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HISTOLOGIC CHANGES IN THE UPPER ALVEOLAR PROCESS AFTER EXTRACTIONS WITH OR WITHOUT INSERTION OF AN IMMEDIATE FULL DENTURE

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INTRODUCTION

Healing of extraction wounds in man has been examined by histologic techniques on autopsy (*Steinhardt,* 1932; *Claflin,* 1936) and biopsy specimens (*Mangos,* 1941; *Thilander,* 1956; *Amler, Salman & Bungener,* 1964). A number of studies on laboratory animals have been reported, the earlier ones usually on the dog (*Euler,* 1923; *Schram,* 1929; *Balogh,* 1932; *Mayer,* 1935; *Claflin,* 1936, 1937), and later also on the Rhesus monkey (*Simpson,* 1960, 1961) and white rat (*Huebsch et al.,* 1952; *Frandsen & Pindborg,* 1961; *Frandsen & Becks,* 1962; *Wade & Fleming,* 1962; *Frandsen,* 1963).

The results of the above-mentioned studies have yielded a largely consistent impression of the course of healing of extraction wounds: (*i*) formation of blood clots in the socket; (*ii*) organization of the clot by the formation of granulation tissue; (*iii*) replacement of the granulation tissue by connective tissue; (*iv*) formation of osteoid tissue, which gradually is converted to new bone, filling out the socket; (*v*) remodelling processes in the

socket and adjacent area of the alveolar process; (*vi*) epithelialization of the wound surface parallel with the reparative processes in the socket.

The time at which the various phases of healing occur varies slightly from one worker to another. It is strikingly slower in man than in the animals studied (*Claflin,* 1936; *Mangos,* 1941; *Frandsen,* 1963).

The effect on healing of factors such as the surgical technique, infection, hypovitaminosis, irradiation, drugs and root fragments has been examined in some of the above studies, and then attention has been directed chiefly on the course of healing in the socket, with no detailed examination of the reconstructive processes in the surrounding bone.

The most suitable time for fitting a full denture after extraction and the effect of immediate insertion on the healing and resorption of the alveolar process has been much discussed. By means of measurement on casts *Johnson* (1963, 1964) has studied changes in the upper alveolar process, and *Wictorin* (1964), using an X-ray photogrammetric method, examined the resorption in the upper anterior segment in a large series. Both workers found that patients receiving the denture immediately after full extraction displayed less resorption than those whose denture was not fitted until after a period of healing. However, in an X-ray cephalometric study of changes in shape of the lower alveolar process after full extraction *Carlsson & Persson* (1967) found no difference in resorption of the lower anterior segment between the group in which the denture was fitted immediately and that in which there was a delay of 2 months.

Except for a study by *Hedegård* (1962) the effect of prosthetic treatment on the healing and reconstruction in the alveolar process would appear not to have been examined histologically. In the present investigation the course of healing and changes in the alveolar process after extraction have been examined histologically in patients with and without immediate dentures.

MATERIAL AND METHOD

The material for the study consisted of patients for whom extractions of all the upper teeth was indicated; they were selected according to the following criteria.

The central incisors should be without apical or advanced periodontal changes. The alveolar bone margin should be at the same level at the 2 central incisors and situated not apically of the border between the coronary and the middle third of the root, as indicated on intra-oral radiographs. The patients should be of sound health and willing to participate in the study.

The patients were collected in two stages. In the first it was intended to form 2 groups of 10 patients, the first group being fitted with the denture immediately after extraction (immediate group) and the other at the end of a 3-month period (conventional group); a comparison of the healing in these 2 groups was to be made.

In the second stage the object was to examine the tissue changes of 16 patients after different healing periods so as to supplement the observations made after the 3-month-healing period and thus obtain a dynamic picture of the healing process. Alternate patients were assigned to the immediate and conventional groups. The observation periods were made as nearly as possible the same for 2 consecutive patients in the series.

A number of patients were lost to the material for various reasons (moving from the district, refusing the second biopsy procedure, etc) and the remaining material consisted of 30 patients; the distribution was then: immediate group 17, conventional group 13. The age and sex distribution and the observation periods of the 30 patients are presented in tables I and II.

The first biopsy specimen was taken immediately after the

Table I

Age and sex distribution for the immediate and conventional groups

Age (years)	20—29	30—39	40—49	50—59	60—69	Total
Men						
Immediate group	3	1	1			5
Conventional group	3	2		2		7
Women						
Immediate group	2	2	4	3	1	12
Conventional group	3	1	1	1		6
Total	11	6	6	6	1	30

Table II

Keratinization of the epithelium and presence of inflammation in the subepithelial connective tissue

Patient	Age (years)	Sex	Healing period (days)	Epithelium			Subepithelial connective tissue		
				Before	After	Change	Before	After	Change
Immediate group									
I.H.	20	F	3	K	K	0	N	N	0
G.N.	58	F	7	K	K	0	N	N	0
G.G.	26	F	9	(K)	P	—	(I)	I	+
K.L.	22	M	17	P	P	0	(I)	(I)	0
L.L.	24	M	25	K	P	—	N	N	0
A.A.	37	M	39	K	K	0	N	N	0
A.L.	62	F	40	P	K	+	N	N	0
M.A.	40	F	91	(K)	(K)	0	N	N	0
K.E.	44	M	91	P	P	0	N	N	0
J.E.	53	F	92	K	P	—	(I)	(I)	0
A.J.	39	F	93	(K)	P	—	N	N	0
L.J.	26	M	93	P	P	0	N	I	+
M.L.	47	F	96	P	P	0	I	I	0
R.S.	35	F	99	(K)	(K)	0	N	I	+
E.S.	56	F	101	(K)	P	—	N	I	+
E.Ö.	43	F	102	(K)	(K)	0	N	N	0
K.G.	40	F	210	P	P	0	N	I	+
Conventional group									
A.J.	53	M	7	P	P	0	N	N	0
G.L.	45	F	9	P	P	0	N	N	0
B.N.	20	F	23	A	A	0	I	I	0
M.W.	25	M	25	K	P	—	I	I	0
A.H.	52	F	37	K	P	—	I	I	0
T.B.	34	M	42	(K)	K	+	N	N	0
I.B.	25	F	90	P	K	+	N	N	0
G.E.	52	M	92	(K)	(K)	0	N	N	0
I.E.	28	M	93	(K)	(K)	0	N	N	0
B.J.	35	M	94	P	P	0	(I)	(I)	0
I.J.	23	F	94	P	P	0	N	N	0
R.Ö.	30	F	95	K	K	0	N	N	0
G.D.	23	M	129	(K)	(K)	0	N	N	0

Legend: K, continuous keratinization; (K), local keratinization;
P, parakeratotic; A, absence of keratinization; N, none; (I) mild;
I, pronounced inflammation;
+ increased keratinization and inflammation, respectively
— decreased keratinization and inflammation, respectively

extractions of the upper incisors. At the middle of the 1+ a section of the labial alveolar wall into the extraction socket, including gingiva and bone, was removed; it measured about 10 mm in length and 3—4 mm in width, and tapered upwards. The defect in the labial alveolar wall was then covered, using a lateral sliding flap technique.

