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SUPERPLANTS

A LONGITUDINAL STUDY

by

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For patients requiring partial dental prostheses there are two main types of restorations, namely the removable dentures and the fixed bridges. As regards removable partial dentures *Hildebrand* (1937) maintained that from many points of view these are distinctly inferior to the fixed types. He considered the "hang-prosthesis" (a bridge) on vital teeth the only type fully adequate from a clinical standpoint. In 1956 he pointed out that by virtue of their clinical superiority, prostheses borne by the periodontium have a considerably wider range of indications than the types supported by the mucosa.

A number of authors agree with *Hildebrand* that the fixed bridge is the most suitable form of prosthetic appliance and should always be provided where indicated (*Applegate* 1960 a, 1960 b; *Johnston, Philipps & Dykema* 1960; *Carlsson, Hedegård & Koivumaa* 1961; *Göransson* 1963; *Krogh-Poulsen* 1960; *Krüger* 1961), for clinical experience and investigations have shown that removable partial dentures often produce local damage and alterations in the remaining teeth and the edentulous parts of the ridges (*Calonius* 1961; *Koivumaa, Hedegård & Carlsson* 1960; *Carlsson, Hedegård & Koivumaa* 1961; *Carlsson, Hedegård & Koivumaa* 1962; *Koivumaa* 1960; *Staegemann* 1960). Even when a removable partial denture is indicated it is valuable to combine it with a bridge (*Göransson* 1963; *Krogh-Poulsen* 1960; *Koivumaa* 1962).

Although a fixed bridge, where indicated, is considered to be the best form of treatment in many respects, it involves a certain measure of risk (*Waerhaug* 1958, 1960).

The fixed bridge also has a limited indication range, since it relies on the presence of a certain number of abutments, suitably distributed within the arches. Other important factors are the loading of the abutments in occlusion and articulation and the condition of their periodontia. To widen the range of indications various types of fixed extension denture have been designed, including the cantilever bridge, the extension bar, the stress-distributing bar, the subperiosteal and endo-osseous implants and the superplant.

The cantilever bridge is used to prolong a fixed bridge at one end. *Linkow* (1961) prefers to solder one or two ponties to the posterior abutment on a full bridge to furnishing a removable denture. When loaded, such free pontics are exposed to a moment that may result in damage to the periodontia of the abutments, and *Applegate* (1960 a) holds that this type of restoration is so fraught with risk that it cannot be recommended. *Nilson* (1958, 1959) considers that no more than one pontic should be added in this manner, and that a distal pontic is potentially more deleterious than a mesial one, because of the greater masticatory pressure near the temporomandibular joint.

The loading is better distributed over the abutments when an extension bar is used. The latter is soldered to the abutments, is flexible, and at its free end carries one hanging tooth, usually an incisor (*Nilson* 1956, 1958, 1959). The hanging tooth should not be situated adjacent to an abutment or to the bridge as in a cantilever bridge, which of course widens the indications for such a restoration.

The purpose of a stressdistributing bar is to distribute the load between the abutments. It is rigid and connects one or more teeth or bridges, usually situated on opposite sides of the arch. It is advantageous from the standpoint of loading because it reduces the effect of potentially deleterious horisontal force components. Moreover, it can be utilized as a fixation for an extension bar (*Nilson* 1956, 1958, 1959).

The subperiosteal implant partial denture is chiefly used to

replace two teeth in Kennedy's Class I and II cases, i.e. instead of removable free-end dentures *(Izikowitz* 1961 a; *Komari & Horvath* 1963). It consists of two parts, *(i)* the substructure, which is placed under the mucoperiosteum and is provided with an implant abutment which passes through the mucosa, and *(ii)* the superstructure, which is a fixed or removable prosthesis placed above the substructure. The technique in this form of treatment is relatively involved, and in the case of complications both substructure and superstructure must be removed. The indications should be restricted *(Bocher* 1960; *Schmidt* 1961).

Part of the endo-osseus dental implant is inserted into the jawbone while the part protruding through the mucosa serves as an abutment for the restoration. These implant dentures are considered to be simpler to make than subperiosteal implant partial dentures, and many different technical procedures have been suggested *(Cherchève* 1962; *Dumont* 1960; *Scialom* 1962).

An original method of widening the range of indications for fixed bridges by using fixed mucosa-borne saddles was first used by *Dahl* in 1951 *(Dahl* 1956; 1961), who called it the *superplant.*

Essentially, the superplant is a fixed saddle-bridge restoration consisting of one or more specially designed saddles resting on the ridge. The saddles are rigidly connected to the abutments; long free-end saddles are sometimes provided with an implant at their free ends to prevent tipping.

THE SUPERPLANT TREATMENT

A series of illustrations is presented in this introduction relating to 5 cases supplied with various combinations of superplants (Figs. 1—21).

Case I Full mandibular superplant with free-end saddles (Figs. 3—5).

Case II Unilateral mandibular superplant with free-end saddles (Figs. 6—9).

Case III Full maxillary superplant with free-end saddles and palatal bar (Figs. 10—13).

Case IV Unilateral maxillary superplant (Figs. 14—16).

Case V Full mandibular superplant with free-end saddles and intermediary saddle (Figs. 17—21).

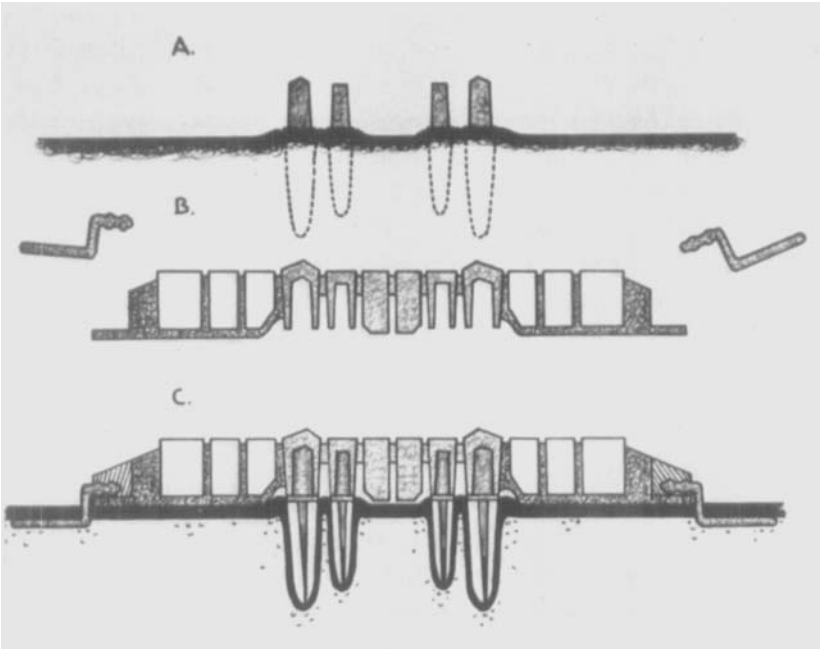


Fig. 1. A. Remaining teeth: —3, —2, 2—, 3—. B. Superplant with 2 free-end saddles, each with one implant. C. Superplant *in situ*.

