Denture stomatitis

A clinical, electron-microscopic, microradiographic and light-microscopic study

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The present study includes a reexamination of 10 patients who, two years ago received complete upper and lower denture treatment to eliminate an existing denture stomatitis. Clinical healing of the denture stomatitis was obtained only in one patient, whereas the remaining nine patients still displayed an obvious denture stomatitis. Biopsies were taken from the palatal mucosa and examined histologically, microradiographically, and by electron microscopy. The results of these examination indicated that, in denture stomatitis there is a reduced thickness of the epithelium, an absence of a stratum corneum, a markedly widened intercellular space, especially in the stratum basale, and an intense infiltration of inflammatory cells, plasma cells and lymphocytes in the connective tissue, as well as in the epithelium. These changes are characteristic features of an inflammatory process, and similar to the changes which occur, for example, in chronic, marginal gingivitis. The composition of the inflammatory infiltrate suggested that, in denture stomatitis, immunological phenomena influence the pattern of the tissue reaction.

Key-words: Stomatitis; denture, complete

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Denture stomatitis has been described clinically by several authors (*Nyquist*, 1952, *Newton*, 1962, *Budtz-Jörgensen*, 1974, *Anneroth & Wictorin*, 1975). The two principal conditions have been called »stomatitis prothetica nudata» (SPN) and »granulomatosa (SPG) (*Andersson & Person*, 1973). SPN is characterized by a reddened, hyperemic mucosa, while SPG is a hyperplastic reaction with a papillary surface of the mucosa mostly in the palatal area.

In the etiology of these conditions four main exogenic factors have been mentioned: traumatic, infectious, toxic and allergic. Among these, trauma (*Nyquist*, 1952) and infection (*Budtz-Jörgensen*, 1974) have been considered as the predominant.

Budtz-Jörgensen (1974) suggested that the infection was caused by Candida species, the trauma being merely a predisposing factor in the development of the denture stomatitis. The actual presence of Candida species was, however, not a regular finding (*Budtz-Jörgensen*, 1974). It is also a well-established fact that even

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after repeated prosthetic treatment reducing the trauma with or without antifungal therapy, a considerable proportion of the patients fail to respond with complete healing. *Anneroth & Wictorin* (1975) demonstrated the importance of endogenic factors such as systemic diseases, heart diseases and arteriovascular diseases as predisposing to denture stomatitis.

An important contribution to the knowledge of the ecology of the interface between the denture and the supporting mucosa was made by *Carlsson et al.* (1969). They demonstrated that the insertion and use of full dentures rapidly interfered with the normal flora of the edentulous mouth. They found that colonization of *Streptococcus mutans* and *Str. sanguis* occurred on the denture, and suggested that the markedly increased concentration of these organisms was related to the presence of a solid surface suitable for bacterial colonization.

The denture supporting mucosa is changed structurally when the denture stomatitis is developed. One histological feature is the reduced thickness of the stratum corneum, which seems to be correlated with the severity of the denture stomatitis (*Östlund*, 1958, *Markow*, 1969; *Anneroth & Wictorin*, 1975). Normally, the alveolar and the palatal mucosa are keratinized. With increasing inflammatory reaction of the mucosa, the keratinization process seems to be disturbed, inducing a reduced keratinization of the oral epithelium. Therefore, the thickness and the dry mass concentration of the keratin layer, as revealed by microradiography, give an indication of the condition of the oral mucosa.

The keratinization process in the oral epithelium has previously been examined by electron-microscopical methods (*Frithiof*, 1970, *Frithiof & Wersäll*, 1965). Ultrastructural data might also provide further information towards the understanding of the pathogenesis of denture stomatitis.

The aim of the present study was to reexamine by means of clinical, histological, microradiographical and electron-microscopical methods 10 patients, who, two years ago received complete upper and lower denture treatment to eliminate an existing denture stomatitis.

MATERIAL AND METHODS

The material consisted of 10 patients treated with complete upper and lower dentures at the Department of Prosthetics, School of Dentistry, Karolinska Institutet, Stockholm. The patients selected for this investigation were suffering from severe denture stomatitis; their mean age was 62 years, 6 females and 4 males. The patients, who had been edentulous for approximately 20 years, were described previously by *Anneroth & Wictorin* (1975). Biopsies were taken two years ago in order to compare the degree of keratinization and the inflammatory signs in denture-wearing mucosa, and in non-wearing areas. The patients received prosthetic treatment at that time. They were recalled for the present control, and re-examination of the maxillar mucosa. The mucosa of the upper jaw was clinically examined with special reference to changes in colour, resilience and other clinical symptoms. Colour prints of the palatal mucosa were recorded in all cases.

Biopsies were taken from 10 patients under local anesthesia. Control specimens were taken from 5 of the same patients and constituted healthy tissue in the vicinity of the area where the pathologic specimens

had been taken. The specimens were cut in two pieces for light and electron microscopy respectively.

