AN EVALUATION OF THE PERIODONTAL STATUS FOLLOWING ODONTECTOMY OF IMPACTED MANDIBULAR THIRD MOLARS - A COMPARISON OF TWO FLAP DESIGNS

by

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ABSTRACT

A study involving thirty (30) patients, with similar bilateral impacted mandibular third molars, and an intact gingival attachment on the distal surface of the mandibular second molar, and with healthy and/or adequately restored mandibular second molars, were chosen to evaluate the effects of mandibular third molar surgery on the periodontium; the effects of flap design used for the access to the impacted mandibular third molar on the periodontium; and the association between mandibular third molar surgery and the maintenance of the oral hygiene on the distal of the adjacent second molar.

On the basis of the data accrued, it would seem that when dealing with a healthy periodontium, regardless of the flap design used, whether the attached gingiva is incised or left intact on the distal surface and buccal surface of the mandibular second molar, statistically significant apical migration of the gingival attachment occurs. However, the sulcular depth is not affected either by the third molar surgery or the flap design used. No correlation between the maintenance of the oral hygiene on the distal of the mandibular second molar and the surgical removal of the adjacent impacted third molar could be demonstrated.

RESUMÉ

Une étude sur trente (30) patients, dont les troisièmes molaires inférieures étaient incluses bilatéralement de façon similaire, dont l'attachement gingival était intact au distal des deuxièmes molaires inférieures et dont les deuxièmes molaires inférieures étaient saines et/ou adéquatement restaurées, ont été choisis pour évaluer les effets de la chirurgie au niveau des troisièmes molaires inférieures incluses sur le périodonte des deuxièmes molaires adjacentes; les effets de la configuration du lambeau utilisé pour accéder à la troisième molaire incluse sur le périodonte de la deuxième molaire adjacente; et l'association entre la chirurgie sur les troisièmes molaires incluses et le maintien de l'hygiene buccale au distal des deuxièmes molaires adjacentes.

Les résultats de l'étude ont démontré qu'une migration apicale de l'attachement gingival apparaît lorsque le tissus péridentaires sont sains, quelle que soit la configuration du lambeau utilisé, que la gencive soit incisée ou laissée intacte au distal des deuxièmes molaires inférieures. Cependant, la profondeur sulculaire n'est pas affectée par la chirurgie de la troisième molaire, ni par la configuration du lambeau utilisé. Aucune association entre la maintien de l'hygiène buccale au distal de la deuxième molaire inférieure et la chirurgie de la troisième molaire incluse adjacente n'a pu être démontrée.

INTRODUCTION

Periodontally, the impacted mandibular third molar has presented, in certain circumstances, a perplexing problem.

Certain investigations have shown that the mere presence of the impacted tooth encourages the development of periodontal disease distal to the second molar, and yet have also demonstrated that the removal of the impacted tooth contributes to the development of periodontal disease of the second molar[2,7,12,18].

What then are the factors which influence the periodontal health in this region following the removal of the impacted mandibular third molar?

Only a few studies have been conducted to evaluate the influences of flap design on the final post-operative periodontal status. The effects of the location of vertical incisions[8], and gingivectomy distal to the second mandibular molar[17], have been investigated. Lateral trepanation versus envelope flap[6], and vertical flap with distal wedge versus envelope flap with distal wedge[13] have been compared in clinical investigations. From the results of these studies, flap design may be a factor in determining the final periodontal status. Preservation of an intact band of attached gingiva around the mandibular second molar may be advantageous periodontally[6,8].

The purpose of this study is to investigate the influence of flap design on the periodontal status of the mandibular second molar, comparing the effects of an envelope flap design which involves an incision of the attached gingiva around the mandibular second molar, and a flap design with a vertical releasing incision, leaving a band of attached gingiva intact around the mandibular second molar. Neither flap design will involve a gingivectomy on the distal of the second molar. Sulcular depth and gingival attachment level will be measured at specific locations and at specific time intervals pre-operatively and post-operatively to evaluate the effects of flap design on the periodontium of the mandibular second molar following third molar surgery. Gingival and plaque indices will be recorded as potential variants that can affect the final periodontal status and will be used to determine if mandibular impaction surgery facilitates the maintenance of oral hygiene on the distal of the mandibular second molar.

REVIEW OF LITERATURE

I. Effects of the Presence of Impacted Third Molar and Third Molar Surgery on the Periodontium.

In 1941, Robb[12] commented on the periodontal problems associated with the presence of impacted third molars. He observed that if bone loss occurs on the distal of the second molar as a result of an adjacent impacted third molar, that this bone rarely, if ever, fills in completely after the extraction of the third molar; the result being a pocket or recession of the gingiva on the distal of the second molar.

In 1962, Ash, Costich and Hayward[2] recognized the lack of investigation relating to periodontal complications following the removal of third molars. A study was done involving two hundred and twenty-five (225) mandibular and maxillary third molars with the adjacent second molar being present. It was attempted to determine the effect of third molar extractions on the periodontium distal to the second molar; the periodontal indications and contra-indications for extraction, and the possible means of minimizing periodontal complications following the extraction of third molars. The periodontium surrounding the second molar teeth was evaluated for the presence or absence of gingivitis, the depth of the gingival crevice

on the distal, disto-buccal and disto-lingual areas, and the height of the alveolar crest in the distal region. This evaluation was carried out immediately pre-operatively, immediately post-operatively, at two (2) weeks post-operatively, six (6) months post-operatively and one (1) year post-operatively. The authors concluded that: "the presence and/or extraction of completely and partially covered third molars results in a high incidence of periodontal pocket formation on the distal of second molars", and suggested that: "All impacted or potentially impacted third molars should be extracted as early as possible to prevent the high incidence of loss of supporting structure on the distal of second molars".

In 1975, Ziegler[18] examined two hundred and fifty-five (255) mandibular second molars with an adjacent erupted, partially-erupted or impacted third molar. He recorded the pocket depth, the distance from the cemento-enamel junction to the gingival sulcus base, and the height of interdental bone on radiographs immediately prior to the removal and one (1) year after the removal of the third molar. His results showed that: "In adults, the presence and/or extraction of impacted and partially erupted third molars results in a high incidence of pockets on the distal of second molars." He suggested that: "All impacted or potentially impacted third molars should be extracted as early as possible to prevent subsequent periodontal

pockets. If the third molars are allowed to remain until they approximate the distal of the second molar and/or partially erupt, periodontal defects should be expected."

In 1963, Szmyd and Hester[15] studied the effects of third molar impaction surgery on the crevicular depth of the adjacent mandibular second molar, and the influence of high-speed bur technique versus mallet and chisel technique on the post-operative crevicular depth. Seventy-five (75) cases of mandibular third molar impactions were selected. Forty (40) were removed using the high-speed bur technique and thirty-five (35) using the mallet and chisel. An envelope flap with a gingivectomy of the tissues overlying the impaction was used for every case. The crevicular depth was measured at the mid-buccal, disto-buccal, mid-distal, disto-lingual and mid-lingual positions of the mandibular second molars. The measurements were recorded immediately pre-operatively, and at six (6) and twelve (12) months post-operatively. The authors concluded that: "crevicular depth of the mandibular second molar was significantly reduced after removal of the adjacent third molar impaction." In addition, they concluded that the surgical method used to remove the impaction was not a factor in the change in the crevicular depth of the second molar.