Indications

The superplant is indicated when for various reasons the patient cannot tolerate a removable partial denture, and when it is impossible to make a conventional bridge (*Izikowitz* 1962 a). In such cases superplants replace free-end dentures (according to Kennedy Classes I and II). Also in the Kennedy Class III type of cases superplants, through intermediary saddles, can be used to relieve the load on the abutments when these are far apart. If the prognosis for an abutment at one end of an edentulous area in the arch is doubtful, an intermediary saddle may be changed to a free-end saddle in the case of extraction of the tooth in question.

The superplant is sometimes used as a replacement for cantilever bridges and then the destructive action of the pontic on a slightly doubtful abutment can be reduced by a stress-distributing saddle.

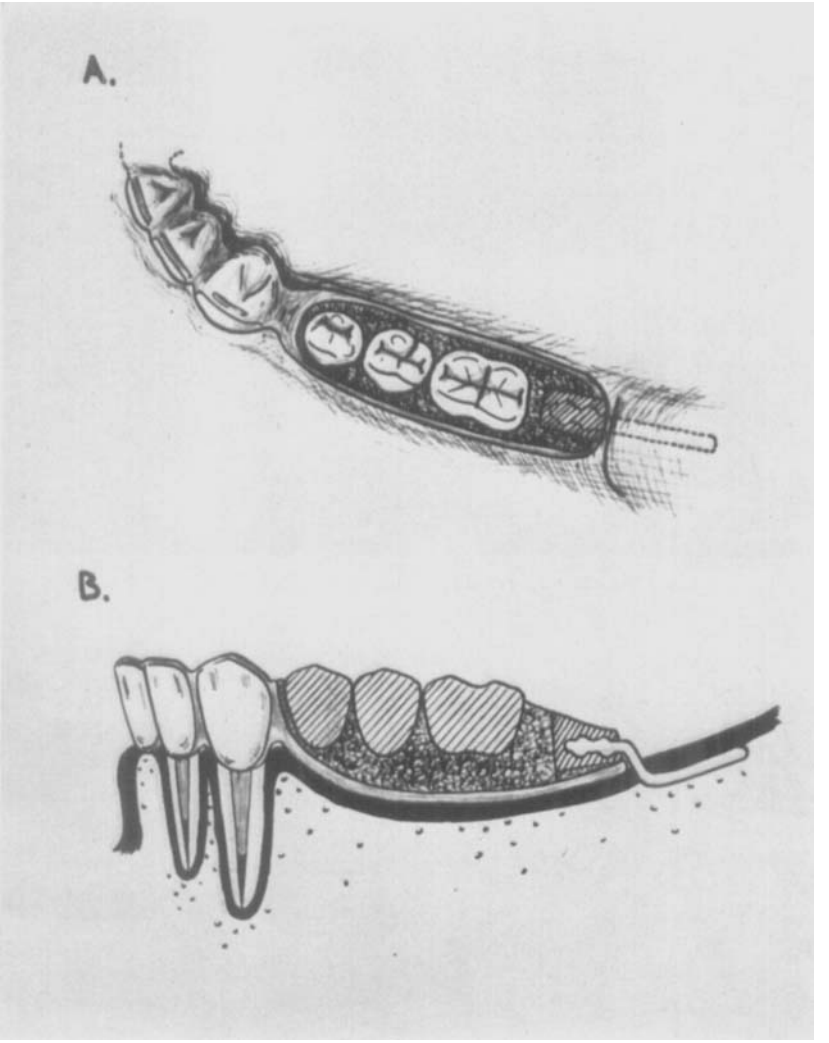


Fig. 2. A. Superplant, occlusal view, with a 3-tooth saddle and one implant. The incision line is seen at the distal end of the saddle. B. Vestibular view of superplant.

Contraindications

The superplant is an unsuitable form of prosthesis for mentally unstable patients, for example patients who are hysterical or hypochondriac or who are uncooperative, as well as for those

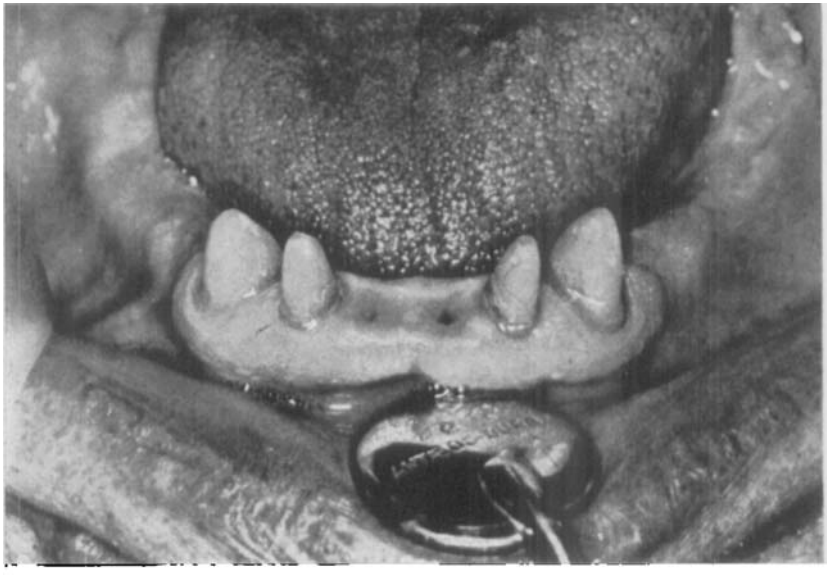


Fig. 3. Remaining teeth: —3, —2, 2—, 3—.

