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PERIODONTAL PROBLEMS RESULTING FROM DENTAL TREATMENT

R.K. KHAMBATTA, B.D.S. (BOMBAY)

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Department of Preventive Dentistry,
Faculty of Dentistry,
University of Sydney.
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"Between dogma on one hand and scepticism on the other, there's another way - open minded uncertainty"

G.F.C.

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INTRODUCTION

The periodontium[1] is composed of the gingiva, the periodontal membrane, and the cementum on the tooth root surfaces and the alveolar bone. Since, at a particular given point in time, it is difficult to draw a clear demarcating line differentiating a gingival lesion from an early periodontal lesion, by mere visual inspection, any dental treatment causing injury to the periodontium will be regarded as capable of causing a periodontal problem.

In the past, excellence in technical procedures was the sole criteria for the evaluation of any form of dental treatment. With the vast knowledge of the biological aspects of the tissues available at the present moment, technical excellence divorced from respect given to the biological aspect of the tissues is no longer acceptable.

It should be realised that the integrity of the periodontium is the key to the survival of the tooth in the mouth, not mere restoration of the crown. Even if the crown is completely lost and intact periodontal tissues surround the root, restorations to simulate the crown can be made. No material as yet has been found which can replace the periodontium.

De Van had stated "The preservation of that which remains, rather than the meticulous replacement of that which is missing" should be the goal of restorative procedures. The objective of this thesis is not to review the history of the literature and

show that this aim has been neglected, but to show that even at the present moment procedures resulting in periodontal tissue injury, do occur.

Technical procedures in the different branches of dental treatment such as oral diagnosis, oral radiography, oral surgery, orthodontics, operative dentistry, partial denture prosthesis both fixed and removable, pedodontics and periodontics which are capable of causing periodontal problems will be examined.

Although intra oral examination is not a dental procedure in the strict technical sense, no treatment can begin without a thorough intra oral examination of the soft and hard tissues.

FAILURES IN DIAGNOSIS LEADING TO PERIODONTAL PROBLEMS

Only those failures associated with incorrect intra oral examination are covered in the first half of this chapter. Systemic conditions which have a modifying influence and must be taken into account in the determination of the prognosis will be dealt with later in the chapter.

The logical sequence of events leading to an ultimately successful treatment must begin with a correct diagnosis. What the eye does not see, the mind cannot perceive, if the signs of pathology are undetected, the lesion will remain untreated. Diagnosis should also be directed towards the detection of conditions which may be capable of causing pathology. The early detection of such conditions will prevent pathology. An example is the early detection of the overhanging margins of interproximal restorations.

Unfortunately, undergraduate training is completely "caries oriented". The fact that the periodontal probe is not even placed on the examination tray should bear sufficient evidence to this sad fact. Most clinicians start an examination by trying to feel for the presence of caries by using a probe, and this is also where the examination usually ends. A cursory glance is directed at the periodontal tissues and the patient is dismissed with a reassuring pat on the back and a statement that the gums "look fine".

Colour changes in the gingiva induced by inflammatory periodontal disease may be extremely difficult to detect[29]. To complicate the picture, a wide variation in the colour of normal gingiva also exists. The degree of colour change may have no relationship to the extent of underlying bone damage[29].

Stippling too, is sometimes used as an indicator of gingival health but it varies from person to person and is known to return in chronically diseased gingival tissue. Fibrotic gingiva resulting in a roughened pebbly surface may be mistaken for stippling[29].

Besides a reduction in bone height which can be detected radiographically the essential changes during periodontal destruction are the loss of fibre attachment and proliferation of pocket epithelium beyond the cemento enamel junction[145]. When the gingival margin is located on the enamel, pocket depth and loss of attachment may coincide, but in cases of gingival recession beneath the cemento-enamel junction large discrepancies between pocket depth and loss of attachment may exist. Destruction of the alveolar bone associated with trauma from occlusion and in periodontosis may occur in absence of periodontal pockets, or with shallow pockets. The[16] level of attachment at the base of the pocket on a tooth is of greater diagnostic significance than the depth of the pocket.

A normal sulcus should not exceed 3mm. in depth, and there can be no substitute for the Periodontal Probe in the measurement of pocket depth. Since pockets are torturous[29], false readings

may occur unless the examiner manipulates the probe accurately and is equipped with a good understanding of root morphology. Inflamed crevicular tissue may often adhere to the tooth surface, causing resistance to the probe. This should not be confused with the true epithelial attachment and can be differentiated by use of firm but controlled force.

A notion still persists in the minds of many that periodontal disease is absent in children, despite the fact that a great many reports to the contrary do exist. W.H.O.[36] reported that at least half the child population of the world had periodontal disease. Surveys have shown that periodontitis is present at a much earlier age than generally realised[37][38].

Sheiham[182] has shown that in British populations at ages 15-19 years 50.5% of persons had periodontal pocketing which was taken to signify alveolar bone resorption i.e. chronic destructive periodontal disease and that the percentage affected in each age group increased with an increase in age, so that by ages 25-29 years, 88.4% were affected.

Davies[183] et al. in a survey of Australian children in country districts found gingivitis present in 82% of all children in age groups 6, 8, 10, 12 and 14 years. This sample represented 2% of the total number of children in Australia of these particular ages.

Stoner and Prophet[184] showed that childhood gingivitis is not always temporary but its incidence may increase with age and that periodontitis is present at a much earlier age than generally realised.

SYSTEMIC CONDITIONS WHICH AGGRAVATE PERIODONTAL DISEASE

"Undoubtedly[190] the oral cavity reflects the state of systemic health more frequently than any other part of the body". Not that the dentist will treat such systemic disorders, but he certainly should recognise their importance to his treatment success. Generalised disease states must be considered as modifying rather than initiating factors[194][195] of periodontal disease.

The effects of -

1. Nutritional deficiencies,[16]
2. Endocrinologic influences,[16]
3. Haematologic[16],

and other systemic disorders in the etiology of periodontal disease have been discussed in great detail by Glickman.

A few systemic conditions which do affect the periodontal tissues and have some importance on the outcome of a successful treatment will be viewed briefly. They are:

1. Diabetes mellitus.
2. Sodium dilantin.
3. Hormonal oral contraceptives.

1. Diabetes mellitus

Periodontal[16] disease in diabetic patients follows no consistent pattern. The response of the tissues to local irritants

is more severe, bone lost is hastened in periodontal disease and post surgical healing is retarded.

Changes occurring in the gingiva such as swelling, gingival bleeding, violaceous hue, pocket formation and recession have been reported[158]. Cheraskin and Ringsdorf reported a distinct correlation between gingival pathosis and relative hyper and hypoglycemia[196]. On the other hand, almost at the same time Shannon and Gibson[197] found from their study that there was no indication that periodontal status was related to glucose tolerance in their subjects.

Viewing these conflicting statements only these facts:

1. The bone loss is more severe in diabetic patients,
2. Post surgical healing is retarded,

should be paid due attention.

2. Sodium dilantin

It is prescribed for the treatment of epilepsy. One of the drug's side effects is it causes gingival enlargement. Its reported incidence varies from 3 to 62 per cent.[201][202] The non inflammatory type of hyperplasia cannot be corrected by gingivectomy whereas the chronic inflammatory and combined cases can be treated by gingivectomy and meticulous oral hygiene.

3. Hormonal oral contraceptive

The recent introduction of an oral hormonal contraceptive commonly referred to as "The Pill"[188][189][197][198][199] has been reported to affect the periodontal tissues. Das[200] et al. stated

that the oral contraceptive had no effect on the depth of pockets but destructive periodontal disease was increased.

The fact that the usage of "The Pill" is on the increase throughout the world, will mean that more women may suffer from destructive periodontal disease. This fact should not be missed in diagnosis.

The failures resulting from improper diagnosis may be summarised[29] as:

1. Improper evaluation of the patient as an entity apart from the disease.
2. Lack of recognition of the causative factors in periodontal disease.
3. Incomplete evaluation of the patient's total health status as it may relate to periodontal disease.

It should be realised that these systemic conditions per se are not as damaging to the periodontium, but that with the presence of local irritants the inflammatory response of the periodontal tissues is more severe in these systemic conditions.

FAILURES IN RADIOGRAPHIC INTERPRETATIONS LEADING TO PERIODONTAL PROBLEMS

L.M. Ennis in 1931 stated, "The scientific dentist must concede that it is absolutely impossible to practice properly, thoroughly, without the assistance of roentgenology as an aid in diagnosis. There can be no discussion on that point. It is final." It is still not completely realised that the roentgenogram is merely an aid in diagnosis of periodontal disease and not the sole indicator of it.

Glickman[16] stated, "A better diagnosis can be made from the patient without the radiograph than from the radiograph without the patient." Yet, clinicians continue to regard the roentgenogram as the sole means of diagnosing periodontal disease, as shown by Bradley's[76] statement - "It is fair to claim that often too much is expected from the oral roentgenogram".

On a radiograph a three dimensional object is reduced to a two dimensional representation, and the dimension of depth is not recorded on the film. The[76] superimposition of x-ray shadows of all structures interposed in the x-ray beam, results in the x-ray being a cumulative record of the radiographic densities of multiple structures. This causes distortion of the image and also due to the overlapping, the buccal and lingual plates of bone are rarely visible.

The[87] nature of periodontal disease is such that the state of disease at the time the x-ray is taken is very important, because the bone picture may change as the disease progresses. Because[16] the radiograph does not reveal minor destruction changes in bone, periodontal disease that produces even slight radiographic changes has progressed beyond its initial stages.

Basically[92] there are two main techniques for intra oral radiographs.

1. Short cone or bisecting angle technique.

2. Long cone or paralleling or right angle technique.

In the former, distortion[87] occurs as the structures further away from the film will be projected on to the film at a greater angulation than the adjacent ones, resulting in dimensional distortion. Steep angulation of bisecting angle technique distorts relationships particularly in the maxillary region so that only approximation of bone contour is possible and the picture of bone loss may vary strikingly with slight changes in either horizontal or vertical angulation of the cone. Since the shadows of buccal and lingual structures are superimposed denser tissue on one side will mask a more rarefied feature on the other side.

The right angle technique avoids superimposition of structures and[87] with the simplification and standardisation of a simple film holding beam directing instrument, a clear x-ray picture is obtainable. However, many clinicians still cling to the use of

the bisecting angle technique and try to interpret radiographs that do not reveal structures as clearly as would be desirable.

The[15] value of the bite wing film in:

(a) Examining the alveolar crest for early periodontal changes,

(b) Checking on the gingival margins of approximal fillings,

should be put to greater use. No intra oral radiographic examination is complete without the use of a bite wing radiograph.

McCall and Wald[15] have listed the causes of faulty roentgenograms. These are mostly technical limitations, not inherent limitations caused by difficulty in placement of the film within the mouth or the limitation of the structures the roentgenogram reveals.

Anatomic[76] restrictions with virtually no choice to the operator in the selection of aspects of tissues to be depicted result in a mesio distal silhouette of teeth and supporting structures immediately mesial or distal to the teeth can be revealed for study on the roentgenogram; unfortunately these aspects are seldom the ones most likely to experience or present evidence of pathologic changes.

Changes in the periodontal space and in the cribriform plate of tooth sockets are frequently those associated with occlusal trauma and breakdown of the supporting tissues will therefore tend to originate in the facial or lingual aspects of

the teeth and roots, aspects not capable of being revealed on the film.