The second specimen was taken at different times after extraction (Table II). In the region of the +1 a section was removed comprising the labial part of the alveolar process with gingiva, bone and the content of the socket as far as the palatal wall of the alveolus. The labial surface of the specimen had about the same dimensions as that taken at the 1+. The technique used to cover the defect, was the same as described above.

The specimens were fixed in 10 per cent neutral formalin, demineralized in 5 per cent nitric acid and embedded in paraffin wax. Five-micron sections were cut at right angles to the labial surface of the specimen. They were stained by the following methods: (a) haematoxylin and eosin, (b) van Gieson's, (c) azan, (d) Gomori's silver impregnation, (e) toluidine blue and (f) periodic acid Schiff reaction; methods *a* to *d* were performed according to *Romeis* (1948), and *e* and *f* according to *McManus & Mowry* (1963).

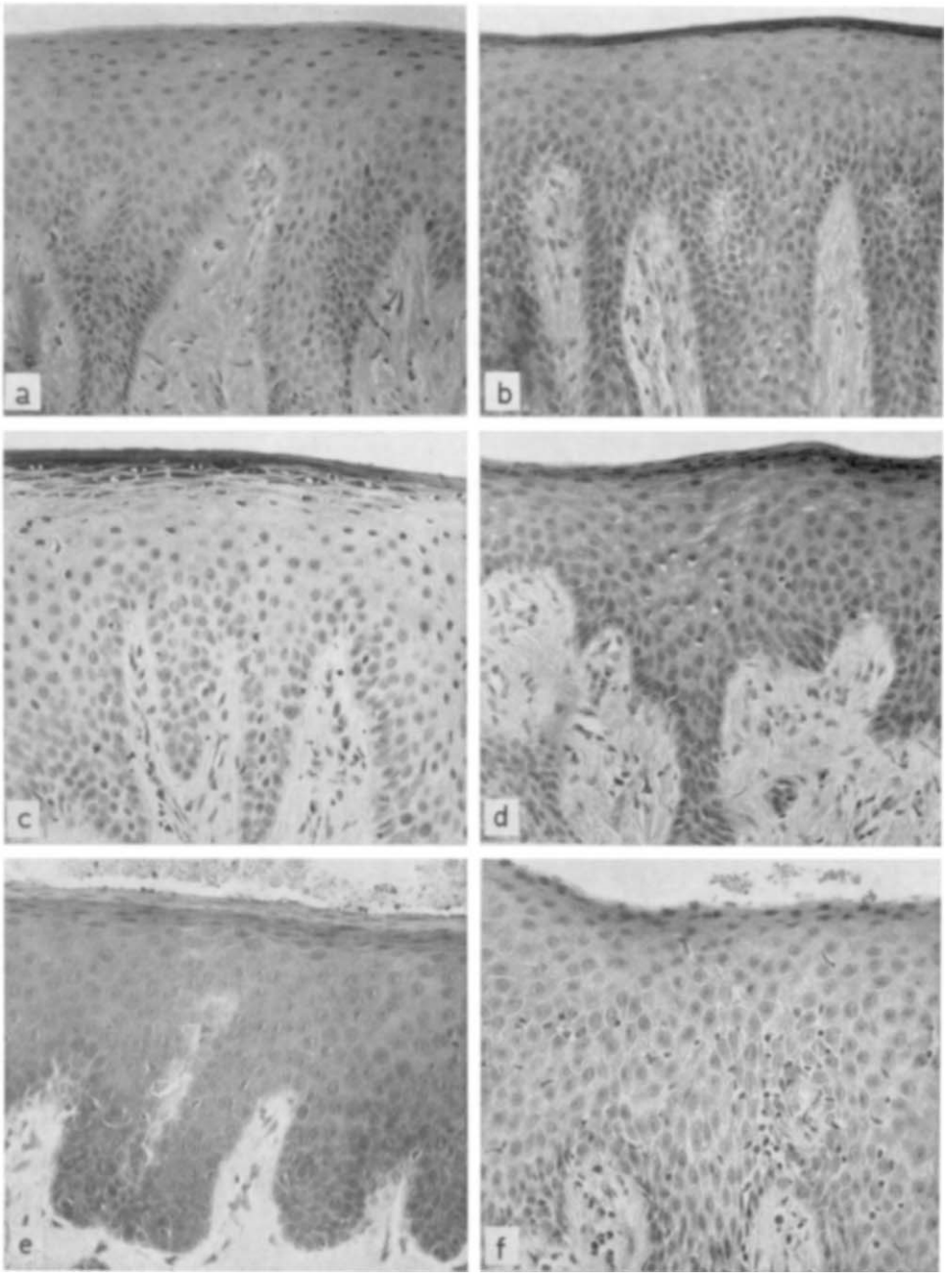
The histologic examination of the specimens was centred chiefly on changes in the keratinization of the epithelium, the presence of an inflammatory reaction in the subepithelial connective tissue and the reconstructive processes in the labial bone plate in connection with the healing of the socket.

The specimens were examined by 2 of the authors independently and without knowledge of which group they belonged to.

RESULTS

Epithelium and subepithelial tissue

In all the specimens taken immediately after the extraction (referred to below as the "first specimens") a mild or moderate inflammatory reaction was observed in the marginal gingival border. For comparison with the corresponding second biopsy (the "second specimen") the labial part of the specimen, corresponding to the attached gingiva, was therefore examined.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The degree of keratinization of the epithelium often differed within the same specimen. Such specimens were described as displaying local keratinization.

Of the first specimens 8 exhibited general and 10 local keratinization and 11 parakeratosis, while in one patient the surface layer consisted only of flattened cells and showed absence of keratinization. A well developed stratum granulosum was found in 8 of the 18 patients with general or local keratinization of the epithelium. Subepithelial inflammation was found in 8 cases, and in 4 of these it was classified as mild.