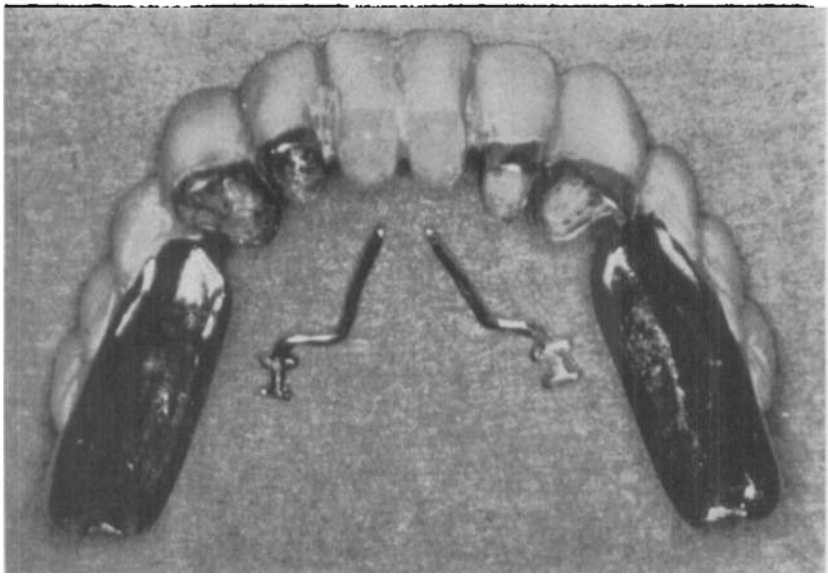


Fig. 4. Superplant with 2 free-end saddles and implants.

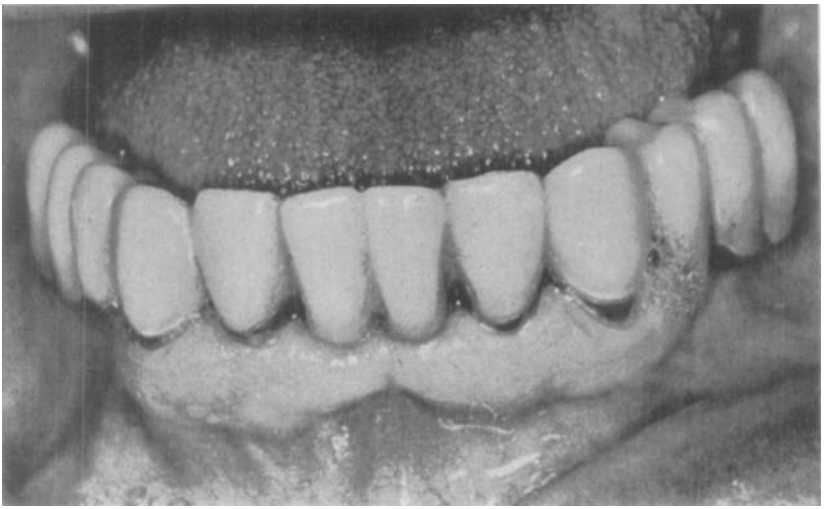


Fig. 5. Superplant *in situ*.

that are careless about oral hygiene. Nor should it be used for persons that are allergic to any substance present in the superplant. There are also temporary contraindications. For instance, a superplant should not be made immediately after an extraction has been performed in the intended saddle or implant region. If an extraction has been carried out in the region corre-

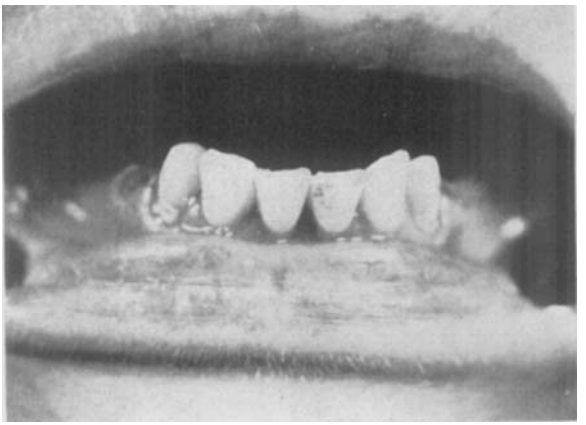


Fig. 6. Abutments: —4, —3 and 3—, 4—

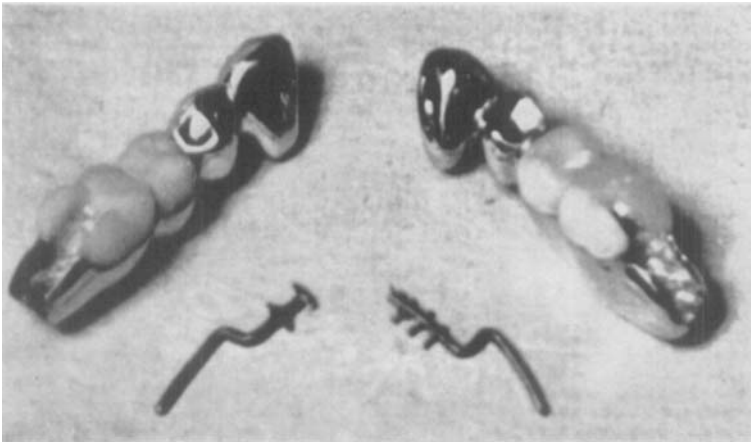


Fig. 7. One premolar and one molar on the saddles. Note the implants and their recesses on the saddles.

sponding to the end of a saddle one should wait six months before the superplant is fitted; otherwise 1—2 months will suffice. If there are flabby ridges, plastic surgery on the mucosa must be performed, but the superplant may be made immediately after the operation.

The presence of any major parafunctions of the masticatory muscles may also rule out the superplant, as does severe loosening of the abutments.

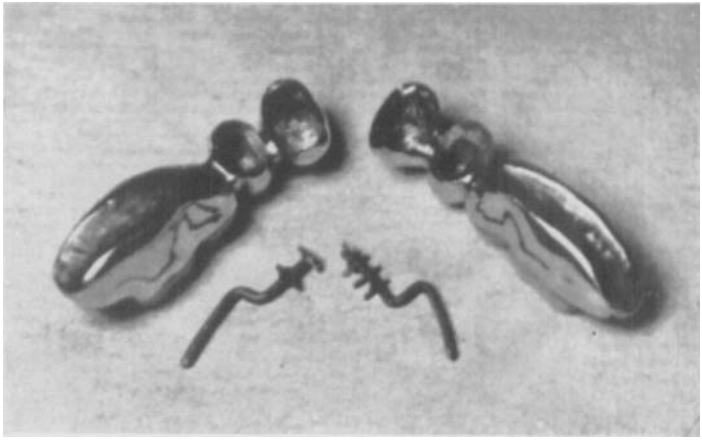


Fig. 8. Restorations seen from below.