Film placement will necessarily be more distal from the teeth, especially from the roots and/or at an angle to their long axes, resulting in dimensional accuracy which can be maintained only through sacrifice of correct structural orientation or vice versa.

Pritchard[70] showed the limitations of x-ray interpretation for periodontal lesions. They are:

1. Roentgenograms do not show the periodontal pocket.
2. Roentgenograms do not record morphology of bone deformities.
3. They do not show structures on buccal lingual or labial aspects of the tooth.
4. They do not show soft to hard tissue relationships.
5. They do not record tooth mobility.
6. They do not specifically distinguish between successfully treated and untreated cases.
7. They do not indicate whether the involvement is on the buccal aspect, lingual aspect or both.
8. They record vertical position but not the width of the alveolar processes in the septal region. Approximate depth of resorption may be seen, but neither the width on buccolingual position of the deformity can be recorded.

Various others[11][74][78] have shown the limitations of the intraoral radiographs.

(a) Pocket[78] depth cannot be related to bone height unless radiopaque material is inserted to the base of the pocket before exposure.

(b) Since shadows of buccal and lingual structures are superimposed, denser tissues on one side will mask a more rarified feature on the other.

Ochsenbein[74] showed that three common deformities - the blunted crest, the crater and the ledge are seldom discernible in roentgenograms. Glickman[16] stated that radiographs do not indicate internal morphology or depth of crater like interdental defects which appear as angular or vertical defects, nor do they reveal the extent of involvement of facial and lingual surfaces.

Patur[11] showed that the ability to follow the marginal alveolar bone in radiographic images is impaired if one alveolar bone is thin or there is progressive reduction in density. Visualisation of the margin is further reduced where there is superimposition of tooth structure and the opposite alveolar bone. Although bone destruction which occurs interproximally can ordinarily be visualised it is difficult to determine whether it extends on to the buccal or lingual surfaces.

McCall and Wald listed the anatomic landmarks which could be mistaken for pathologic conditions. A[82] few others are:

1. Sloping alveolar interseptal bone resulting from mesially inclined teeth.

2. Flat posterior crested bone resulting from wide interproximal spacing.
3. Lack of radiopacity because of thin bone, particularly in the lower anterior region.

Fenestrations and dehisences cannot be seen radiographically, but both of these may have some significance in the production of rapid bone loss in periodontal disease.

Lost[70] marginal bone will not be restored fully following periodontal therapy, but the diffuse roentgenographic appearing area of bone undergoing active resorption will be changed to a homogenous one after successful therapy.

The[76] absence of an evident radiopaque border to the alveolar bone does not necessarily imply the absence of the normal layer of cortical bone, but may mean simply that the x-ray beam did not encounter compact bone in sufficient depth as it traversed the bone. It is noteable that very slight variations in the angulation of the beam may cause the appearance or the disappearance of the visible radiopacity ascribed to cortical bone.

There must be evidence of characteristic radiopacity of compact bone of interdental crests or that surrounding the tooth roots for a roentgenographic conclusion.

Incorrect viewing conditions of the radiographs may lead to a mistaken prognosis and treatment plan, because[76] discernment of density differences which are often quite slight, and require an even intensity of illumination over the entire film area and elimination of most of the reflected light.

Specific offenders are:

1. High level of general illumination.
2. Viewbox facing towards window or ceiling light fixture.
3. No transparent or semitransparent backing such as celluloid or frosted celluloid which acquire dust and scratches.
4. Also stray light is eliminated by using dark opaque film mounts.
5. Use of 2X or 3X magnification makes viewing more concentrated.
6. Adequate time must be given to study the radiograph thoroughly.

Other[78] information tempts the clinician unconsciously to read into the film what he would like to find to strengthen earlier impressions at the risk of missing the true interpretation.

Despite its drawbacks and limitations there can be no substitute for the roentgenogram as an aid in diagnosis of periodontal disease. "The x-ray film is an important means to an end, but not an end unto itself."

PROCEDURES IN ORAL SURGERY CAUSING PERIODONTAL PROBLEMS

The careless use of forceps during tooth removal can cause gingival injury to the adjacent teeth. Elevators[186] which use an adjacent tooth as a fulcrum during extraction can traumatise the adjacent tooth. If an elevator slips and adequate protection is not given to the soft tissues, laceration of the soft tissues may occur.

The[180] incorrect design of a mucoperiosteal flap can cause a periodontal problem. If the incision begins at the interdental papilla, a fine suture point results and during suturing the needle may tear through the fine point, or the suture may pull through during the post operative recovery period. Flap designs when sutured should rest on bone and not over a blood clot which may result in the formation of a "dead space" causing a breakdown of the wound. Incorrect[65] incisions may cause gingival recession of mucosa because incisions extend to the margin of healthy teeth which are not to be extracted, favouring consequent erosion of the teeth at the gingival margin.

Ash[88] studied the periodontal problems involving the presence and/or extraction of third molars. He found that frequently partially covered or apparently covered impacted third molars are considered "asymptomatic" because of absence of discomfort to the patient. However, it is very common in such instances for the gingival creyice on the distal of the second

molar to be pathologically deepened and for the supporting bone on the distal of the second molar to be incompletely developed or lost after development. Thus, "asymptomatic" third molars are rarely symptomless from a periodontal standpoint.

The presence of calculus, debris and irritants associated with a pathologically deepened crevice leads to progressive destruction of supporting structures on the distal of second molars. Although there is very little discomfort to the patient and the destruction is incipient, the presence and consequences of the impacted third molar can hardly be termed "asymptomatic". The use of periapical, occlusal and bite wing roentgenograms are necessary to evaluate the periodontal status of second molars along with adequate probing using a thin periodontal probe.

When roentgenographically there appears to be a close approximation of the crown of the third molar to the cervical area of the second molar it should be assumed that the crevice of the second molar will ultimately involve the crown of the impacted third molar.

From[88] a periodontal standpoint, probably the only asymptomatic molar is one which is completely covered and has no potential for exposure or eruption. Practically, such teeth are completely covered and apically placed in relation to the roots of the second molar.

Laskin[3] showed that constant food impaction between a partially erupted third molar and the adjacent second molar can

result in inflammation and considerable bone loss. Such periodontal pocket formation weakens the support of the second molar, which may become quite loose. In instances of deep pocket formation devitalisation of the second molar by apical extension of the infection may also occur. When severe periodontitis has developed, even removal of the impacted tooth will not eliminate the pocket.

Laskin[3] thought that extraction of such impacted teeth is therefore indicated at the first sign of periodontal disease. In fact prevention of these problems should be considered an indication for the prophylatic removal of third molars, since this procedure has been shown to actually reduce the crevicular depth on the distal of the second molar.

On the other hand, Ash et al.[25] found a high incidence of periodontal pockets and/or root exposures occuring following extractions of completely covered and partially covered types of impactions.

Ash[88] found that generally the extraction of completely covered, apically placed, impacted third molars does not appear to be warranted when comparing the incidence of loss of supporting structure and the incidence of potential hazards associated with their retention. In those beyond the age of 25 years, or the time when the roots of the third molars are completed, loss of supporting structures associated with the extraction of deeply impacted third molars is very common and should be considered a more significant hazard than potential hazards related to the

retention of third molars.

Occasionally[88] the problems of dehisence or fenestration may increase the loss of supporting structures of the distobuccal of the maxillary second molars prior to or following the extraction of maxillary third molars. Occasionally the buccal plate of bone is lost during or following the extraction of maxillary third molars. The loss of bone may decrease the depth of the gingival crevice on the distal of the second molar but expose the cemental surface of the distal and distobuccal surface of the root of the second molar.

Ash et al.[25] recommend that the extraction of third molars early in their development is the only method for preventing the loss of periodontal support on the distal aspect of second molars.

Laskin[3] stated that prevention of periodontal problems should be considered an indication for the prophylactic removal of impacted third molars, since the procedure has been shown to actually reduce the crevicular depth on the distal of the second molar.

As Groves and Moore[131] stated, opinion is divided about treatment. Some recommend the extraction of all impacted lower third molars in the young adult whether or not symptoms are present. Others believe that after the extraction of the impacted third molar the periodontal condition of the second molar deteriorates with increased pocketing and buccal recession. One

is left to conclude that the continued presence or the extraction of the impacted lower third molar can both be factors in the etiology of periodontal deterioration about the second molar.

Teeth involved with periapical pathology are being treated by periapical surgery and endodontic therapy, whereas formerly extraction was the only treatment for such teeth. This has led to the increasing use of the elevation of "flaps" to gain access to the periapical area.

A flap raised from the gingival margin reapposed and sutured back is capable of causing a periodontal problem. It is much safer from a periodontal viewpoint for the flap to be reflected in the area of the alveolar mucosa. In this technique, the epithelial attachment is left undisturbed.

Careful handling of tissues, proper flap design and perhaps early prophylactic removal of the third molar could do much to reduce the incidence of periodontal problems caused by oral surgery.

ORTHODONTIC PROCEDURES CAUSING PERIODONTAL PROBLEMS

Gingivitis and periodontitis have been shown to occur in children[36][37][38][182][183][184] and at a much earlier age than is generally realised. All active periodontal conditions must be corrected prior to orthodontic treatment. The placement of bands and appliances make oral hygiene procedures more difficult to carry out, and if gingivitis is already present, it is increased and the vicious circle continues.

Many orthodontic patients may be pubescent and even minor gingival irritation could produce an exaggerated inflammatory hyperplastic response in the gingiva[141].

Burket[9] stated, "Instead of causing direct irritation of the tissues the orthodontic appliances furnish a favourable environment for plaque development and retention." As the appliance becomes more complex, the difficulty in maintaining oral hygiene increases.

The orthodontist is usually under the impression that because his appliances are temporary, the iatrogenic diseases should also be temporary. This is far from the truth, as shown be several reports[36][37][38]. Often the orthodontist feels that supervision of the patient for plaque control does not come under the realm of his treatment, whereas very often the patient sees only the orthodontist and not the general practitioner during the course of the treatment. Zachrisson[135] showed that in spite of

good cleaning and low PI scores most children in his study developed moderate hyperplastic gingivitis within one or two months after placement of fixed appliances. This shows how much more damaging poor oral hygiene could be.

Cohen[39] showed the epithelium covering the interdental area in a young patient is very thin and very easily damaged by plaque and other irritants and a pocket can be formed in an early stage of the patient's life[40]. Restorations placed under the gingival margin[5][51] produce inflammatory conditions even when apparently well contoured. How much more damaging the orthodontic band must be, with its inexact fit, and so many are placed so deeply that the epithelial attachment is severely damaged, sometimes producing an acute abscess[124][144]. Removable appliances may be no better, and produce an inflamation in the same way as does a faulty partial denture[144]. They could[124] lead to:

1. Occlusal trauma from the acrylic base or active and passive components.
2. Undesired tooth movement from the retentive arms and clasps which are not passive.
3. Irritation to the gingiva and soft tissues if occlusal rests, relief in undercut areas, and paths of insertion are not considered in appliance design.
4. Food impaction from wires passing over the occlusal surfaces of teeth.

Deleterious habits such as obvious tongue and thumb habits, cheek and lip sucking habits occuring prior to treatment should be corrected, or may be promoted by treatment[48].

