertram <sup>(16)</sup> suggested that particular care should be exercised for the preparation of the rest seats so that tooth substance or restoration were not weakened.

6.4.3 Inflammation of mucosa: Thirty-seven per cent of dentures showed some inflammatory conditions of mucosa related to them. These could be grouped under 3 categories:

(i) Traumatic conditions of which the patient was aware but had not taken any action. It seemed that the patients due to lack of proper advice and education expected some inconvenience from the appliances and were prepared to endure these as natural.

(ii) Denture sore mouth: There was clinical evidence of inflammatory conditions but the patient was not aware of its presence. These conditions could be related to many factors such as lack of surface adaptation, undesirable movements of the denture, wide area of coverage, excessive pressure from the denture base, fungal infection and possibly some allergic or drug reactions.

These above two conditions were also reported in other surveys<sup>(6-20)</sup>. Bergman et al<sup>(11)</sup>, Schwalm et al<sup>(24)</sup> and Derry and Bertram<sup>(16)</sup> have most emphatically concluded that patients should be properly advised and educated about the need for recall appointments for periodical checks and maintenance of the appliances.

(iii) Hypertrophic mucosa: Possibly due to incorrect preparation of the food line on the cast and the consequent sinking of the margins of the denture into the tissue; the mucous membrane next to the margins appears to grow over the margins of the appliance. This third condition may possibly be due to the dentist not giving enough information about the displaceability of the mucoperiosteum relative to the denture design to the technician, who consequently has to himself decide about the depth of food line and the tissue relief for the denture.

McCracken<sup>(100)</sup> pointed out in his survey that a great number of denture failures resulted from the dentist leaving the designing of the dentures to the technicians and/or not giving them appropriate guidance and instructions for the technical procedures.

The incidence of inflammatory conditions of mucosa was also found to be related to other factors such as location of denture - Maxillary and mandibular, denture type according to Kennedy's classification, denture base materials — acrylic or cobalt-chromium alloys, retention and stability and denture usage habits (Table Nos. 16-18).

It was found that in general mandibular dentures showed a higher incidence of inflammatory involvement of the mucosa than the maxillary dentures. This observation appears to contradict observations by Roberts <sup>(17)</sup>, Carlsson et al <sup>(8)</sup> and Nakazawa <sup>(18)</sup> possibly because these investigators distinguished inflammation of the denture foundation areas from those of the gingival tissues. In the present survey the assessment has a more generalised character and all areas covered by the denture, gingival or otherwise, have been grouped together.

The incidence of inflammatory mucosa associated with free-end saddle dentures was higher than with bounded saddle dentures and it was higher in relation to mandibular dentures than the maxillary. There was a greater tendency for inflammation related to acrylic dentures involving a wider area of coverage than cobalt-chromium skeletal designs. Similarly, dentures with poor retention and stability showed a higher incidence of inflammatory conditions. The dentures used "always" showed a much higher incidence of pathological conditions of the mucosa than the denture used only during the day time (Table No. 19). These observations agree with observations by Derry and Bertram <sup>(16)</sup>, Carlsson et al <sup>(8)</sup>, Tomlin

and Osborne<sup>(15)</sup>, Anderson and Bates<sup>(13)</sup> and Nakazawa<sup>(18)</sup>.

#### 6.5 Design of the partial dentures:

A summary of philosophy of the removable partial denture design as taught in this institution has been presented in "Section III". The general principles taught are also confirmed by other prominent teachers and investigators from other institutions. In the dentures examined, there was ample evidence of successful application of these principles. A few failings were observed. These could be related to lack of understanding and experience on the part of the student and the fact that during the period under survey the treatment plan and denture design developed by the students were not assessed very rigorously and were approved by teachers without adequate clinical examination of the patients. This shortcoming was realised and has been rectified and treatment plans are now presented and discussed in a seminar-type clinical session. Some of the examples of the failings of denture design are:

##### EX. I

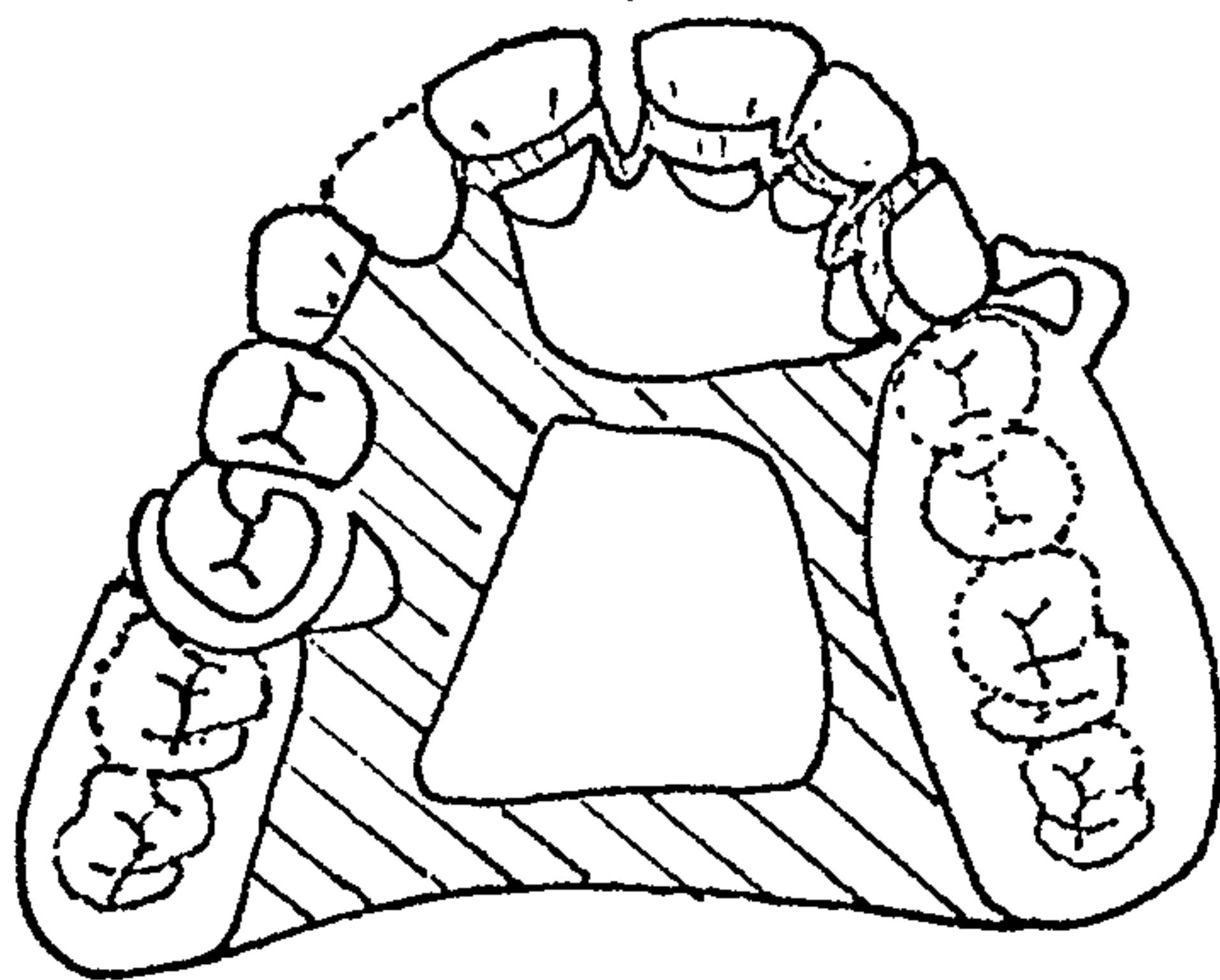


Fig. 16

In a class I maxillary denture (Fig. 16), the patient could

not use the denture because of gagging, possibly due to greater weight of the appliance and inadequate means of retention. The posterior part of the denture developed a loose contact with the palatal tissue causing stimulation of the gagging reflex. Removal of the posterior bar resulted in improvement of the gagging condition. In this case retention could be supplemented by increasing the palatal coverage thus increasing the retention by surface adhesion.