Advantages

One advantage of the superplant over other fixed prosthetic restorations lies in the possibility of providing large fixed prostheses for edentulous regions with a very minor surgical operation or even none at all. Experience has shown that a fixed free-end saddle can be furnished with up to 3 teeth in the case

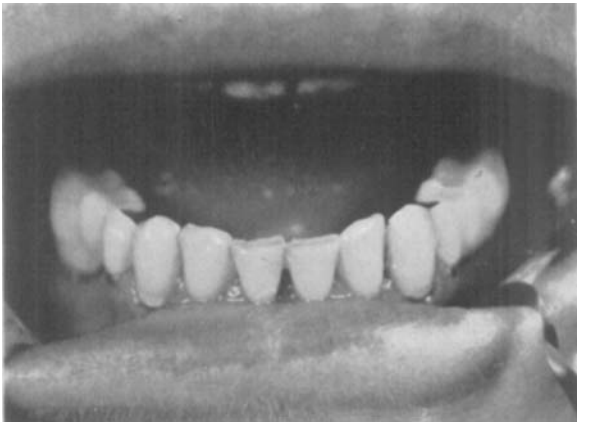


Fig. 9. Superplant *in situ*.

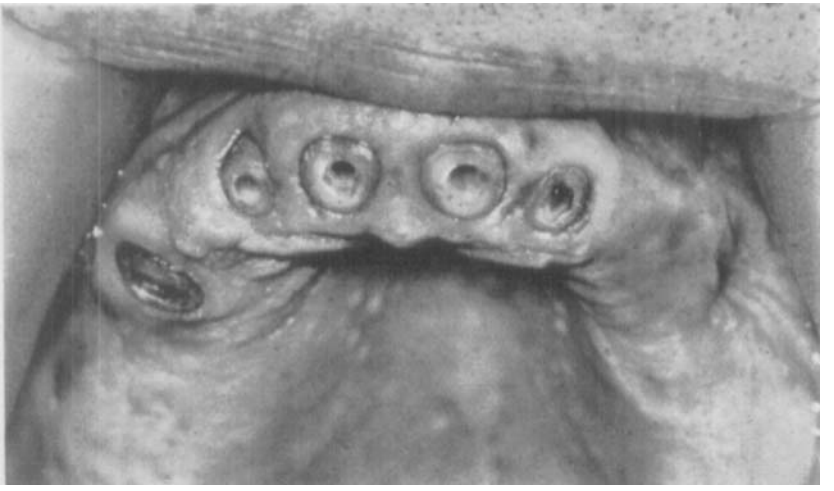


Fig. 10. Remaining teeth: 4+, 2+, 1+, +1, +2.

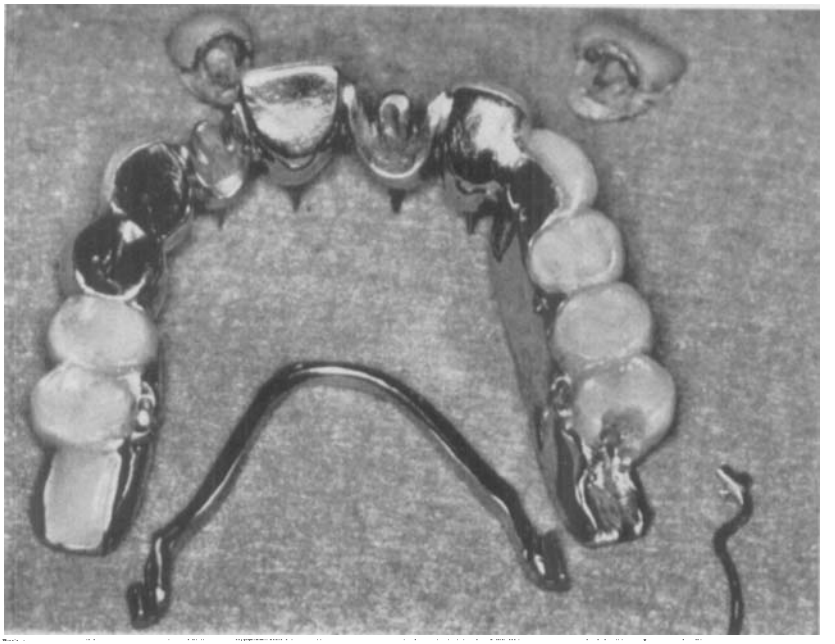


Fig. 11. Occlusal view of superplant. The longer saddle has implants, the shorter none. Palatal bar, removable by dentist.

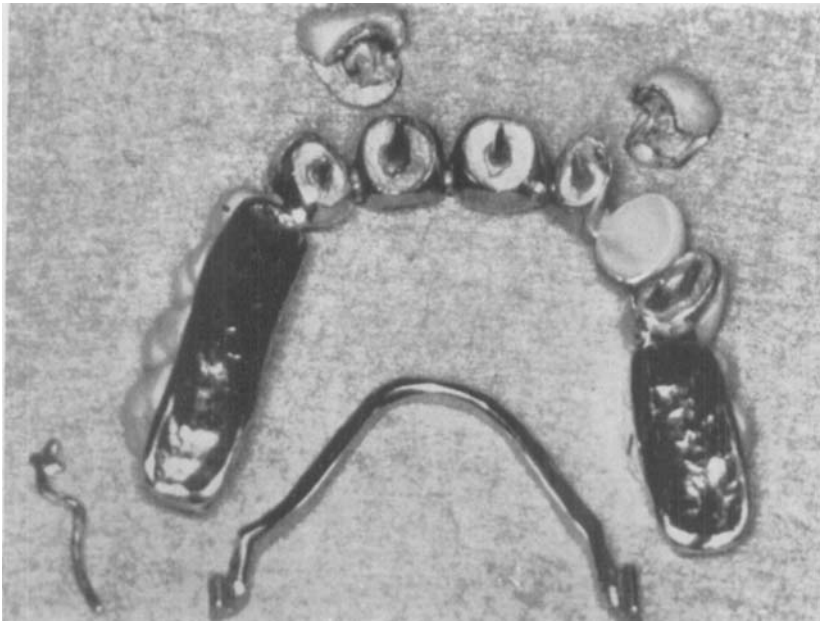


Fig. 12. Restoration seen from the mucosa side.

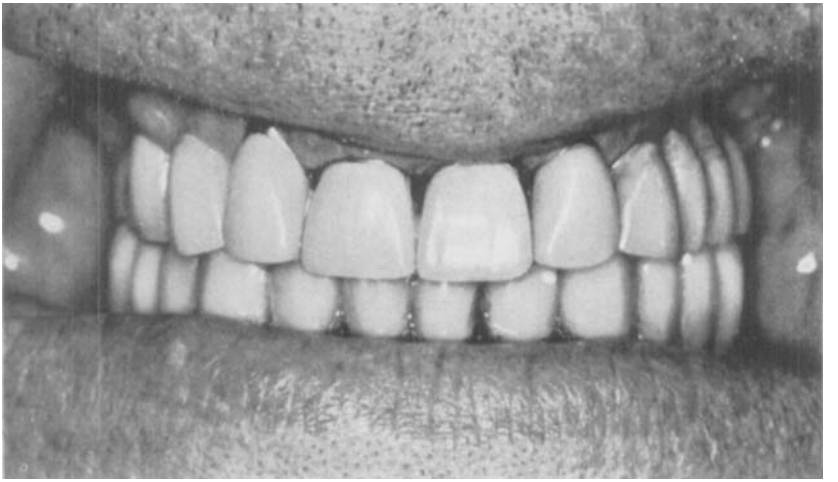


Fig. 13. Cases I and III in occlusion.

