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A HISTOLOGICAL STUDY OF SOFT-TISSUE REACTIONS UNDER AND ADJOINING FIXED FREE-END SADDLES

by

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INTRODUCTION

In order to extend the range of indications for fixed restorations a special type of fixed saddle-bridge — so-called superplants — has been designed. These constructions were first used in 1951 (*Dahl*, 1956, 1967). With the help of specially designed saddles resting on the mucosa and soldered to the abutments, it is thus possible to restore extensive edentulous regions.

Histological studies of soft-tissue changes in connection with such saddles have been performed earlier (*Izikowitz*, 1961, 1965, 1966). However, the biopsy specimens could be taken only in the periphery of the saddles by attempting to reach in under the saddles. The excisions were made in a single region at each free-end saddle, in most cases at the buccodistal part. It was not possible to observe any noteworthy changes in the soft tissues in these examinations.

It would, however, be of value to ascertain the status of the soft tissues *centrally* under the saddles. In this way it would be possible to find out whether a study of the peripheral and the central saddle regions gives equivalent histological results or whether e.g. changes occur only centrally under the saddles, changes which might constitute a contraindication for permanently fixed saddle-bridges. It is possible to elucidate this problem, due to

Received for publication, September 4, 1968

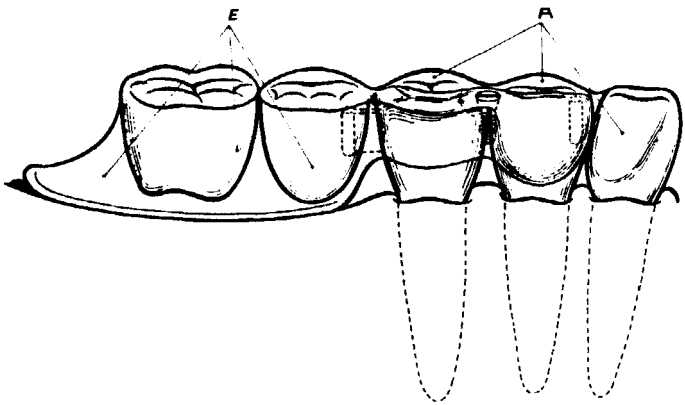

Fig. 1. Saddle-bridge with extension (E) fixed to anchorage (A) by means of attachment, screw and retention peg (removable only by dentist). Viewed orally.

an equivalent construction — the fixed bridge with saddles removable only by the dentist (Fig. 1) — which makes it possible, without destroying the construction, to observe the tissue reactions in the entire saddle region (*Izikowitz & Wedendal*, 1968).

It is only now that the writer has had access to a patient material with saddles removable only by the dentist.

The aim of the present study has been to ascertain whether histologically demonstrable differences in the soft tissue, as between different regions, occur in connection with fixed free-end saddles. To this end the following questions have been studied:

1) a. Are there histologically demonstrable differences in the soft tissue as between peripheral and central regions in connection with fixed free-end saddles?
   b. Is there a correlation with respect to the degree of changes between peripheral and central regions?

Besides the above, the following questions have also been studied:

2) a. Are there histologically demonstrable differences in the soft tissue as between distal and mesial regions in connection with fixed free-end saddles?
   b. Is there a correlation with respect to the degree of changes between distal and mesial regions?
3) Are there differences between loaded and unloaded parts of the ridge?

MATERIAL AND METHOD

In order to ensure the greatest possible homogeneity in the material the following criteria for the material were applied:

Only bilateral lower-jaw constructions implicating all remaining teeth were to be studied. These were to be furnished with one or more free-end saddles of Vitallium or C-gold.*) Only one saddle in each individual was included for study. In the case of constructions with two free-end saddles one saddle was taken by lot. The length of the saddles was to be at least 18 mm. In an opposing jaw only natural teeth and/or fixed bridges were to be accepted. The minimum follow-up period was to be one year. All constructions were to be the work of one and the same therapist (Wedendal).

Nineteen patients met the above requirements. A number from 1 to 19 was assigned to each patient by lot. The patients allotted the numbers 1 to 10 were summoned for registration. Of these, two patients were unable to present themselves on account of illness. Another two patients, nos. 11 and 12, were accordingly contacted, and these duly presented themselves.