In 1973, Gröndahl and Lekholm[7] studied the changes occurring in the

periodontal structures distal to the mandibular second molar in the presence of an impacted or semi-impacted third molar, and twelve (12) months after the removal of the third molar. They also compared the level of the supporting bone as well as the clinical state of the periodontium distal to the mandibular second molar in patients presenting with third molars and in those patients with congenitally absent third molars. They examined thirty-three (33) patients with impacted or semi-impacted third molars and eleven (11) patients with congenitally absent third molars. They recorded the amount of dental plaque, and gingivitis and also measured the sulcular depth at the disto-buccal, distal and disto-lingual line angles of the second molars. They observed a reduction in the sulcular depth on the distal of the second molars, that they explained was due to a reduction of the inflammatory oedema, indicating that the hygiene distal to the second molar can be improved by the extraction of the adjacent semi-impacted or impacted third molar. Considering also that gain in bone height was not observed post-operatively in their study, they advised the removal of impacted and semi-impacted third molars without undue delay.

II. Flap Designs.

Many flap designs to gain access to mandibular third molars have been described in the past and recent literature. In 1965, Costish[5] reviewed the principles of flap design and stated the following:

1. make the incision at right angles to the surface,
2. have a broad base for adequate blood supply,
3. be sure the incision is supported by bone,
4. always avoid an acute angle at the corner of the flap.

Costich[5] also suggested the removal of a wedge of tissue on the distal of the mandibular second molar in order to decrease the gingival crevice.

The vertical flap and the envelope flap are the two (2) main flap designs discussed in the literature to gain access to the impacted mandibular third molars. Many variations of these two (2) flaps have been suggested by different authors.

In 1932, Thoma[16] described a vertical flap where: "the incision should be made along the post-molar triangle, starting well up on the ramus and keeping nearer the lingual side than the buccal. It should terminate 2mm behind the second molar. From this point it is extended over the alveolar ridge and down on the buccal side" (Illustration I).

In 1959, Kruger[10] described a variation of this flap, where the horizontal incision is brought in contact with the distal surface of the disto-buccal cusp of the mandibular second molar (Illustration II).

In 1979, Kaminishi et al[9] described what they called "the classical vertical flap" where the incision is begun near the disto-lingual aspect of the mandibular molar and is extended approximately 1½cm distally to the second molar just lingual to the external oblique ridge. This incision is then extended buccally around the neck of the second molar to the interdental space between the first and second molars. From this point the vertical component is extended downward at 45° approximately 1 to 2 cm towards the mucobuccal fold (illustration III).

The envelope flap was described by Kruger[10], in 1959, as a variation of the vertical flap, where rather than extend the second arm of the incision vertically from the disto-lingual cusp of the second molar, it was extended anteriorly around the neck of the second molar and first molar, allowing the elevation of a large flap buccally (Illustration IV).

In 1971, Szmyd[14] described a variation of both flap designs, where he included a gingivectomy of tissue overlying the third molar impaction.

In 1970, Bhaskar[4] studied forty-eight (48) specimens of split and full thickness repositioned mucogingival flaps in four (4) miniature swine which were sacrificed five (5), ten (10) and eighteen (18) days after surgery. He showed that the split thickness and full thickness flaps heal equally well, and that in the repositioned flap, a full thickness reflection of mucoperiosteum is biologically as sound as a split thickness flap. However, for prompt and uneventful healing, flaps should be well approximated to their tissue bed and bone should not be left partially or completely exposed, since in areas where the flaps become dislodged from bone, severe acute inflammation, bone necrosis, sequestration, root resorption and bone resorption of the crestal, periosteal and periodontal surfaces occurred.

III. The Effects of Flap Design on the Periodontium.

In 1970, Grooves and Moore[8] investigated the influence of flap design on the periodontal condition of the second molar after removal of the adjacent third molar. Fifty-nine (59) cases of impacted mandibular third molars were examined at one (1) day pre-operatively and three (3) months after the removal of the third molars. The sulcular depth, and gingival inflammation were recorded. Three (3) flap designs were used, the main variation being in the location of the vertical incision (Illustration V). Their results suggested that the removal of the mandibular third molar does not necessarily increase the amount of pocketing distal to the mandibular second molar. They found that it was advantageous to maintain intact the attached gingiva on the distal of the second molar. Their study suggests that flap design may influence the final periodontal state of the mandibular second molar.

In 1977, Stephens[13] evaluated the effects on the periodontium of two (2) mucoperiosteal flap designs used for access in removing impacted mandibular third molars. Fifteen (15) patients with bilaterally impacted mandibular third molars were included in his study. In each patient, one of the impactions was approached using an envelope flap, and the other approached using a vertical releasing incision to the mucogingival line. Both flaps involved the excision of a distal wedge (Illustrations VI and VII).

The level of attached gingiva, the level of the free gingival margin and the width of the masticatory mucosa were measured immediately prior to surgery, at two (2) weeks, six (6) weeks and twelve (12) weeks after surgery. The investigator found no significant clinical difference between the two (2) types of flaps employed. He concluded that: "the decision to use one or the other of these flaps should be based on operator preference rather than on the assumption of improvement of the periodontal health status of the adjacent second molars." In this study, the surgery was performed by four (4) different operators allowing for variability in technique, and a small group of fifteen (15) patients was used.

In 1978, Woolf et al[17] studied the periodontal implication of two (2) flap designs. Twenty-four (24) mesio-angular impacted mandibular third molars, in twelve (12) patients were chosen. In each patient, one of the impactions was approached using an envelope flap, and the other approached using an envelope flap with a wedge of tissue removed on the distal of the second molar. The investigators found no difference in the results obtained between the two (2) flap designs at six (6) months post-operatively. With respect to the periodontal pocket depth, both flap designs tended to decrease the periodontal pocket depth.

In 1981, Finne and Klamfeldt[6] compared two (2) surgical approaches used for the removal of lower third molar tooth germs. In the first group a

conventional incision, consisting of an incision started at the midpoint of the distal surface of the second mandibular molar and extending distally and buccally to the external oblique ridge, was used. The mesial incision was started at the same point and was extended towards the mucobuccal fold at 45° to the gingival line (Illustration II). The lateral trepanation technique was employed in the second group. The soft tissue procedure consisted of a 25mm long incision made in the mucobuccal fold from the anterior border of the ascending ramus to the mesial root of the first mandibular molar (Illustration VIII). In this technique the attached gingiva surrounding the second mandibular molar was left undisturbed. Nineteen (19) patients were included in this study and both incisons were used in every patient. Two (2) months after the removal of the mandibular third molar tooth germs, the sulcular depth on the distal of the second molar was measured. The investigators found that on the side where the flap design had disturbed the attached gingiva on the distal and buccal surfaces of the second molar, there was an increase in periodontal pocket depth and an increase in the amount of unattached gingiva.

A review of the literature indicates that only a few studies have been published concerning the periodontal status of the mandibular second molar in the presence of or after the surgical removal of impacted mandibular third molar. The published results are also contradictory.

On the one hand, there were three studies demonstrating that the presence or the surgical removal of impacted mandibular third molar can lead to periodontal problems. Robb[12], from his clinical observations, recognized the periodontal hazards associated with the presence or surgical removal of mandibular third molars. Ash et al[2], and Ziegler[18] from their clinical research observed that periodontal pocketing on the distal of the mandibular second molar was more frequent when periodontal problems existed pre-operatively or periodontal damage had occurred on the distal of the second molar as a result of the presence of an erupted, partially erupted or impacted third molar. From those observations, they suggested the early surgical removal of impacted teeth before periodontal damage occurred on the distal of the second molar.