Light microscopy

Specimens for light microscopy were fixed in a 10 per cent neutral solution of calcium formol according to *Adams* (1959), and embedded in paraffin. Sections 6 μm thick were stained with Mayer's haemalun-eosine and van Gieson's stain.

All sections were evaluated qualitatively for the following reactions in the epithelial and connective tissue: the degree of keratinization, the occurrence of acanthosis, epithelial proliferation, epithelial atrophy and inflammatory infiltration. The above-mentioned reactions were graded as indicated in Table I.

Microradiography

Some sections from each specimen were used for microradiographic examination with ultrasoft X-rays according to the principles for contact microradiography presented by *Engström* (1946), *Engström & Lindström* (1950), and *Engström & Lundberg* (1957). The sections were transferred to distilled water and floated on a fine-grained photographic emulsion (Kodak Maximum Resolution Plate). The emulsion was precoated with a thin celloidin film by immersing the plate twice in a 1 per cent celloidin solution at intervals of 5 minutes. The emulsion was subsequently dried overnight in a vertical position.

The section was then exposed to ultrasoft X-rays at 1.5 kV and 1.0 ma for 50 minutes in an X-ray tube constructed by *Engström & Lundberg* (1957). Most of the emitted X-ray quanta had wavelengths between 8—12 Å. The contrast in the microradiographs reflected variations of the dry weight in the different organic components of the tissues. The cathode consisted of a tungsten wire, and the anode was of copper.

The sample was placed at a distance of 55 mm from the anode, giving a uniformly exposed area. The focal spot had a diameter of about 0.1 mm. The tube was continuously evacuated during the exposure. A 1000 Å thick aluminium filter protected the photographic emulsion against light from the cathode.

After exposure the section was covered with adhesive tape and immersed in pure acetone for 3—5 minutes. The acetone dissolved the celloidin film between the tissue section and the emulsion, so that when removing the tape, the section followed with the tape.

Electron microscopy

Specimens for electron microscopy were fixed in a 3 per cent solution of glutardialdehyde for 1—3 hours. They were fixed for two hours in a 1 per cent buffered solution of osmium tetroxide according to *Rhodin* (1954), embedded in Epon and sectioned in 400 Å thick sections with an Ultratome (LKB). Sections, stained in solutions of uranyl acetate (*Watson*, 1958) and lead acetate (*Karnowsky*, 1961), were studied in a Siemens Elmiskop I operating at 80 kv.

RESULTS

Clinical observations

All patients except one demonstrated signs of denture stomatitis. The mucosa of eight patients showed localized red and glossy areas of diffuse erythema. One patient exhibited a hyperplastic type of inflammatory, papillary hyperplasia with moderate colour changes. In five patients the resilience of the mucosa was increased

Table I. *Description of light microscopical findings*

Patient No.	Degree of keratinization		Occurrence of acanthosis		Occurrence of epithelial proliferation		Occurrence of epithelial atrophy		Degree of inflammation	
	D.S.	N	D.S.	N	D.S.	N	D.S.	N	D.S.	N
1	0	+	++	0	++	0	0	0	++	+
2	0/+	+	+	+	++	0	0	0	++	0
3	0	—	++	—	++	—	+++	—	+++	—
4	0	—	++	—	++	—	0	—	++	—
5	0/+	+	++	0	++	0	+++	0	++	0
6	0	++	+++	0	+++	0	+++	0	+++	+
7	0	—	+++	—	+++	—	+++	—	+++	—
8	0	++	+++	0	+++	+	++	0	+++	+
9	+	—	++	—	+	—	0	—	++	—
10	0/+	—	++	—	+++	—	+++	—	++	—

D.S. = Denture stomatitis
N = Normal palatal mucosa

The degree of keratinization
0 = no keratinization
+ = parakeratosis
++ = orthokeratosis
+++ = hyperorthokeratosis

The occurrence of acanthosis
0 = no acanthosis
+ = mild acanthosis
++ = moderate acanthosis
+++ = marked acanthosis

The occurrence of epithelial proliferation
0 = no epithelial proliferation
+ = mild epithelial proliferation
++ = moderate epithelial proliferation
+++ = pronounced epithelial proliferation

The occurrence of epithelial atroph2
0 = no atrophy
+ = slight atrophy
++ = moderate atrophy
+++ = marked atrophy

The degree of infiammation
0 = no inflammation
+ = slight inflammation
++ = moderate inflammation
+++ = severe inflammation

compared with control areas. In one patient preprosthetic surgery was needed to eliminate flabby ridges.