Comparison of the first and the corresponding second specimen disclosed in the conventional group a change from parakeratosis and local keratinization to general keratinization in 2 cases and the reverse change from keratinized epithelium to parakeratotic in 2 others. In this group there was no change as regards inflammation of the subepithelial connective tissue (Table II).

In the immediate group one subject was found to display a change from parakeratotic to keratinized epithelium (observation period 40 days); in 3 cases there was a change from general or local keratinization to parakeratosis and in 2 other cases with an observation period of 3 months the changes were pronounced and practically all evidence of cornification had disappeared (Fig. 1). In the subepithelial connective tissue the infiltration of inflammatory cells appeared to have increased in 5 patients (Table II; Fig. 2).

Incipient proliferation of the epithelium peripherally from the alveolar border over the surface of the extraction wound was observed 3 days after extraction. Epithelialization appeared to have been complete after about 25 days. After as long as 3 months the epithelium over the area of the extraction wound was usually parakeratotic. There was no obvious difference between the treatment groups as regards the epithelialization.

Fig. 1. Changes in surface layer of epithelium from first to second specimen. Immediate group.

a and *b:* From parakeratotic to keratinized; observation period 40 days.

c an *d:* From keratinized to parakeratotic; observation period 25 days.

e and *f:* From parakeratotic (from a specimen with local keratinization) to flattened surface cells (absence of keratinization); observation period 101 days. Hematoxylin and eosin.

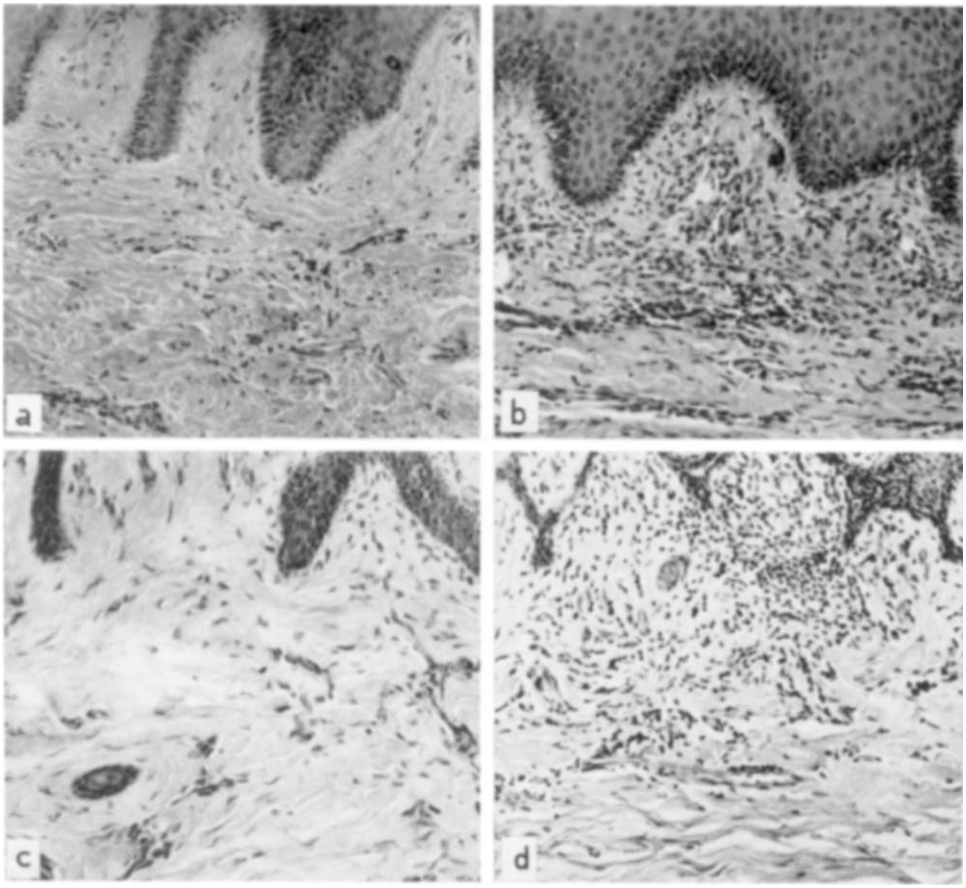


Fig. 2. Increase in subepithelial inflammatory reaction from first to second specimen. Immediate group.
a and *b:* Observation period 9 days.
c and *d:* Observation period 101 days. Hematoxylin and eosin.

Content of socket

In the specimen taken 3 days after the extraction the socket was filled with a blood clot in which there were thick fibrin strands. Peripherally at the alveolar wall there was incipient organization of the clot. After 7 days there were only small, central residues of the clot, and after 9 days it had been completely replaced by granulation tissue.

In specimens taken more than 20 days after the extraction the granulation tissue had been replaced completely by fibrous con-

nective tissue in all but 2 cases (one from each group) 25 and 37 days after extraction; here the granulation tissue remained in the central part of the socket (Fig. 4 b).

There was no difference between the 2 groups in respect of the state of healing.