On the other hand, Smyd et al[15] and Gröndahl et al[7] observed a reduction in sulcular depth around the mandibular second molar after surgical removal of the adjacent impacted third molar. Smyd and Hester[15] used a gingivectomy type flap for the surgival removal of all their impacted third molars. They questioned the effectiveness of an gingivectomy type flap design on the crevicular depth in impaction surgery and suggested a comparative study to determine the effects of a gingivectomy type flap versus a non-gingivectomy type flap on the crevicular depth. Gröndahl and Lekholm[7] attributed the reduction in sulcular depth that they

observed to a reduction in the gingival inflammatory oedema, since their results showed a decrease of the plaque and gingival indices. They concluded that the hygiene distal to the second molar can be improved by the removal of the adjacent semi-impacted or impacted third molar.

Flap designs and their effects on periodontal status have been the subject of only a few studies. Grooves et al[7] and Finne et al[6] demonstrated that it was of advantage periodontally to maintain the attached gingiva intact around the mandibular second molar, suggesting that flap designs may influence the final periodontal status of the mandibular second molar. Stephens[13] found no clinical difference between a vertical and envelope flap design both involving the incision of attached gingiva around the mandibular second molar and the exision of a distal wedge. In his study, the surgery was performed by four (4) different operators allowing for variability in technique.

Woolf et al[17] studied the periodontal implications of including a gingivectomy on the distal of the second molar when an envelope type of flap design was used. He did not find any difference in the results obtained between the two (2) flap designs. Both types of flaps tended to decrease the periodontal pocket depth. His study involved a small group of twelve (12) patients, which were free of major periodontal defect pre-operatively.

METHODOLOGY

Thirty (30) patients, seven (7) males and twenty-three (23) females, between the ages of sixteen (16) and thirty (30) years old (mean: 21.4), who required the surgical removal of their mandibular third molars were selected from the Oral and Maxillofacial Surgery Clinic of the Montreal General Hospital.

The patients were selected according to the following criteria:

1. the patients were healthy, and had taken no medication for one (1) week prior to surgery;
2. an intact gingival attachment was present upon periodontal probing on the distal surface of the mandibular second molar;
3. the position of the left and right impacted mandibular third molars in relation to the adjacent second molar was as similar as possible. The anticipated degree of surgical difficulty would be essentially the same for both sides;
4. the mandibular second molars were free of disease and/or adequately restored.

At the initial visit, the patients were required to answer a short medical questionnaire (Appendix I) and were submitted to head and neck, and intraoral examinations (Appendix II). Panoramic radiographs were obtained. All selected patients were required to sign a consent form indicating their willingness to participate in the study (Appendix III).

An alginate*[1] impression of the mandibular dentition was obtained of each patient, at the initial visit. The impression was poured immediately in cocal stone*[2]. The cast was separated after one (1) hour and was allowed to set for at least twenty-four (24) hours before trimming. A cold cure acrylic*[3] stent covering the occlusal surface of all the mandibular teeth was then fabricated (Illustration X).

The acrylic was allowed to set completely on the cast. Once set it was separated and trimmed. Care was taken to develop a flat surface over the second molar so that it could be used as a horizontal reference plane (Illustration XI). Using a #700 taper fissure bur, grooves were then placed at the mid-buccal, mid-distal, and mid-lingual points, and mesio-lingual, disto-lingual, disto-buccal and mesio-buccal line angles of the mandibular second molar (Illustration XII). The grooves were used as reference points for standardization of the measurements of sulcular depth and gingival attachment.

The following measurements were obtained immediately pre-operatively and at four (4) weeks, eight (8) weeks, and twelve (12) weeks post-operatively:

1. sulcular depth,
2. level of gingival attachment from the upper surface of the custom made acrylic stent,

3. gingival index according to Loe's criteria[11] (Appendix IV)

4. plaque index according to Loe's criteria[11] (Appendix V)

All measurements were obtained by the same clinician, a certified periodontist, who was unaware of the type of incision used on either side. All measurements were made using a Hu-Friedy periodontal probe. The probe was modified to include a ten (10) millimeters and a twelve (12) millimeter reference mark. Measurements were recorded on the data recording form (Appendix VI).

All surgical procedures were performed by the same operator. Sedation was used for patients who because of anxiety and apprehension required its use. Secobarbital*[4] 100 mg with diazepam*[5] 10 mg were given orally, one (1) hour prior to the procedure, to three (3) patients. Meperidine*[6] in a range of 25 to 50 mg and Phenergan*[7] in a range of 25 to 50 mg were used intravenously in a drip of Dextrose 5% in Water*[8], in eight (8) patients. The intravenous drugs were titrated until the desired level of sedation was achieved.

Local anaesthesia was achieved through routine inferior alveolar, lingual and long buccal nerve blocks[3]. Mepivacaine 2% with neocobefrine 1:20,000*[9] was used, in an amount of about 1.8cc for the inferior alveolar and lingual nerve blocks and of 0.5cc for the long buccal nerve block. Post-operative pain was controlled with Ibuprofen 400 mg*[10],

taken orally every four (4) hours as needed. Post-operative antibiotics, Penicillin 300 mg*[11] taken orally every six (6) hours for seven (7) days, were given to eight (8) patients, because of the extent and duration of surgery required.

Surgical access to the impacted mandibular third molars was obtained on one side using an envelope flap so described by Kruger[8], except that the incision was stopped at the mesio-buccal line angle of the mandibular second molar (Illustration IX). On the contralateral side the surgical access was obtained using a vertical flap desigr as described by Thoma[16] (Illustration I). With this flap design, a 2mm band of attached gingiva was maintained intact on the distal of the second molar. After elevation of the buccal mucoperiosteal flap, bone removal and tooth sectioning was achieved using a high-speed surgical bur with copious irrigation, when indicated. After curettage of the follicular sac and careful irrigation, the incision was closed using 4.0 plain gut interrupted sutures. All patients received the same post-operative instructions (Appendix VIII) and were examined one (1) week post-operatively by the surgeon to ensure proper surgical healing.

The patient sample was randomly divided into two (2) groups. Patients were alternatively placed into Group A, even numbers, and Group B, odd numbers. In Group A, the envelope flap design was employed on the left

side, and the vertical flap design on the right side. In group B, the envelope flap design was employed on the right side and the vertical flap design on the left side. This random division of the patients was done in order to avoid any technical preference on the part of the surgeon to use one flap design on one side rather than on the other. The periodontist recording the measurements was unaware of the grouping of the patients until completion of the study.

*[1]Super-gel - Type II, Harry J. Bosworth Company, Skokie, Illinois
*[2]Cires Dentaires ABC, Montreal Quebec
*[3]Perm: The Hygenic Corporation, Akron, Ohio
*[4]Seconal, Eli Lilly Canada Inc., Scarborough, Ontario, Canada
*[5]Valium, Hoffman-La Roche Limited, Vaudreuil, Quebec, Canada
*[6]Pethidine, Abbott, Montreal, Canada
*[7]Promethasine, Sabex International Ltd., Montreal, Canada
*[8]Abbott, Montreal, Canada
*[9]Carbocaine, Winthrop Laboratories, Aurora, Ontario, Canada
*[10]Motrin, The Upjohn Company of Canada, Don Mills, Ontario
*[11]Pen-Vee, Wyeth Ltd., Downsview, Ontario, Canada

RESULTS

Tables I and II contain the mean and the standard error of the gingival attachment level recorded at the seven (7) measurement locations for the four (4) different time intervals, for both the envelope flap design and the vertical flap design.

Tables III and IV contain the mean and standard error of the sulcular depth recorded at the seven (7) measurement locations for the four (4) different time intervals, for both the envelope flap design and the vertical flap design.