The total number of recorded patients was thus 10, 2 men and 8 women. The patients' ages at the time of recording was between 44 years and 68 years, with an average age of 57 years.

Of the 10 saddles, 8 were of C-gold and 2 of Vitallium.

The length of the saddles was between 19 and 53 mm, with a mean length of 27.8 mm.

The number of teeth per saddle varied between 2 and 8, with on an average 3.1 teeth to a saddle.

The follow-up period for the constructions was between 12 months and 49 months, with an average observation period of 22 months.

The total number of biopsies was 50, of which 5 were taken for each patient on previously determined regions. Further, it was decided to take biopsy specimens also where clinical changes occurred in other parts of the saddle region. However, no such changes were observed.

The biopsy specimens were taken with a round punch with a diameter of 2 mm. Before fixation the biopsies had a thickness of about 2 mm, i.e. the section was located close to the periosteum, though care was taken not to damage this.

Five biopsy specimens were taken in each patient from the following regions at right angles to the mucosa (Fig. 2).

1. With the construction *in situ;*

at the vestibular part of the margin of the saddle, both distally (PD)

*) John Sjöding & Co., Solna, Sweden

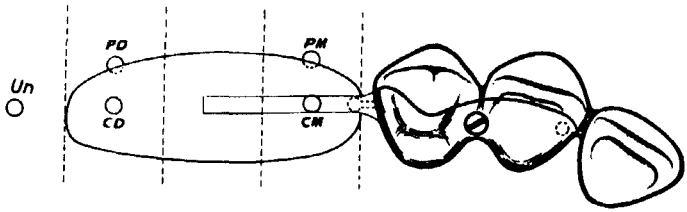

Fig. 2. Position of the biopsy specimens.
The length of the saddle is divided into three equal parts, a mesial part, a middle part and a distal part.
The sites of the biopsy specimens are marked as follows.
PD = peripherally and distally (peripheral in the middle of the distal part of the saddle)
PM = peripherally and mesially (peripheral in the middle of the mesial part of the saddle)
CD = centrally and distally (central in the middle of the distal part of the saddle)
CM = centrally and mesially (central in the middle of the mesial part of the saddle)
Un = part of the ridge not under load (centrally and distally to the saddle)

and mesially (PM), and at the part of the unloaded ridge (Un) centrally and distally to the saddle.

2. After removal of the saddle;
centrally under the saddle, both distally (CD) and mesially (CM).

Before the excision the regions in question were anaesthetized with 2 % xylocaine-exadrin at a distance of at least 10 mm from the biopsy region. The specimens were fixed in 7 % neutral formalin solution for at least 24 hours and were sectioned after embedding in paraffin with a thickness of approximately 5 μ cut at right angles to the surface of the mucosa. The biopsy specimens were cut with a semi-serial sectioning technique, i.e. the whole tissue in question was cut at different levels, and about 20 sections from each biopsy were taken for histological staining and microscopy.

The sections were stained with Ehrlich hematoxylin-eosin.

Criteria for the histological evaluation

The changes observed at the microscopic examination are presented in tables and graded as none 0, insignificant (+), slight +, moderate ++ and pronounced +++.

The criteria applied have been the following.

1. Epithelial hyperplasia.
   0 = no changes; no observable thickening of the covering epithelium.
   (+) = insignificant changes; a certain thickening of the epithelium

due to a slight increase in the number of cells, though no actual hyperplasia could be said to exist.

+ = slight changes; slight hyperplasia.

++ = moderate changes; moderate thickening of the epithelium, distinct hyperplasia.

+++ = pronounced changes; marked thickening of the epithelium, pronounced hyperplasia.

2. Inflammation.

0 = no changes; no observable inflammatory cellular infiltration.

(+) = insignificant changes; presence of isolated lymphocytes and/or leucocytes in the connective tissue.

+ = slight changes; occurrence of small groups of inflammatory cells here and there in the connective tissue. The space between these regions almost entirely free from cellular infiltration.

++ = moderate changes; larger local cell agglomerations together with diffuse infiltration of inflammatory cells.

