

Periodontics 1975: a review – plaque and the dento-gingival environment

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PLAQUE REMOVAL AND INHIBITION

"Is there a mouthwash or toothpaste that removes this plaque and calculus?" asks the patient undergoing periodontal treatment, particularly one who has not succeeded in removing plaque with a toothbrush and dental floss. In reviewing the literature on this subject it was found that scientists and clinical researchers are making a determined effort to understand plaque, while at the same time testing various anti-microbial agents. In a clinical evaluation of a quaternary ammonium-containing mouthrinse, Ciancio, Mather and Bunnell (1975), found that the test rinse produced a statistically significant reduction in dental plaque when compared with a *placebo* rinse. On the other hand an iodine mouthwash was found to be ineffective in the control of plaque, either with or without brushing and flossing. Iodine applied topically, however, and combined with tooth brushing and flossing was more effective in plaque control than brushing and flossing alone. Three aqueous mouth rinse solutions of benzethonium chloride, zinc chloride and benzethonium chloride combined with zinc chloride were compared for their plaque and gingivitis inhibiting capabilities. According to Compton and Beagrie (1975), the benzethonium chloride solution inhibited up to 42,9 per cent less plaque than the others.

The study of the role of plaque as an etiological factor in gingival and periodontal disease has taken two main courses. In one, induced experimental gingivitis was achieved, by means of withdrawing oral hygiene procedures. This form of study was carried out on young (20-24 years) and elderly (65-78 years) groups of patients (Holm-Pedersen, Agerback and Theilade, 1975). The development of gingival inflammation was more severe in the elderly group during the oral hygiene abstinence period. There was however no difference in the rate of healing of the inflamed gingivae following resumption of oral hygiene in the two groups, but the gingival exudate remained slightly higher in the elderly group, indicating a slightly slower recovery of the tissues.

The host response to micro-organisms was also considered in this study. It was hypothesised that alterations in the immune response to dental plaque an-

tigens with ageing, may offer an explanation for the observation that the development of gingivitis is more rapid and severe in elderly persons. The difference in nature of the gingival exudate before and after periodontal surgery may also reflect the metabolism of the collagen content of the gingival tissue (Hara and Takahashi, 1975).

A further study of induced gingivitis was carried out amongst dental students by Spolsky *et al* (1975), using an alexidine mouthwash. This was a double-blind, cross-over study, permitting all subjects to use two mouthwashes. Each subject was given a thorough prophylaxis on day 0, after which they refrained from routine oral hygiene for two weeks. During the two-week period their regime was twice daily rinses for one minute, after breakfast and before retiring, with 15 ml of either the treatment, or *placebo* mouthwash. The cross over was achieved 3 weeks after the initial two-week trial, when the *placebo* and treatment groups were reversed. The results of the study showed that alexidine mouthwash was effective in decreasing plaque scores and plaque weight, but did not clinically decrease gingivitis scores.

There was however a decrease in the number of micro-organisms. Fornell, Sundin and Lindhe (1975), using a proprietary mouthwash, found a reduction in both plaque and gingival index scores. No reduction in plaque accumulation was found by Robinson *et al* (1975) using a proteolytic enzyme mouthwash in their study on 131 young adults. A suggestion made by Fishman *et al* (1975), was that the evaluation of therapeutic agents such as chlorhexidine and zinc mouthwashes, should be carried out in a brushing population. They found very small differences between the groups who only used one or other of the mouthwashes and that found on the control group who only brushed.

Plaque control measures were removed from 7 subjects to induce gingivitis; biopsies were taken from the buccal marginal gingiva of the first premolars on 0, 2, 4 and 8 days. At 2 and 4 days following plaque accumulation, alterations were seen in the perivascular collagen, and an increase in the neutrophils in the junctional epithelium. By the eighth day an early lesion had formed. This was described by Payne *et al* (1975), and once again emphasised the need for early plaque removal.