Labial bone plate and bone formation

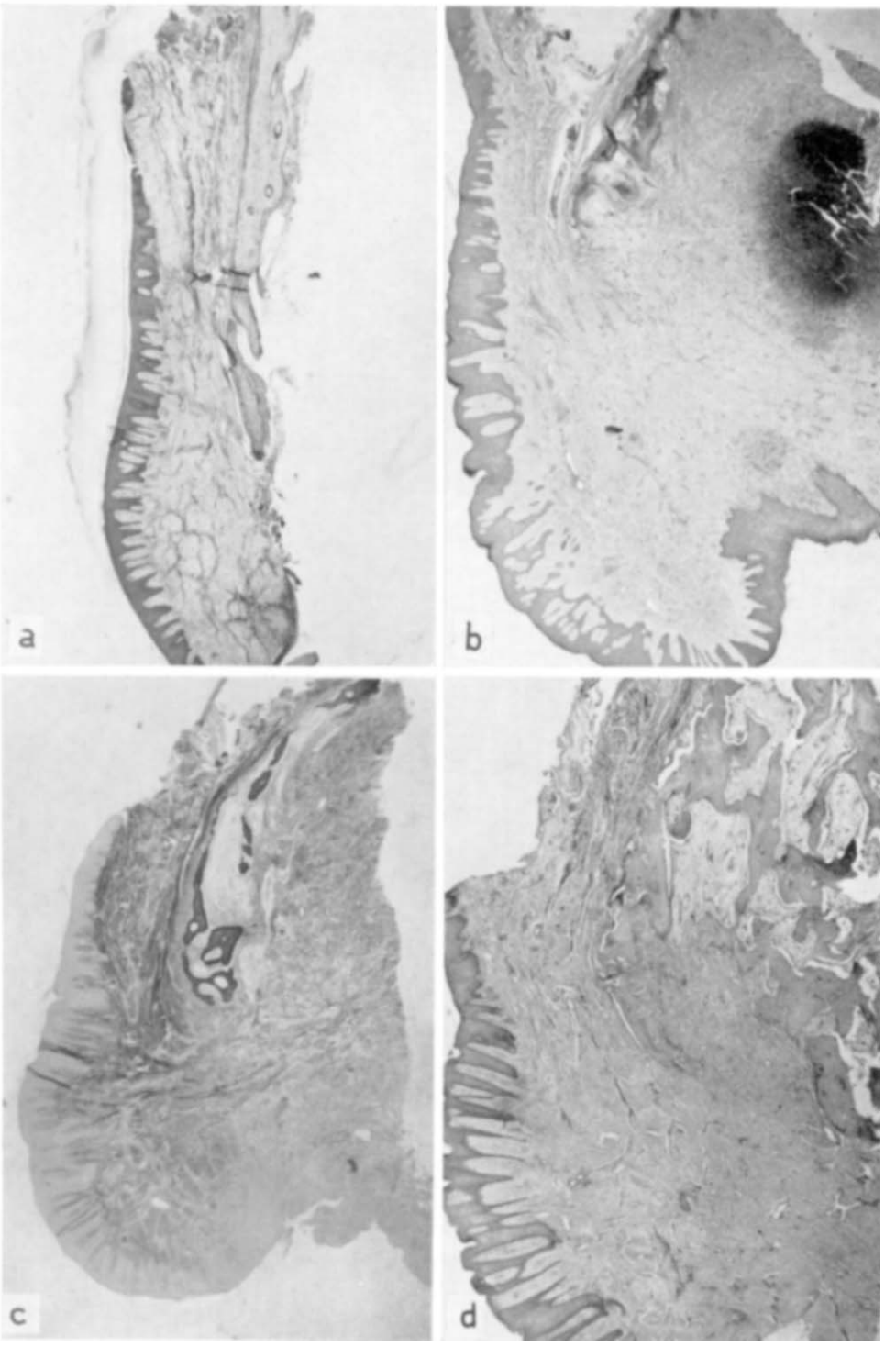
In the specimen taken 3 days after extraction no changes were found in the labial bone plate. After 7—9 days there was in both groups incipient resorption of the labial bone plate as evidenced by the osteoclastic activity. The resorption began in the extreme marginal region of the bone plate, chiefly on its buccal surface (Figs. 6 a, b). After about 20 days it had resulted in a considerable thinning of the marginal part (Figs. 3 b, 4 b, 5, 6 c, d), and after 40 days only small fragments of the original bone could be found in the most apical part of the specimens (Figs. 3 c, 4 c, 7).

Parallel with this resorption process new bone was formed; this began next to existing bone in the periphery of the socket, that is to say, from the alveolar side of the bone plate. The first sign of such formation was seen in specimens taken after 7—9 days. This tissue was of a coarse fibrillar nature. On the specimens taken after about 20 days the new tissue projected as short spicules or trabeculae into the connective tissue. This tissue in the former socket contained no "isolated islands" of new bone; what in individual sections might seem to be such islands of new bone were found by following a series of sections to be parts of a trabeculum from the socket wall.

As mentioned above, after 40 days the labial bone plate had practically disappeared and was partly replaced, or in the course of replacement, by a newly formed bone plate; this, however, was not continuous and lamellar as the original one.

Of the 4 patients with a healing period of about 40 days one in the immediate group had a socket that was almost completely filled with bone and the other displayed a moderate formation of bone tissue towards the centre of the socket, while in the 2 patients in the conventional group the activity seemed to be restricted to reconstruction of the alveolar wall (Figs. 3 c, 4 c, 7).

In the 15 patients with an observation period of about 3 months after extraction there were also large variations in bone forma-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tion. In 7 (4 in the immediate group, 3 in the conventional) the sockets were largely filled with osseous tissue (Figs. 3 d, 4 d). In the other 8 the formation of osseous tissue appeared to have been restricted to areas near the alveolar wall and the rest of the former socket consisted of connective tissue. In some of the patients, where the formation of osseous tissue was farthest advanced, the bone trabeculae near the original alveolar wall were mature and rather lamellar in structure, while the central trabeculae consisted of osseous tissue with an immature irregular structure. In 4 patients in the immediate group and one in the conventional group there was a continuous labial bone plate, which, however, was much more uneven than the corresponding part prior to extraction. In the other 10 patients and in the 2 with the longest observation period there was no continuous bone plate.

Signs of the continuous process of reconstruction in the form of resorption and bone apposition in the osseous tissue formed in the earlier socket were seen in specimens with the longest observation periods.

New bone was distinguished from old on the basis of the structure and staining properties. The new tissue was irregular compared with the typical lamellar structure of the original labial bone plate. In the new bone the osteocytes were more numerous, larger and rounder than those in the original bone plate (Fig. 5, 6 d, 7 c). In the 23-day and later specimens the residues of the original bone seemed to be necrotic, to judge from the numerous empty bone lacunae.

DISCUSSION

The degree of keratinization of the epithelium varies widely in different areas of the oral cavity, and even in the area corresponding to the denture-bearing mucosa of the maxilla (*Pendleton*,

Fig. 3. Reconstruction of the labial bone plate. Conventional group.

a: Labial bone plate immediately after extraction.

b: 25 days after extraction. Resorption of the bone plate mainly from the labial side and new bone at the side of the socket.

c: 37 days after extraction. The original labial bone plate has been entirely replaced by new bone.

d: 95 days after extraction. The socket filled with bone.
a-c van Gieson, *d* Hematoxylin and eosin.

1951). In all his 22 subjects without dentures *Östlund* (1953) found a well developed stratum corneum resting on a stratum granulosum in the palatal mucosa. *Wentz, Meier & Orban* (1952) found that clinically attached gingiva displayed complete cornification in 92 per cent of their cases, while *Weiss, Weinmann & Meyer* (1959) found only 32 per cent with full keratinization in the same area of the uninflamed gingiva. In the first specimens of the present series 8 patients (26 per cent) were judged to have a continuous stratum corneum, and in 10 (33 per cent) the epithelium exihibited both local keratinization and parakeratosis. Such discrepancies in reports may be due in some measure to differences in the series and the fact that the specimens were taken from different regions of the mouth, and partly to differences in staining technique and definitions. For instance, several of the authors mentioned stated that various degrees of keratinization could be found in neighbouring areas of the same section, and this was also the case in the present series. There is also a diffuse boundary between ortho- and parakeratotic epithelium.