Paired "t" tests at the 0.01 level of significance, with twenty-nine (29) degrees of freedom, were done to evaluate the effects of surgical removal of impacted mandibular third molar on the gingival attachment level and the sulcular depth for each flap design. Table V contains the significance level of paired "t" tests done to compare the mean gingival attachment level scores obtained immediately pre-operatively and twelve (12) weeks post-operatively, for all seven measurement locations and for each flap design. Significant levels of paired "t" tests were obtained at point A (disto-buccal) and point F (disto-lingual) for the envelope flap, and at point A (disto-buccal) and point G (mid-distal) for the vertical flap. Analysis of the data presented in Table V, indicates that the maximum mean apical migration, at any point of measurement and using either flap design, was 1.4mm.

Table VI contains the significance level of paired "t" tests done to compare the mean sulcular depth scores obtained immediately pre-operatively and twelve (12) weeks post-operatively, for all seven (7) measurement locations and for each flap design. No significant level of the paired "t" tests was obtained.

Paired "t" tests at the 0.01 level of significance, with twenty-nine (29) degrees of freedom, were done to evaluate the effects of flap design on the gingival attachment level and the sulcular depth. Table VII contains the significance level of paired "t" tests done to analyse the effects of flap design on the gingival attachment level, at all seven (7) measurement locations at four (4) weeks, eight (8) weeks, and twelve (12) weeks post-operatively. No significant level of paired "t" tests was obtained. Table VIII contains the significance level of paired "t" tests done to analyze the effects of flap design on the sulcular depth at all seven (7) measurement locations at four (4) weeks, eight (8) weeks and twelve (12) weeks post-operatively. No significant level of paired "t" tests was obtained.

Chi-squared (x^2) test, at the 0.05 level of significance for a critical value of 3.85, with one (1) degree of freedom, was done to evaluate the association existing between the oral hygiene maintenance on the distal surface of the second mandibular molar prior and twelve (12) weeks after

the surgical removal of the adjacent impacted third molar for both types of flap design. Table IX contains the significance level of the x^2 test done to analyse the association between the plaque index level obtained on the distal surface of the mandibular second molar, immediately prior and twelve (12) weeks after the surgical removal of the adjacent impacted mandibular third molar for both envelope flap design and vertical flap design. No significant level of the x^2 tests was obtained. Table X contains the significance level of the x^2 test done to analyse the association between the gingival index level obtained on the distal surface of the mandibular second molar, immediately prior and twelve (12) weeks after the surgical removal of the adjacent impacted mandibular third molar for both envelope flap design and vertical flap design. No significant level of the x^2 test was obtained.

DISCUSSION

Subjective clinical evaluation of the healing of the two flap designs compared in this study revealed that complications were more frequent on the side where the vertical flap was employed. Four (4) post-operative infections occurred, all four (4) infections occurring on the vertical flap side. All occurred approximately one (1) week post-operatively and were successfully treated with antibiotherapy except for one that required the surgical removal of a bony spicule. One (1) patient suffered from a dry socket, which occurred on the side where the envelope flap was employed.

The results of Table V indicate that regardless of the flap design used, apical migration of the gingival attachment occurred on the distal surface of mandibular second molar twelve (12) weeks after the surgical removal of the adjacent impacted third molar. When the envelope flap was used, which involved incising the attached gingiva on the distal and buccal surfaces of the mandibular second molar, gingival attachment loss was most significant at the disto-buccal and disto-lingual locations. When the vertical flap design was used, which left a 2mm. band of attached gingiva undisturbed around the mandibular second molar, gingival attachment loss was most significant at the disto-buccal and mid-distal locations. The results of the paired "t" test comparing the mean gingival attachment level scores of the envelope flap designs

with the mean gingival attachment level scores of the vertical flap design (Table VII) show no significant difference existing between the two flap designs at four (4) weeks, eight (8) weeks, and twelve (12) weeks post-operatively.

The results of Table VI indicate, that regardless of the flap design used, sulcular depth was not significantly increased or decreased in any location around the mandibular second molar, twelve (12) weeks after the surgical removal of the adjacent impacted third molar. The results of the paired "t" test comparing the mean sulcular depth scores of the envelope flap with the mean sulcular depth scores of the vertical flap (Table VIII) show no significant difference existing between the two (2) flap designs at four (4) weeks, eight (8) weeks and twelve (12) weeks post-operatively.

No significant level of the chi-squares test (x^2) was obtained, regardless of the flap design, for both plaque index (Table IX) and gingival index (Table X). Those results indicate that no association existed in this study between the maintenance of the oral hygiene on the distal of the mandibular second molar and the surgical removal of the adjacent impacted third molar.

SUMMARY AND CONCLUSIONS

Thirty (30) healthy patients, with similar bilateral impacted mandibular third molars, and an intact gingival attachment on the distal surface of the mandibular second molar, and with healthy and/or adequately restored mandibular second molars, were chosen to evaluate the effects of mandibular third molar surgery on the periodontium; the effects of flap design used for the access to the impacted mandibular third molar on the periodontium; and the association between mandibular third molar surgery and the maintenance of the oral hygiene on the distal of the adjacent second molar. The conclusions are summarized as follow:

1. Whether the attached gingiva on the distal surface and buccal surface of the mandibular second molar is incised or maintained intact, and regardless of the flap design used when dealing with a healthy periodontium, statistically significant apical migration of the gingival attachment was observed on the distal of the mandibular second molar at twelve (12) weeks post-operatively. However, no significant difference in the gingival attachment level was demonstrated when the two flap designs were compared.

2. Sulcular depth was not affected either by the third molar surgery or by the flap design employed.

3. The data obtained in this study indicate that at twelve (12) weeks post-operatively there is no correlation between the maintenance of the oral hygiene on the distal of the mandibular second molar and the surgical removal of the adjacent impacted third molar, when the mandibular third molar is covered with soft tissue and the gingival attachment is intact on the distal of the second molar.

TABLE I

The Mean Score (Standard Error) for the Gingival Attachment Level in Millimeters - Envelope Flap

	Baseline	4 weeks	8 weeks	12 weeks
A	7.1 (0.17)	9.6 (0.38)	9.1 (0.33)	8.5 (0.23)
B	8.0 (0.19)	8.8 (0.28)	8.8 (0.31)	8.4 (0.21)
C	8.0 (0.19)	8.4 (0.23)	8.3 (0.21)	8.3 (0.18)
D	7.6 (0.16)	7.9 (0.19)	7.9 (0.16)	8.0 (0.18)
E	7.4 (0.19)	7.5 (0.20)	7.8 (0.18)	7.8 (0.19)
F	7.0 (0.16)	7.7 (0.20)	7.7 (0.16)	7.6 (0.13)
G	6.9 (0.15)	8.4 (0.35)	7.9 (0.20)	7.8 (0.27)

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE II

The Mean Score (Standard Error) for the Gingival Attachment Level in Millimeters - Vertical Flap

	Baseline	4 weeks	8 weeks	12 weeks
A	6.8 (0.22)	8.6 (0.28)	8.3 (0.27)	8.1 (0.25)
B	8.0 (0.23)	8.8 (0.23)	8.6 (0.24)	8.5 (0.21)
C	8.3 (0.22)	8.4 (0.21)	8.4 (0.20)	8.5 (0.18)
D	7.7 (0.17)	7.7 (0.14)	8.0 (0.19)	7.8 (0.18)
E	7.6 (0.16)	7.6 (0.17)	7.8 (0.15)	7.8 (0.15)
F	7.3 (0.17)	7.8 (0.17)	7.8 (0.20)	7.7 (0.15)
G	7.1 (0.17)	8.0 (0.20)	7.9 (0.20)	7.8 (0.18)

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE III

The Mean Score (Standard Error) for the Sulcular Depth in Millimeters - Envelope Flap