Light microscopical observations

Areas of denture stomatitis. Some of the histological findings are given in Table I. There was a total lack of keratinization in seven patients, whereas in the remaining three patients some areas showed parakeratosis. Nine patients showed moderate or marked acanthosis and epithelial proliferation. In connection with the epithelial proliferation of the rete pegs epithelial pearls were seen. Owing to tangential section directions, pearls and islands of epithelium could be seen in the subepithelial connective tissue. Alternating with pronounced proliferation of rete pegs epithelial atrophy was observed in 6 patients and the papillae of the connective tissue were thereby covered by only a few, often (Fig. 1) hydropic, epithelial cell layers. In the superficial cell layers there were intraepithelial accumulations of inflammatory infiltrate, resembling microabscesses. Intraepithelial, leucocyte infiltration could be demonstrated in the

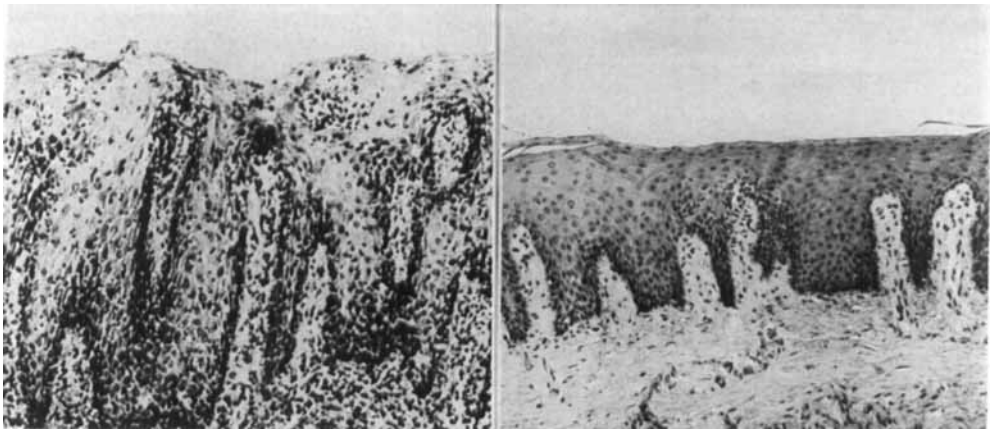


Fig. 1. A stained section of a highly inflamed alveolar mucosa from a denture stomatitis. There is no keratin layer and the cells in the surface layer are hydropic. Accumulations of polymorphonuclear leucocytes in the different epithelial cell layers resemble microabscesses. The subepithelial inflammatory infiltrate is composed of lymphocytes and plasma cells. There is also acanthosis and epithelial proliferation. Htx-eosin. × 150.

Fig. 2. A stained section of normal palatal mucosa. Parakeratosis with a well-defined surface layer. A mild, chronic inflammatory reaction is seen in the subepithelial connective tissue. Htx-eosin. X 75.

different epithelial cell layers. The basal cell layer was usually invaded by lymphocytes and plasma cells due to a moderate (3 cases) or severe (7 cases) chronic subepithelial inflammation. Edema was observed in this region of the connective tissue, and the histopathological picture in this region resembled a highly vascularized granulation tissue.

Owing to the above-mentioned inflammatory changes, the basement membrane was, in nine cases, masked, and intra- and intercellular edema in the basal, epithelial-cell layer could be demonstrated in 8 patients.

Areas of normal oral mucosa. The degree of keratinization (Table I) varied from parakeratosis (3 patients) to orthokeratosis (2 patients). In parakeratosis a well-defined surface cell layer (Fig. 2) of flat cells, with pycnotic cell nuclei was observed. In orthokeratosis a distinct homogenous stratum corneum, without nuclear remnants, was discernible. No acanthosis was seen except in two cases were a slight and a moderate acanthosis was noted. A slight epithelial proliferation was observed in one patient. In 8 patients there was no inflammation in the connective tissue. In 2 patients a mild, chronic inflammation was demonstrated.

Microradiographic observations

Areas of denture stomatitis. The surface epithelial layer (Fig. 3) exhibited no well-demarcated zone of high dry mass concentration, except in two cases, where a parakeratotic surface layer was recorded in the light microscope. In the different epithelial cell layers, vacuoles could be seen, and the cell cytoplasm had a low dry mass concentration. The intercellular spaces often had a relatively low dry mass concentration, and were frequently widened. No basement membrane structures could be observed, and in the subepithelial connective tissue no collagen bundles were present.

