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GINGIVAL REACTIONS TO DENTAL RESTORATIONS

by

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INTRODUCTION

Based upon the experience that caries does not develop below the gingival margin, restorations for caries-prophylactic reasons are commonly extended subgingivally. Also the retention and aesthetics of crowns may be improved by placing their margins below the gingival border.

Thus, it seems well justified to finish the restorations close to the bottom of the pocket. However, experimental histologic investigations in animals have revealed unforeseen adverse effects on the soft tissue as a consequence of such procedures (*Waerhaug*, 1956a, 1960; *Waerhaug & Zander*, 1957).

The aim of the present experimental series is to study the clinical and histological reactions in the gingivae following the application of different types of sub- and supra-gingival restorations, which as closely as possible, are made under conditions similar to those in an ordinary dental practice.

MATERIAL AND METHOD

Two adult dogs and three monkeys were used. The animals had healthy gingivae with localized areas of gingivitis. Only teeth with clinically healthy gingivae were chosen. All the clinical procedures were carried out under

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Nembutal* (etylbutyl-1-metyl barbituric acid) or Sernylan** (phencyclidine) anaesthesia, and the following restorations were made:

21 full gold crowns (shoulderless preparation),
6 micro-bond crowns (shoulder preparation),
15 class V gold inlays, and
9 class V heat-cured acrylic resin inlays.

One third of the different types of restorations were finished one millimeter or less above the gingival margin, whereas the rest of them were extended into the pocket. The preparations were carried out under water spray, by means of ordinary burs, diamond points and discs.

Temporary crowns and fillings were applied during the period of one week between preparation and cementation.

For the inlays the direct impression technique was employed and for the crowns the indirect technique. The indirect impressions were either taken with copper bands and compound or with rubber base in specially fitted resin trays. In the latter case, the gingivae were retracted by means of Gingi-Pak.

The majority of the crowns and inlays fitted well. Two subgingival gold crowns, one subgingival micro-bond crown and two subgingival gold inlays displayed minor marginal inaccuracies, but they were inserted in spite of that. The fit of all the class V acrylic resin inlays was mediocre. One subgingival gold inlay fell out abour 3 months prior to the animal's death and the cavity remained unfilled. All the restorations were cemented with zinc phosphate cement.

To study the effect of the preparation *per se*, 4 subgingival crown preparations were made, but crowns were not inserted. Likewise, 4 subgingival class V cavities were filled with a zinc phosphate cement to study the effect of this material. No oral hygiene measures were undertaken during the observation period, which varied from 2 to 12 months. Teeth with clinically healthy gingivae served as normal controls. In the inlay cases, normal control sections were taken from the same teeth, either mesially or distally to the inlay.

The animals were sacrificed under Nembutal anaesthesia and the jaws removed and fixed in 10 % neutral buffered formalin. After fixation, the occlusal surfaces of the crowns were perforated to facilitate the penetration of the 5 % nitric acid. After decalcification, which also dissolved the phosphate cement, the restorations could easily be removed without visible damage to the adjacent gingivae. However, plaque attached to the restora-

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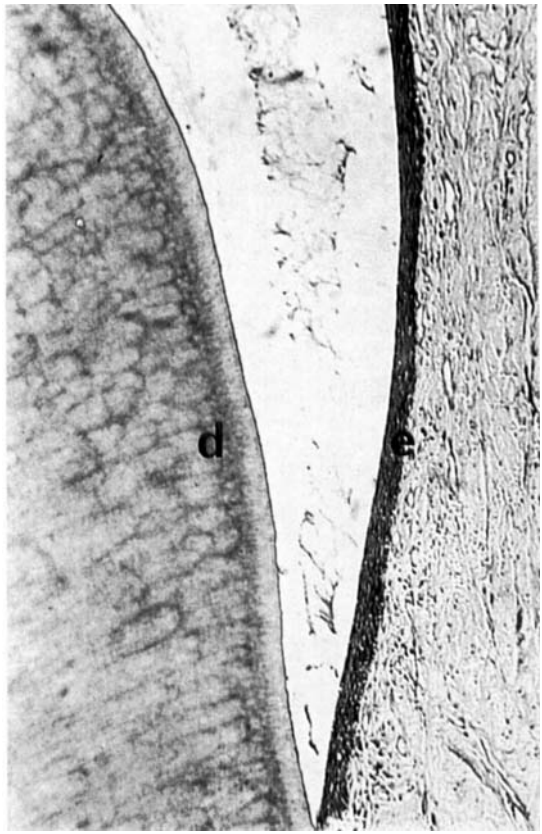

Fig. 1. Dog. Control gingivae. Pocket epithelium (e) of uniform thickness, the basal layer follows a straight line. d, dentine. ×100.

tions, was often removed at the same time and thus lost its contact with the soft tissue. The specimens were sectioned bucco-lingually (6—10 μ), and stained with haemotoxylin and eosin.