of a full superplant and with 2 teeth in the case of a unilateral one, even without the support of implants. A superplant can, moreover, be fitted a shorter time after an extraction than can other subperiosteal implants, which require a healing period of

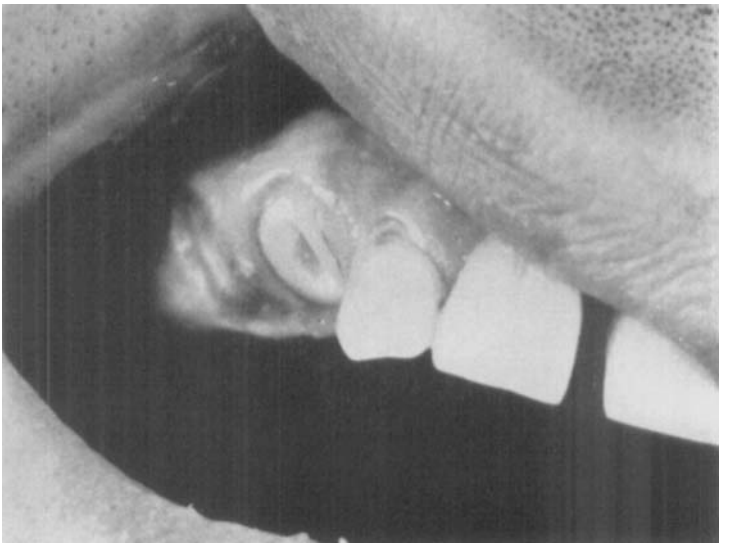


Fig. 14. Abutments: 3+ and 4+.

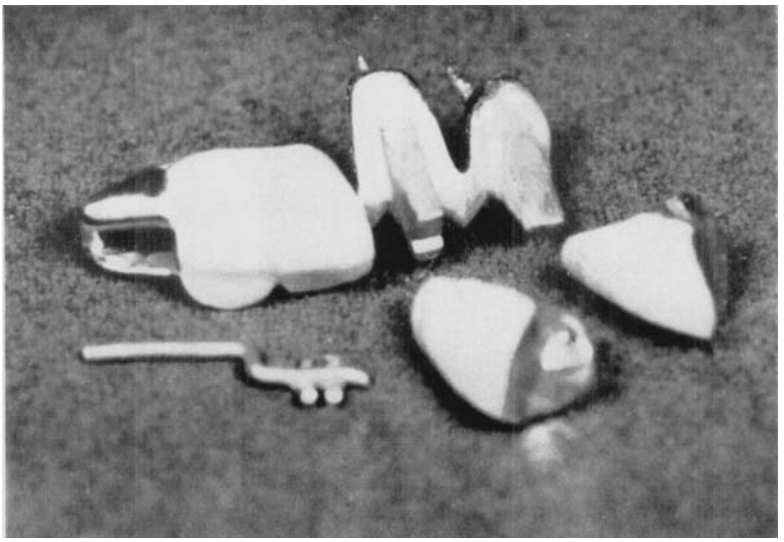


Fig. 15. Superplant with 2-tooth saddle and one implant.

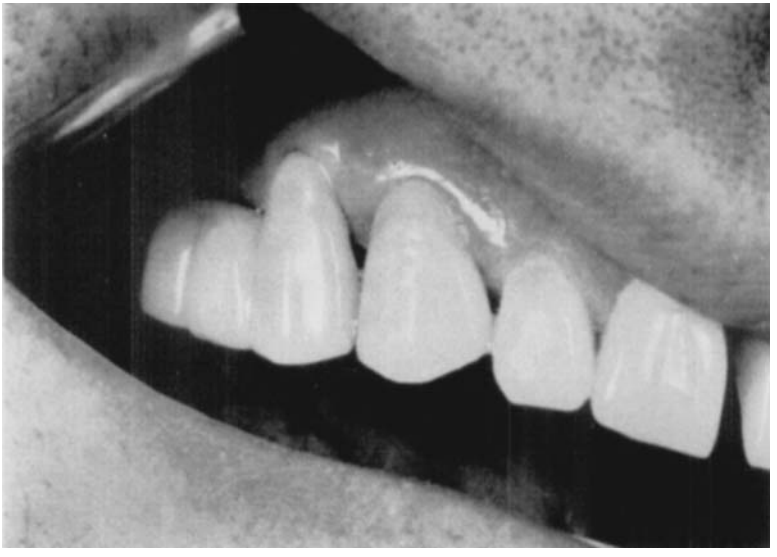


Fig. 16. Superplant *in situ*.

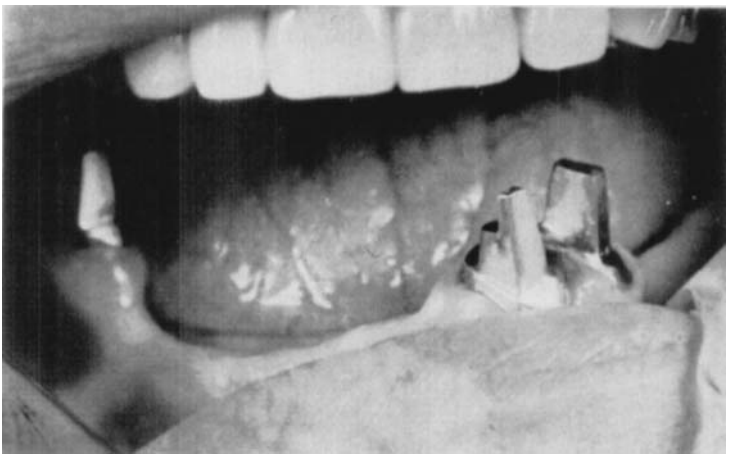


Fig. 17. Remaining teeth: 5—, —3, —4.

18—24 months. Furthermore, the latter, unlike the superplant, are contraindicated where the mucosa is thin. In the case of the superplant the implants are fairly easy to remove and to reinsert should they fracture (*Mattila* 1963); in the case of other subperiosteal implants this is an extensive procedure as the whole substructure must be removed. Moreover, implants included in a superplant bear on the bone indirectly and the risk of resorption has proved to be negligible (*Andreas* 1960).

Fig. 18. Roots furnished with gold posts.

The advantages of the superplant must, however, be balanced against the damage the restoration can cause to the remaining teeth, the periodontal tissues and other oral tissues.