Areas of normal oral mucosa. The

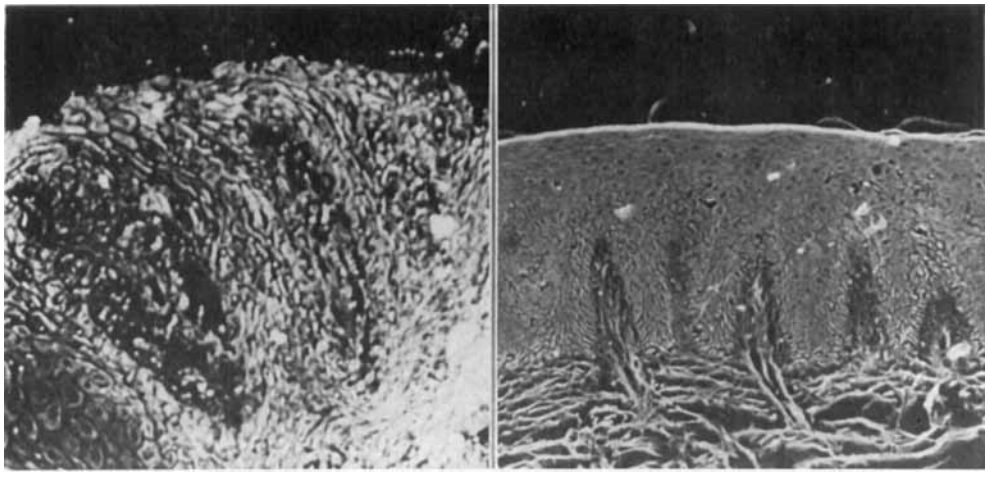


Fig. 3. Microradiograph of denture stomatitis. Low absorption of ultrasoft X-rays in the superficial cell layer indicates low dry mass concentration, and lack of keratinization. × 75.

Fig. 4. Microradiograph of normal palatal mucosa. High absorption of ultrasoft ×-rays in the superficial cell layer indicates high dry mass concentration, and orthokeratosis. Observe the arrangement of the collagen bundles transmitting branches of fibrils into the papillae of the connective tissue. × 75.

appearance of the surface cell layers was homogenous (Fig. 4) in the microradiographs, and they were seen as a dense band with a high dry mass concentration. The cytoplasm of the epithelial cells seemed to be more dense than the nuclei, indicating a higher dry weight. In some cases a thin zone, with high dry mass concentration (Fig. 5), was observed in the region where the basement membrane was usually found. In the subepithelial connective tissue, dense collagen fibers

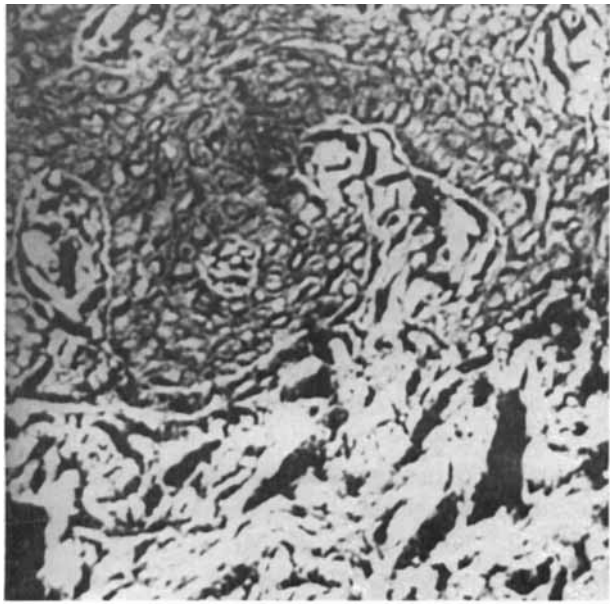


Fig. 5. Microradiograph of normal palatal mucosa. High absorption of ultrasoft X-rays indicates high dry mass concentration. Observe the basal zone with high dry mass concentration, which, presumably, corresponds to the 5-micron wide band of fibrous tissue, which was observed in the electron-microscope (Fig. 8) × 400.