RESULTS

Clinical examination. The gingiva adjacent to 5 out of the 18 subgingival crowns was inflamed. In 2 of these cases the gingival margin was magenta in colour, swollen and bled on slight pressure; in the other three cases the symptoms were moderate. The signs of inflammation tended to be more pronounced the deeper the preparation and the less accurate the fit of the crowns. The soft tissue around the remaining subgingival crowns was similar

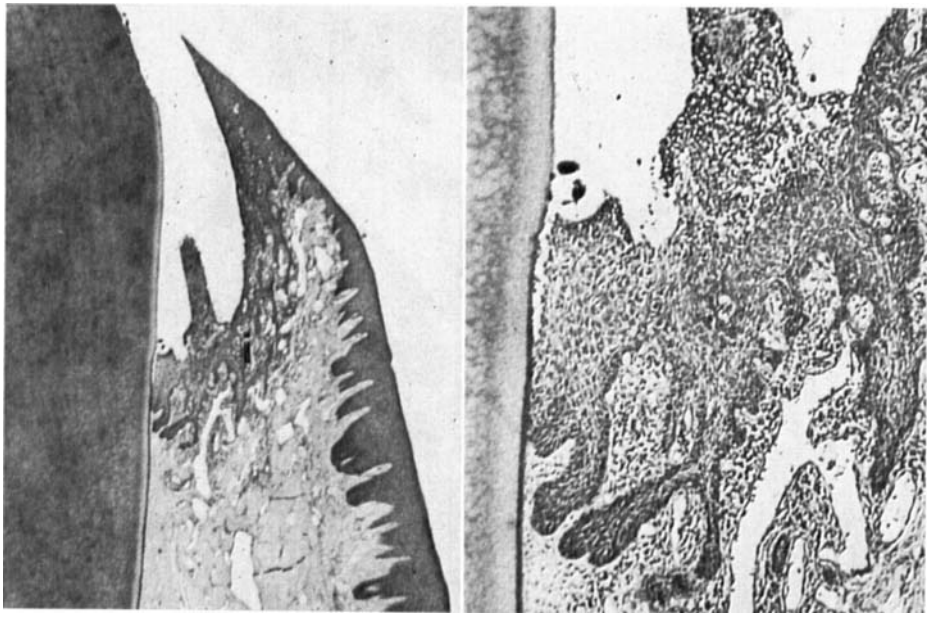

Fig. 2a. Dog. Full crown case. The margins had a slight overhang and were placed near the bottom of the pocket. The gingivae receded and a dense inflammatory infiltration (i) is present in the connective tissue. Epithelium is hyperplastic with numerous and extensive rete pegs. Twelve months observation. ×27.
b. Greater magnification of the cuff area. ×100.

in appearance to that adjacent to the unoperated teeth. The reaction to the full gold crowns and the micro-bond crowns was similar; in both instances the gingivae had receded slightly.

The gingival conditions adjacent to the subgingival class V inlays were generally similar to those adjacent to the crowns. The acrylic resin inlays gave the poorest results in contrast to the well fitting class V gold inlays which were the best tolerated of all the subgingival restorations.

The gingival conditions of the different types of supragingival restorations were similar to those of unoperated teeth, only a slight reaction was discernible at 2 acrylic inlays.

No signs of inflammation were observed where preparation had been made without subsequent insertion of restorations. All the 4 subgingival phosphate cement fillings were associated with considerable gingival reactions.

Histological examination. In the gingivae of control teeth, which had been classified as clinically healthy, inflammatory cells were regularly present in the marginal part. In some cases, limited rete pegs extended into the connective tissue. In most of the control cases the epithelial cuff was of uniform thickness and the basal layer followed a straight line (Fig. 1).