During orthodontic treatment the movement of teeth cause soft tissue changes producing in some cases[41][124] piling of gingival tissue in front of the tooth being moved and recession and bone loss behind.

The technique of discing to reduce mesiodistal width in anterior crowding may alter embrasure spaces which would affect the gingiva adversely[144]. Similarly if a tooth is tilted when moved to close a space poor gingival contour may result with a subsequent gingival inflammation from plaque collection and food impaction.

It has been stated that the treatment of nearly all cases of class II malocclusions result in root resorption[46]. Presented with just this situation and combined with bone loss at the coronal end of the root makes loss of the tooth difficult for the periodontist to prevent.

Horizontal and/or vertical bone loss may be caused by orthodontic therapy alone[124]. Forces used to move teeth, which are in excess of the tissue tolerance haye been known to cause tissue necrosis, root resorption and even loss of vitality of the tooth.

Burket[9] stated that orthodontic treatment has been too frequently directed towards achievement of the "normal" mesiodistal relation of the jaws and the classical pattern of cuspal inter

digitation. The so called "ideal" relation however may not be effective for the preservation of the gingival and periodontal tissues. It is important for periodontal health that there exists or is developed a smooth functional occlusion in which cuspal interferences are eliminated or minimised as much as possible. It[9] is a common clinical observation that cases beautifully completed by the orthodontist often appear after a number of years in the office of a periodontist. Mershon himself expressed concern about the high percentage of cases in which orthodontic treatment has done harm, in contrast to the undetermined number of cases in which such treatment had produced material and lasting improvements.

Schluger[45] stated that most orthodontists "seem to be interested in malposition and malarrangement of teeth, but not their functional relationship".

Glickman[43] stated that dentitions that are retained in traumatic occlusion and that continue in traumatic occlusion after retention is removed are susceptible to relapse and premature periodontal breakdown. The teeth tend to shift because of the disparity between the support provided by the weakened periodontium and the various muscle induced forces of occlusion.

Ramfjord and Ash[148] stated any tooth placed in an unharmonious position tends to challenge the neuromuscular system to move the tooth into a harmonious position, even so orthodontic retainers are used to maintain a tooth in a desired orthodontic position in spite of occlusal interference.

In adult patients perpetual trauma from occlusion[148] is associated with orthodontic therapy when attempts are made to extrude molars and bicuspids while anterior teeth are being intruded by a bite plane or similar appliance. Patients are told to wear the appliance at night for an indefinite period of time. This type of therapy produces a perpetual traumatic occlusion.

Dehiscene of the alveolar process and gingival recession may also develop from moving teeth too far out on the alveolar process[148]. This result should be carefully avoided since it permanently reduces the periodontal support for such teeth and often leads to exposure of the root surfaces.

At times[124] rubber bands have been used in an attempt to close an anterior maxillary diastema. However the bands have a tendency to slip gingivally above the contour of the tooth[21] and produce gingival irritation, besides applying excessive continuous forces. The rubber bands may also cause a low and painless detachment of the periodontal ligament[149][161][162]. This misuse of rubber bands should be discouraged. Fortunately periodontal problems are not often caused by these bands, but the possibility of it occuring should not be ignored.

When[163] skeletal disharmonies are sufficiently great to produce malocclusions which defy orthodontic treatment, surgical repositioning of the jaws can offer a means of attaining the desired correction. The end result should be a harmonious relationship

of both the dentition and the facial skeleton. The tooth should not be repositioned into a traumatic occlusion but a stable and functional occlusion.

There can be no denying the orthodontists the great achievements of their treatment procedures, but this should not detract from Burket's statement[9] "The general impression held by many periodontists is that orthodontic treatment may be one of the etiological factors in the development of periodontal disease in the later years of life.

PROCEDURES IN PEDODONTICS CAUSING PERIODONTAL PROBLEMS

A few aspects of dental treatment specifically related to the pedodontic patient that cause periodontal problems are described in this chapter. Dental procedures capable of causing periodontal problems in the adult are also capable of causing the same problem in the pedodontic patient.

According to Kauffmann[22], "Pedodontics is not a specialty; it is the general practice of dentistry at a child age level. For dento-biometric purposes, childhood is herein considered to be the first 18 years of life and, in a genetic sense, the pre-natal period of gestation".

Kauffmann[22] further stated, "Dental prosthesis currently (1971) takes up from 30 to 40 per cent of both undergraduate and post graduate education". This means that the training process for dentists is designed to treat crippled adult mouths, not to prevent the occurrence of dental disease and malocclusion. Pedodontics should be given a greater position in undergraduate training".

Articles in the dental literature tend to deal with children's dentistry and treatment of periodontal disease on an either/or basis as though they were unrelated aspects of dentistry. On[129] one hand propogandists for attention to dental disease in the child's mouth deal with that subject simply on the basis of caries control as an end to itself. On the other hand periodontists view periodontal disease as something affecting only the middle

age group, with little attention being paid to gingival disease in the child or teenager whereas periodontal disease does occur in the young[36][37][38][182][183][184]. If the occurrence of periodontal disease is not recognised, it will remain untreated.

Mucogingival[14] problems occur in about 6 per cent of children and is most often seen in the mandibular anterior area. It is usually seen as a localised recession with rolled and inflamed gingival margins that move when the lip is retracted. Plaque retention and subsequent calculus formation are often seen in these areas.

Parfitt and Mjor[85] claim that 6.5 per cent of the pedodontic population have irreversible mucogingival problems. Bradley[32] stated, "There is strong evidence that much of the periodontal disease seen in the adult, is but a reflection of their earlier episodes of gingival disturbances during youth. Recognition and treatment of the early periodontal lesion seems to be the most practical either in the child or the adult."

Carman and Kopczyk[14] showed that the iatrogenic factors associated with periodontal disease in the child are:

1. Overhanging margins.
2. Open margins.
3. Overextended margins on stainless steel crowns and orthodontic bands.

4. Open contacts.

5. Overcontoured restorations.

White[28][103] spot lesions due to subsurface demineralisation can now be treated chemically and be remineralised. If white lesions develop near a class V restoration, no longer has the restoration to be extended to include these lesions. The extension of the restoration may result in gingival irritation. If a white spot lesion is situated at the gingival margin, a restoration which is gingivally irritating does not have to be placed.

The[34] chrome steel crown is used almost exclusively in pedodontics. Because of its ease of handling, this restoration is very tolerant to careless manipulation. Some of the consequences of shoddy crowns are gingival overhangs which prevent adjacent teeth from erupting, poorly adapted margins which produce chronic gingival irritation, and failure to maintain arch length because of improper proximal contour and inadequate mesiodistal dimension. All these failures can easily be prevented by careful operation.

Detailed knowledge of growth patterns would help in prevention of malocclusion which may result in periodontal problems due to:

1. Plaque[49] accumulation because malaligned teeth are more difficult to clean properly.
2. Traumatic occlusion which may ultimately cause tissue breakdown in adult life.

It is unfortunate that the pedodontist is not able to prevent the occurrence of malocclusion by interceptive treatment. This requires detailed knowledge of growth. Teuscher[18] suggested that the time may come when the pedodontist will become better educated about growth problems, and will learn to deal with them clinically.

The importance of space maintainers has been described by many[44][50][53][56][169][179]. Mink[169] stated that the loss of arch length due to interproximal caries attack in the primary dentition can result in a crowded condition and is probably one of the most common causes of space loss. Many dentists believe that untreated primary teeth should be left in the mouth as space maintainers, although it has been shown in many clinical cases that a mesial migration of the adjacent teeth into the interproximal lesion occurs, with resulting space loss and shortening of arch length. This shortening may occur at any time but is critical during the eruption of the first molars. If several millimeters are lost on both sides of the dental arch, the result may be a crowded arch or a tooth that is totally blocked out when the permanent teeth erupt.

If bands or stainless steel crowns are used in the fabrication of the space maintainer, care should be taken to ensure that they are properly contoured at the gingival margin. A poorly fabricated acrylic partial denture designed to maintain space can be as damaging as a partial denture. Care should also be taken that the space maintainer does not hamper the eruption of permanent teeth.

Kobren et al.[47] and Lindahl[63] discussed the use of partial dentures for children. He pointed out that one should never make the mistake of removing the acrylic gradually from the tissue side of a saddle, when modifications are made for erupting teeth because this creates a good collection area for debris.

Hirschfeld[69] showed that a loss of a deciduous molar without use of space retaining appliances and the extraction of permanent teeth without replacement are common causes of occlusal disharmony. The[148] classic example are the undesired sequelae following the loss of the mandibular first molar resulting in resorption of bone around the maxillary molars and the anterior teeth in long standing cases. Other sequelae are food impaction, open contacts, uneven marginal ridges and lack of functional cleaning of teeth during mastication.

Another[148] example of far reaching consequences to the dentition is the extraction of a mandibular incisor in an attempt to relieve crowding of mandibular teeth, which eventually results in an increased overbite and an additional tendency for occlusal interferences in lateral and protrusive excursions.

The loss of any functional tooth within the occlusal arrangement will have a tendency to create a disturbance in occlusal relations between the remaining teeth. The effect of the loss is not restricted to the area in the immediate vicinity of the lost tooth or teeth but changes may be observed in distant

areas of the dentition. Thielemann's[71] diagonal law described this effect. "If an interference such as a hypererupted or tipped tooth, third molar gum flaps, etc. restricts the functional gliding movements of the mandible, elongation of the anterior teeth, and often periodontal disease will develop in the anterior region diagonally opposite to the interference". The dynamics of occlusal forces following extraction of teeth merits a very careful study in each individual case. Occasionally, the occlusion may be so balanced that the changes described will not occur. In other instances, the effects of lost teeth may, after some years, become stabilised and compensated for by rearrangement of the occlusal relations to a point where the occlusion is no longer traumatic.

To[169] prevent space loss in those children where a first permanent molar is indicated for extraction or where the tooth has been lost, a fixed bridge is the best space maintainer. Before considering a bridge as a space maintainer, one should be certain that all permanent teeth except the third molar are in occlusion. In the past[169], it has been recommended that the patient be at least 18 to 21 years of age before fixed bridge work is constructed. Many reasons have been given, but, when analysed, few of these were valid. Because of high tissue line on the distal and lingual surfaces of the second molar an inlay bridge is recommended.

A[72] large number of malocclusions are caused by pernicious habits and pedodontists must make every effort to learn more about the habits which may produce malocclusion.

Very often a child's first dental treatment experience is unpleasant. This leaves a strong dislike for the profession which lingers on even in adulthood. Due to this dislike the patient will visit a dentist only for emergency treatment. Much could have been done if the patient had come for routine check ups. Therefore the importance of creating a good lasting impression on a child is very important for the pedodontist.

The pedodontist by the use of preventive and interceptive techniques should be in a position to prevent malocclusions which may lead to periodontal problems in later life.

OPERATIVE PROCEDURES CAUSING PERIODONTAL PROBLEMS

The periodontal problems caused by intra-coronal restorative procedures will be discussed in this chapter. Crown and bridge work, and gingival retraction will be covered in a separate chapter.

In the field of operative dentistry there are many iatrogenic factors contributing to periodontal disease[5][26][51][67][111][119]. During the course of the preparation of a restoration especially in class II and class V situations trauma[16][111][186] from the bur can injure the periodontal tissues.