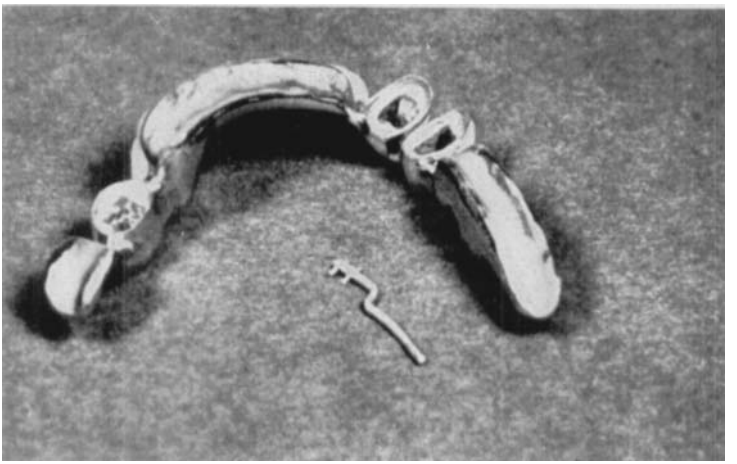


Fig. 19. Superplant furnished with 2 free-end saddles and one intermediary saddle; the longer saddle has implant.

PREVIOUS STUDIES OF SUPERPLANTS

In an experimental study of the mechanical effect of superplants *Dahl* found that the transverse, axial and rotatory movements of the abutment roots were much less pronounced in the case of a superplant, and that the stresses were even less than for a movable denture (*Dahl* 1963 a, 1963 b). The rigid anchorage of the superplant proved mechanically superior to a movable stress-distributing restoration under practically all conditions. In 1959 and 1960 *Izikowitz* performed preliminary clinical, radiologic and histologic studies with the object of assessing the value of the superplant method and any damage caused by this form of restoration to the remaining teeth and surrounding tissues (*Izikowitz* 1961 b–e and 1963). The results of this investigation prompted the more thorough testing of this form of prosthesis to be reported in the present paper.

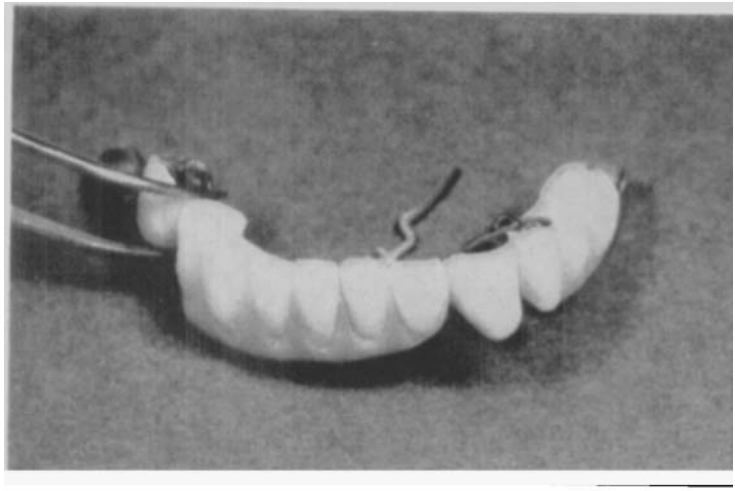


Fig. 20. Facial view of superplant.

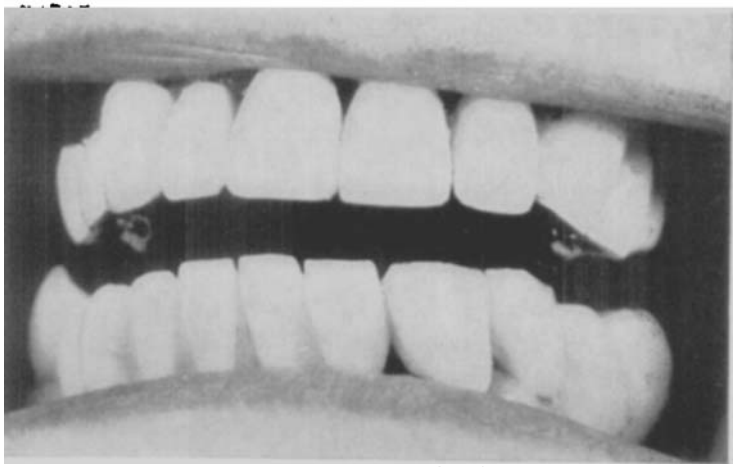


Fig. 21. Superplant *in situ*.

ORIGINAL INVESTIGATION

The present study is part of a more extensive investigation, the purpose of which is to test the superplant method. In the study presented here the results of the treatment were followed over a period of 12—14 months. Another follow-up is in progress, viz. 2—3 years after the superplants were placed.

Object of the study

The object of the study was to examine clinically and radiographically the reactions of the remaining teeth and the periodontal and other oral tissues to the presence of superplant restorations. In addition, the patient's opinion of the results of the treatment was recorded.

General treatment programme

I. *Analysis*

(a) Case history.

(b) Clinical examination.

(c) Radiographic examination of the alveolar process and possibly of the temporomandibular joint.

(d) Tests on the patient, including those for allergy.

II. *Preliminary treatment*

1. General therapeutic measures: caries treatment, root canal therapy, surgical operations such as extractions, plastic surgery on the ridge, and periodontal therapy.

2. Pre-prosthetic measures: selective grinding, correction of malocclusion, acrylic screens in bruxism, temporary screens prior to any intended increase in vertical dimension, etc.

III. *Prosthetic restoration*

1. Restorative work on the remaining teeth, including bridgework.

2. Alginate impressions for preparing the individual tray.

3. Impressions: with the bridge *in situ* a mucostatic impression (by means of "plastogum") is taken, including the edentulous part of the ridge and, in the case of full upper superplants, the hard palate.

4. Outlining of the saddles and saddle teeth and scratching the saddle region on a stone case *(Izikowitz* 1962 b). The vestibulolingual extent of the saddles should be 3.5—6 mm in the mandible and 5.5—8 mm in the maxilla.

5. The saddles are cast (Austenal Vitallium or platinum gold alloy) and connected with the abutments by special solder by a method worked out by *Dahl.*

6. In cases in which implants are to be used an orthoradial-isometric radiograph is taken of the implant region with saddles and bridges *in situ.* With the guidance of the radiograph a number of implants with different curvatures are made. (The implants, which are cast in Vitallium, possibly in tantalum, should be about 10 mm long and 1 mm in diameter).

6. In cases in which implants are to be used an orthoradial-troduced without cementing. Under terminal anaesthesia an incision about ½—1 cm long is made adjacent to the distal end of the saddle. With a small elevator the periosteum is separated from the bone. The superplant is then cemented. The implant is inserted centrally on the alveolar crest below the detached periosteum. It should be mobile and should not press against the mucosa. The position of the implant should be checked on radiographs.