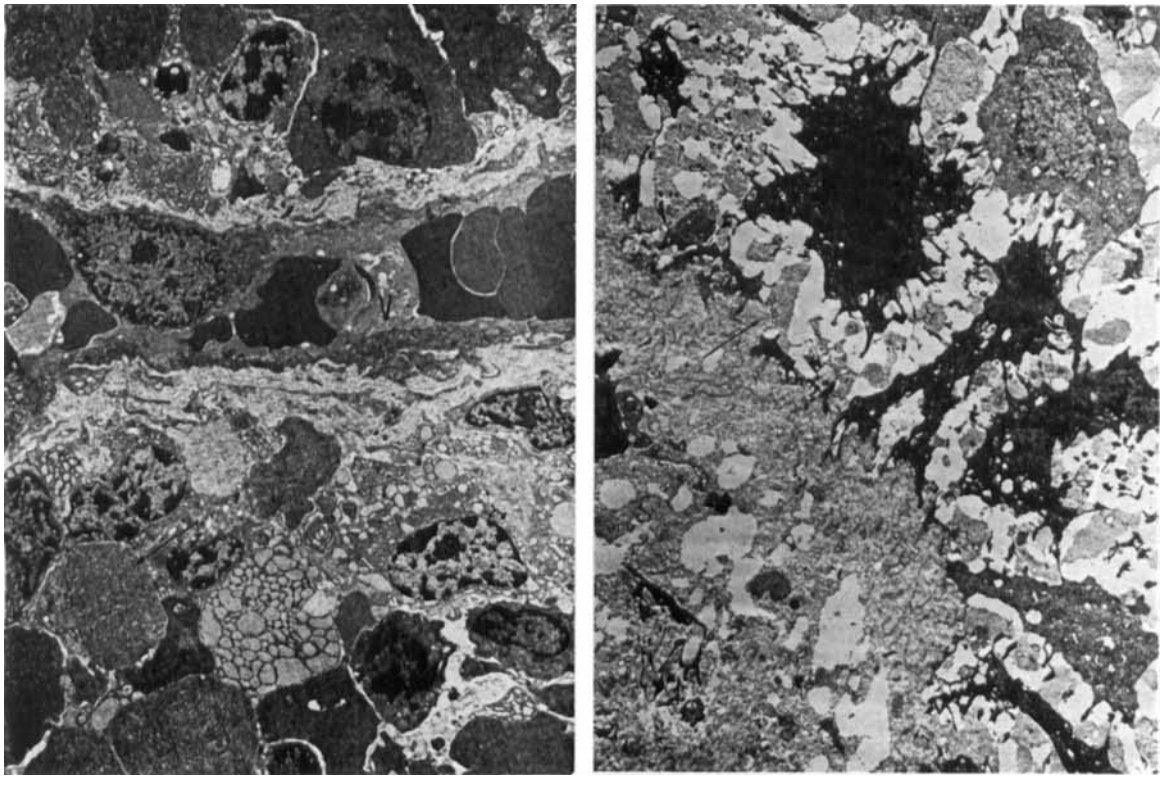


Fig. 6. Electron microscopy of the subepithelial connective tissue in denture stomatitis. Dense infiltrate of inflammatory cells. There are plasma cells with distended, endoplasmic reticulum (arrow). A small vessel (V) traverse the picture. × 600.

Fig. 7. Electron micrograph from the inteface between epithelium and connective tissue. The basal lamina is fragmented and, in some places appears in several layers. The wide, intercellular space is sporadically continuous with the connective tissue (arrow). In places, slender cytoplasmic processes along the basal lamina separate the wide less dense intercellular space from the connective tissue × 6000.

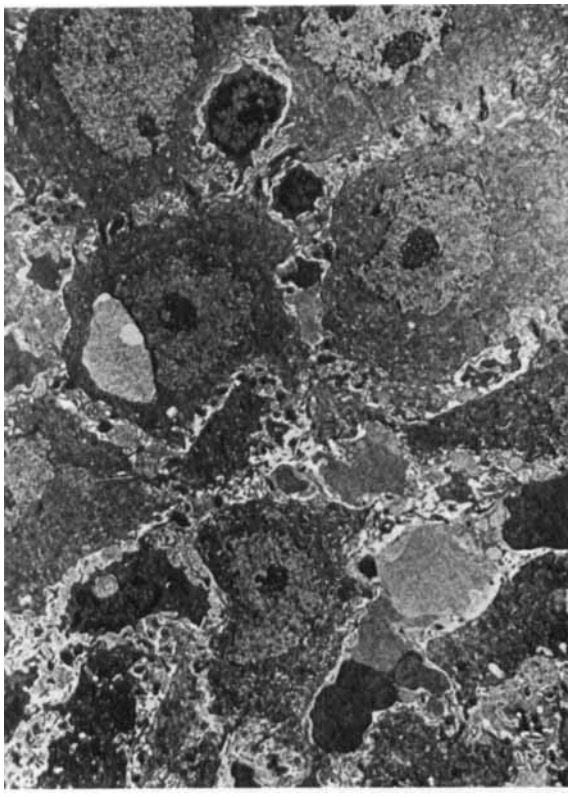
were arranged in a characteristic pattern (Fig. 4), with bundles of fibrils extending into the connective tissue papillae.

Electron-microscopic observation

Areas of denture stomatitis. All the specimens displayed an extremely thin non-keratinized epithelium with an irregular border towards the connective tissue.

Connective tissue. The subepithelial connective tissue was densely infiltrated by various types of inflammatory cells (Fig. 6). The infiltrate usually occupied all the connective tissue within the section. Frequently, only scattered collagen fibrils were present. A large number of plasma cells were seen; some of them with a markedly distended endoplasmic reticulum (Fig. 6). Several blood vessels appeared close to the epithelial border (Fig. 6).