EX. II

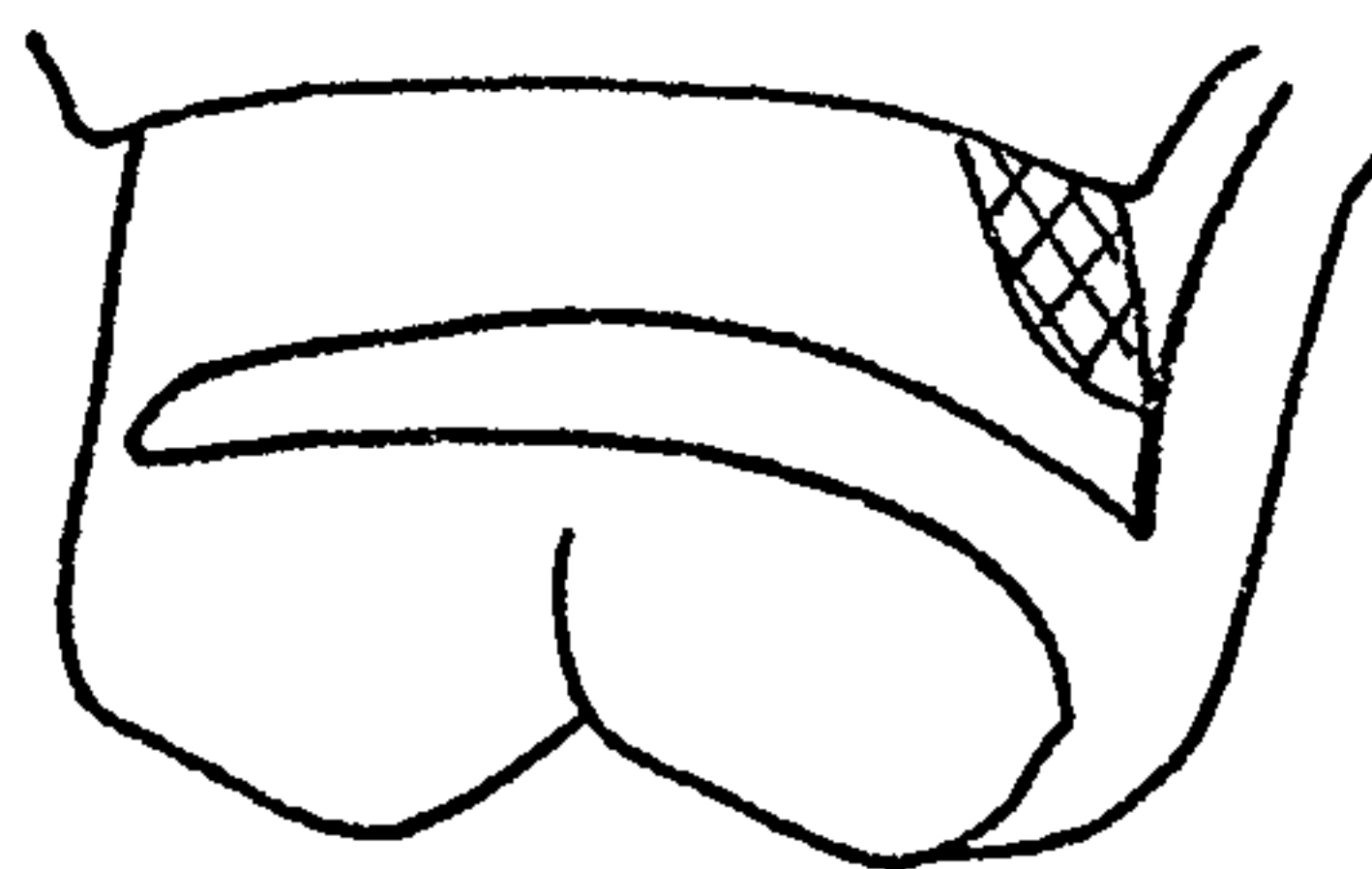


Fig. 17

The most common sites of the occurrence of carious lesions was the lingual proximal aspect of the axial surface of the abutment teeth (Fig. 17). Nakazawa<sup>(18)</sup> has referred this as "the dead space".