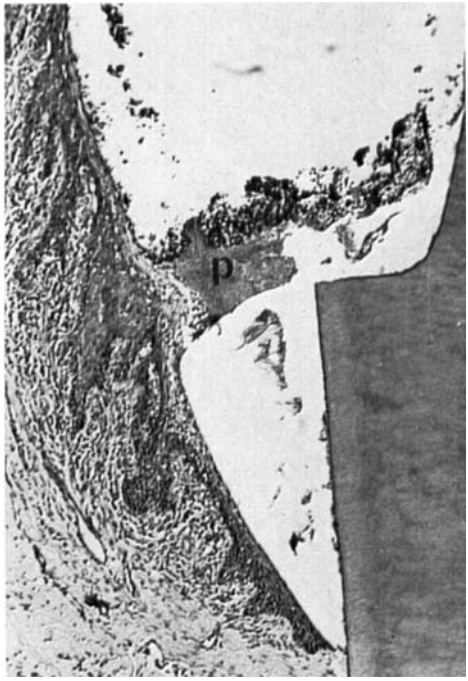

Fig. 3. Dog. A Micro-Bond crown was placed which on probing was classified as relatively well fitting. Considerable plaque accumulations (p) and corresponding inflammatory reactions adjacent to the crown margin. The shoulder preparation was placed near the bottom of the pocket. Sixth months observation. × 100.

In the gingivae adjacent to the different types of subgingival crowns inflammation of varying degree was an almost constant finding, even if the reaction was mild in most cases. The crowns which had been extended deepest into the pocket, and those with marginal inaccuracies, were regularly associated with the poorest conditions. Here a band of inflammatory cells could be followed from the gingival margin beyond the apical part of the pocket. Numerous rete pegs penetrated into the inflamed connective tissue, and an increase of the inflammatory reaction was often observed corresponding to the margin of the crowns (Figs. 2a, b). In some cases small accumulations of plaque were observed (Fig. 3). By and large the two different types of crowns induced the same degree of inflammation, although the conditions around the full gold crowns tended to be better.

The two impression techniques gave similar results.

Among the subgingival class V restorations the acrylic inlays and the moderate fitting gold inlays caused the heaviest inflammation (Fig. 4). The

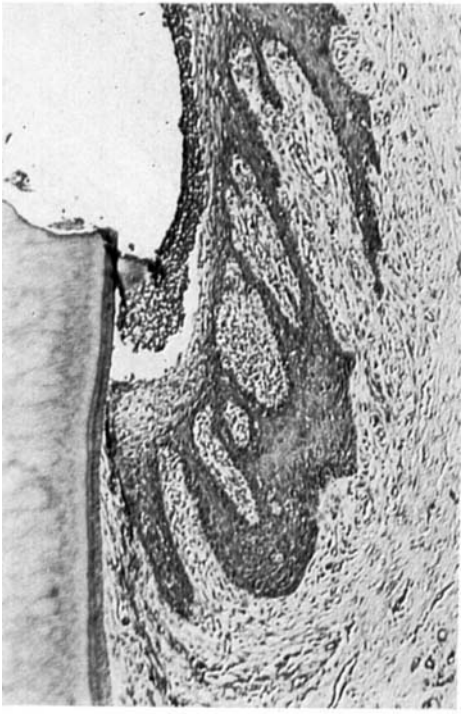

Fig. 4.

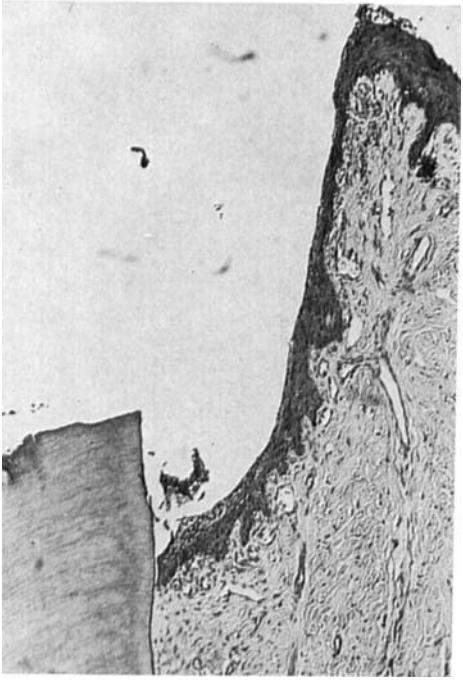

Fig. 5.