Various histologic alterations have been observed in the denture-bearing mucosa, and the actual wearing of a denture as the cause of these changes has been interpreted in different ways. *Pendleton* (1951) found similar mucosal changes in edentulous areas of the jaws in patients both with and without dentures. On the basis of a histologic examination of 291 specimens *Östlund* (1958) found that in connection with the wearing of dentures keratinization of the palatal mucosa diminished and even disappeared, and oedema of the subepithelial connective tissue ensued. On the other hand, in a follow-up study of 9 patients, *Kapur & Shklar* (1963) found increased keratinization and no inflammatory changes in the mucosa of the ridge after dentures had been worn for 3 months. According to *Turck* (1965) no differences in the histologic appearance of the denture-bearing

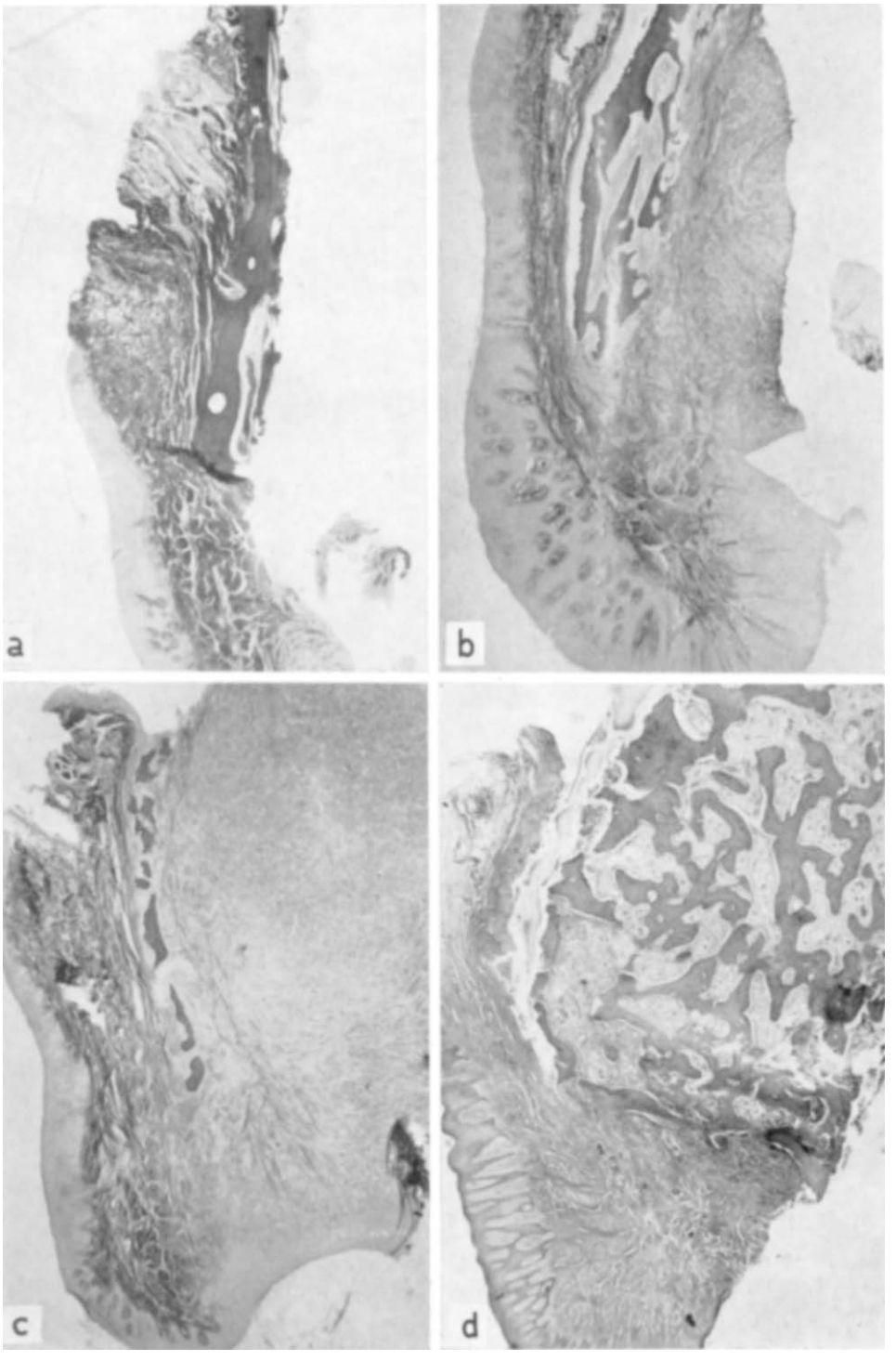
Fig. 4. Reconstruction of the labial bone plate. Immediate group

a: Labial bone plate immediately after extraction.

b: 25 days after extraction. Remnants of the original bone plate still visible. New bone at the side of the socket. An old haematoma surrounded by granulation tissue in the centre of the socket.

c: 40 days after extraction. The original labial bone plate has been entirely replaced by new bone.