	Baseline	4 weeks	8 weeks	12 weeks
A	3.3 (0.22)	4.4 (0.37)	3.7 (0.26)	3.7 (0.22)
B	2.4 (0.05)	2.7 (0.11)	2.8 (0.23)	2.5 (0.06)
C	2.5 (0.06)	2.5 (0.03)	2.5 (0)	2.5 (0.06)
D	2.8 (0.11)	2.9 (0.12)	3.0 (0.10)	2.8 (0.10)
E	2.6 (0.07)	2.6 (0.06)	2.6 (0.05)	2.6 (0.05)
F	3.2 (0.10)	3.1 (0.12)	3.1 (0.12)	3.0 (0.10)
G	3.8 (0.12)	4.0 (0.20)	3.9 (0.16)	4.2 (0.21)

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE IV

The Mean Score (Standard Error) for the Sulcular Depth in Millimeters - Vertical Flap

	Baseline	4 weeks	8 weeks	12 weeks
A	3.5 (0.18)	3.5 (0.23)	3.3 (0.15)	3.4 (0.17)
B	2.5 (0.07)	2.5 (0.07)	2.5 (0.05)	2.5 (0.03)
C	2.5 (0.08)	2.5 (0.06)	2.6 (0.05)	2.5 (0.03)
D	2.9 (0.14)	2.8 (0.10)	2.8 (0.11)	2.9 (0.10)
E	2.6 (0.09)	2.6 (0.07)	2.7 (0.07)	2.6 (0.08)
F	3.3 (0.13)	2.9 (0.11)	2.9 (0.11)	3.0 (0.10)
G	3.8 (0.14)	3.9 (0.15)	3.7 (0.15)	3.9 (0.15)

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE V

Paired "t" Tests Comparing Pre-operative Gingival Attachment Level (Baseline) to the Gingival Attachment Level at Twelve Weeks Post-operatively

	Mean Gingival Attachment Level Scores		Significance Level of Paired "t" Tests (29 Degrees of Freedom)
	Baseline	Twelve Weeks	
Envelope Flap			
A	7.1	8.5	$p<0.01$
B	8.0	8.4	NS
C	8.0	8.3	NS
D	7.6	8.0	NS
E	7.4	7.8	NS
F	7.0	7.6	$p<0.01$
G	6.9	7.8	NS
Vertical Flap			
A	6.8	8.1	$p<0.01$
B	8.0	8.5	NS
C	8.3	8.5	NS
D	7.7	7.8	NS
E	7.6	7.8	NS
F	7.3	7.7	NS
G	7.1	7.8	$p<0.01$

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE VI

Paired "t" Tests Comparing Pre-operative Sulcular Depth (Baseline) to the Probing Depth at Twelve Weeks Post-operatively

	Mean Sulcular Depth Scores		Significance Level of Paired "t" Tests (29 Degrees of Freedom)
	Baseline	Twelve Weeks	
Envelope Flap			
A	3.3	3.7	NS
B	2.4	2.5	NS
C	2.5	2.5	NS
D	2.8	2.8	NS
E	2.6	2.6	NS
F	3.2	3.0	NS
G	3.8	4.2	NS
Vertical Flap			
A	3.5	3.4	NS
B	2.5	2.5	NS
C	2.5	2.5	NS
D	2.9	2.9	NS
E	2.6	2.6	NS
F	3.3	3.0	NS
G	3.8	3.9	NS

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE VII

Paired "t" Tests Comparing the Gingival Attachment Level Between the Envelope Flap and Vertical Flap

	Mean Gingival Attachment Level Scores		Significance Level of Paired "t" Tests (29 Degrees of Freedom)
	Envelope Flap	Vertical Flap	
A - 4 weeks	9.6	8.6	NS
8 weeks	9.1	8.3	NS
12 weeks	8.5	8.1	NS
B - 4 weeks	8.8	8.8	NS
8 weeks	8.8	8.6	NS
12 weeks	8.4	8.5	NS
C - 4 weeks	8.4	8.4	NS
8 weeks	8.3	8.4	NS
12 weeks	8.3	8.5	NS
D - 4 weeks	7.9	7.7	NS
8 weeks	7.9	8.0	NS
12 weeks	8.0	7.8	NS
E - 4 weeks	7.5	7.6	NS
8 weeks	7.8	7.8	NS
12 weeks	7.8	7.8	NS
F - 4 weeks	7.7	7.8	NS
8 weeks	7.7	7.8	NS
12 weeks	7.6	7.7	NS
G 4 weeks	8.4	8.0	NS
8 weeks	7.9	7.9	NS
12 weeks	7.8	7.8	NS

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
F: Disto-lingual
G: Mid-distal

TABLE VIII

Paired "t" Tests Comparing the Sulcular Depth Between the Envelope Flap and Vertical Flap

	Mean Sulcular Depth Scores		Significance Level of Paired "t" Tests (29 Degrees of Freedom)
	Envelope Flap	Vertical Flap	
A - 4 weeks	4.4	3.5	NS
8 weeks	3.7	3.3	NS
12 weeks	3.7	3.4	NS
B - 4 weeks	2.7	2.5	NS
8 weeks	2.8	2.5	NS
12 weeks	2.5	2.5	NS
C - 4 weeks	2.5	2.5	NS
8 weeks	2.5	2.6	NS
12 weeks	2.5	2.5	NS
D - 4 weeks	2.9	2.8	NS
8 weeks	3.0	2.8	NS
12 weeks	2.8	2.9	NS
E - 4 weeks	2.6	2.6	NS
8 weeks	2.6	2.7	NS
12 weeks	2.6	2.6	NS
F - 4 weeks	3.1	2.9	NS
8 weeks	3.1	2.9	NS
12 weeks	3.0	3.0	NS
G - 4 weeks	4.0	3.9	NS
8 weeks	3.9	3.7	NS
12 weeks	4.2	3.9	NS

A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D: Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

TABLE IX

2x2 Contingency Tables Analyzed with x^2 Test Plaque Index (P.I.) on the Distal Surface of the Mandibular Second Molars

ENVELOPE FLAP

12 weeks

Baseline	P.I. 0,1	P.I. 2,3	Row Totals
P.I. 0,1	22	4	26
P.I. 2,3	4	0	4
Column Totals	26	4	30

x^2 - 0.710, One Degree of Freedom, N.S.

VERTICAL FLAP

12 weeks

Baseline	P.I. 0,1	P.I. 2,3	Row Totals
P.I. 0,1	23	5	28
P.I. 2,3	2	0	2
Column Totals	25	5	30

x^2 - 0.429, One Degree of Freedom, N.S.

TABLE X

2x2 Contingency Tables Analyzed with x^2 Test

Gingival Index (G.I.) on the Distal

Surface of the Mandibular Second Molars

ENVELOPE FLAP

12 weeks

Baseline	G.I. 0,1	G.I. 2,3	Row Totals
G.I. 0,1	1	5	6
G.I. 2,3	6	18	24
Column Totals	7	24	30

x^2 - 0.186, One Degree of Freedom, N.S.

VERTICAL FLAP

12 weeks

Baseline	G.I. 0,1	G.I. 2,3	Row Totals
G.I. 0,1	7	9	16
G.I. 2,3	5	9	14
Column Totals	12	18	30

x^2 - 0.201, One Degree of Freedom, N.S.