The other main path that plaque removal had taken was in the surgical situation and during wound healing. The response to root planing and oral hygiene was assessed both histologically and clinically by Tagge, O'Leary, and El-Kafrawy (1975). For each patient three clinically similar, buccal or lingual suprabony pockets were selected, one of which was designated as a control and biopsied. This then was accepted as a pretreatment microscopic condition for the other two pockets selected for the study. The second pocket tooth was root planed to a smooth hard surface. The third pocket was not instrumented, but treated only by the patients' daily oral hygiene. Fifty-six to 63 days later the treated areas were evaluated clinically and histologically. Both types of therapy reduced the mean pocket depth and the incidence and severity of the gingivitis. The root planing technique combined with oral hygiene measures showed a statistically greater improvement than the oral hygiene alone.

Two important points in plaque removal were found by Hamp, Nyman and Lindhe (1975) in their study on periodontal treatment of multirouted teeth. After a period of 5 years, they showed that periodontal surgical treatment could prevent continued tissue breakdown in teeth with furcation involvement, if there were

- 1) total elimination of plaque retention areas and
- 2) meticulous patient oral hygiene in conjunction with regular scaling and polishing of the teeth.

Lindhe and Nyman (1975) undertook a five-year study on the effect of plaque control and surgical pocket elimination. The patients were selected because of their ability to maintain plaque-free dentitions. Gingivectomy and the modified Widman techniques were the main surgical procedures used. All the procedures were designed to give the maximum access for plaque control, even furcation involvements. This was a thorough and well controlled study that demonstrated that it is possible, by detailed plaque control programs to treat periodontal disease even in advanced cases and prevent a deterioration over a five year period. The authors compared their findings to that of Lovdal *et al* (1961), Theilade *et al* (1966) and Ramfjord *et al* (1973), and concluded that the difference between their findings and that of Ramfjord *et al*, who found a deterioration after three years, resulted from the efficiency in plaque control by their patients. In a study of maxillary molar root amputation, Klaven (1975) found one failure out of 24 teeth, the reason for this being food impaction. Again, at a surgical level, but still with the emphasis on plaque elimination, Zamet (1975), compared three periodontal surgical techniques; curettage, replaced flap and apically repositioned flap. The three procedures reduced pocket depth, with the apically repositioned flap procedure being the most successful. The post-operative plaque indices varied, in that the no-treatment and curettage groups demonstrated rises. Emphasis was placed on findings that good healing was related to a high standard of oral hygiene.

A test group of patients received professional cleaning every three weeks after periodontal surgery, while the control group once every six months. The control patients were unable to maintain a high standard of oral hygiene and it was said that their treatment failed, while the test groups were maintained at a high standard with

a resultant successful outcome to the treatment over a period of two years (Nyman, Rosling and Lindhe, 1975).

FORMATION OF PLAQUE

The early formation of plaque in human subjects increased with time. Large numbers of cocci and micro-colonies were observed after 120-240 minutes. In addition to this the number of leukocytes and epithelial cells also increased (Ronstrom, Attstrom and Engelberg 1975). Microbial plaque lying in close proximity to gingival tissue is said to be an important etiological factor in initiating gingival inflammation. An examination of viable micro-organisms of the gram negative type were found to increase significantly with increasing gingival index scores. Helderman (1975) found that total counts of these organisms were nine times higher in moderately inflamed than non-inflamed gingival crevices. Listgarten, Mayo and Tremblay (1975) studied the internal structure of plaque. They confirmed that early plaque contains primarily coccal forms, then predominantly filamentous forms after 3 weeks. The sub-gingival, more mature plaque contains many motile forms, while spirochetes have a preference for the external surface of the subgingival plaque and are in close contact to the gingival tissue of a deepened sulcus. In view of their high concentration in this situation they may play an important role in the etiology of periodontal disease. Gram-negative and gram-positive organisms with associated filamentous forms were found adjacent to the gingival margin in children aged 8-15 years. These observations by Newman (1975), are related to stagnant conditions produced by soft foods which allow the accumulation of plaque in sites predisposing to disease. One should however ask the question: "Where was the gingival margin in relation to the contour of the crown and the cemento-enamel junction in these 8-15 year old children, and is the position of the gingival margin as possible predisposing factor to the accumulation of plaque in young people and therefore a predisposing factor to disease?"