The routine use of the rubber dam for operative procedures has been advocated by many[4][138][140]. The injury to the periodontal tissue caused by the injudicious use of the rubber dam clasps, ligatures and separators is well known[16][111][140][178][185]. Lundeen[185] stated that overzealous use of separators may damage the periodontal membrane. The interdental papilla can be inadvertently strangled by ligatures. Occasionally a thin ring of rubber dam material will be retained around the cervix of the tooth. If it remains undetected for a period of time, irreversible damage to the periodontium can occur. Hazen[111] stated that a rubber dam clamp improperly applied can be injurious to the gingival tissues. A small wooden wedge can be carefully placed interproximally to retract the tissues further with little or no injury to the gingiva.

A[148] restoration should be in harmony with the grinding factors of the masticatory system. Transient trauma from occlusion caused by newly placed restoration which may result in a "high bite" are usually alleviated when the tooth is repositioned or the restoration is worn down. However if the tooth cannot reach a stable harmonious relationship chronic trauma from occlusion will ensue. Changes[178] in the natural contour of the tooth surfaces by operative procedures can also give rise to destructive lesions of the supporting tissues of the tooth.

It is often[111] stated that an overcontoured filling will cause pressure or irritation to the soft tissues of the gingiva and cause their breakdown. This is particularly so because the patient is unable to clean the non physiologic area leading to development of microbial plaque which causes the tissue to break down. Uneven[148] wear resulting from uneven hardness of the restoration, teeth or both may also induce traumatic occlusion.

The occlusal anatomy of the filling should be similar to that of the natural tooth. The fossae, grooves, ridges and cusps deflect the food off the occlusal table and away from the interproximal area. Faulty[148] carving of occlusal amalgam restorations and failure to allow for some eruption may lead to interferences on the cuspal inclines in lateral excursions. Exaggerated[132] contours provide a sheltered position for food and material also and inadequate contouring permits direct trauma to the free gingiva because of lack of protection.

Adjacent marginal ridges should be restored to an equal height and at a functional level. The[132] marginal ridge is the most important anatomic feature of the occlusal table. Its function is to direct food away from the interproximal area to the occlusal table. Unequal height of marginal ridges or improper contour leads to food impaction and consequent breakdown of interdental tissues. A faulty[148] marginal ridge on a single occlusal inlay could alter direction of occlusal forces, inducing a slide in centric which worsens with time, because of the spreading of maxillary incisors. The occlusal relations of all the teeth may change to a great extent and induce muscle spasms and tempero mandibular joint pain.

Linkow[6] stated that the proximal marginal ridge, triangular groove and contact areas act in unison to divide the bolus of food. Overcarving[148] of occlusal restorations to the point where the central stops are removed lead to interference in lateral excursions.

Contact areas should be restored as they normally exist. The placement of the contact occlusally results in a flattened marginal ridge which encourages food impaction between teeth. Lack of contact also results in the same. Broadened contact areas produce an interdental area that the patient is less able to clean and microbial plaque develops more readily. Because the epithelium of the col is non keratinized and this area is

broadened due to a broad contact point, the chances for innitiation of periodontal disease are enhanced.

The improper use[111][119][173][178] of the matrix band to supply the missing wall of a compound amalgam restoration is a common fault. Research[2] has shown that unless the matrix is wedged and contoured good proximal contour with corresponding contact area is impossible to obtain. A recent[119] radiographic survey of 17,100 class II restorations reveals that over 20 per cent failed through lack of interproximal contacts or pressure of gingival overhangs. This type of failure is an immediate one; prior to the dismissal of the patient. Many matricies need reinforcement with dental compound or auto-polymerizing acrylic resin to prevent its distortion. A correctly placed matrix serves as a guide to correct carving and finishing.

Additional[119] error and cause for failure is the misuse, or lack of use, of a wedge at the inter proximal gingival margin, though wedge size and shape should not violate good physiologic contour. It should prevent gross overhang of excess material. Interproximal[178] wedges should be placed in such a way that the band is held in intimate contact with the proximal surface of the tooth beneath the gingival cavosurface angle. If the wedge is placed above this point, horizontal food packing will result and perhaps a marked overhang. Matrix[127] retainers are capable of serious trauma and where the gingival sulcus is less than 1mm. deep this is difficult to avoid.

Overhanging margins of inter proximal restorations cause periodontal problems[5][7][26][51][54][132][137]. Alexander[5] showed that the gingival condition around teeth which had restorations with overhanging edges was significantly worse than the gingival condition around the remaining teeth. It is generally accepted that overhanging margins cause mechanical irritation but Waerhaug[121], Waerhaug[122] and Loe, Waerhaug and Zander[123] believe their action is to facilitate the retention of bacterial plaque in the sulcus and this causes inflammatory response in the adjacent tissues.

Turgeon[7] et al. studied the periodontal effects of restoring proximal tooth surfaces with amalgam. They found immediate gingival inflammation characterised by erythema and increased crevicular depth, but without significant migration of the epithetial attachment. After 8 months erythema persisted on the lingual side of the experimental teeth. It could have resulted from improperly trimmed amalgam restoration. Chances are that placement of the rubber dam, matrix band or the carving of the amalgam could have a permanent damage in this area.

Gilmore and Sheiham[26] found more sevère periodontal disease with the presence of overhanging margins. They state that the high percentage of posterior restorations which had overhangs indicates that overhanging dental restorations are important local factors contributing to the severity of periodontal disease in human population groups.

Bjorn[51] et al. reported a highly significant reduction in alveolar bone height to metal restorations with marginal excess equal to or greater than 0.2mm. A lesser non significant reduction was related to marginal defects of less than 0.2mm. In this study radiographs were used consequently differentiation between gold and amalgam restorations was not possible.

Cripps[132] stated that gold inlays with imperfect margins were equally responsible for pathological changes in the periodontal tissues. Pritchard[21] stated that underextension of the gingival margin of a casting furnishes a crevice for the accumulation of bacteria and food debris and may be a greater source of irritation than an overextended margin.

Harvey and Hession[178] showed that another cause of marginal excess is one inherent in the material itself, whereby a small degree of flow over a period of time occurs in large proximo occlusal amalgam restorations. This is minimised by proper manipulation of the material during its placement.

Restorations may be finished at above or below the gingival margin. Silicate cements, acrylic resins and amalgam fillings are usually finished close to the gingival margin. Inflammation of the gingivae adjacent to the restoration may be due to the irritation of the material per se, rough surfaces, overhanging margins, retained bacterial plaque or a combination of all these factors.

Karlsen[54] found that gingival inflammation was almost a constant finding in subgingival restorations as contrasted to the favourable response in supra gingival cases. Gingival condition is closely related to the marginal fit.

Waerhaug[67] stated that pure gold is non irritating to the epithelial lining of the gingival crevice and alloys used for restorations are probably the same. However the possibility that the electric current engendered when gold restorations are placed in mouths where other metals are present may cause some slight irritation. More research in this field is required.

Lorato[58] showed that when composite resins were used to restore class V cavity preparations in subjects with clinically normal gingivae:

1. Gingival tissues adjacent to restorations with subgingival margins developed marginal gingivitis in patients who practiced good oral hygiene.
2. Plaque materials formed more easily on the surface of composite resins than on tooth enamel.

Lorato[59] found that a gradual erosion of silicate cements may occur in the mouth resulting in the exposure of cavity walls and/or rough margins. This encourages the accumulation of food debris and bacteria with the eventual accumulation of plaque within the defect. If the silicate restoration is located at or beneath the gingival margin, an inflammatory process may occur as a result of plaque deposition.

Loss of proper contour because of disintegration in the oral fluids may result in a deficient proximal contact encouraging impaction of food debris and bacteria leading to inflammation of the gingival papillae.

Another factor which cannot be overlooked is the irritating quality of the material. With the same marginal discrepancies for silicate, amalgam and acrylic there is a much greater response with the silicate and acrylic resin than with the amalgam. Zander found that the reaction of the gingiva to silicate cement and amalgam produced an inflammatory reaction similar to that caused by subgingival calculus. Waerhaug and Zander found that self curing acrylic restorations produce a chronic inflammatory reaction in the adjacent gingival cuff. This[60] brings up the possibility that teaching patients proper oral hygiene may not be the entire answer in prevention of periodontal disease but that the restorative material itself should be considered.

Only in cases where gingival margins are inflamed excision of the gingiva is justifiable. The use of a gingivectomy for placement of rubber dam clamps, subgingival[127] placement of gingival margins of class V fillings in healthy gingival tissue has been advocated[138][140]. This may not cause a periodontal problem but certainly puts the patient through unnecessary discomfort.

Lorato[58][59] stated that the principle of "extension for prevention" in cavity preparations designed for silicate cements and composite resins may help initiate the development of marginal gingivitis and this concept should be re-evaluated.

Zeines[60] stated, "It may be much better to place a restoration in what is considered a caries susceptable area and teach the patient proper oral hygiene than to promote the greater evil of periodontal pathology."

It[26] would be indeed ironical if in the process of restoring teeth affected by dental caries, dentistry in any way contributed to the causation of periodontal disease thereby threatening the longevity of the restored teeth.

PERIODONTAL PROBLEMS CAUSED BY CROWN AND BRIDGE WORK

It[137] has been traditional to extend crown margins into the gingival crevice under all circumstances and it has been claimed that tooth structure within the crevice is immune to caries. However, placement of the crown margin below the gingival crest for this reason alone is difficult to justify[64], since there is strong evidence in favour of keeping the margin above the gingival[73][77][155] tissues.

The[137] reason for not entering the crevice is that the junction of any restoration with the tooth is sufficiently rough[66][68] to cause plaque accumulation and thereby produce chronic inflammatory changes in the adjacent soft tissues. Margins[106] of preparations which extend too far into the sulcus, detach and destroy the epithelial attachment. When the epithelium heals it cannot return to its previous location on the tooth because it is covered by the crown. The epithelium proliferates beyond the margin of the crown in an attempt to attach to the cementum. Proliferation of the epithelim combined with gingival inflammation associated with food accumulation constitutes the early stage of pathologic pocket formation.

Silness[55] found that when the margins of a bridge retainer have been placed below the gingival crest, an increased accumulation of plaque occurs. This is apparently so even in patients who have been taught methods to improve the oral hygiene. He also found

that deterioration in periodontal conditions as characterised by the amounts of plaque, severity of gingivitis and pocket depth was most pronounced in areas with the retainer margin in a subgingival position. In areas with the crown margin level with the gingival crest, the alteration in the periodontal state was less marked. The results of his study suggest that a supragingival position of the crown margin is the most favourable one.

Mount[137] stated that the inflammation of the tissues will change its relation with the margin of the crown. The inflammation may exist prior to any operative procedure or may result from preparation of the tooth or from the crown itself following insertion. To prevent any change in the contour of the gingival margin adequate preparation is necessary as well as care during and after operative procedures.

Glickman[16], Morris[96] stated that gingival tissue can most easily be maintained in health if the finishing line is occlusal to the gingival third of the crown. Too often this is not possible because of considerations of retention, caries susceptibility and aesthetics. If it is not possible to locate the finishing line distant from the gingival margin it is best that it is just apical to the margin of the gingiva. When it is immediately occlusal to the margin of the gingiva it will inevitably create an inflammatory situation.