While it is being cemented to the saddle with auto-polymerizing resin the implant is held in place by light pressure. The surgical operation is a minor one and no sutures are required.

Postoperative discomfort is rare. During the first 24 hours a liquid diet should be taken, and during the next week tough and adhesive foods that might exert traction on the restoration should be avoided. In addition to the routine cleaning of the teeth the patient should brush *along the margins of the saddle* with a small soft tooth brush; this not only cleans the mucosa but massages and stimulates it.

The patient is urged to return for checks 2 or 3 times a year for any necessary corrections of the restoration and for attention to any damage to the tissues.

Material

The case series for the clinical and radiographic studies consists of all the persons for whom the author made superplants between 1st May, 1961, and the end of 1962, a total of 19 patients for whom 22 superplants were made (Table I). Of these 19 patients 14 declared themselves to be in perfect health at the beginning of the investigation; 2 were suffering from weak hearts, one from vertigo, one from chronic headache and one from insomnia and low basal metabolic rate.

All 19 patients attended the initial examination. The clinical part took place 4—15 days after the superplant had been cemented, while the radiographic examination was performed 3—17 days after cementing. One patient (P) was unable to attend the radiographic examination for 51 days.

The clinical and radiographic follow-up examinations took place 12—14 months after the initial registration. Seventeen of the patients, 10 women and 7 men, attended. Their mean age at the time the superplants were made was 54 years (Table II). One of the 2 patients (H) absent from the follow-up was in the United States at the time. At the request of the author she was given clinical and radiographic examinations by an American dentist 13 months after the initial examination. Colour photographs were taken and casts of the jaws made. This material was forwarded to the author and the radiographs were assessed by the two dentists who analysed the other radiographs in this study. The report for this patient is given separately (p. 51). The second absentee (Q) was prevented by illness from attending the follow-up.

The 17 patients examined by the author were supplied with 20 superplants, 10 of them in the lower arch and 10 in the upper. Two patients (O and R) had been provided with full superplants in the upper and lower jaws on different occasions and one patient (A) had 2 unilateral superplants in the mandible.

The superplants were of different types as regards design and material. The distribution of the various types of restoration is given in Table III.

Table I.

The case series and the superplant restorations.

Superplant no.	Patient	Sex	Age	Superplant*	Abutments*	Saddle*	Implants
1	A	F	66	−5 . . . −2	−3, −2	−5, −4	One
2	A	F	66	3− . . . 5−	3−, 4−	5−	
3	B	F	46	−7 . . . −2	−7, −3, −2	Int. −6, −5, −4	
4	C	M	40	3+ . . . 6+	3+, 4+	5+, 6+	One
5	D	F	49	−6 . . . 7−	−4, −3, −2, 3−, 5−, 7−	−6, −5	
6	E	F	35	−6 . . . 5−	−6, −3, −2, −1, 1−, 2−	Int. −5, −4 and 3−, 4−, 5−	
7	F	F	52	−7 . . . 6−	−7, −5, −3, 3−, 5−	6−	
8	G	F	66	2+ . . . 5+	2+, 3+, 4+	5+	
9	H	F	28	−6 . . . 6−	−6, −4, −3, −2, 2−, 3−	4−, 5−, 6−	One
10	I	F	56	+7 . . . 5+	+7, +4, +3, +2, 1+, 2+, 3+, 4+	5+	
11	J	M	62	3+ . . . 5+	3+, 4+	5+	
12	K	F	45	−6 . . . −4	−5, −4	−6	
13	L	F	53	+6 . . . 6+	+5, +3, +1, 3+, 4+, 5+, (6+ pontic)	+6	
14	M	M	60	+7 . . . 6+	+7, +5, +3, +1, 1+, 2+, 3+	4+, 5+, 6+	
15	N	M	45	3+ . . . 5+	3+, 4+	5+	
16	O	F	46	+6 . . . 6+	+6, +3, +1, 1+, 3+, 6+	Int. 4+, 5+	
17	P	M	71	−5 . . . −2	−3, −2	−5, −4	One
18	Q	F	53	−8 . . . 8−	−8, −5, −4, −3, 3−, 4−, 8−	Int. 5−, 6−	
19	R	M	58	−5 . . . 5−	−3, −2, 2−, 3−, 4−, (5− pontic)	−5, −4	One
20	O	F	46	−6 . . . 6−	−3, −2, 2−, 3−	5−, 6− and −6, −5	Two
21	S	M	62	+7 . . . 6+	+5, +4, +3, +1, 1+, 3+, 5+, 6+	+7, +6	
22	R	M	58	+6 . . . 5+	+5, +3, +1, 1+	+6 and 2+, 3+, 4+, 5+ Palatal bar	One

* According to the Haderup dental stenography + indicates the upper jaw, − the lower jaw. If the sign is placed on the right of the figure, the right tooth is indicated and *vice versa*.

Table II.
Age and sex distribution of the case series.

Group	30—39	40—49	50—59	60—69	70—80	Total
Men	—	2	1	3	1	7
Women	1	4	3	2	—	10
Total	1	6	4	5	1	17

Table III.
Distribution of 20 superplants according to type and jaw.

Type of superplant	Mandible	Maxilla	Total
Full superplant	5	6	11
Unilateral superplant	5	4	9
Total	10	10	20

Table IV.
Distribution of 20 superplants according to number of abutments per superplant, type of restoration, and jaw.

Number of abutments in the superplant	Mandible		Maxilla		Both jaws	
	Full	Unilateral	Full	Unilateral	Full	Unilateral
8	—	—	2	—	2	—
7	—	—	1	—	1	—
6	2	—	2	—	4	—
5	2	—	—	—	2	—
4	1	—	1	—	2	—
3	—	1	—	1	—	2
2	—	4	—	3	—	7
Total	5	5	6	4	11	9

All the superplants included goldwork and one or more saddles. In some cases the saddles were provided with implants at their free ends. The remaining teeth were furnished with crowns

Table V.

Saddles distributed according to length, type of superplant, and jaw.

Length of saddle (mm)	Mandible				Maxilla				Both jaws
	Full		Unilateral		Full		Unilateral		
	Free-end	Interm.	Free-end	Interm.	Free-end	Interm.	Free-end	Interm.	
11—15	1	1	2	—	3	—	3	—	10
16—20	1	—	2	—	1	1	—	—	5
21—25	3	—	—	1	1	—	1	—	6
26—32	1	—	—	—	1	—	—	—	2
Total	6	1	4	1	6	1	4	—	23

of various types, all made in platinum gold alloy (either Auroplatin I or C-gold). The abutments (totalling 37 lower and 48 upper) numbered 2 or 3 for the unilateral and 4—8 for the full superplants (Table IV). There were altogether 50 other teeth (24 lower and 26 upper) situated in the same jaws as the unilateral superplants but not associated with them.