THE ROOT SURFACE

The dento-gingival complex as an environmental factor in periodontal disease has taken its correct place in periodontal therapy.

Controversy, however, still exists on the degree of root preparation and instrumentation required in periodontal treatment. The removal of calculus and plaque from a root surface is essential for primary healing of the gingivae and in reattachment procedures. Kerry (1975) writes that the biological significance of a smooth cemental surface has not been precisely defined. Calculus and plaque can form on any root surface no matter how smooth it feels clinically. Her study on a new method for viewing root surfaces, does not at this time help the clinician, as it refers mainly to a sophisticated scanning electron microscopic technique. The colour illustrations obtained of root surfaces after instrumentation are vivid, but disconcerting as one is still not sure which instrument to use for root planing. Alco, De Renzis and Farber (1975) also believe that there is controversy regarding the removal of dead cementum from a root surface in order to achieve reattachment of soft tissue. They extrapolate from their

data of an *in vivo* situation that clinical success depends upon complete removal of toxic material from diseased cementum, or the removal of the cementum itself.

Woodruff, Levin and Brady (1975) compared the effect of two ultrasonic instruments on root surfaces, by means of the scanning electron microscope. They found that both instruments removed plaque material, but that there was a residual smearing of some of the collagenous fibrils. Stahl (1975) posed the following question: "How do we best treat the root surface for potentiating reattachment?" After reviewing the literature he confronts the reader with five further questions. Examples of these are: "Should root planing of the exposed root portion aim at removal of cementum or merely at accretion removal?" "Does frequent root planing performed during maintenance therapy have any effect on subsequent reattachment potential?" "Should acellular cementum and attached fibrils be removed?" At this time there does not seem to be an answer to the questions posed. Experience of the past has leaned towards the removal of debris and the creation of a smooth surface. In this direction, Saglio, Johansen and Tollefsen (1975), have shown that gingival epithelial-like cells have grown on glass slides and compared these to epithelial remnants on extracted teeth. This does not answer the question of a "diseased root" and the possible inhibitory influence this may have on the reattachment of soft tissue or the regeneration of cementum and bone. Morris (1975) attempted to investigate whether the inhibitory influence was in the organic or inorganic parts of the dentine and cementum. It would appear that the inhibitory influence shown by periodontally diseased root residues is in the organic component. The results however are not very clear.

Papers by Waerhaug (1975), Saglie, Johansen and Tollefsen (1975) and Saglie, Johansen and Flotra (1975), deal in depth with the nature of roots in periodontally involved mouths. Immediate post-extraction examination of these roots revealed "imprints" (Waerhaug) of periodontitis by means of a staining technique. Utilising a stereomicroscope the other two studies revealed plaque-free zones on extracted periodontally involved teeth and the nature of periodontal fibres in pathological pockets respectively. One would hope that these techniques would lead to information on reattachment of connective tissue and the morphology of cementum.

TOOTHPASTES, GELS AND DRESSINGS

A further consideration in the removal of plaque is the domestic usage of toothpastes. Two papers appeared on this subject. The first was concerned about the effect of toothpaste on the mucous membranes. Four well known dentifrices were tested on human palatal tissue, and only one of these, "Crest", was found to be comparable to the test sites. Allen *et al* (1975), found that the other three pastes produced erythematous changes on the tissues. The other study was concerned about the abrasive nature of "cosmetic" toothpastes, designed to remove stains. Volpe *et al* (1975) tested the dentifrices over a period of 54 months with no adverse reactions on the soft tissues, but with similar patterns of cervical abrasion.