The[98] first and most direct damage occurs during preparation. The margins must be carried below the gingiva therefore the tissues will be significantly disturbed in removing the tooth substance in this area. The inter distal papillae are softer and more yielding than the gingiva on the buccal and lingual aspects, which is firmly attached and presents a shallower sulcus. Thus it becomes readily apparent that any pressure or damage beyond the buccal or lingual gingiva will more likely tear the gingival attachment and result in permanent damage.

Minker[79] advocated that in all types of crown preparations with the exception of porcelain jacket procedures, the margin must end just above the epithelial attachment. This corresponds to a level at or slightly below the free margin of the gingiva. As a rule it is better to underextend than to overextend.

Lundeen[185] stated that whenever possible avoid carrying the crown preparation margins into the gingival sulcus area. This procedure, of course, is limited to those individuals in whom caries attack is not a problem and where esthetics is not demanding.

Hampson[19] pointed out that due consideration should be given to the care of the gingival tissues in the young, as gingivitis in such patients often leads to marked periodontitis in adults. One particular instance is where fractured incisors are treated with basket crowns. The labial extension fitting

around the neck of the tooth is a constant irritant which unfortunately has to be retained for a number of years.

Alexander[153] stated that the so called caries immune areas in the gingival sulcus which G.V. Black had observed might be a fallacy in the light of recent work. A surprisingly high inflammatory score was found around all crowned teeth whatever material was used. In many cases the gingival tissues all around a full crown were inflamed.

Hurt[186] stated that a shy margin of a crown is just as irritating as an overhang. This is a point frequently overlooked when searching for a cause of gingival inflammation.

Mannerberg[52] in a study of porcelain jacket crowns found that despite an apparently clinically acceptable result it appears that the porcelain crown whose cervical border is placed down to "half the depth of the gingival pocket" implies a risk for permanent inflammatory irritation to the gingiva. This is because the porcelain crown cannot be shaped so well that the joint between the crown and the tooth is so smooth as not to interfere with oral hygiene. Plaque deposits can therefore be retained around the border between the porcelain crown and the prepared tooth. He[52] concluded that placing of the cervical border of the crown to half the depth of the gingival pocket probably therefore always implies a risk of paradontologic disease.

Viewing these conflicting opinions on the location of the finishing line, it should be realised that there is no single

location of the finishing line that is universal but each case should be treated on its own merits. Waerhaug[67] stated that when deciding the location of the margin of the restoration in relation to the gingival margin and bottom of the crevice consideration must be given to caries rate, predisposition to periodontitis, oral hygiene and esthetics.

Minker[79] observed that a shoulder or type of crown preparation is more frequently used than a shoulderless tapered type. Each one has its advantages and disadvantages under given conditions. Shoulderless preparations are indicated for almost all teeth with finish lines extending one third the distance or greater on to root surface. When prepared to receive a veneer restoration, it is indicated particularly where an arch or a major segment of an arch of periodontally involved teeth most of them with more than one third bone loss are to be splinted by a fixed bridgework.

The full shoulder type of crown preparation is needed in cases where porcelain jacket crown is the restoration. It[164] supplies sufficient room for proper stimulation of the interproximal area and thus prevents impingement of the interproximal tissue. The health of the interproximal papilla directly affects the bone and this area is the most difficult to stimulate. Provided the appropriate type of finishing line is used with regard to the restorative material, the main importance is the location of the finishing line.

A variety of methods have been advocated for tissue retraction[16][33][83][84][86][106][107][113][120][133][170][185]. Lundeen[185] stated that permanent damage to the supporting structures can result from some of the methods for displacing gingival tissues away from the tooth to allow for the making of elastic impressions of the gingival margins of crown preparations. Repeated packings of various types of cord and medicaments into the gingival sulcus traumatises the tissue. The caustic effect of some of the drugs employed in excess has caused necrosis and sloughing of the gingival tissues.

Xhonga[33] studied the effects of four types of retraction techniques. They were as follows:

1. Gingiva was retracted by gently probing it back.
2. A single vertical incision was made on the centre, facial portion of the gingiva, and then the tissue was retracted.
3. A double incision was made on the facial surface of the gingiva, followed by retraction of the soft tissues.
4. An envelope incision was performed by making two horizontal incisions, higher coronally toward the top of the papillae, on the facial surface. He found that the double incision showed less incidence of gingival inflammation and soft tissue recession than the three other methods.

Anneroth[84] and Nordeman found that cotton threads should not be removed from a dry environment. When this was done the cotton thread was liable to tear away the gingival pocket epithelium from the underlying connective tissue. An injury of this kind may be more serious than the damage which may be caused to the pocket epithelium as reported in other studies in which the cotton thread was impregnated with various escharotic, astringent and vaso constrictor agents. In the individual case the tissue resistance may be lowered or eliminated and careless handling of tissues may lead to an injury which heals with difficulty.

Stein and Glickman[106] stated that copper bands inadvertently detach gingival tissue from the roots when the impression is taken. Provided no particles of wax or compound are permitted to remain in this area, healing is uneventful. Mechanical and chemical methods of gingival retraction leave a temporarily widened gingival sulcus favouring the accumulation of food debris that could interfere with the restoration of the desired physiologic sulcus. Removal of the gingiva by electrosurgery eliminates the problem of bleeding but introduces the necessity of fastidious precaution to prevent injury to the underlying tissues.

Joseph[133] stated that packs made by spinning cotton wool between the fingers are generally unsatisfactory because of their uneven diameter and their tendency to stretch during insertion. The various proprietary packs impregnated with astringents overcome

these difficulties but can cause sloughing if left in for more than a few minutes. It should be remembered that packs which have been soaked in dilute caustics and allowed to dry out before application will, in fact, contain the concentrated form of that caustic.

The[95][106] interim between the impression and cementation of the completed restoration is an important one from the viewpoint of the gingiva. Coverage of the prepared abutment with crowns constructed of metal bands adapted to the gingival portion of the teeth and covered with acrylic may give rise to detachment and recession of the gingiva if they remain in position for periods of one month. Irritation to the gingiva from quick cure acrylics may also occur.[137] If the temporary crown is short of the gingival margin, the gingiva will be irritated by the temporary cement.

The evaluation of the abutment tooth or teeth to be used for support of a bridge is most important. A structure[89] is as good as the foundation upon which it rests. Dental[114] restorations often fail because the dentist did not properly evaluate the integrity of the abutment teeth.

A[90] suggestion to be used in evaluating abutment teeth for fixed partial dentures is based on the area of remaining periodontal membrane supporting the teeth in question. Double the occlusal load as computed by the square millimetres of periodontal membrane might be the approximate limit to be placed on a tooth. If

the clinical root has been reduced by periodontal involvement the figure should be reduced proportionately. Complete fixation as afforded by fixed partial dentures is one of the more effective means of preserving periodontally involved teeth. Beaudreau[114] has examined the criteria for evaluation of the abutment teeth in detail.

Tracings of radiographs should be evaluated to determine the axial loading of a bridge. If the forces fall outside the axis of the teeth the bridge will cause periodontal damage to the abutment teeth and with the passage of time the use of the bridge will be lost.

The[96] ideal direction of a force acting upon a tooth is parallel to the long axis of the root and is close to the centre of rotation. The oblique or lateral forces are the ones that potentially are the most damaging since they tend to rotate the tooth, about the centre of rotation, producing areas where the periodontal membrane is crushed between the hard structures of root and bone. A vertical force may be changed to an oblique and therefore potentially unfavourable one by the angulation of the cusps. The more steeply angled cusps will produce the greater obliqueness of resultant vectors. A vertical force acting on a tooth with an extremely wide occlusal table will also produce an oblique force since the force is outside the centre of gravity and frequently outside the anatomic borders of the root structure. A vertical force may be converted to an oblique one by a tilted tooth.

Studies[93] show that 15 to 30 minutes a day is required to masticate food. However, activities such as bruxism and other habit patterns usually have strong components of horizontal force and are frequently concentrated on isolated teeth. Thus, a comparison of the time and type of force required for mastication, and the time and type of force directed during parafunctional activities indicates that the potential danger from parafunction is greater than that from masticatory function.

Schweitzer[94] et al. stated that the most typical free end pontic on fixed partial dentures with anterior free end pontics is a single pontic attached to a single abutment casting. They found that where an upper central incisor supports an adjoining central incisor pontic, the long term results are not so successful. When a lateral incisor supports an adjoining central incisor pontic the results are least successful because the lever arm in the horizontal plane is longest and least favourable. It[94] was found, that when abutment casting is placed on an adjacent molar to extend to and fill in the small space created by the natural drifting of teeth after the loss of a bicuspid or molar the vertical forces create unfavourable pressures and a periodontal pocket forms on the side of the abutment tooth.

They[94] also found that when broken stress fixed partial dentures are used in mouths with weakened supporting structures, deterioration of the bone was more rapid and more severe. Hunt[186]

stated that a less obvious but frequently damaging situation is seen in bridges with a fixed abutment on one end and a precision attachment on the other. This type of bridge may cause breakdown of the periodontal attachment of the fixed abutment tooth.

Prosthetic[106] restorations must be designed so that they meet biologic requirements of the periodontal tissues. When esthetic considerations overbalance the biologic requirements the periodontal tissues suffer.

The[106] occlusal form should be such as to direct the functional forces in the long axis of each tooth. A satisfactory type of occlusal form consists of shallow modified cuspal carving that permits maximum freedom in all functional movements of the mandible. Shallow cusp to fossa relationships suffice to provide satisfactory functional stimulation to the supporting tissues. There appears to be no factual basis for the concept that narrowing the buccolingual diametres benefits the periodontium because it decreases lateral stress. On the other hand Hampson[19] stated it was a mistake to construct bridges with the pontics the same diametre as the missing teeth. This should be unconditionally condemned as it encourages food leaks, discourages tissue stimulation, produces excessive stress upon abutments and undue contact of tissue with the pontics. Herlands[100] et al. support Hampson and recommend narrowing of the occlusal food table to enable stresses to be directed into the long axis of the tooth. Stein and Glickman[106] thought that correct cuspal incline rather than a narrow morsal table was a more realistic approach to the establishment of

physiologic functional relationships. Herland et al.[100] thought that lowering of cuspal inclines minimises harmful lateral stresses.

Overcontouring[106] or undercontouring results in a disruption of the normal deflection of food. Too often in an attempt to satisfy the esthetics demands the buccal contour is sacrificed to a point where it is incompatible with gingival health. Detailed attention should be given to lingual contours. Acute angles which cause food impaction in the gingival sulcus should be avoided in shaping the lingual aspect of maxillary and mandibular teeth.

It was found that most appliances that failed were constructed with tight embrasure spaces which had a tendency to force the gingival papilla out of its natural habitat. These papillae, forced to the buccal and lingual, soon became inflamed owing to the loss of protection from the prosthesis. When this occured, papillae can be traumatised by food or toothbrush bristles and can easily collect great quantities of undesirable debris. When prostheses are constructed with excessively large embrasure spaces, lateral food impingement and retention then becomes the major source of annoyance. A slightly large embrasure is preferred to a smaller one.

Hirshberg[57] found that oral hygiene exerted a more important influence on the health of the gingiva and mucosa adjacent to fixed prostheses than does the height of the embrasure and that the oral mucosa is more likely to remain healthy under spheroid or

modified spheroid pontics than under ridgelap pontics.