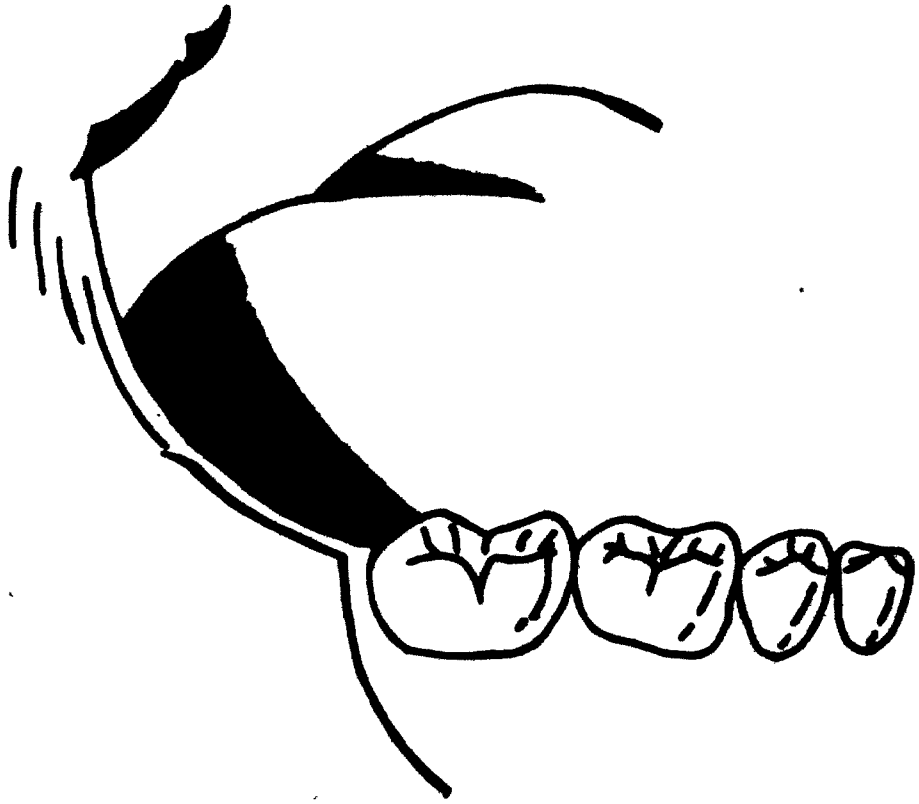


Illustration I.

Vertical flap design described by Thoma[16], in 1932, and employed in this study.

Illustration II.

Variation of Thoma's vertical flap design, described by Kruger[10] in 1959, and used by Finne and Klamfeldt[6] in their clinical investigation.

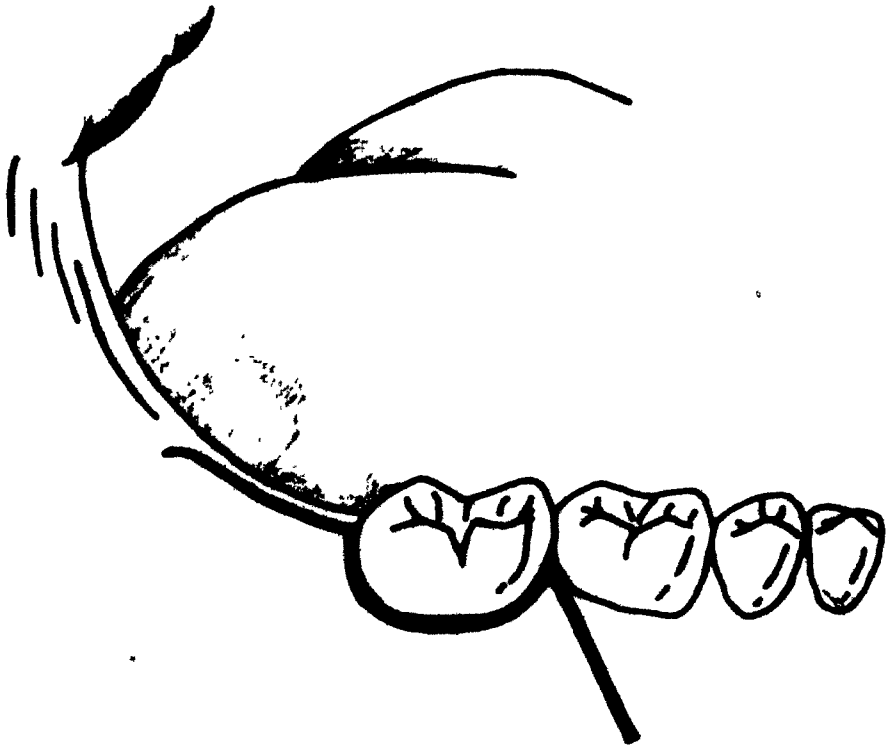


Illustration III.

"The classical vertical flap" described by Kaminishi et al[9].

Illustration IV.

Envelope flap design described by Kruger[10] as a variation of the vertical flap design.

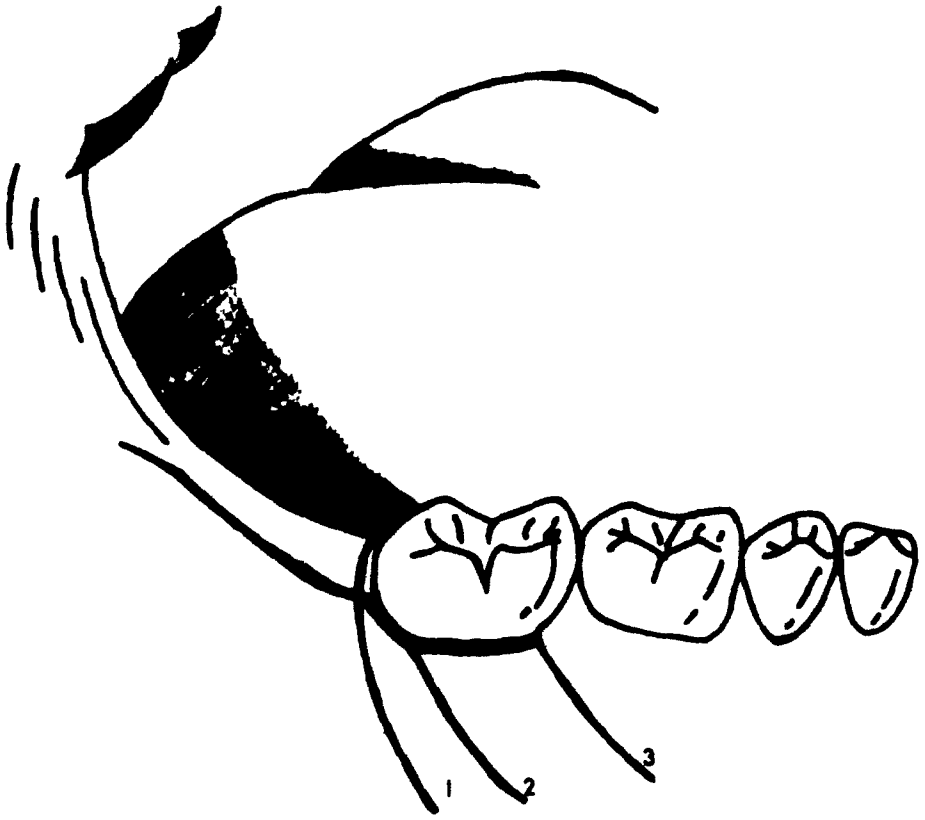


Illustration V.

The three vertical flap designs used by Grooves and Moore[8] in their clinical investigation on the influence of flap design on the periodontium of the mandibular second molar after the removal of the adjacent impacted third molar.

Illustration VI.

The envelope flap design with the excision of a distal wedge used by Stephens[13] in his comparative study.