+++ = pronounced changes; massive infiltration of inflammatory cells throughout the whole tissue.

The histologic evaluation was made by a pathologist with a wide experience of histological changes in the mucosa of the oral cavity. When studying the material he had no knowledge of clinically observed changes.

The criteria applied for the gradation of the changes were such that any pathologist would be able to classify the tissue alterations in a similar way.

In the earlier histological studies of soft-tissue changes in the immediate vicinity of fixed saddles two pathologists have assessed the material independently of each other. As their assessments have been in complete agreement, one pathologist was considered sufficient in the present study (*Izikowitz*, 1966).

RESULTS

In all the saddle regions there was a *clinically* healthy mucosa except in one case (no. 10) where it showed some reddening vestibularly. Corresponding histologically to this find was an »insignificant» inflammation observed in the regions PD and PM.

A summary of the histological results is given in Table I. Changes classified as »moderate» or »pronounced» were thus not observed. »Insignificant» and »slight» changes were observed, though only in the saddle regions, in which the mucosa in the majority of cases was free from pathological changes (Fig. 3). Changes recorded as »slight» were few in number. The changes

Table I.

Background data and histological findings in patients wearing facultatively removable saddle-bridges

Patient		1	2	3	4	5	6	7	8	9	10	The 10 patients distributed according to degrees [b] of epithelial hyperplasia and of inflammation			
Sex		♀	♀	♀	♀	♀	♀	♀	♂	♂	♀				
Age at reg. (yrs.)		50	56	66	67	44	59	68	59	57	45				
Material (constructions)		Vital-lium	C—gold	C—gold	Vital-lium	C—gold	C—gold	C—gold	C—gold	C—gold	C—gold				
Length of saddle		21	25	35	53	29	21	28	19	27	20				++
Follow-up period (yrs.)		$4\,^{1}/_{12}$	$1\,^{4}/_{12}$	$1\,^{2}/_{12}$	$1\,^{2}/_{12}$	$2\,^{1}/_{12}$	3	$1\,^{2}/_{12}$	$1\,^{9}/_{12}$	1	$1\,^{4}/_{12}$	0	(+)	+	+++
PD [a]	Site of biopsy	—6—	6—	—7	—7	6—	6—	6—	—6	7—	—6				
	Degree of epithel. hyperpl.	0	0	(+)	(+)	0	0	0	0	0	0	8	2	0	0
	Degree of inflammation	0	0	(+)	+	0	0	(+)	0	0	(+)	6	3	1	0
PM [a]	Site of biopsy	—4—	4—	—4	—3	4—	4—	4—	—4	4—	—4				
	Degree of epithel. hyperpl.	0	0	0	(+)	0	0	(+)	0	0	0	8	2	0	0
	Degree of inflammation	0	0	(+)	(+)	0	+	(+)	0	0	(+)	5	4	1	0
CD [a]	Site of biopsy	—6—	6—	—7	—7	6—	6—	6—	—6	7—	—6				
	Degree of epithel. hyperpl.	0	0	0	0	0	0	0	0	0	0	10	0	0	0
	Degree of inflammation	0	(+)	0	0	0	0	+	0	0	0	8	1	1	0
CM [a]	Site of biopsy	—4—	4—	—4	—3	4—	4—	4—	—4	4—	—4				
	Degree of epithel. hyperpl.	0	0	0	+	0	0	+	0	0	0	8	0	2	0
	Degree of inflammation	(+)	0	(+)	+	0	0	+	0	0	0	6	2	2	0
UN [a]	Site of biopsy	—8—	8—	—8	—8	8—	8—	8—	—8	8—	—8				
	Degree of epithel. hyperpl.	0	0	0	0	0	0	0	0	0	0	10	0	0	0
	Degree of inflammation	0	0	0	0	0	0	0	0	0	0	10	0	0	0

[a] PD = peripherally and distally (peripheral in the middle of the distal part of the saddle)
PM = peripherally and mesially (peripheral in the middle of the mesial part of the saddle)
CD = centrally and distally (central in the middle of the distal part of the saddle)
CM = centrally and mesially (central in the middle of the mesial part of the saddle)
UN = part of the ridge not under load (centrally and distally to the saddle)