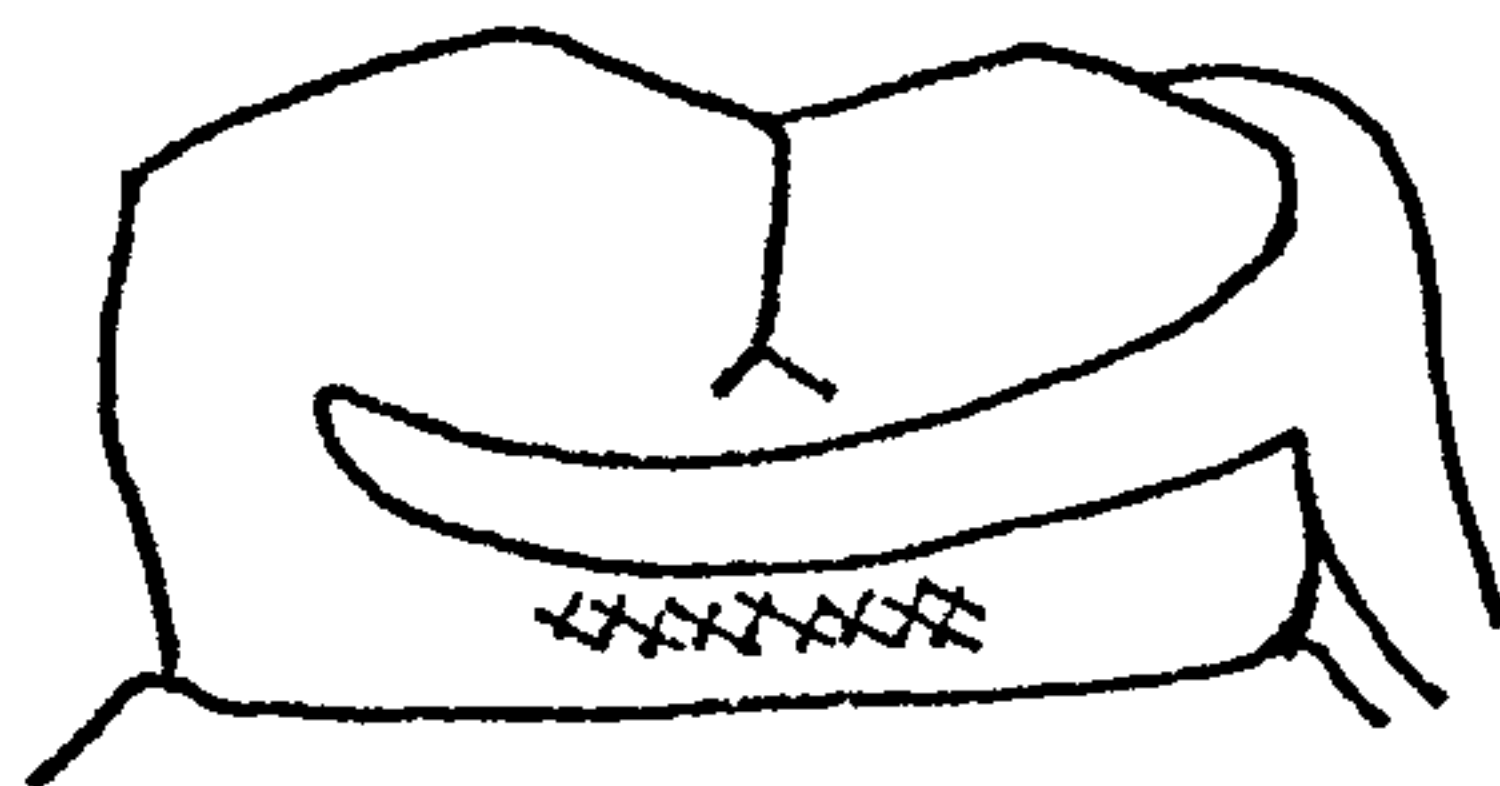


Fig. 18

The next common site was gingivally to the retentive arm on the buccal surfaces of the abutment teeth (Fig. 18).