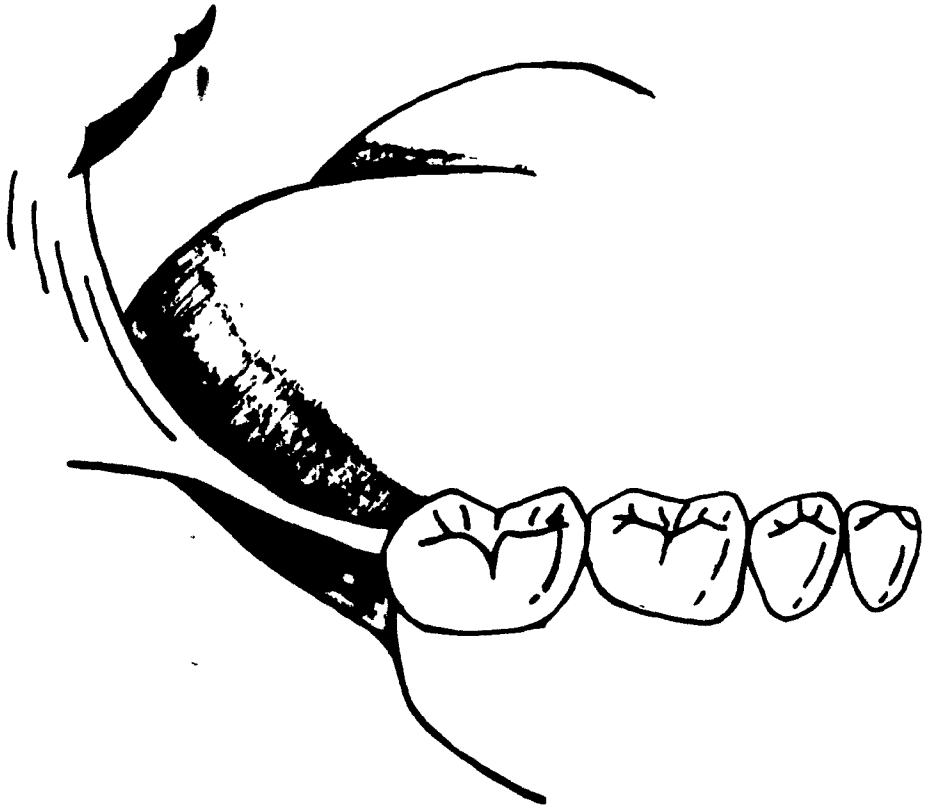


Illustration VII.

The vertical flap design with the excision of a distal wedge used by Stephens[13] in his comparative study.

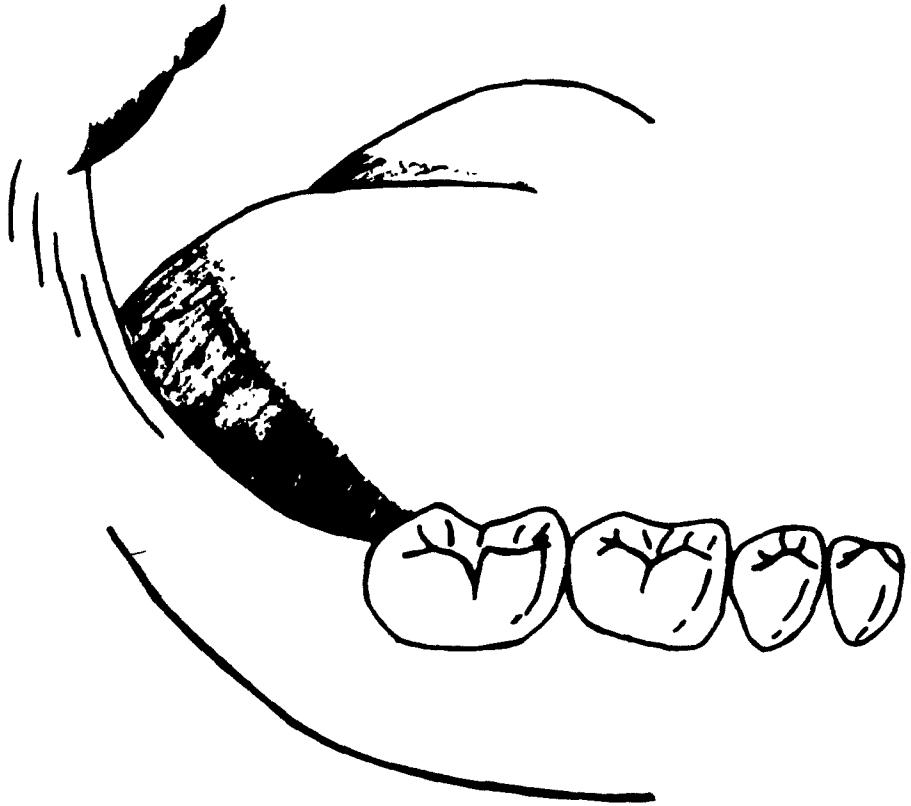


Illustration VIII.

Lateral trepenation technique used by Finne and Klamfeldt[6] in their clinical investigation.

Illustration IX.

Modification of the envelope flap design described by Kruger[8] used in this study. The incision is stopped at the mesio-buccal line angle of the mandibular second molar.

Illustration X.

The cold cure acrylic stent covering the occlusal surface of all mandibular teeth.