[b] 0 = no changes
(+) = insignificant changes
+ = slight changes
++ and +++ = moderate and pronounced changes

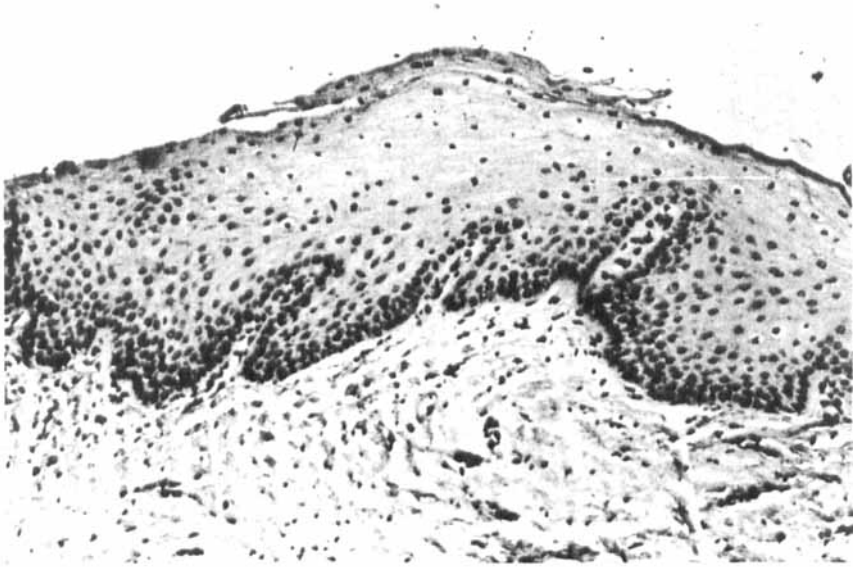

Fig. 3. Follow-up period: 3 years, 0 months. Centrally and mesially under the saddle. Region of 4—. Mucosa without hyperplasia or inflammation. × 170.

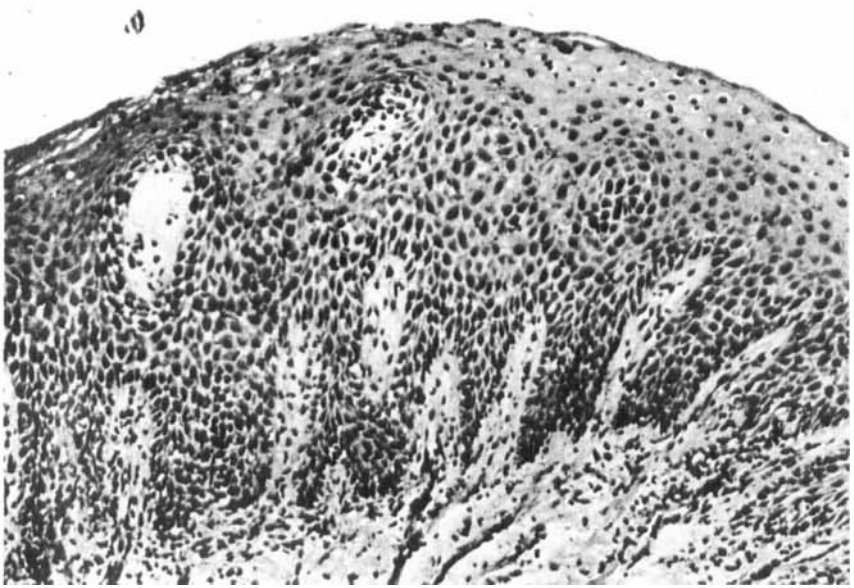

Fig. 4. Follow-up period: 1 year, 2 months. Centrally and mesially under the saddle. Region of 4—. »Slight» epithelial hyperplasia and inflammatory cell infiltration recorded as »slight» (these changes were the most pronounced of those found in the whole biopsy material). × 170.

Table II.