A newer advent to the periodontal scene was a chlorhexidine gel used as a toothpaste. In a double-blind cross-over study, Hansen, Gjermo and Eriksen (1975) found that the chlorhexidine-containing gel seemed to have no effect on gingivitis, and only a slight inhibitory effect on plaque formation. Chlorhexidine gluconate was added to a dentifrice by Johansen, Gjermo and Eriksen (1975), who reported that no differences were found in the periodontal and gingival indices between the active and *placebo* dentifrices. Similar results were found by Kaslick, Shapiro and Chasens (1975) using a urea peroxide gel. Chlorhexidine was also tested in periodontal dressings by Plüss, Engelberger and Rateitschak (1975). A periodontal pack was coated with a chlorhexidine dihydrochloride powder and allowed to remain on the surgical site for 4 days, with the result that significantly less plaque formed under the dressing than with the control packs. Chlorhexidine was added to a methacrylic gel by Addy and Douglas (1975) whose concern was on the ability of the dressing to carry the pharmacological agent. They found that *in vitro* and *in vivo* studies demonstrated effective release of the chlorhexidine from the dressing throughout the time that it was in place.

The antibacterial effects of periodontal dressings were considered by O'Neil (1975), who suggested that the susceptibility of periodontal patients to bacterial plaque necessitated a pack to protect the surgical site until such time as the patient was capable of maintaining the area, and that it was the physical rather than the antibacterial properties that protected the surgical wound.

THE PERIODONTAL ENVIRONMENT

When one considers plaque and its inflammatory potential, the environment adjacent to the periodontal tissues must also be of concern. For example the roughness of restorations, or the type of material used, whether the restoration is placed supra- or subgingivally is significant to the amount of direct irritation, or the accumulation of plaque. Waerhaug (1975) examined extracted teeth with restorations placed below the gingival margin. He maintains that rough surfaces and or inadequate marginal adaptation are likely to facilitate a more rapid adherence of bacteria to the restorations than to a smooth tooth surface. Gold foil restorations were placed below the gingival sulcus in Beagle dogs by Frank, Brion and De Rouffignac (1975) and chronic inflammatory changes were seen within 3 weeks in the adjacent epithelium and connective tissue of the gingiva. No inflammation was found in the junctional epithelium and connective tissue after burnished gold strips were similarly placed. They noted that the different responses were probably the result of the presence or absence of dental plaque and probably the surface difference of the gold restorations. The concept of periodontal care in relation to operative dentistry was considered by Burch (1975). He stated that restorations should establish a favourable environment for the periodontium and be easily cleaned by the patient. His considerations included the development of the various line contours of restorations that would allow for the maintenance of healthy periodontal tissues, and proximal contours and marginal ridge relationships that could be related to food retention and arch integrity.

In an essay on the dento-gingival junction, Ten Cate (1975) asks the reader to be more concerned about the connective tissue and not the epithelium, if the periodontal therapist desires a keratinised sulcular epithelium. As periodontal disease is mainly initiated through the sulcular epithelium, this is not an unreasonable observation. The gingival epithelium and its underlying connective tissue are the essence of periodontal reattachment procedures, and gingival and oral mucosal grafts (Karring, Lang and Løe, 1975).

Whether full thickness or split thickness flaps should be raised in periodontal surgery also hinges on the connective tissue component of the periodontium and the ability of this tissue to heal, reorganise and regenerate. This subject should in itself form an entire article or be combined with studies on epithelium, epithelial attachment, wound healing, the nature of granulation tissue, bone and cementum induction and formation.