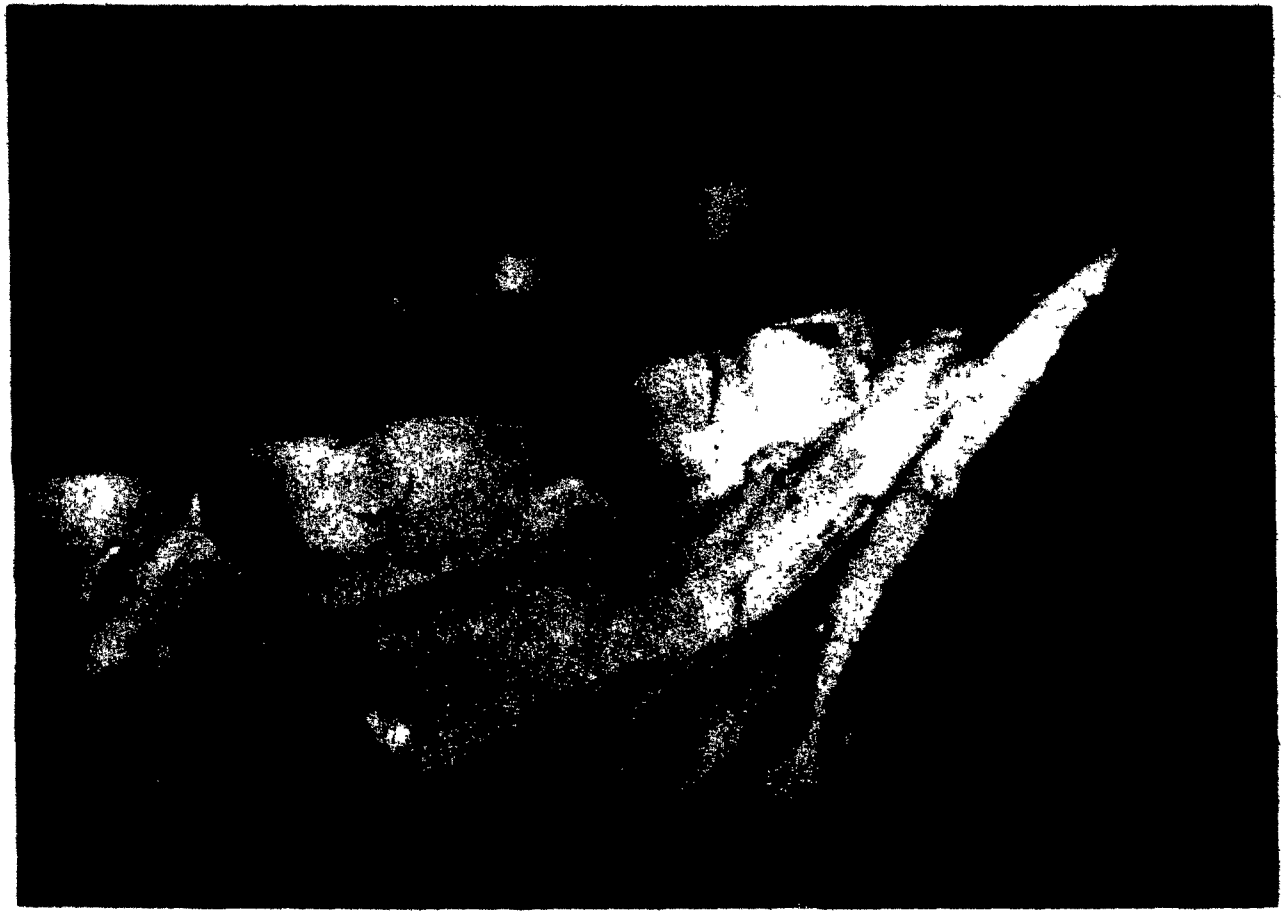


Illustration XI.

The flat surface developed over the second molar and used as a horizontal reference plane.

Illustration XII.

The grooves placed at the mid-buccal, mid-distal and mid-lingual points, and mesio-lingual, disto-lingual, disto-buccal, and mesio-buccal line angles of the second mandibular molar and used as reference points for standardization of the measurements of sulcular depth and gingival attachment.

APPENDIX I

Department of Dentistry - Emergency Room Form

Name:_____ Chart No.:_____

Date: Day____/Month_____/Year____ Time:_____ Hours

Chief complaint:_____

_____

_____

H.P.I.:_____

_____

_____

_____

Functional Enquiry:

1. Have you ever been hospitalized?	Yes	No
2. Have you ever had rheumatic fever?	Yes	No
3. Have you ever had any serious illness?	Yes	No
4. Do you have any bleeding problems?	Yes	No
5. Are you allergic to any medication?	Yes	No
6. Have you ever taken cortisone or other steroids?	Yes	No
7. Are you presently under a physician's care?	Yes	No
8. Are you taking any medication at present?	Yes	No
9. (If applicable) Are you pregnant?	Yes	No

If any of the above are answered yes, elaborate further.

_____

_____

_____

_____

_____

_____

APPENDIX II

Department of Dentistry - Division of Oral Surgery

Examination Form

Name: _____ Chart No.: _____

Date: Day____/Month____/Year____ Time:_____Hours

Vital Signs: Pulse _____/min. Temp: _____ Resp: _____min B.P. ___/

Extraoral Findings: _____

_____

_____

Intraoral Findings:

Vestibular and buccal mucosa: _____

_____

Palate: _____

_____

Floor of mouth: _____

_____

Pharynx: _____

_____

Salivary glands: _____

_____

Gingiva: _____

_____

Other: _____

_____

Radiographic Examination: _____

_____

Diagnostic Impression: _____

_____

Management: _____

_____

_____

APPENDIX III

CONSENT FORM FOR THIRD MOLAR PROJECT

NAME: _____

ADDRESS: _____

_____

PHONE: _____

I authorize Dr. Denis Gosselin to perform the surgical removal of my mandibular third molars. Using two accepted surgical procedures.

I understand that the intervention will be done free of charge as long as I fulfill the requirements of the study, that is, that I agree to return for a periodontal examination at four (4) weeks, eight (8) weeks and twelve (12) weeks post-operatively.

PATIENT SIGNATURE: _____

DATE: _____

WITNESS: _____

DATE: _____

APPENDIX IV

Criteria for the Gingival Index System[11]

0 - Normal gingiva

1 - Mild inflammation - slight change in color, slight oedema. No bleeding on probing.

2 - Moderate inflammation - redness, oedema, and glazing. Bleeding on probing.

3 - Severe inflammation - marked redness and oedema. Ulceration. Tendency to spontaneous bleeding.

APPENDIX V

Criteria for the Plaque Index System[11]

0 - No plaque in the gingival area

1 - A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may only be recognized by running a probe across the tooth surface.

2 - Moderate accumulation of soft deposits within the gingival pocket on the gingival margin and/or adjacent tooth surface, which can be seen by the naked eye.

3 - Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.

APPENDIX VI

THIRD MOLAR PROJECT

Examination: _____ Side (R or L) _____ Patient Name: _____

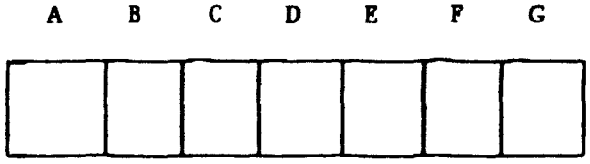
0 - baseline Age: _____

1 - 4 weeks Sex: _____

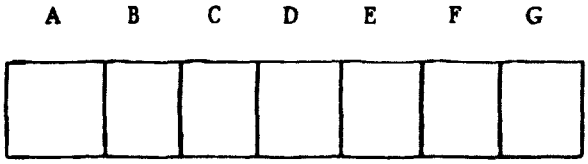
2 - 8 weeks

3 - 12 weeks

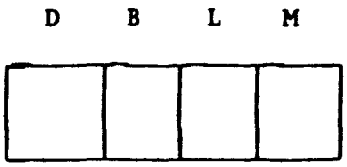
Gingival attachment level



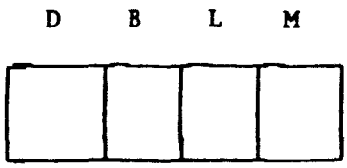
Probing depth



Plaque Index



Gingival Index



A: Disto-buccal
B: Mid-buccal
C: Mesio-buccal
D; Mesio-lingual
E: Mid-lingual
F: Disto-lingual
G: Mid-distal

D: Distal surface
B: Buccal surface
L: Lingual surface
M: Mesial surface

APPENDIX VII

POST-EXTRACTION ADVICE

The removal of a tooth is a surgical operation. Appropriate post-operative care is therefore necessary.

1. RINSING
   No rinsing, or mouth wash during the first twelve hour period following extraction is permitted.

2. AVOID touching the wound with your fingers; you might infect it.

3. HAEMORRHAGE
   Should excessive bleeding occur, remain calm and rest, preferably in a seated position. Excitement can only be injurious and may even increase the bleeding.

   Place a moistened teabag over the wound and close the teeth tightly enough to produce steady, gentle pressure for about 15 minutes. Repeat two or three times if necessary.

   If bleeding persists, consult the clinic. It may be necessary to take means to check the haemorrhage.

4. SMOKING
   No smoking is permitted during the first twelve hour period. Smoking may cause bleeding to occur.

5. PAIN
   A certain amount of discomfort for a few hours should be expected. One or two pills usually controls most pain. Repeat, if necessary, as prescribed.

   Persistent pain may indicate the presence of complications. The same applies if the pain should arise a few days after the extraction. Contact the Clinic additional treatments may be necessary.

6. SWELLING
   Swelling frequently occurs after extractions and should not cause anxiety. Ice should be applied for the first 12 hours only. (15 minutes on, 15 minutes off). Do not apply any ice after the first twelve hours.

7. DIET
   Liquid of soft foods (soup, milk, porridge, mashed potatoes, custard, eggs, etc.) are preferable during the first 24 hours which follow an extraction.

8. DAY AFTER SURGERY
   On the day following surgery, if swelling is present, heat (hot water bottle heating pad, hot compresses) may be applied.

   The mouth may also be rinsed with warm salt water (one teaspoonful of salt to a tumbler of water, four times a day).

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