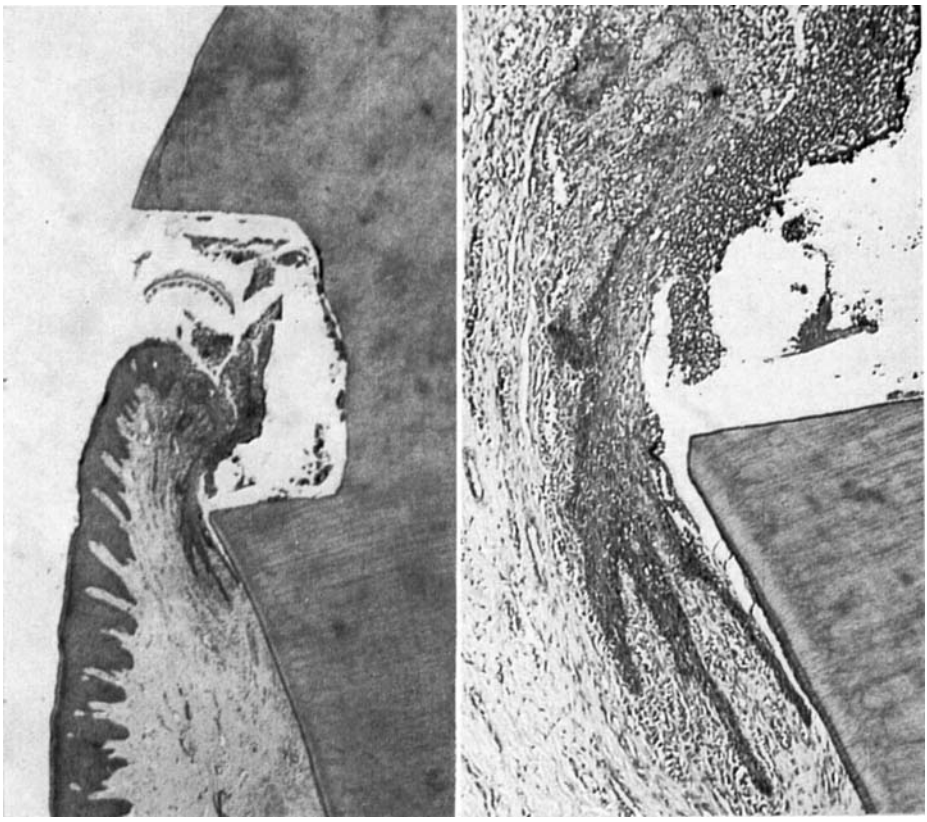

Fig. 6a. A class V gold inlay fell out and the cavity was left open. The gingivae surrounded by plaque accumulations proliferated into the cavity. Heavy inflammatory reactions occurred. Three months observation. ×27.
b. Greater magnification of the reaction area. ×100.

well-fitting gold inlays gave the most favourable results of all the subgingival restorations (Fig. 5), although a slight reaction was observed in the tissue adjacent to the inlays as compared with the control areas mesially or distally to them. In the one case, where a class V gold inlay had fallen out, the gingivae, which had proliferated into the cavity, displayed a severe inflammation (Figs. 6a, b).

Fig. 4. Dog. A moderate fitting class V gold inlay was cemented. Considerable inflammatory reaction. Four months observation. ×100.

Fig. 5. Dog. A perfect fitting class V gold inlay was cemented. Gingival reactions are negligible. Ten months observation. ×100.

Crowns and inlays finished supra-gingivally undoubtedly gave the best results, even if slight inflammatory reactions were also observed in some of these cases.

Where subgingival preparations had been carried out, without placing restorations, only minor gingival reactions occurred. All the subgingival class V phosphate cement fillings were associated with severe inflammations.

Plaque was observed in many of the subgingival cases, and occasionally also in the supra-gingival ones. In the subgingival restorations the plaque was as a rule found within the pocket area, whereas in the supra-gingival cases the plaque was mostly localized above the gingival margin. It should be noticed, however, that plaque was easily lost when removing the restorations or during the histological procedures. Plaque, wherever present in the pocket areas, was always associated with inflammation (Fig. 3). Minor plaque accumulations were also found in some of the control sections.