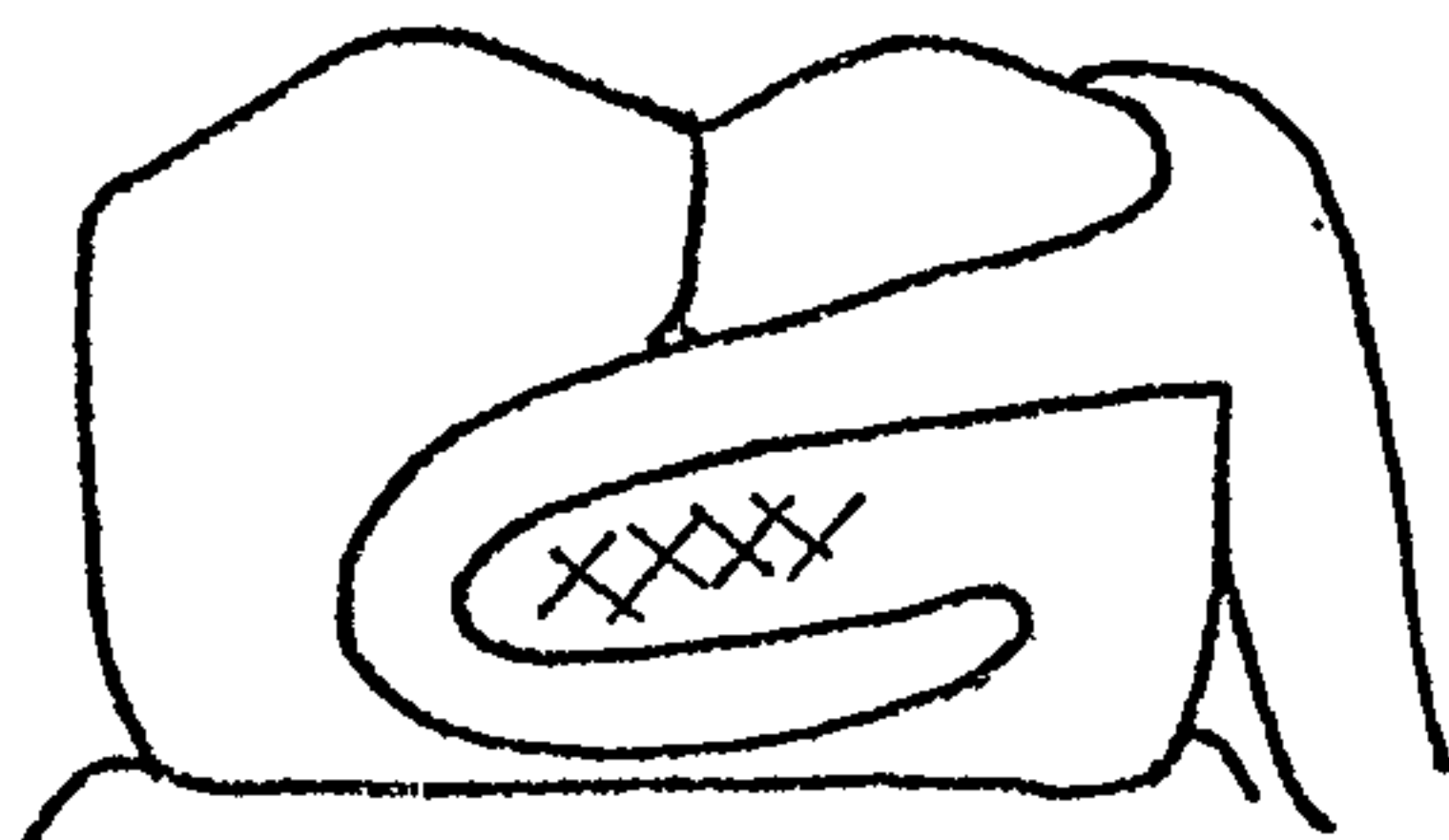


Fig. 19

In one instance, carious lesions were found between the two parts of the hair-pin retainer (Fig. 19).

These locations are also very similar to the dead space pointed out by Nakazawa<sup>(18)</sup>. The presence of carious lesions was always associated with obvious plaque deposits. It appeared that the patients did not fully realise the importance of oral hygiene. Most of the patients during the clinical assessment were issued with tooth brushes and were instructed in tooth brushing techniques and proper oral hygiene.

6.6 Patient education: From the clinical survey and the questionnaire, it was found that in most cases the patients' attitude towards their dentures was based on ignorance and wrong notions. Often, dentures were considered only mechanical substitutes for the lost teeth and their possible effects on the remaining oral tissue and the patient's general health were ignored. Many patients very sincerely believed that a certain amount of suffering and discomfort was a normal phenomenon associated with artificial dentures and they used the dentures religiously inspite of discomfort

and inconvenience. Many patients who were using dentures "always" were not aware of the undesirable effects of their habit and when questioned, said that they were never told otherwise. Many patients believed that the dentures were either good or bad and that their performance could not be improved with adjustment after they were issued. The patients discarded their dentures without having any adjustments after the issue stage. The attitude of the patients towards their dentures appeared also to be related to the strength of motivation towards denture usage. Many patients insisted upon using their dentures "always" inspite of the fact that the undesirable effects of this habit were duly explained to them by the author. In these patients aesthetics was a very strong motivating force. The patients did not want to be seen without dentures at any time. Most of the patients were not aware of the