Basement-membrane region. The border between the connective tissue and the epithelium was very irregular and, in places impossible to distinguish due partly to the heavy infiltrate of inflammatory cells into both the connective tissue and the epithelium, and partly to the excessively wide intercellular space in the stratum basale (Fig. 7). The lamina densa



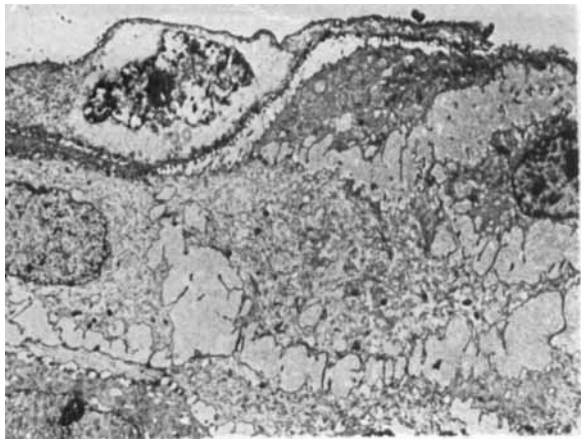


Fig. 9. Stratum superficiale in denture stomatitis. The surface cells are nonkeratinized. Electron-optically empty spaces appear intracellularly in the flattened cell layer. × 6000.

Fig. 8. Stratum spinosum in denture stomatitis. In the widened, intercellular space there are numerous inflammatory cells, and occasional erythrocytes. × 6000.

of the basement membrane was identified as one or more layers situated close to the basal cells. It frequently failed to bridge the wide intercellular space which separated the majority of the basal cells (Fig. 7). In such areas there was an obvious structural continuity between the content of the intercellular space and the joining connective tissue. However, even in areas with extremely large intercellular spaces, several basal cells were seen maintaining their function as a borderline layer by long, flat, cytoplasmic processes (Fig. 9).

Stratum basale. The basal cells (Fig. 9) were irregular in size and shape. They contained a large number of mitochondria, with more or less irregularly arranged cristae. In several specimens the mitochondria were vacuolated. Both free, and membrane-attached, cytoplasmic ribosomes appeared in high concentration. There were moderate amounts of tonofilaments, mainly aggregated in bundles. Slender cytoplasmic processes were numerous, and were easily identified as they extended into the wide intercellular space. The intercellular space was bridged by wide-based, tonofilament-containing processes, by which intercellular desmosomal contacts were established. The intercellular space between the basal cells contained islands of moderately dense, intercellular material in close proximity to the cellular surface (Fig. 9).

There were also white blood cells, mainly lymphocytes, and occasional polymorphonuclear leucocytes. The nucleus of the basal cell was highly irregular in shape. Its content was more dense than the cytoplasm. Considerable amounts

of free chromatin appeared as dense islands in the nucleus, and also attached to the nuclear membrane (Figs. 6, 7).

Stratum spinosum. In the spinous layer the basal cells were gradually transformed into larger and less dense cells (Fig. 8). In some specimens the width of the intercellular space was gradually reduced within the spinous layer, narrow spaces were maintained also in the superficial layer of flattened cells. In most specimens, however, markedly wide intercellular spaces appeared in all the cell layers.

The concentration of white blood cells, mainly lymphocytes, was highest in the basal part of the spinous layer, and gradually decreased towards the epithelial surface. In one specimen scattered erythrocytes were seen in the intercellular space (Fig. 8). The morphology of the spinous cells varied, to a certain degree, between different specimens. The mitochondria were small, and not vacuolated. The tonofilaments were distributed throughout the cytoplasm, and their tendency to aggregate in bundles decreased towards the epithelial surface. Tonofibrils were not seen. Both the free, cytoplasmic ribosomes, and the membrane-attached ribosomes, were numerous. Specimens with a wide intercellular space displayed an irregular cellular surface, with cytoplasmic processes and numerous peripheral vacuoles, or crossout invaginations. The nuclei tended to assume a rounded shape, with a smooth surface, one or two rounded nucleoli, and a gradually reduced amount of chromatin (Fig. 8).

The main part of the nuclear content was less dense than the cytoplasm (Fig. 8). The Odland bodies, which are normally seen in the superficial part of the spinous layer in palatal epithelium, appeared as empty vacuoles, in the periphery of which, remnants of the typically layered, membrane-system may occasionally be recognized.

Stratum superficiale. The transformation into flattened surface cells proceeded gradually. Keratohyalin granules were not seen. Increasing areas void of organelles appeared in the cytoplasm as the cells assumed a flattened shape (Fig. 9). In the flattened cells a few mitochondria were still recognized as well as tonofilaments and ribosomes. There were numerous round vacuoles. The nuclear content of the superficial cells was reaggregated, presenting a dense flocculent structure. The overall density of the nuclear content was again higher than the density of the cytoplasm. The surface cells were not keratinized. Microorganisms were usually not seen on the epithelial surface, in the intercellular space, or intracellularly. The dense intercellular material appeared even between the superficial cells. The number of desmosomes gradually decreased towards the surface.