Contact[95][106] with the ridge should be kept to a minimum. This may be accomplished by use of the bullet design in the posterior quadrants rather than the "ridge lap" type of construction. It is preferable to avoid contact of the pontic with the ridge. A[16] design such as the sanitary type pontic eliminates the risk of irritation to the mucosa. However, Miller[164] feels that in areas where multiple pontics are to be placed, the ridge-lap type should be used rather than the bullet-rose design, which invites food retention.

The[106] ultimate value of the prosthesis is severely jeopardised by Horn[110] who stated that the ~~cementation requirement~~ is the Achilles heel of fixed partial dentures. (improper cementation) Cavity margins should be cleared of all capillary growths that develop beneath temporary packs. If allowed to remain, this tissue is "pinched off" of destroys the marginal seal of the casting. Retained cement particles are a source of gingival irritation[106][137]. Meticulous exploration will reveal any cement which remains in situ. This task is difficult and may be facilitated by coating the exterior surface of the prosthesis carefully with mineral oil prior to cementation. The zinc oxyphosphate cements being acid in nature will continue to irritate gingival tissues after cementation.

The[106] recent trend of avoiding permanent cementation and substituting in its stead a regimen of repeated removal of the prosthesis and temporary cementation is to be discouraged. Failure to finalise the relationship of the prosthesis to the periodontium

by permanent cementation prevents definitive healing and adaptation of the gingiva to the structure of the prosthesis.

Cavazos[147] studied the tissue response to a number of different types of materials used as pontics. He found that tissues responded dramatically to acrylic resin and in a lesser degree, to gold alloy, which makes both these undesirable as tissue contacting materials. In order to maintain a completely healthy and hygienic condition for fixed partial dentures the pontics must be constructed of highly glazed, high[157] fusing porcelain of an ovoid design with minimal adaptation to the tissues and properly reinforced with a gold alloy casting.

Casts[106] should not be scraped or scored in an attempt to provide for suitable pontics. Pressure atrophy of the ridge as well as disturbance of the periodontium of teeth adjacent to the edentulous area results from this procedure. Conversely, leaving a small space beneath the pontic and the mucosa of the ridge[30] will foster food entrapment and irritation to the underlying mucosa and the periodontal tissues of the adjacent teeth.

Cavazos[147] found that the adaptation of a pontic to the ridge or the amount of "relief" (scraping of the cast) is hihgly significant and directly proportionate to the amount of unfavourable tissue change. Absolute minimal contact (0.0 to 0.25mm. of cast scraping) produced no tissue change. When the cast scraping was increased to 1mm., tissue changes were produced varying from mild inflammation to acute ulceration.

For a fixed partial denture to be successful it must be in harmony with the occlusion of the rest of the mouth. Often[97] an operator finds after preparing a tooth for a full or three quarter crown, making a die of the prepared tooth, taking a wax bite of the occlusal, using care not to add to the occlusal surface while waxing the restoration, the finished crown "hits high" necessitating grinding of the opposing teeth. This is because sufficient attention is not given to the participation of the mandibular buccal surface or maxillary lingual surface in occlusion. The crown does not actually "hit high". It hits wide and the overcontoured buccal or lingual surface restrains the crown for full entry into the sulcus of the opposing tooth. Checking the occlusion in the mouth after insertion is imperative to avoid the development of sensitivity and soreness of the teeth, bruxism, erosion and tempers mandibular joint disturbances.

The potential hazards capable of causing periodontal problems in every stage of fabrication of crown and bridge work has been depicted, in an attempt to bring about the realisation that the longevity of a bridge is no longer or greater than the integrity of the periodontal ligament of the supporting teeth.

PERIODONTAL PROBLEMS CAUSED BY REMOVABLE PARTIAL DENTURES

Applegate[62] stated that there are perhaps no two dental services more dependent each upon the other than periodontics and removable partial denture prosthesis. From[104] a periodontist's point of view the partial denture is the least desirable of any dental appliance. Nevertheless, factors such as economics, poor health, loss of posterior teeth or the presence of a long span between the anterior and posterior abutments necessitate the making of such an appliance. But[99][105], removable partial denture should not be an interim restoration between a healthy, natural dentition and complete dentures but a scientifically designed method of restoring function in a mouth in which teeth have been lost. In addition, a removable partial denture can preserve the residual ridge in a healthy state with a minimum amount of undesirable change. Yet, as Krajicek[118] pointed out, "In this era of advanced scientific knowledge the removable partial denture continues to be the most abused, misunderstood oral restoration in all of prosthetic dentistry."

Before abutment evaluation, or partial denture design is undertaken, there must be a thorough understanding that all[118] partial dentures place added stresses on the three basic structures: tooth, periodontium and the edentulous ridges. It follows, then, that there will be responses to these stresses. "The success

of a partial denture is directly proportional to the living tissues' ability to withstand the forces imposed on it. The master of success is the living cell, not the partial denture."

There[105][114][118][166] have been several articles dealing with the requirements for the selection of abutment teeth needed to support removable partial dentures. Beaudreau[114] has discussed these factors adequately. The[118] degree of mobility does not necessarily decide the fate of a tooth but rather an understanding of the reasons why it is mobile. Mobility in itself does not decide its suitability as an abutment. A mobile tooth could be tightened by a prosthetic device, and a tight tooth may be loosened by one.

The real key to successful partial denture construction is the supporting apparatus, but unfortunately the retention of the partial denture depends for the most part on the tooth and its morphology. Quite often the contour of abutment teeth needs correction. This is done by either selective grinding of the natural dentition or the restoration and modification with crowns. If a tooth has a buccal, lingual or mesial inclination, the entire tooth and not just the crown must be aligned so that the force is in a vertical direction.

Krajicek[118] stated that splinting is not a panacea, nor does it ensure the successful retention of, abutment teeth. Schluger once said, "Splinting is not a treatment for periodontal disease. It is only a device for stabilising mobile teeth. If the teeth are in periodontal health the splint may be successful. It is possible

to hold a dead horse up, but don't expect to ride him very far."

All[148] splints have a tendency to interfere with oral hygiene and self cleansing of the teeth and gingival tissues. Whenever splints make contact with the gingival tissues it is almost impossible to avoid completely gingival irritation and inflammation. It is especially crucial for patients with a tendency for destructive periodontal disease, who, unfortunately are the patients who most often need splints. It is also difficult to achieve proper contour of a splint at the gingival margin, especially in the interproximal areas. They should never be used as a "shot gun" substitute for accuracy and exactness in occlusal therapy of the individual teeth.

Glickman[115] stated, "Alveolar bone is dependent upon functional stimulation for the preservation of its structure." Alveolar[62] bone is particularly prone to show "disuse atrophy" in areas of the dental arch from which function has been eliminated by the extraction of teeth.

Sudden[118][186] forces exerted on such teeth may be damaging. Many[62] partial dentures of the free-end extension base type are ruined because an excessive occlusal load is permitted in the early months of use. Until bone has been reorganised so as to be capable of supporting the newly applied work, the tissue tolerance is likely to be exceeded and the vertical level of the ridge reduced. To lessen the extent of this resorptive process,

the maximum permissable extension of the base borders should be obtained in order to achieve the most equitable distribution of the work load throughout the area of the supporting tissue. Also the amount of stress produced on the occlusal table should be reduced by narrowing the teeth.

Only from an overall extensive examination plan can a diagnosis be made which results in a realistic treatment plan. Without[118] first eliminating and treating all existing abnormal oral conditions, no partial denture restoration could be successful.

The[118] multiplicity of periodontal implications associated with the removable partial denture seems overwhelming, but some of the more common causes of failures, are associated with design and fabrication.

Probably[118] the most important point in designing any prosthetic appliance is an application of the rule of simplicity. Failures in partial dentures many times arise from the concept that the more tentacles, rests, springs and attachments we design for the appliance the more efficient it will be in function. As Krajicek stated "We want to support our appliance and dentition, not bind and gag it." Our professional dedication to rigid mechanical principles is regrettable apparent when we reflect upon "retention" as it relates to the partially edentulous mouth. Have we not been concerned merely with retention of the restoration; that is, "how to keep the partial in", rather than with the fabrication of a partial denture that will help to retain teeth, or how to keep the teeth in?

The[61] plate work denture, supported entirely by the mucosa, which is often defined as "a full denture with holes for the remaining teeth", can be considered as being the simplest type of removable partial denture. It is easy to construct and is inexpensive, and consequently it is the most used partial denture even today.

The border of the mucosa borne partial denture touches the tooth necks and thus covers the gingival mucosa. The free gingival margin is easily traumatically injured and clinical experience with this type of denture is probably best expressed by the well known phrase "gum stripper". Hildebrand found that periodontal changes were more common in cases wearing mucosa-borne "stress prosthesis" than in those fitted with "hang prosthesis" (bridgework) or hang stress prosthesis (dentogingivally supported removable partial dentures.). Andersson and Lammie could present evidence of cases of severe inflammation in the gingival margin under the acrylic plate of mucosa borne dentures. They also found that a depth of the gingival pockets of 3mm. was very common in their series of cases. Kiovumaa found that the incidence of inflamed gingival margins was 74 per cent in patients wearing their dentures day and night, and 44 per cent in those using their dnetures only in daytime. Seeman[175] found that a partial denture did not improve the periodontal condition of teeth in a partially edentulous jaw where those teeth were involved in the denture design.

Lechner[174] stated that the free end lower partial denture may be considered as one of the major problems of prosthetic dentistry resulting very often in tissue deterioration.

Glickman[16] recommended that to provide maximum stability for removable partial denture every effort should be made to retain posterior teeth for the distal support of the saddle areas. Finger-like[16][118] projections between the teeth irritate the interdental papillae and marginal gingiva and lead to food impaction, periodontal pockets and gingival enlargements. These problems can be avoided by using a wide major connector on the palate rather than a horse-shoe type design which encroaches upon the gingiva.

Insufficient saddle coverage is responsible for torsional and lateral stresses[116] upon abutment teeth which lead to periodontal destruction and premature tooth loss. With lingual bars without distal support, this is a particular problem. To provide maximum stability saddles should be extended on the facial and lingual surfaces as far as the patient's tissues permit.

Pritchard[21] stated that maxillary removable partial dentures should have a cross arch palatal strap or plate instead of anterior and posterior palatal bars. A palatal bar permits rocking across the palate which supplies severe torque to the abutment teeth. A removable partial denture should not replace both anterior and posterior teeth because medial and distal vectors of force are added to forces from the buccal and lingual direction.

Ideally edentulous spaces anterior to abutment teeth should be restored with a fixed partial denture.

The margins[16][105][118] of facial and lingual flanges adjacent to abutment teeth should be thinned and rounded, with a wide taper from the crest of the ridge. This design provides for self cleansing action of unobstructed food passage. Blunt borders close to the abutment teeth form narrow troughs which trap irritating food debris.

Krajicek[118] stated that in many cases if the stress is beyond the epithelial tolerance there will be exaggerated inflammatory response with subsequent hyperplasia. He also found another soft tissue response - one of developing "granulation tissue" in periodontal pockets. By definition, granulation tissue is new reparative tissue consisting of new fibroblasts, increased vascularity and vascular cellular elements. This tissue transforms into mature tissue during the healing phase after injury. Microscopic studies of tissue removed from periodontal pockets has shown that this is not the case. "What we have been calling "granulation tissue" is in fact a superimposed inflammatory response in mature connective tissue."