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REFERENCES

- Addy, M. & Douglas, W.H. (1975) A chlorhexidine-containing methacrylic gel as a periodontal dressing. *Journal of Periodontology*, **46**, 465-468.
- Alco, J.J., De Renzis, F.A. & Farber, P.A. (1975) In vitro attachment of human gingival fibroblasts to root surfaces. *Journal of Periodontology*, **46**, 639-645.
- Allen, A.L., Hawley, C.E., Cutright, D.E. & Seibert, J.S. (1975) An investigation of the clinical and histologic effects of selected dentifrices on human palatal mucosa. *Journal of Periodontology*, **46**, 102-112.
- Burch, J.G. (1975) Periodontal considerations in operative dentistry. *Journal of Prosthetic Dentistry*, **34**, 156-163.
- Ciancio, S.G., Mather, M.L. & Bunnell, H.L. (1975) Clinical evaluation of a quaternary ammonium-containing mouthrinse. *Journal of Periodontology*, **46**, 397-401.
- Compton, F.H. & Beagrie, G.S. (1975) Inhibitory effect of benzethonium and zinc chloride mouthrinses on human dental plaque and gingivitis. *Journal of Clinical Periodontology*, **2**, 33-43.
- Fischman, S., Picozzi, A., Canero, L & Pader, M. (1975) Influence of a chlorhexidine and zinc mouthrinse on gingivitis. *Journal of Periodontology*, **46**, 710-714.
- Fornell, J., Sundin, Y. & Lindhe, J. (1975) Effect of listerine on dental plaque and gingivitis. *Scandinavian Journal of Dental Research*, **83**, 18-25.
- Frank, R.M., Brion, M. & De Rouffignac, M. (1975) Ultrastructural gingival reactions to gold foil restorations. *Journal of Periodontology*, **46**, 614-624.
- Hamp, S.E., Nyman, S. & Lindhe, J. (1975) Periodontal treatment of multirrooted teeth. *Journal of Clinical Periodontology*, **2**, 126-135.
- Hansen, F., Gjermo, P & Eriksen, H.M. (1975) The effect of chlorhexidine-containing gel on oral cleanliness and gingival health in young adults. *Journal of Clinical Periodontology*, **2**, 153-159.
- Hara, K. & Takahashi, T. (1975) Hydroxyproline contents in gingival exudate before and after periodontal surgery. *Journal of Periodontal Research*, **10**, 270-274.
- Holm-Pedersen, P., Agerback, N. & Theilade, E. (1975) Experimental gingivitis in young and elderly individuals. *Journal of Clinical Periodontology*, **2**, 14-24.
- Johansen, J.R., Gjermo, P. & Eriksen, H.M. (1975) Effect of 2-years use of a chlorhexidine-containing dentifrice on plaque, gingivitis and caries. *Scandinavian Journal of Dental Research*, **83**, 288-292.
- Karring, T., Lang, N.P. & Løe, H. (1975) The role of gingival connective tissue in determining epithelial differentiation. *Journal of Periodontal Research*, **10**, 1-11.
- Kaslick, R.S., Shapiro, W.B. & Chasens, A.I. (1975) Studies on the effects of a urea peroxide gel on plaque formation and gingivitis. *Journal of Periodontology*, **46**, 230-232.
- Kerry, G.J. (1975) New method for viewing root surfaces. *Journal of Periodontology*, **46**, 673-676.
- Klaven, B. (1975) Clinical observations following root amputation in maxillary molar teeth. *Journal of Periodontology*, **46**, 1-5.
- Klingerman, B.A. & Bissada, N.F. (1975) Clinical study of iodine as a chemotherapeutic agent for the control of dental plaque and gingivitis in man. *Journal of Periodontology*, **46**, 478-487.
- Lindhe, J. & Nyman, S. (1975) The effect of plaque control and surgical pocket elimination on the establishment and maintenance of periodontal health. A longitudinal study of periodontal therapy in cases of advanced disease. *Journal of Clinical Periodontology*, **2**, 67-79.
- Listgarten, M.A., Mayo, H.E. & Tremblay, R. (1975) Development of dental plaque on epoxy resin crowns in man. *Journal of Periodontology*, **46**, 10-26.
- Lovdal, A., Arno, A., Schei, O.L. & Waerhaug, J. (1961) Combined effect of subgingival scaling and controlled oral hygiene on the incidence of gingivitis. *Acta Odontologica Scandinavica*, **19**, 537-555.