Clinically normal areas. In five of the stomatitis patients there were also denture-bearing areas with a normal appearance. There were marked ultrastructural differences between the normal areas and the stomatitis areas. The normal denture-bearing areas were covered with a markedly thicker epithelium with several layers of keratinized cells.

Connective tissue. The connective tissue contained fibroblasts, mast cells, and occasional white blood cells. In some places the cellular elements were lined up along a 5 μ-wide zone situated close to the basal cells, and mainly containing collagen fibrils (Fig. 10).

Basement-membrane region. The border between the epithelium and the connective tissue was easily recognized. There were numerous cytoplasmic processes extending from the basal cells towards the connective

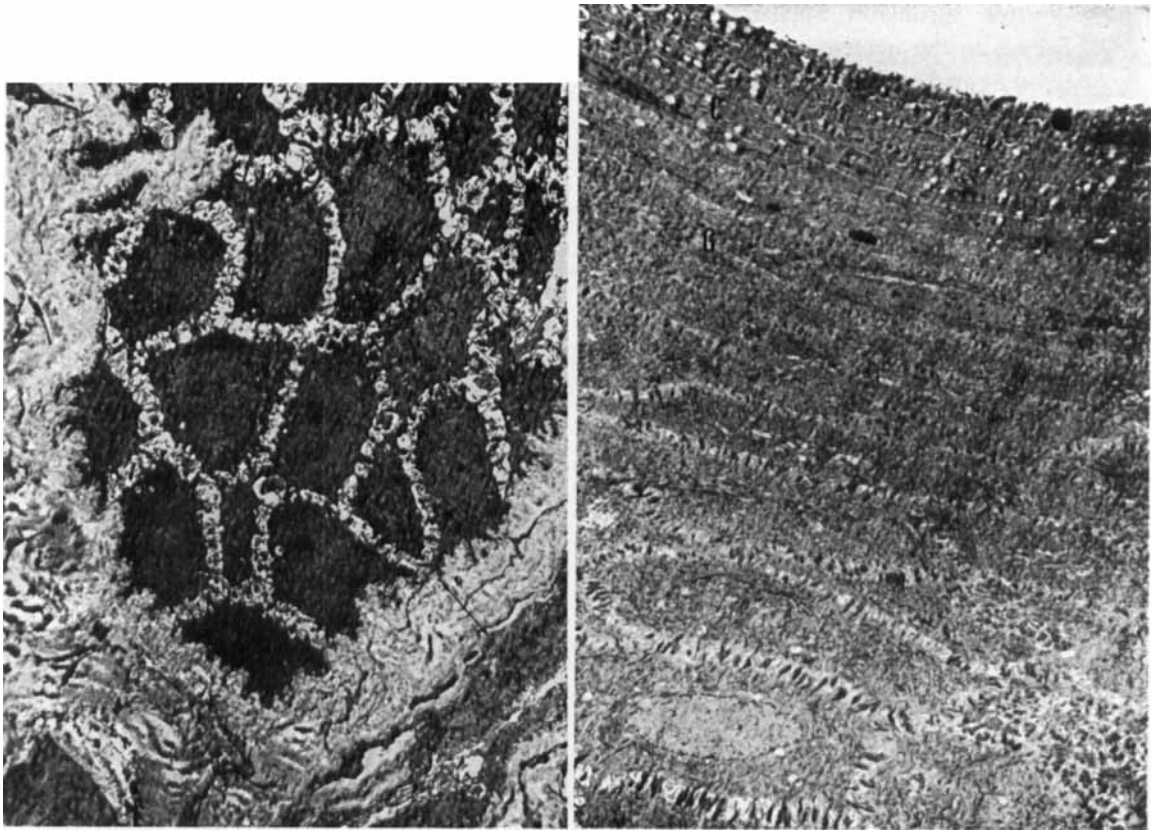


Fig. 10. Electron micrograph of an epithelial ridge in a clinically normal, denture-supporting mucosa in a case of localized denture stomatitis. There is a 5-micron wide band of dense fibrous tissue separating the epithelium from the cellular components of the connective tissue (arrow). × 6000.

Fig. 11. Area of normal, denture-supporting mucosa in a case of localized denture stomatitis. A thin layer of the stratum granulosum (G) is seen below the stratum corneum (C). The small vacuoles (arrows) in the keratinized surface cells also appear in normal tissue. × 6000.

tissue; these were all covered by the lamina densa of the electron microscopic, basement membrane. The basement lamina was continuous, and appeared mostly as a single moderately dense layer (Fig. 10).

Stratum basale. The basal cells were of fairly equal size, and were separated by a clear intercellular space about 1 μ wide. The cytoplasm contained tonofilaments in bundles, freely arranged ribosomes and mitochondria with a normal structure. The density of the nucleus equaled that of the cytoplasm. The nuclear membrane was less irregular than in the stomatitis specimens, with only one or two major indentations. The chromatin and the nucleolus were identified as areas of slightly increased density (Fig. 10).