A chrome[99] cobalt base has an advantage over a plastic base in that it is not subject to dimensional change after being cast. Also[174] a lack of thermal conductivity of an acrylic base will inhibit stimulation. In this regard metal is superior

to acrylic as a denture base. The plastic based free end saddle partial dentures need rather frequent rebasing in order to maintain an acceptable degree of fit. The chrome cobalt has this disadvantage of not being able to be rebased.

Many[118] failures of the removable partial denture can be attributed to improper laboratory function. The[166] dentist is not meeting his responsibilities if he permits the laboratory technician to design the denture. A large Australian laboratory carrying out chrome cobalt castings reported that of cases received, only about one per cent were designed in detail. The dental laboratory's only obligation is to carry out accurately and faithfully any design according to the records and instructions provided by the dentist. Anything which contributes to uncertainty in the laboratory invites the technician to make decisions which are properly the function of the dentist. Therefore an adequately prepared model on which the design has been accurately outlined, accompanied by a laboratory work order setting out the necessary specification is essential, especially since[117] it appears that the average dentist sends more work to the laboratory than he did in 1958.

Probably[99] more common than the carious destruction of abutments is the more insidious destruction of periodontal disease. The partial denture can slowly loosen and destroy abutments through destruction of the attachment apparatus - the periodontal membrane and bone. In a clasp partial denture the potential destructiveness

appears to be in proportion to the amount of movement which occurs during function and the firmness of the grip which the denture has on the abutment tooth.

Clasp partial dentures do not utilise the shim as does the precision attachment. Hence no matter what the base material might be, the fit is not quite so intimate and slight movements occur in function before the base reaches the rock bottom of incompressibility of the soft tissues. Such movements as would occur in a clasp partial denture under such circumstances drops the base on to the soft tissue not in a simultaneous vertical drop, as occurs in a precision attachment partial with the only movement being a strictly vertical one as determined by the path of insertion of the precision attachments. Rather, the movement is the greatest in the area most remote from the occlusal rests, which act as a hinging mechanism or fulcrum around which the denture tips down in the distal and up in the mesial. The sequence to this, if resorption occurs, is the continued rocking of the denture when loaded occlusally, with the occlusal rests of the last abutments acting as fulcrums. This establishes what appears to be a self perpetuating, or rather, self worsening situation where more movement causes more resorption and more resorption allows more movement. In the precision attachment partial denture the dropping of the base is in a vertical direction, increasing the pressure on all areas simultaneously, and because of the mechanics

of the attachment, which stop it at a given point, it cannot follow and encourage any further resorptive changes in the soft tissue.

Stress breakers which connect the retainer and saddle areas by flexible and moveable joints are sometimes used to prevent excessive occlusal forces on abutment teeth. However, comparisons have revealed no advantage of stress breakers over rigid connectors in this respect. With rigid connectors between the clasps and saddle areas the resiliance of the mucosa acts as a stress breaker. It permits controlled movement of the prosthesis so that the tissue borne sections take the initial occlusal stresses and prevent sudden impact on the periodontium of natural teeth.

There are several types of stress breakers used, on the basis that they allow the denture base to move slightly without strain on the abutments. The hinge type of stress breaker leaves the denture base in much the same situation as described for the fulcrum action of the occlusal rest. The ball and socket type allow essentially the same tipping action and add to it lateral or rolling mobility which tends to allow bucco lingual rolling or tipping motion. Those which allow only vertical drop commonly have the weakness of excessive space for vertical drop. This space is greatly in excess of that provided by the shim used in precision attachments, and without the present stopping point, the base is allowed to drop and follow resorptive tissue changes.

Movement[99] of the denture allowed by the stress breakers may be in itself a factor in hastening resorption under the denture. To damage an alveolar ridge in order to ease the tipping strain on abutments would seem to be a rather high price to pay.

Most[99] of the complex clasps have come about as a result of dentists' accepting abutment teeth in their original form and thereby causing the technician to use extremely complex and ingenous clasp designs to seek out available undercuts with rigid elements of the clasp. Some of these clasps fail because they do not follow what we now consider basic principles; others fail because slight changes in denture position alter their critical contacts with the tooth so that they no longer function as designed and may place destructive pressures on abutment teeth. Others fail because fatigue of the metal necessitates adjustments by the dentist which are virtually impossible to make because of the extreme complexity of design. Such adjustments by the frustrated dentist often resulted in the clasp being overtightened and becoming a traumatic force on the abutment.

No[136] matter what the design of a clasp, if certain basic principles are not followed the forces originating in the occluding partial denture will be transmitted to the abutment tooth and dissipated in such directions that they cannot be readily absorbed without causing destruction of the supporting periodontal membrane and the supporting bone and eventually the loss of the tooth.

Natural teeth were not designed to hold partial dentures and many times they must be appreciably altered in order to make them suitable to accept a non-traumatic clasping. This is especially true of anterior teeth.

The vertical forces of occlusion constitute the greatest part of the total load placed on abutment teeth, if these vertical forces resulted in anything but vertical forces along the long axes of the abutment teeth, the destruction of the abutment is a probable result. We must realise that any partial denture abutment is at best overloaded, and slightly improper direction to some of this load may destroy the periodontium. Lateral[99][105] or torquing forces are of less magnitude but the periodontal membrane is less able to withstand such pressures.

The[105] fulcrum (point of rotation) of a tooth to tipping forces lies in the root of the tooth apical to the crest of its supporting bone. The length of the lever arm of an abutment tooth is that distance from the fulcrum to the point of application of a horizontal force on the tooth. The effective length of the lever arm of an abutment is reduced by placing the bracing and retentive components as far cervically on the crown of the tooth as possible. Recontouring of tooth surfaces to reduce the height of contour permits the location of rigid components in the most favourable position in relation to leverage factors.

Opposition must be provided for forces created by retentive arms when they flex over the height of contour of abutments. Reciprocation prevents undesirable tooth movements which may result in traumatogenic occlusion.

Clayton and Jaslow[120] using experimental conditions found that all the clasps designs exerted forces against an abutment tooth when the casting base was "at rest". The wrought wire retentive clasp design exerted greater force against the abutment tooth than the cast bar type retentive clasp design when the casting base was seated, at rest, and removed, and when the casting base was depressed, moved away from the ridge and moved buccally.

The "restless"[105] partial denture rarely has a place in a practice orientated to preventive dentistry. The ideal location of the rest seat overlies the greatest mass of the root(s) of the tooth and direct forces axially so as to utilise the maximum number of fibres of the periodontal ligament. In this manner the stress to the abutments is distributed to the greatest amount of supporting bone.

Anterior[99] teeth are commonly destroyed by partial dentures because they are subjected to destructive lateral forces due to the placing of an occlusal rest on the lingual surface of the tooth. The occlusal rest tends to slide down the rather steep lingual slope, pushing the tooth labially as it goes and

creating a self perpetuating situation of a moving tooth and a settling denture until the tooth is finally lost. Contrary[99] to some opinions, the bucco lingual width of the occlusal rest is not critical for its width does not determine its rigidity or the amount or direction of forces transmitted to the abutment tooth.

Guiding planes that exist or have been specially prepared to be parallel with the path of insertion of the removeable partial denture framework prevent unnecessary movement of teeth during placement and removal of the restoration. In a like manner, opposing parallel surfaces also provide resistance to placement of the restoration in any direction other than the path of insertion.

Removal of the restoration is accomplished by engaging some component of the denture on each side with the fingernails and unseating the restoration with equally applied force. The application of simultaneous inserting force on both sides will reduce tendencies for torque which could either overstress on abutment or overflex a retaining element of the restoration.

During replacement of the restoration opposing teeth should not be allowed to contact the denture before it has been fully seated by hand in the correct resting position in the mouth. The risk of the retainer distortion and soft tissue abuse contraindicate the often used method of "biting" the denture into place.

The[99] type of occlusion to be established has been a constant problem. The basic element of the problem has been whether to attempt to give maximum or minimum function to the

partial denture. Maximum function would relieve some of the strain from the remaining natural teeth other than the primary abutments and the supporting alveolar ridge. On the other hand, minimum function decreases the risk of damaging the primary abutments and residual ridge but leaves the remaining teeth overloaded. Regardless of the amount of occlusion to be established, any error in occlusion, either in centric or eccentric, is multiplied in its effect on the primary abutments depending on the distance of the prematurity from the fulcrum point. The risk of error increases as the number of occlusal contacts is increased.

The[(99)] occlusal pattern of the opposing teeth is a major error which could cause failure of the partial denture. The presence of plunger cusps, extruded and intruded teeth, tipped and rotated teeth will seal the fate of the residual ridge and the abutment teeth. The correction of these abnormalities must be considered as a part of the task of making the denture. If this cannot be done, the dentist should not accept the case because it can only fail.

Though "The World Workshop in Periodontics" 1966 stated, "The question may even be raised whether partial dentures do not cause more harm than good, and it suggests that partial dentures should only be made when the patient for esthetic or functional reasons cannot be without them" Bergman[(130)] et al. found from a longitudinal study over two years that a removeable partial denture per se will not cause periodontal and carious lesions. With a careful planning of the prosthetic treatment, and with an adequate oral and denture hygiene, checkup up at every clinical visit,

little, if any, damage will be caused to the remaining teeth.

PERIODONTAL PROBLEMS CAUSED BY PERIODONTAL THERAPY

(186)"It is a paradox that the phase of dentistry directly concerned with the maintenance and health of the supporting tissues may be involved as an etiologic agent of periodontal disease. This occurs when the periodontal procedures are improperly carried out."

Periodontal(186) abscesses may occur after an injudicious deep scaling, especially in the diabetic patient. Roughness(16) during instrumentation produces extensive tissue injury and postoperative discomfort and reduces healing. It may force infected material into the deeper periodontal tissues and lead to serious postoperative infection.

Bristle brushes and rubber cups have been known to cause injury to the periodontium. With the increasing use of a rubber polishing cup with Improved Zircate the number of cases of sloughing of the gingiva due to injudicious use of the cup is also increasing, especially if the gingiva was already inflamed.

The patient can traumatise the gingival tissue by the incorrect use of the toothbrush. In 1939 Hirschfeld(159) made a detailed report of the damage to teeth and periodontium by the incorrect use of toothbrushes and other instruments used in oral hygiene. He called attention to gingival recession, clefts, and hard, pink, prominent gingival festoons caused by chronic

irritation with the toothbrush as well as painful lacerations and superficial abrasions.

For[1] years a controversy has been raised regarding the value of massage in the treatment of gingivitis and periodontitis[125][126][128][134][142][143][150][152]. Increased keratinisation was reported in the studies of Robinson and Kitchin[150], Stahl et al.[152] and Sanjana[139]. However, Castenfeld[156] in a carefully controlled study reported that keratinisation does not occur as a result of increased toothbrushing.

The[16] risk of gingival injury from unsupervised massage is recognised. Yet[1], no-one has documented the value of increased keratinisation in the prevention or treatment of periodontal inflammation. The disease occurs in the gingival sulcus and the keratinisation occurs on the surface of the attached gingiva. No researcher seems to have attacked the problem of need of massage in the absence of gingival irritation nor documented damage by massage in the presence of gingival inflammation.