Ten biopsies from region PD matched against 10 biopsies from region CD and distributed according to degree of epithelial hyperplasia and inflammation. [a] [b]

	CD					
	Hyperplasia			inflammation		
	0	(+)	+	0	(+)	+
0	[8]	—	—	[5]	1	—
PD (+)	2	[—]	—	2	[—]	1
+	—	—	[—]	1	—	[—]

Table III.

Ten biopsies from region PM matched against 10 biopsies from region CM and distributed according to degree of epithelial hyperplasia and inflammation. [a] [b]

	CM					
	Hyperplasia			Inflammation		
	0	(+)	+	0	(+)	+
0	[8]	—	—	[4]	1	—
PM (+)	—	[—]	2	1	[1]	2
+	—	—	[—]	1	—	[—]

Table IV.

For each of 10 patients the most unfavourable degree of epithelial hyperplasia and inflammation in region PD and region PM has been combined with the most unfavourable degree in region CD and region CM. [a] [b]

	CD and CM					
	Hyperplasia			Inflammation		
	0	(+)	+	0	(+)	+
0	[7]	—	—	[3]	2	—
PD and PM (+)	1	[—]	2	1	[1]	1
+	—	—	[—]	1	—	[1]

[a] As regards the symbols PD, PM, CD, CM and UN, and the signs 0, (+) and +, see footnotes in Table I.

[b] The diagonally placed squares in the tables show for how many of the patients there was agreement in the matter of the degree of changes.

Table V.

Ten biopsies from region PD matched against 10 biopsies from region PM and distributed according to degree of epithelial hyperplasia and inflammation. [a] [b]

	PM					
	Hyperplasia			Inflammation		
	0	(+)	+	0	(+)	+
0	[7]	1	—	[5]	—	1
PD (+)	1	[1]	—	—	[3]	—
+	—	—	[—]	—	1	[—]

Table VI.

Ten biopsies from region CD matched against 10 biopsies from region CM and distributed according to degree of epithelial hyperplasia and inflammation. [a] [b]

	CM					
	Hyperplasia			Inflammation		
	0	(+)	+	0	(+)	+
0	[8]	—	2	[5]	2	1
CD (+)	—	[—]	—	1	[—]	—
+	—	—	[—]	—	—	[1]

Table VII.

For each of 10 patients the most unfavourable degree of epithelial hyperplasia and inflammation in region PD and region CD combined with the most unfavourable degree in region PM and region CM. [a] [b]

	PM and CM					
	Hyperplasia			Inflammation		
	0	(+)	+	0	(+)	—
0	[7]	—	1	[3]	1	1
PD and CD (+)	1	[—]	1	1	[—]	—
+	—	—	[—]	—	—	[—]

[a] As regards the symbols PD, PM, CD, CM and UN, and the signs 0, (+) and +, see footnotes in Table I.

[b] The diagonally placed squares in the tables show for how many of the patients there was agreement in the matter of the degree of changes.

observed appeared partly in the covering epithelium and partly in the form of inflammatory cellular infiltration in the subepithelial connective tissue.

The only observable epithelial change had the character of a hyperplasia, i.e. thickening of the epithelium with an increased number of cells (Fig. 4). In none of the cases, on the other hand, was it possible to observe any noteworthy changes of other type, e.g. in the form of atrophy, hyperkeratosis, parakeratosis or acanthosis. Nor was it possible to record any epithelial changes as pronounced as those which may occur in cases of leukoplakia.

The inflammatory reaction consisted in a sparse infiltration of lymphocytes and leucocytes as well as a few isolated plasma cells. In most cases, however, only lymphocytes were noted. The inflammatory cells were observed only in the connective tissue (Fig. 4). In the majority of cases they were restricted to smaller areas in the biopsy specimens.

Other histological changes such as hyperemia, degeneration of tissue or granulomatous formation were lacking in all cases.

In none of the 50 biopsy specimens was it possible to observe any proliferative changes or cellular atypias that might be suspected of a neoplastic process.

Tables II—VII show the distribution of the 50 biopsy specimens studied according to the degree of the changes. The tables also give matched combinations between different positions in the saddle region. The tabular account has here been restricted to epithelial hyperplasias and inflammatory reactions. As regards the other histological attributes studied no changes were observed. For this reason the unloaded region has not been combined with other positions.