need for regular servicing and maintenance of dentures. Many patients when questioned about the reason for not using their mandibular dentures, simply said that they were not using them because they did not ask for them. Such patients always had a certain amount of masticatory efficiency with their remaining natural teeth and were not prepared to suffer any inconvenience from a removable partial denture. Anderson and Lammie<sup>(12)</sup> also made similar observations. Roberts<sup>(17)</sup> also pointed out, "A significant association between those with good and poor dental interest and the success or otherwise of the prosthetic treatment was found. There was a significant

relationship between chances of success and whether the denture was suggested by the dentist or the patient. The prosthetic treatment was more likely to have been successful if it had been initiated by the subject himself rather than by the dentist".

Oral hygiene index and tooth mobility were excluded from the survey because of the lack of appropriate data at the time of issue of the denture. From the survey, there was convincing evidence that oral hygiene played a great part in the success or failure of removable partial dentures and that in subsequent surveys, assessment of the oral hygiene should be included.

7. Conclusion:

1. The dental students should be educated in the need for a recall programme for their private practice.
2. The patients should be educated that removable partial dentures need regular maintenance and servicing like any other appliance and that it is essential for the maintenance of health of their masticatory system and the rest of the body.
3. Patients should be educated about proper use of the dentures and care of oral hygiene.
4. It was found that the success rate of the partial dentures was related to (i) types of denture, (ii) previous denture experience, (iii) the masticatory efficiency of the remaining natural teeth, and (iv) the motivation for the denture.

## SECTION V

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