Chronic[21] injury from the overzealous use of dental floss is being seen today with increasing frequency. It is easier to injure the gingiva with the unwaxed material.

The[21] rubber tip is designed for interdental cleaning and stimulation. The need for stimulation has never been determined and injury often results from the use of rubber tips. It is the most injurious instrument because the gingival papillae are easily crushed with it.

For[21] a while after periodontal surgery the marginal and papillary gingiva are composed of immature tissue. Rapid and severe destruction of the periodontium can be caused by the traumatic use of brushes and interproximal "stimulators" during this period of tissue immaturity. This frequently repeated severe injury causes greater damage and much more rapid destruction than complete neglect of oral hygiene. Compulsive patients who are determined to practice perfect oral hygiene and "massage their gums" after periodontal surgery sometimes create a more destructive process than the disease itself.

Due respect should be given to Hirschfeld's[159] statement that all of the instruments used for oral hygiene can cause injury when they are improperly used.

A[102] successful periodontal result attests to the careful analysis of all etiologic factors, the skillful execution of therapy and the maintenance of this result by the patient through assiduous oral physiotherapy techniques. When any of these steps are compromised, a less than favourable response to therapy may be expected. In addition, there are often negative influences which are unmanageable or unknown. Kirsch and Ward[102] have listed the factors contributing to failure in periodontal therapy.

Kramer[160] listed the importance of ten steps in periodontal therapy before committing the patient to periodontal surgery, which cannot be overstated.

Rather than discuss the drawbacks and failures of each individual technique utilised in periodontal surgical therapy such as gingivectomy, Gingivoplasty, Gingival Curettage, Mucogingival Surgery, Osseous Surgery, Theraputic Procedures Involving Occlusion and Splinting, the lack of a philosophy of periodontal treatment will be discussed.

Waerhaug[112] stated, "The dilemma of periodontology in 1970 arises from the lack of a generally accepted philosophy on which gingival surgery can be safely based, and there is no agreement regarding the goal." Over the years innumerable surgical techniques have been described and advocated; apparently long before their advantages and disadvantages have been established and before their efficacy has been compared with other methods.

He[112] further stated "Many clinicians seem obsessed by a desire to cut the gingiva without considering what beneficial effect the cutting may have for the patient. In addition, physicians and dentists, like women, are fashion minded. If one leading periodontist has started to use a certain technique, everybody must use the same method. Thus, for the purpose of increasing the width of the attached gingiva, it may be the highest fashion one year to expose the alveolar bone or periosteum by throwing away the mucosa that covered it; the next year mucosa may be transplanted, for the same purpose, from a distant site as free gingival grafts. Some periodontists reposition the flaps

apically, whereas others push them coronally. One year bony defects are eliminated by ostectomy; the next year they are eliminated by one type or another of bone graft. The development of surgical methods has been influenced by coincidence more than by organised clinical trial, and these methods reflect technical exhibitionism, rather than biological insight. A skeptic may be allowed to inquire, "Is it because of the treatment, or in spite of it," when discussing the remarkable capacity for healing that the periodontal tissues exhibit, when exposed to uninhibited experimentation of surgical methods.

Waerhaug[112] also presented the following questions: "Over the last decades, has the scientific evidence collected on the etiology and pathogenesis of periodontal disease been properly considered, when the goal of the surgery and the basic principles of the techniques were outlined? Has it been a leading underthought that the main purpose of the operation is to contribute to the elimination of the etiological factors and to their control in the future? The answer is no."

Cohen[42] stated, "A clinician occasionally reports that after examination of a patient and documentation of the situation, the patient, for some reason fails to return for treatment. On his reappearance possibly seven or maybe ten years later, without having received any therapy in the interval, re-examination of the patient's oral condition reveals no clinical or radiographic increase in the state of the periodontal disease. There is immediate need

for fundamental studies to determine whether these isolated case reports are the exception or the rule. Until such data are available on the sequence of events in periodontal breakdown, it must be kept in mind that the clinical studies that will be described, as well designed as they were, are not adequate for measuring the true effectiveness of theraputic methods in periodontics. Moreover, several observations in these investigations emphasise the possible cyclic phenomenon of periodontal pathology."

It was noted at the 1966 World Workshop[1] that there is no statistical verification to determine whether pocket elimination is necessary for increased tooth longevity. And increased tooth longevity is the ultimate rationale behind the use of these various surgical techniques. However, there is currently no scientific proof that this goal is accomplished by routine periodontal care.

Several concepts of occlusion such as centric relation occlusion[16], functional occlusion[187], balanced occlusion[191] cuspid guided occlusion[12], group function[192], hinge axis[93] occlusion and functionally generated occlusion[203] exist. Glickman[204] stated, "Such terms represent man-made, technical guidelines for correcting and reconstructing the occlusion rather than physiologic occlusal relationships of the functioning natural dentition. There is more information regarding techniques for adjusting the occlusion than there is about how the natural dentition functions. Most methods of occlusal adjustment are exercises in

technical precision with minimal biologic relevance. We have been able to develop systematic techniques for occlusal adjustment, insist that they are correct and advocate slavish adherence to their every detail. We have not been able to substantiate them on a physiologic and theraputic basis."

He[204] further stated that intra oral telemetry has raised many serious doubts about the validity of many popularly held opinions regarding occlusion.

Ramfjord and Ash[148], and Pritchard[21] outlined the dangers of occlusal adjustment. There is no denying the fact that occlusal adjustment does have a role in periodontal therapy, but each case should be evaluated and treated on its own merits and not by a blind application of mechanical principles, but in order to reduce forces applied to teeth and to direct them vertically so that they can be effectively resisted without damage to the attachment apparatus.

There are a number of articles discussing the indications for splinting based upon the clinical impression of the authors[20][75][81][82]. However[1], no research has documented when a splint should be used, when a splint should not be used, the relative efficiency of different types of splints or even if a splint is of benefit.

The time has come for an honest evaluation of why a particular treatment plan has been designed, rather than which treatment plan should be used.

There[8][10][154] has been a widespread acceptance of the importance of good oral hygiene in the prevention of periodontal disease. This has led to quite a few articles in the literature dealing with the failures in motivation of dental home care by the profession[17][35]. Possibly because there are no definite results to be shown by dentist to the patient for the time he spends in giving oral hygiene instructions, the dentists are not themselves motivated to try and motivate the patient. There is a drawback from the patient's side too. Because periodontal disease causes little or no discomfort in the early stages, the patient does not feel the necessity to try and maintain a clean oral cavity free of plaque. Because human behaviour is so difficult to change perhaps a better solution ot the problem of plaque control would be to find a way to negate its deleterious effect on the periodontium.

A re-evaluation of the treatment method on a proven scientific basis is urgently needed. Waerhaug[112] stated, "I have felt it a duty to speak out on behalf of the patients who are going to have such surgery. They are justified in expecting not to be treated like experimental animals; it is their right to expect that before a certain surgical method is used on them, there should be acceptable evidence that the operation is likely to solve their problem". It is time to heed his plea.

SUMMARY AND CONCLUSIONS

Bohannon[108] et al. stated, "Errors of omission (indicated dental procedures which were not performed) or errors of commission (dental procedures improperly performed) play far too great a role in the development of periodontal disease." An attempt has been made to substantiate this statement by describing the periodontal problems caused by different types of dental procedures, or by the lack of performance of appropriate dental procedures.

Every aspect of treatment, starting from diagnosis of both intra oral and systemic factors which aggravate periodontal disease, radiographic interpretation, and treatment procedures in oral surgery, orthodontics, pedodontics, operative dentistry, crown and bridge work, removable partial dentures and ending up with periodontics have been described.

The objective of this thesis is not to decry the excellent work that is being done by the dental profession, but to bring about an awareness that periodontal problems can be caused by dental treatment. It is upon the integrity of the periodontium that the survival of a tooth in the mouth depends and it would be ironical if whilst restoring the coronal portion of a tooth, unknowingly the support to the tooth is destroyed leading ultimately to the loss of the restored tooth.

People seem ever willing to discuss their successful accomplishments but try and hide their failures. But it is the failure that makes a more lasting impression and without failure success can never be achieved.

In recent years, there seems to be a great many articles in the literature on the periodontal problems caused by dental treatment, yet textbooks on conservative and restorative dentistry give no more than a passing mention to this topic. If teachers do not emphasise the importance of handling the periodontal tissues with great care, the student is led to believe that maintaining the integrity of the periodontal tissues is unimportant. It is these same students who later on become dentists and carry on making the same mistakes throughout their years of service.

It is unfortunate that the vast majority within the profession regard dental caries as the only dental disease. This is easily seen when one sees that the periodontal probe is never found on an examination tray. It is time to shift the focus from a "caries orientated training" to a "periodontal orientated training".

A realisation must occur that periodontal disease is not a disease of the middle aged as previously thought, but that it occurs among children and young adults as recent studies have found.

A closer integration of the speciality of orthodontics and pedodontics would prevent the occurance of malocclusions which may lead to periodontal problems in later life.

If greater emphasis was placed on teaching the phenomenon of growth during the undergraduate training and as Kauffmann[22] suggested, pedodontics be abolished as a speciality, the general

practitioner who is the one who usually sees young patients, would then be in a position to prevent malocclusions from occuring. This would be the application of the concept of preventive dentistry in its truest sense.

With the introduction of water fluoridation and other preventive measures, old concepts should be re-evaluated. Alexander, and Lorato[58][59] have questioned the existence of "caries immune areas" and the need for extension for prevention". The practical application of this is that there is no scientific basis for extending cavity preparations into the gingival sulcus or placing crown margins in these areas, where the restorations or crowns act as irritants and facilitate the deposition of plaque.

With the new concepts of dental teams and utilisation of auxiliaries, the dentist must maintain the position as the head of the team. There is no justification for delegation of tasks which the dentist should perform to the auxiliaries. The design of a removable partial denture cannot be left to the dental technician.

Waerhaug[112] stated, "The dilemma of periodontology in 1970 arises from lack of a generally accepted philosophy on which gingival surgery can be safely based, and there is no agreement regarding the goal". Many clinicians seem obsessed by a desire to cut the gingiva without considering what beneficial effect the cutting may have for the patient. In addition, physicians and dentists, like women, are fashion-minded. If one leading periodontist has started to use a certain technique, everybody must use the same method". This may sound severe, but the basis of Waerhaug's

argument appears to be very sound. It would be preferable to question the benefit of a particular technique of periodontal surgery rather than to carry out the technique and hope to achieve success.

Much[17][109] has been written about the dentist's failure to motivate the patient to maintain good oral hygiene. If one notices the poor response to the medical profession's warnings on the hazards of smoking and obesity, one may justifiably form the opinion that it is a profession's duty to inform patients about either the hazards of smoking or obesity or the need to maintain good oral hygiene. To motivate people is very difficult. How many dentists are obese and smoke heavily? Yet these same dentists expect to try and motivate people to maintain a clean mouth, in a situation where oral hygiene is much less damaging to overall health than is smoking or obesity.

It is hoped that this thesis has brought about an awareness of the periodontal problems than can be caused by dental treatment. In the words of Erichson, "There is little that cannot be remedied later, there is much that can be prevented from happening at all.".

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