The diagonally placed squares in the tables show for how many of the patients there was agreement in the matter of the degree of changes. Tables II, III and IV, which indicate the relation between peripheral and central regions, thus show that with respect to inflammatory reaction there was in 5 patients agreement while in 5 there were differences. As regards the epithelial hyperplasias the agreement was better, though here, too, there were differences. There were also differences as between distal and mesial regions. It should be emphasized, however, that the rather numerous deviations occurring were only inconsiderable, since neither »moderate» nor »pronounced» changes were recorded.

The tables also show whether the differences exhibited any particular trend, i.e. whether they were systematic. Thus from Table II it may be seen that 3 patients had a higher degree of inflammation peripherally than centrally, while in 2 patients the case was the reverse (see below and above the diagonal). There was thus no evident regularity. The other tables may be studied in a similar way. In this connection it was found that there were

no significant systematic differences as between different positions in the saddle region with respect to mucosal changes.

The unloaded parts of the ridge were completely free from changes (Fig. 5, Table I). There was a significant difference — at the 5 per cent level in a one-sided test — as between the loaded region PM and the unloaded region with respect to the occurrence of inflammatory reaction. However, 4 of the 5 changes in the PM region were to be classified as »insignificant».

Table VIII shows the connection between the degrees of change in Tables II—VII. The strength of the relation was measured with the help of the coefficient of correlation. The table shows that all coefficients were positive. As regards inflammatory reaction the correlations were low as between peripheral and central regions. In no case did the correlations attain the level of significance.

Concerning the significance of the background factors for the histological finds shown in Table I, no differences were observed, even in the form of tendencies, respecting the material of the constructions or the follow-up period; but this was possibly due to the small number of patients. The two men in the material were completely without histological changes, but it

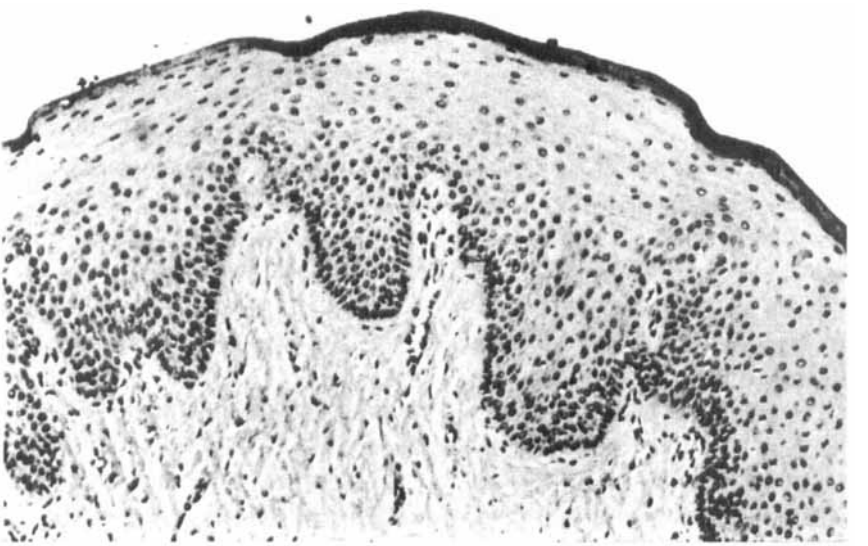

Fig. 5. Follow-up period: 3 years, 0 months. Unloaded ridge. Region of 8—. Normal mucosa. × 170.

Table VIII.

Coefficients of correlation respecting degree of change according to code given below. [a]

Correlation between	Epithelial hyperplasia	Inflammation	Primary data in Table
PD and CD	—	0.12	II
PM and CM	1.00	0.26	III
PD + PM and CD + CM	0.76	0.34	IV
PD and PM	0.38	0.45	V
CD and CM	—	0.43	VI
PD + CD and PM + CM	0.38	0.57	VII

Quantification: 0 coded as 0
(+) coded as 1
\+ coded as 2

[a] As regards the symbols PD, PM, CD, CM and UN, and the signs 0, (+) and +, see footnotes in Table I.

was not possible to show any significant differences as between the sexes. There seems to be a tendency, though this is not significant, for more tissue changes to occur in connection with longer saddles.