There were no appreciable differences in the gingival reactions between dogs and monkeys.

DISCUSSION

The density of inflammatory cell exudate and the extension of the rete pegs have been used as parameters in the histological evaluation of the gingival tissues (*Zachrisson & Schultz-Haudt*, 1968). However, in a study like the present one, it is hardly feasible to express the findings in exact terms. Furthermore, when evaluating the findings it should be kept in mind that also the control gingivae in some cases displayed slight inflammation. This is in keeping with the generally held opinion that slight inflammation is a common histologic observation in clinically healthy gingivae (*Schultz-Haudt & From*, 1961; *Zachrisson & Schultz-Haudt*, 1968).

When the gingiva adjacent to supra-gingival restorations was compared with control gingiva, no obvious difference could be observed. This indicates that supra-gingivally located crowns and fillings scarcely interfere with gingival health, and that the injuries inflicted upon the soft tissues during preparation, impression taking and cementation are of no permanent consequence.

Conversely, inflammation of varying degree was present in the gingivae adjacent to practically all the subgingival restorations. In this respect the junction between tooth and restoration is most likely a critical zone since conspicuous inflammatory reactions and plaque deposits often occurred just adjacent to this junction (Fig. 3). These reactions were especially pronounced in cases with marginal inaccuracies (Fig. 4) as contrasted to the more favourable conditions adjacent to the well fitting gold inlays (Fig. 5). This again

indicates the role of uneven and rough surfaces in the retention of bacterial plaques (*Waerhaug*, 1956a, b). Possibly, also the strong reactions adjacent to the class V phosphate cement fillings are due to rough surfaces, resulting from a gradual dissolution of the cement. Leakages between tooth and restorations (*Granath*, 1967; *Mortensen, Boucher & Ryge*, 1965) should also be taken into account.

The poor correlation between clinical and histological findings is in agreement with previous records (*Schultz-Haudt & From*, 1961).

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SUMMARY

Sub- and supra-gingival restorations were placed in dogs and monkeys to study the effect of these on the gingival tissues. Gingival inflammation was an almost constant finding in sub-gingival restorations as contrasted to the favourable response in supra-gingival cases. Furthermore, the gingival conditions seem to be closely related to the marginal fit, particularly in restorations in contact with the soft tissue. As the reactions of the human gingivae most probably are similar to those in dogs and monkeys (*Waerhaug*, 1956 a), the present findings should be considered when crowns and fillings are prepared.

RÉSUMÉ

RÉACTIONS DE LA GENCIVE AUX RESTAURATIONS DENTAIRES

Différentes restaurations sous-gingivales et sus-gingivales ont été placées dans des dents de chiens et de singes pour étudier leur action sur les tissus gingivaux. L'inflammation gingivale était pratiquement constante lors des restaurations sous-gingivales, contrairement à la réaction favorable dans les cas de restaurations sus-gingivales. De plus, l'état de la gencive semble être étroitement lié à l'adaptation marginale, particulièrement dans les restaurations placées au contact des tissus mous. Etant donné qu'il est très probable que les réactions de la gencive humaine sont semblables à celles des chiens et des singes (*Waerhaug*, 1956a), il convient de tenir compte des considérations ci-dessus lors de la préparation des couronnes et des obturations.

ZUSAMMENFASSUNG

GINGIVALE REAKTIONEN AUF FESTE ZAHNERSÄTZE

Verschiedene sub- und supra-gingivale zahnersätze wurden in Hund- und Affenzähnen gemacht, um die Einwirkung dieser Wiederherstellungen auf das gingivale Gewebe zu studieren. Gingivale Inlfammation war bei fast allen subgingivalen Arbeiten zugegen; im klaren Gegensatz zu den auffallend günstigen Resultaten der supragingivalen Arbeiten.

Weitherhin war die Genauigkeit der marginalen Anpassung der subgingivalen Arbeiten von grösster Bedeutung für die Reaktion des gingivalen Gewebes. Da die gingivalen Reaktionen bei Menschen, Hunden und Affen wahrscheinlich sehr ähnlich sind (*Waerhaug*, 1956a), sollten diese Observation bei Kronen- und Brückenarbeiten beobachtet werden.

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