Stratum spinosum and stratum granulosum. The spinous cells closely resembled the basal cells. Towards the surface of the epithelium they increased slightly in volume, but their general cytoplasmic and nuclear features were maintained even when they gradually assumed a flattened shape. The intercellular space was gradually reduced in width. Desmosomes were more numerous in all the strata, compared with the stomatitis tissue. There were characteristic Odland bodies and, in the

flattened cell layers, keratohyaline granules (Fig. 11).

Stratum superficiale. The keratinized surface cells contained numerous egg-shaped clear vacuoles about 0.5 μ in diameter (Fig. 11), which is a normal finding.

DISCUSSION

The present study is a reexamination of a material previously analyzed by *Anneroth & Wictorin* (1975). Two years ago these patients received denture treatment to eliminate the existing denture stomatitis. They were also instructed regarding hygienic measures. When comparing the clinical data with previous records, it was found that a complete clinical healing of the denture stomatitis was obtained in only one patient. The remaining nine patients still displayed an obvious denture stomatitis, though their clinical manifestations were less pronounced. The reduced or inhibited keratinization, which was found in this study, may in part, depend on longtime denture-wearing as suggested by *Markow* (1969).

The epithelium of the denture-wearing mucosa is liable to intermittent loading and possibly also attrition during the masticatory movements. The epithelium is also tightly covered and confined under the denturebase. The local conditions in the fluid-filled space between the denturebase and the epithelial surface are such as to promote bacterial growth. The situation may resemble the condition in the gingival sulcus and the pathological pocket where the epithelium is facing a fluid-filled space, closely adjacent to the root surface. Hence, there are reasons to believe that the conditions under the denture-base favours the creation of an artificial ecological system, which has many features in common with that in the gingival pocket.

Carlsson et. al. (1969) demonstrated that the insertion and use of full dentures rapidly interfered with the normal flora of the edentulous mouth. They found that colonization of *Streptococcus mutans* and *Str. sanguis* occurred on the denture, and they suggested that the markedly increased concentration of these organisms was related to the presence of a solid surface suitable for colonization. These observations should be seen in relation to the fact that *S. mutans* and *S. sanguis* play an important role in the formation of the dental plaque (*Goldman & Cohen*, 1963). These organisms may play either a commensal or pathogenic role in periodontal disease (*Savage*, 1972).

The type of host-parasite relationship responsible for the tissue-reactions in periodontal disease might therefore be considered also in discussions concerning the pathogenesis of denture stomatitis.

As shown morphologically and microradiographically, no orthokeratinization was found in the patients suffering from denture stomatitis. The changes found in the light microscope were in part similar to those reported by *Östlund* (1958), *Markow* (1969), *Nedelman, Gamer & Bernick* (1970) and *Anneroth & Wictorin* (1975). The observations indicate that gingivitis and denture stomatitis have certain morphological features in common. On the light microscopic level the acanthosis and the epithelial proliferation of the rete pegs alternating with atrophic areas is similar to the morphological features of the pocket epithelium in periodontitis (*Glickman*, 1972). Dense accumulations of leucocytes within the epithelium are also frequently seen in both conditions. The distribution of lymphocytes and plasma cells corresponds to the

pattern observed in periodontal disease (*Zachrisson*, 1968).

The loss of collagen bundles is clearly demonstrated in the microradiograms. This destructive tissue reaction paralells the collagenolysis which occurs in periodontal disease (*Goldman & Cohen*, 1973).

On the ultrastructural level there were, in the stomatitis specimens, marked deviations, not only from the non-denture-wearing palatal mucosa described by *Thilander* (1968 a), but also from the clinically normal denture-wearing mucosa included in the present material.

The reduced thickness of the epithelium, the absence of orthokeratosis, the reduced amount of tonofilaments and Odland bodies, the markedly widened intercellular spaces, especially in the stratum basale, and the intense infiltration of plasma cells and lymphocytes in the connective tissue and in the epithelium, are characteristic features of the inflammatory process of the stomatitis specimens. Similar ultrastructural changes occur in the chronic marginal gingivitis as demonstrated by *Thilander* (1968 b), *Freedman, Listgarten & Taichman* (1968), *Schroeder* (1968) & *Gavin* (1970).

The tissue reactions to the dental plaque are still not fully understood. An increasing amount of scientific evidence (*Rizzo & Mergenhagen*, 1965, *Brandtzaeg*, 1966, *Dick & Trott*, 1970) suggests that the reaction of the host to the bacterial plaque and its products is more important than the deteriorating effect of bacterial toxins and enzymes *per se*. The pronounced accumulation of highly active plasma cells in the connective tissue and small lymphocytes in the epithelium suggest an immunological reaction, which may explain the clinical features of denture stomatitis.

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