There were, in all, 7 »slight» changes in the material. Six of these were found in the two oldest patients. This may be interpreted as a sign that soft-tissue changes increase with increasing age, but the explanation may perhaps reside in the fact that one of these patients had an extremely long saddle.

DISCUSSION

The author has had access to a patient material with saddles removable only by the dentist, and has thus been able to examine the soft tissue centrally under the saddles — it has hitherto been possible to study only the saddle periphery. In the present investigation the biopsy specimens were taken distally and mesially in the saddle region and also in the region not loaded by the saddle, in order to ascertain whether the soft tissue shows differences in these different regions.

A large number of possibilities of making intra-individual comparisons were utilized. The chief question, however, was whether these are histologically demonstrable differences in the soft tissue as between peripheral and central regions in connection with fixed free-end saddles.

A source of error in assessing the degree of hyperplasia may be constituted by an eventual oblique sectioning. However, the histological result was

based upon a number of sections taken at different levels, which eliminated the above-mentioned source of error.

Only »insignificant» or »slight» changes were observed, and the latter in only a few of the biopsy specimens taken from the saddle regions. The only demonstrable epithelial change had the character of a hyperplasia. Inflammatory reaction was observed in the connective tissue in 30 per cent of the biopsy specimens taken. It took the form of a sparse infiltration of lymphocytes and leucocytes and one or another plasma cell. In the majority of cases the inflammatory cells were restricted to smaller areas of the specimens. With respect to mucosal changes the differences as between different positions in the saddle region were not significantly systematic, i.e. the pathological finds in the soft tissue did not occur more frequently in the peripheral than in the central position or vice versa, or more frequently distally than mesially. There were, on the other hand, deviations — though not necessarily of a systematic nature — especially with respect to inflammatory reaction as between the peripheral and central regions. Where such deviations did occur they were from the medical point of view not striking — it was a matter of differences between »no», »insignificant» and »slight» changes.

The unloaded regions were completely free from tissue changes. Even if the observed tissue reaction in the saddle regions was characterized as »insignificant» or »slight», there was nevertheless a difference in the soft tissue as between loaded and unloaded regions. This difference was even significant at the 5 per cent level in a one-sided test concerning the occurrence of inflammatory reaction in the loaded region PM and the unloaded region respectively. The circumstance that there were tissue changes in the loaded region but not in the unloaded region suggests that it would be valuable to use saddles removable only by the dentist, as these would permit of observations under the saddle. In this way it would amongst other things be possible at an early stage to disclose pathological changes caused by the construction and to treat these accordingly.

As regards the significance of the background factors for the histological finds, it was not possible to show any significant differences.

The hyperplasia observed occurred only in cases with demonstrable inflammation. It therefore seems reasonable to assume a causal connection between these two tissue reactions.

The results of the investigation would seem to show that, from the point of view of the pathology of the soft tissue, fixed saddles resting on the mucosa are indicated in certain cases of the partly edentulous mouth. This view is based on the finding that tissue reactions in the saddle region occurred with only slight frequency and to an unimportant extent.

Acknowledgment. The writer wishes to convey his warm thanks to his colleague Paul Wedendal for permission to use his patient material and for help with the excision of biopsy specimens. He also wishes to thank Assoc. Prof. Gunnar Moberger for the histological evaluation and helpful advice. — The statistical analyses were performed by Assoc. Prof. Gunnar Eklund.

SUMMARY

The chief aim of the investigation was to ascertain whether there are histologically demonstrable differences in the soft tissue peripherally and centrally in relation to specially designed saddles removable only by the dentist. A further desideratum was to find out whether the frequency of mesially localized tissue reactions differed from those localized distally, and whether the tissue reactions in regions under load differ from parts of the ridge not under load.

In no cases was it possible to observe »moderate» or »pronounced» reactions. »Insignificant» and »slight» reactions did occur, though the latter were only few in number. The observed changes took the form of epithelial hyperplasia or of inflammatory cellular infiltration in the subepithelial connective tissue. No other histological reactions could be observed. The regions not under load were completely free of such changes.