- Morris, M.L. (1975) An inhibitory principle in the matrix of periodontally diseased roots. *Journal of Periodontology*, **46**, 33-39.
- Newman, H.N. (1975) The gingival border of plaque: Morphological studies in 8-15 year old children. *British Dental Journal*, **138**, 335-345.
- Nyman, S., Rosling, B. & Lindhe, J. (1975) Effect of professional tooth cleaning on healing after periodontal surgery. *Journal of Clinical Periodontology*, **2**, 80-86.
- O'Neil, T.C.A. (1975) Antibacterial properties of periodontal dressings. *Journal of Periodontology*, **46**, 469-474.
- Payne, W.A., Page, R.C., Ogilvie, A.L. & Hall, W.B. (1975) Histopathologic features of the initial and early stages of experimental gingivitis in man. *Journal of Periodontal Research*, **10**, 51-64.
- Plüss E.M., Engelberger, P.R. & Rateitschak, K.H. (1975) Effect of chlorhexidine on dental plaque formation under periodontal pack. *Journal of Clinical Periodontology*, **2**, 136-142.
- Ramfjord, S.P., Knowles, J.W., Nissle, R.R., Schick, R.A. & Burgett, F.G. (1973) Longitudinal study of periodontal therapy. *Journal of Periodontology*, **44**, 66-77.
- Robinson, P.J., Stoller, N.H., Vilardi, M. & Cohen, D.W. (1975) Clinical evaluation of the effect of a proteolytic enzyme mouthwash on plaque and gingivitis in young adults. *Journal of Community Dentistry, Oral Epidemiology*, **3**, 271-275.
- Ronstrom A., Attstrom, R. & Engelberg, J. (1975) Early formation of dental plaque on plastic films. *Journal of Periodontal Research*, **10**, 28-35.
- Saglie, R., Johansen, J.R. & Flotra, L. (1975) The zone of completely and partially destructed periodontal fibres in periodontal pockets. *Journal of Clinical Periodontology*, **2**, 198-202.
- Saglie, R., Johansen, J.R. & Tollefsen, T. (1975) Plaque-free zones on human teeth in periodontitis. *Journal of Clinical Periodontology*, **2**, 190-197.
- Spolsky, V.W., Bhatia, H.L., Forsythe, A. & Levin, D. (1975) The effect of an antimicrobial mouthwash on dental plaque and gingivitis in young adults. *Journal of Periodontology*, **46**, 685-690.
- Stahl, S.S. (1975) The nature of healthy and diseased root surfaces. *Journal of Periodontology*, **46**, 156-161.
- Tagge, D.L., O'Leary, T.J. & El-Kafrawy, A.H. (1975) The clinical and histological response of periodontal pockets to root planing and oral hygiene. *Journal of Periodontology*, **46**, 527-533.
- Ten Cate, A.R. (1975) The dento-gingival junction. An interpretation of the literature. *Journal of Periodontology*, **46**, 475-477.
- Theilade, E., Wright, W.H., Börglum-Jansen, S. & Løe, H. (1966) Experimental gingivitis in man. II. A longitudinal clinical and bacteriological investigation. *Journal of Periodontal Research*, **1**, 1-13
- Van Palenstein Helderman, W.H. (1975) Total viable count and differential count of *Vibrio (campylobacter) sputorum*, *Fusobacterium nucleatum*, *Selenomonas sputigena*, *Bacteriodes ochraceus* and *Veillonella* in the inflamed and non-inflamed human gingival crevice. *Journal of Periodontal Research*, **10**, 294-305.
- Volpe, A.R., Mooney, R., Zumbrennen, C., Stahl, D. & Goldman, H.M. (1975) A long term clinical study evaluating the effect of two dentifrices on oral tissues. *Journal of Periodontology*, **46**, 113-118.
- Waerhaug, J. (1975) A method for evaluation of periodontal problems on extracted teeth. *Journal of Clinical Periodontology*, **2**, 160-168.
- Waerhaug, J. (1975) Presence or absence of plaque on subgingival restorations. *Scandinavian Journal of Dental Research*, **83**, 193-201.
- Woodruff, H.C., Levin, M.P. & Brady, J.M. (1975) The effects of two ultrasonic instruments on root surfaces. *Journal of Periodontology*, **46**, 119-126.
- Zamet, J.S. (1975) A comparative clinical study of three periodontal surgical techniques. *Journal of Clinical Periodontology*, **2**, 87-97.