d: 91 days after extraction. The socket filled with bone.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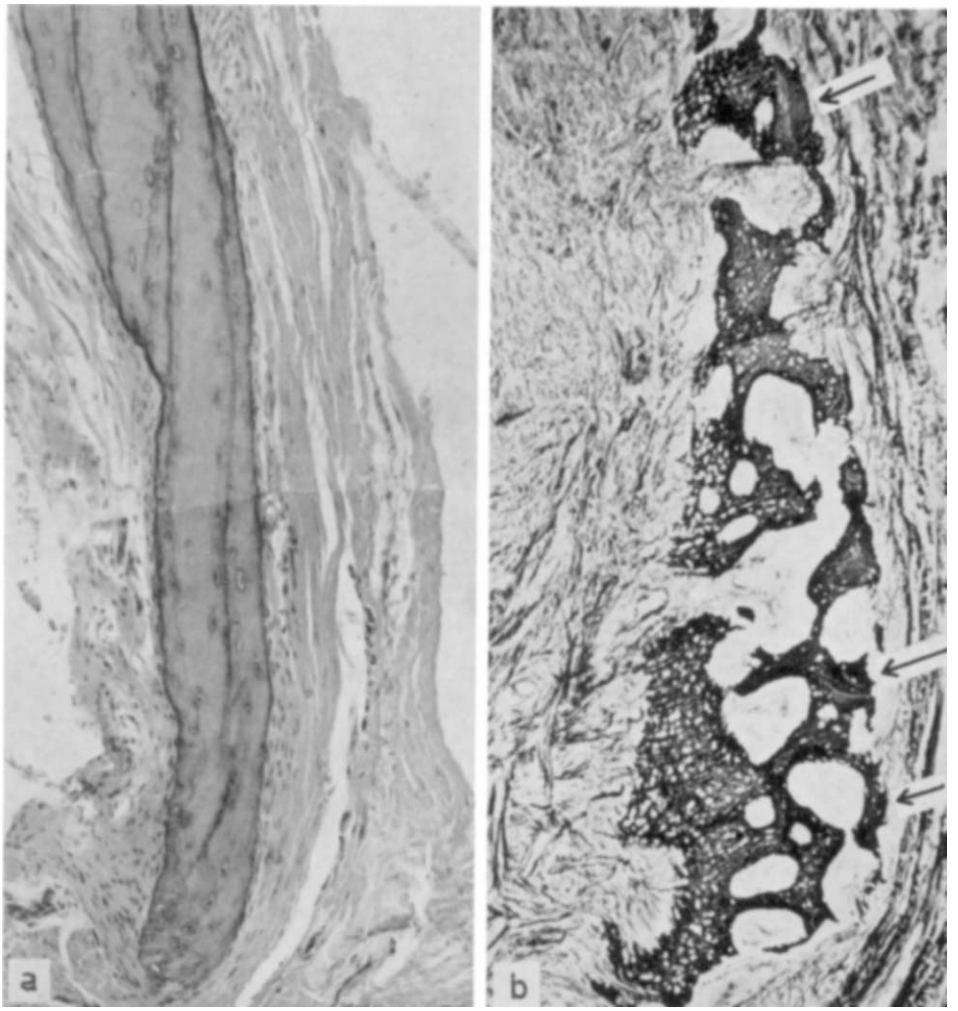

Fig. 5. Labial bone plate (*a*) immediately and (*b*) 25 days after extraction. *b:* On the labial side (to the right) remnants of the original bone plate (*arrows*).
a: Hematoxylin and eosin, *b* Gomori's silver impregnation.

and other mucosa were found in patients with well-fitting dentures, while abnormal mucosal reactions were found under ill-fitting dentures. By means of a cytologic technique *Al-Ami, Shklar & Yurkstas* (1966) have found that the wearing of dentures resulted in a decrease in keratinization. In our series the

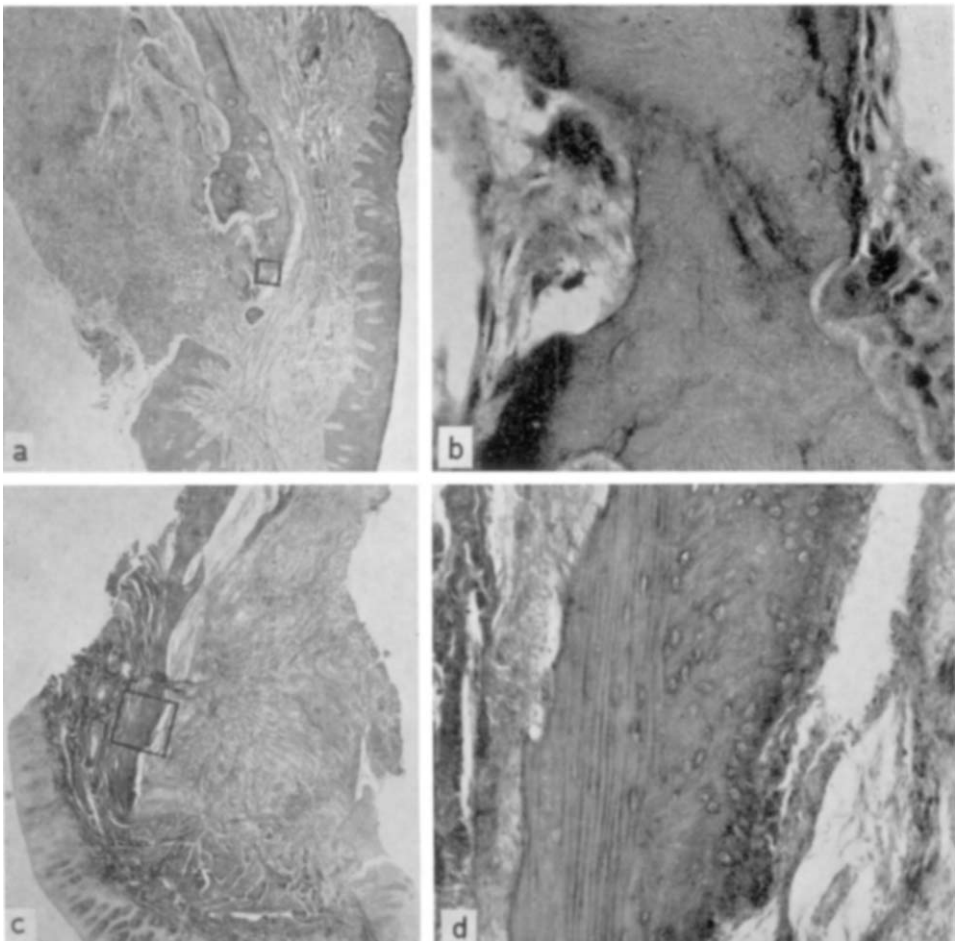

Fig. 6. *a* and *b:* Labial bone plate 7 days after extraction. Osteoclastic activty

Fig. 6. *a* and *b:* Labial bone plate 7 days after extraction. Osteoclastic a at its margin; framed area of *a* shown at higher magnification in *b*.

c and *d:* Labial bone plate under reconstruction 23 days after extraction. *d* shows at higher magnification the different appearance of old (*left*) and new (*right*) bone (framed area of *c*). Conventional group.

a and *b:* Hematoxylin and eosin; *c* and *d* van Gieson.

same tendency was observed, and in addition there was a greater degree of inflammation, probably due to the irritative action of the denture. Our results are in this respect in agreement with those of *Östlund* (1958). Increased keratinization was seen in