With respect to mucosal changes there were differences as between different regions, though with one single exception — viz. concerning the occurrence of inflammatory reaction between the peripheral and mesial saddle region and the region not under load — without attaining the level of significance (5%).

RÉSUMÉ

ÉTUDE HISTOLOGIQUE DE LA RÉACTION DES TISSUS MOUS SITUÉS À LA PÉRIPHÉRIE DE SELLES FIXES EN EXTENSION ET SOUS CELLES-CI

L'auteur décrit un type de pont fixe à selles. Il est possible d'assurer de cette façon, en utilisant des selles d'une construction spéciale, s'appuyant sur la muqueuse et reliées aux dents-piliers d'une manière rigide, la reconstitution de régions édentées, même lorsqu'elles sont très étendues.

Le but principal de cette étude a été de déterminer s'il est possible de mettre en évidence des différences histologiques entre les tissus mous situés à la périphérie de la région des selles et ceux qui sont situés au centre de cette région. De plus, l'auteur souhaitait vérifier si les altérations des tissus à la partie mésiale correspondaient aux altérations existant à la partie distale,

et s'il existait des différences entre les régions subissant la charge de ces constructions et les régions des crêtes ne supportant pas de charge.

Les résultats de ces observations sont les suivants:

Dans aucun cas il n'a été possible de constater d'altérations »moyennes» ou »marquées». On a pu constater des altérations »insignifiantes» ou »légères»; ces dernières étaient relativement peu nombreuses. Les altérations observées consistaient d'une part en une hyperplasie épithéliale, d'autre part en une infiltration cellulaire inflammatoire dans le tissu conjonctif sous-épithélial. On ne constatait pas d'autres altérations histologiques. Les régions ne supportant pas de charge ne présentaient aucune de ces altérations.

On constatait des différences entre les différentes régions en ce qui concerne les altérations de la muqueuse, mais sans que ces différences atteignent un niveau significatif (5 %), à une exception près, la différence entre la région ne subissant pas de charge et la périphérie de la région des selles à la partie mésiale, en ce qui concerne la présence d'une réaction inflammatoire.

ZUSAMMENFASSUNG

EINE HISTOLOGISCHE UNTERSUCHUNG ÜBER WEICHGEWEBSREAKTIONEN UNTER UND IM ANSCHLUSS AN FESTSITZENDE FREIENDSÄTTEL

Es wird eine Art fester Sattelbrücken beschrieben. Mit Hilfe von besonders geformten, mit den Pfeilerzähnen fest verbundenen, von der Schleimhaut getragenen Sätteln, werden dadurch auch grössere zahnlose Gebiete rekonstruiert.

Es war der hauptsächliche Sinn der Untersuchung, festzustellen, ob histologisch erfassbare Unterschiede zwischen den Weichgeweben der periferen und denen der zentralen Teile der Sattelregionen vorlagen. Ausserdem hat der Verfasser versucht, festzustellen, ob distale Gewebeveränderungen mesialen Veränderungen entsprechen, und ob sich Gebiete, die von den Konstruktionen belastet werden, von nicht belasteten Cristagebieten unterscheiden.

Dabei ist folgendes beobachtet worden:

»Mässige» oder »ausgesprochene» Veränderungen sind in keinem Falle beobachtet worden. »Unbedeutende» und »leichte» Veränderungen kamen vor, die letzteren jedoch nur in wenigen Fällen. Die beobachteten Veränderungen traten teils in der Form einer Epithelhyperplasie auf, teils in der Form eines inflammatorischen Zelleninfiltrates in dem subepithelialen Bindegewebe. Andere histologische Veränderungen wurden nicht beobachtet.

In den unbelasteten Gebieten kamen solche Veränderungen überhaupt nicht vor.

Was die Schleimhautveränderungen in den verschiedenen Regionen betrifft, lagen Unterschiede vor; sie erreichten jedoch nur in einem einzigen Fall ein signifikantes Niveau von 5 %. In diesem Falle handelt es sich um einen Unterschied der inflammatorischen Reaktion zwischen der perifermesialen Sattelregion und dem unbelasteten Gebiet.

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