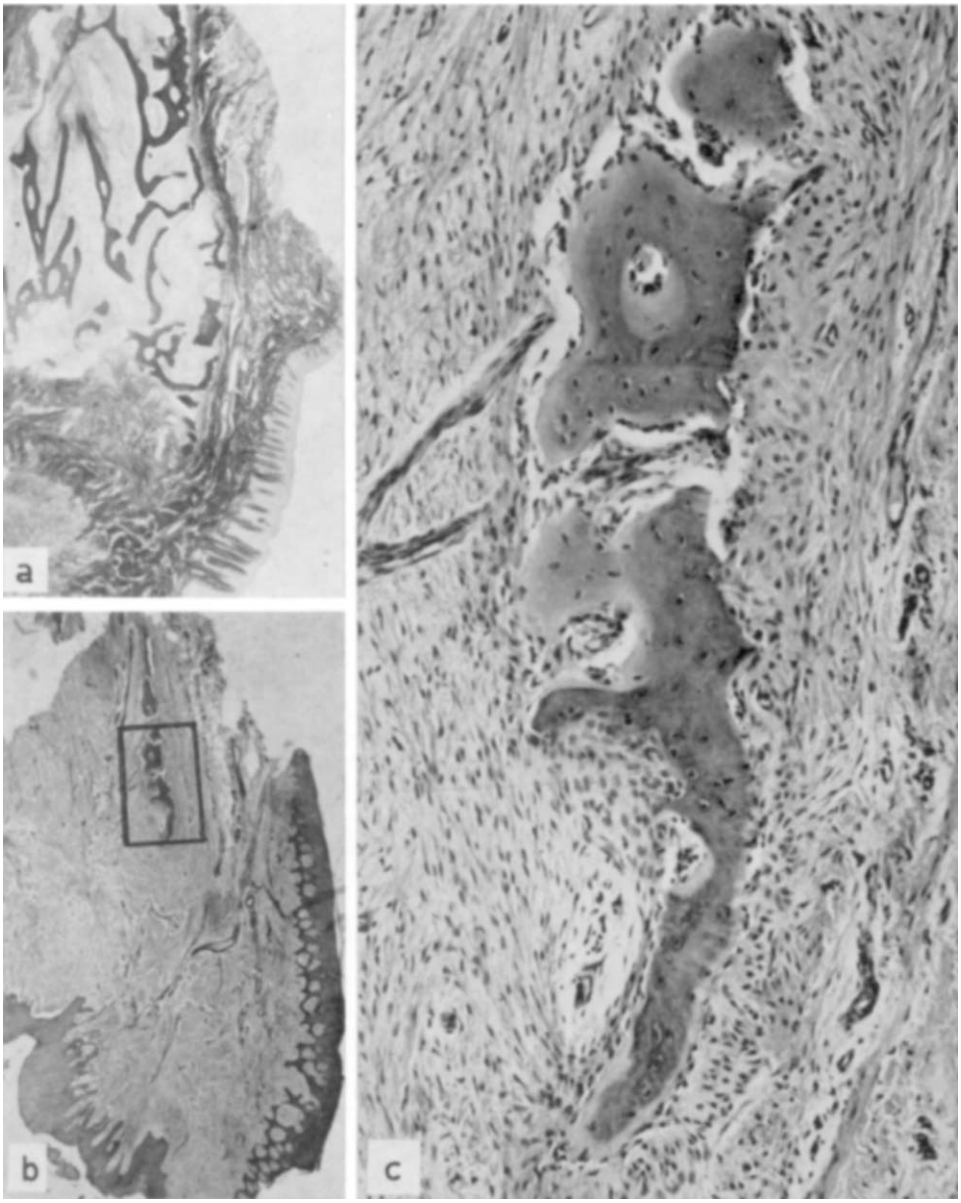

Fig. 7. Variability in the rate of healing.

a: 39 days after extraction, immediate group. Socket filled with bone.

b: 42 days after extraction, conventional group. Only a small amount of new bone at the site of the original labial bone plate, of which nothing is seen.

c: Higher magnification of the framed area in *b*, showing the apperance of the new bone.

only one patient in the immediate group, but in *Kapur & Shklar's* (1963) study it was a consistent finding. The divergences in these results may be due to differences in the effect of the denture in the various regions from which the biopsy specimens were taken.

The transformation of the socket content from the aspect of structure and tissue is largely in agreement with the description by *Amler et al* (1960). In the present series, however, the individual variations in rate and extent of the changes were very marked, even within the treatment groups.

The resorption of bone began about one week after extraction, and after about 3 weeks had resulted in a considerable thinning of the original labial bone plate; in 5—6 weeks this had practically disappeared. In a preliminary report *Hedegård* (1962) considered that in some of the patients the labial bone plate was still present 3 months after extraction. No other histologic studies for comparison of these results have been found. In radiographic studies, however, *Kittner* (1933), *Mangos* (1941) and *Amler et al.* (1960) found that after 20 days the contour of the lamina dura was slightly less well defined, after about 40 days it could no longer be defined clearly, and by 50 days or so had completely disappeared. These results were thus essentially the same as those for the resorption of the labial bone plate found in our specimens by histologic examination.

Apart from the greater individual variation, the picture of bone formation in our specimens is largely consistent with the description by *Amler et al* (1960). No attempt was made in the present study to determine the time at which the mineralization of the new tissue occurs, but it has been examined radiographically and histochemically by other workers (including *Kittner*, 1933; *Lundberg*, 1955; *Amler et al.*, 1960, 1964). Mineralization was reported to have begun after about 20 days and the maximum was reached 100 days to 1 year after extraction.

Although some caution is indicated in evaluation of differences in bone formation between the treatment groups the following might be mentioned. The formation of bone had after about 40 days advanced further in the 2 patients in the immediate group than in the 2 in the conventional group, but for the other observation periods there was no such difference. The resorption of the labial bone plate during the first 40 days would also appear

to be independent of whether or not the denture was inserted immediately after extraction. It is possible, however, that there is a greater tendency for reconstruction of a more continuous labial bone plate in the patients with dentures.

SUMMARY

From 30 patients with indications for extraction of all the maxillary teeth biopsy specimens were taken just after extraction and after an observation period of 3—210 days. The first specimen was taken at the middle of the 1+ and consisted of a section of the labial alveolar wall into the socket measuring 3—4 mm in width and about 10 mm in length. The second specimen was a similar section of the alveolar process in the region of the 1+, and consisted of gingiva, bone and the contents of the socket as far as the palatinal alveolar wall. The patients were assigned to 2 groups, one, the immediate group (17 patients) receiving the full upper denture immediately after the extractions and the other, the conventional group (13 patients), being without the denture during the observation period.

The histologic examination was focused on the changes in keratinization of the epithelium, the presence of an inflammatory reaction in the subepithelial connective tissue and the reconstruction processes in the labial bone plate associated with the healing of the socket.

In the immediate group a reduction in the keratinization of the epithelium was noted in 5 patients and an increased inflammatory reaction in the subepithelial connective tissue in 5, while in the conventional group the changes in the mucosa were negligible.

The first sign of osteoclastic activity was seen after 7 days, and after about 20 days the resorption had resulted in a considerable thinning of the labial bone plate. After about 40 days practically all of the original plate had been resorbed and partly replaced by new bone. There were large individual variations in the rate of bone formation; in one of 4 patients the socket was filled with new bone 40 days after the extraction; after 3 months this proportion was 7 out of 15 patients. No definite differences between the 2 groups were found as regards resorption and the forma-

tion of new bone, but there was a greater tendency for re-formation of a continuous labial bone plate in the patients fitted with a denture immediately after the extractions than in those not wearing dentures during the observation period.

RÉSUMÉ

MODIFICATIONS HISTOLOGIQUES DANS LE PROCÈS ALVÉOLAIRE SUPÉRIEUR APRÈS EXTRACTIONS, AVEC ET SANS POSE D'UNE PROTHÈSE IMMÉDIATE

Des prélèvements pour biopsies ont été faits sur 30 patients chez qui l'extraction de toutes les dents supérieures était indiquée. Ces prélèvements ont été faits d'abord immédiatement après les extractions puis après une période d'observation de 3 à 210 jours. Le premier prélèvement a été fait au niveau du milieu de l'incisive centrale supérieure droite (1+) et consistait en une section de la paroi alvéolaire vestibulaire mesurant 3—4 mm de largeur et environ 10 mm de longueur. Le second prélèvement était une section analogue du procès alvéolaire dans la région de 1+, et comprenait la gencive, l'os et le contenu de l'alvéole jusqu'à la paroi alvéolaire palatine. Les patients ont été divisés en deux groupes, l'un, groupe "immédiat" (17 patients), chez qui la prothèse complète du haut a été posée immédiatement après les extractions, l'autre, groupe "classique" (13 patients), restant sans prothèse pendant la période d'observation.

L'examen histologique a été centré sur les modifications de la kératinisation de l'épithélium, sur la présence d'une réaction inflammatoire dans le tissu conjonctif sous-épithélial et sur les processus de reconstruction prenant place dans la table osseuse externe au cours de la cicatrisation de l'alvéole.

Dans le groupe "immédiat", on a observé une réduction de la kératinisation de l'épithélium chez 5 patients et une augmentation de la réaction de la réaction inflammatoire dans le conjonctif sous-épithélial chez 5 patients, tandis que, dans le groupe "classique", les modifications de la muqueuse étaient négligeables.

Les premiers signes de l'activité ostéoclastique ont été vus au bout de 7 jours, et, au bout de 20 jours environ, la résorption a abouti à un amincissement considérable de la table osseuse ex-

terne. Au bout de 40 jours, la quasi-totalité de la table osseuse originale avait été résorbée et remplacée par du tissu osseux néoformé. La rapidité de la formation osseuse était très différente d'un individu à l'autre; chez un des patients sur quatre, l'alvéole était rempli d'os néoformé 40 jours après l'extraction; au bout de trois mois, la proportion était de 7 patients sur 15. Aucune différence nette n'a été trouvée entre les deux groupes en ce qui concerne la résorption et la néoformation osseuse, mais il existait une tendence plus forte à la reconstruction d'une table extrene continue chez les patients ayant reçu une prothèse immédiatement après les extractions que chez les patients n'ayant pas porté de prothèse pendant la période d'observation.

ZUSAMMENFASSUNG

HISTOLOGISCHE VERÄNDERUNGEN DES OBEREN ALVEOLARFORTSATZES NACH ZAHNENTFERNUNG MIT UND OHNE EINGLIEDERUNG EINER SOFORTPROTHESE

Von 30 Patienten mit Indikation für Entfernung aller Oberkieferzähne wurden jeweils 2 Präparate entnommen, teils unmittelbar nach der Zahnentfernung, teils nach verschiedenen Observationszeiten (3—210 Tage). Das erste Präparat wurde im Bereich des rechten oberen grossen Schneidezahnes entnommen und bestand aus einer 3—4 mm breiten und ca. 10 mm langen Sektion der labialen Wand des Alveolarfortsatzes bis zur Alveole. Das zweite Präparat war eine Sektion des Alveolarfortsatzes von gleicher Grösse aus dem Bereich des linken oberen grossen Schneidezahnes und bestand aus Gingiva, Knochen und Alveoleninhalt reichend bis zu der palatinalen Alveolenwand. Die Patienten wurden in zwei Gruppen eingeteilt. Die 17 Patienten der "Immediatgruppe" erhielten eine obere Vollprothese sofort nach der Entfernung der Zähne; die 13 Patienten der "konventionellen Gruppe" trugen keine Prothese während der Observationszeit.

Die histologische Untersuchung wurde auf Veränderungen der Verhornung des Epithels, Vorkommen von Entzündungserscheinungen des subepithelialen Bindegewebes und Umbauprozesse der labialen Knochenwand konzentriert.

In der Immediatgruppe wurde eine Reduktion der Verhornung des Epithels bei 5 Patienten und eine Verstärkung der Entzün-

dungserscheinungen des subepithelialen Bindegewebes bei 5 Patienten bemerkt, während die Veränderungen der Schleimhaut in der konventionellen Gruppe gering waren.

Die ersten Zeichen osteoklastischer Aktivität wurden nach 7 Tagen gesehen und nach ca. 20 Tagen resultierte die Resorption in einer wesentlichen Verdünnung der labialen Knochenwand. Nach ca. 40 Tagen war der grösste Teil der ursprünglichen Knochenwand resorbiert und teilweise durch neugebildetem Knochen ersetzt worden. Grosse individuelle Variationen der Geschwindigkeit des Knochenaufbaus wurden beobachtet. Bei einem von 4 Patienten war die ganze Alveole 40 Tage nach der Zahnentfernung mit neugebildetem Knochen ausgefüllt; nach etwa 3 Monaten betrug das Verhältnis 7 zu 15 Patienten. Betreffend Ab- und Aufbau des Knochens konnten keine sicheren Unterschiede zwischen den zwei Gruppen festgestellt werden. Es bestand aber eine stärkere Tendenz zum Wiederaufbau einer Zusammenhängenden labialen Knochenwand bei den Patienten, welchen eine Sofortprothese eingegliedert wurde, als bei denen, die während der Observationszeit ohne Prothese waren.

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