Twenty-three saddles were made, 12 in the lower and 11 in the upper jaws. Twenty of these were free-end saddles, and 3 were intermediary. Eighteen were cast in Vitallium. Five saddles in 4 patients — all of them free-end saddles — were made of platinum gold alloy and in these cases 22 carat solder was used for the joints between the saddle and the goldwork. In 2 patients (A and L) the saddles were not made of Vitallium because these patients (with 3 superplants) were allergic to constituents of this alloy. Gold saddles were used in the 2 remaining cases because the dental technician who performed the chrome-cobalt work could not make these saddles.

All but one of the saddles were soldered to the goldwork, the exception being an intermediary upper saddle made in May, 1962. From this time onwards such saddles were made so as to be removable by the dentist only. They are connected to the bridge by attachments, with the male parts on the saddle and the female parts in the abutments. The male parts were made slightly lower than the female parts and the difference in level was filled out with auto-polymerizing resin.

Table VI.

Distribution of saddles according to the number of teeth, type of superplant, and jaw.

Number of teeth on the saddle	Mandible				Maxilla				Both jaws
	Full		Unilateral		Full		Unilateral		
	Free-end	Interm.	Free-end	Interm.	Free-end	Interm.	Free-end	Interm.	
1	1	—	2	—	3	—	3	—	9
2	4	1	2	—	1	1	1	—	10
3	1	—	—	1	1	—	—	—	3
4	—	—	—	—	1	—	—	—	1
Total	6	1	4	1	6	1	4	—	23

The saddles ranged in length from 11 to 32 mm, and each had 1 to 4 teeth. The distribution of saddles between the lower and upper jaws, and a specification of the lengths of the saddles for the various types of restoration are given in Table V. The number of teeth on the respective saddles appears in Table VI.

All the teeth on the saddles were acrylic.

One stress-distributing bar was made to strengthen an upper superplant. This bar was of Vitallium and could be taken out in the same way as the saddles that could be removed by the dentist.

The free-end saddles were supplied with one implant in 7 cases; 6 of them were made in Vitallium and one in tantalum. The latter was made for a superplant for one of the allergic patients (A). Five of the 7 implants were placed in the mandible, 2 in unilateral and 3 in full restorations. The other two implants were connected to upper saddles, one in a unilateral and one in a full superplant.

Three of the 17 patients had removable dentures in the opposite jaws at the time the superplants were made; 2 of these (A and E) had a full upper denture with acrylic teeth, and the third (L) had a lower partial denture with —4, —3, 3— , 4— remaining. The other 14 patients had their natural teeth and/or fixed prosthetic restorations.

I. CLINICAL STUDY

Method

Registrations were carried out at the initial examination shortly after the superplant had been placed and again at the follow-up about one year later; all were performed by the author.

The patients were examined according to a scheme specially designed for this study. It was developed from a type of record sheet used in a longitudinal study on dentogingivally supported partial dentures (*Koivumaa, Hedegård & Carlsson,* 1960).

Classification of the observation items

Oral hygiene

Oral hygiene was recorded on the basis of the patient's statements and the investigator's assessment.

The classification according to the patient's statements was as follows,

(a) *Good:* Brushing of the teeth twice daily, and mouth rinsing after meals.

(b) *Fairly good:* Brushing once or twice a day (irregularly).

(c) *Poor:* Brushing rarely, if at all.

The author's assessment was based on probing of visible surfaces with a straight explorer. Classification:

(a) *Good:* No soft deposits on the visible surfaces of teeth or superplants.

(b) *Fairly good:* Minor soft deposits.

(c) *Poor:* Major soft deposits.

Dental calculus

Dental calculus was assessed by inspection and probing in the gingival pockets, and classified as *none, little* and *more than a little.*

Mobility of teeth and stability of saddles

All the teeth in the jaw in question were tested for mobility, and the stability of the superplant saddles was examined.

A force of 300 g was applied for a few seconds to the tooth

and saddle by means of a Correx spring gauge (*Forsberg & Häggglund*, 1955). The ball of the instrument was applied perpendicularly to the incisal edge and as close as possible to its midpoint. Before the load was applied, the tooth was pressed firmly 3 or 4 times in the vestibulolingual direction. The pressure was applied to the saddle at one, two or three points, depending on its length. For free-end saddles these points were situated 0.5, 1.5 and 3.0 cm distal to the nearest abutment, and for intermediary saddles 0.5, 1.5 and 3.0 cm distal to the mesial abutment nearest the saddle. The mobility and stability were estimated by inspection.

The findings were classified:

Grade 0: No mobility of teeth or instability of saddles.

Grade 1: Mobility of teeth or instability of saddles in the vestibulo-lingual direction.

Grade 2: Axial mobility of teeth or axial instability of saddles.

Exposure of the cemento-enamel junction

The examination for exposure of the cemento-enamel junction was extended to all the teeth in the jaw in question and the classification was based on naked-eye inspection of the vestibular and lingual surfaces:

Group 1: Cemento-enamel junction *not visible* above the gingival margin in the horizontal plane.

Group 2: Cemento-enamel junction thus *visible.*

Depth of gingival pockets

The depths of the gingival pockets of all teeth in the arch in question were measured with a graduated explorer. The calibrated part was moved parallel to the longitudinal axis of the tooth until a definite resilient resistance was encountered. The measurements were made at the middle of the vestibular and lingual surfaces and as near the middle of the two proximal surfaces as the adjacent teeth permitted. The depth was read as the distance between the bottom of the pocket and the gingival margin. The reading was converted into a point score as follows:

Pocket depth $\leqq$ 2 mm, score 2 points
$>$ 2 mm, score equal to depth in millimetres.

The pocket depths were classified as follows,

Group 1: Normal depth: The mean of 4 readings did not exceed 2.5 points.

Group 2: Deepened gingival pockets,

(a) The mean of the 4 readings exceeded 2.5 points, or

(b) One measured depth was at least 4 mm.

State of the gingiva for all teeth in the relevant arch and the state of the mucosa around saddles, implants and palatal bar

A three-grade classification was made separately for the gingiva and mucosa.

Grade 0: Healthy, the tissue was pink and firm in consistency; no signs of oedema or tendency to bleeding.

Grade 1: Slightly inflamed, local reddening of the tissue or a tendency to bleeding; signs of oedema.

Grade 2: Severely inflamed, the tissue was deep red or tended to be violet; bleeding readily on palpation; definite oedema.

Exposure of implants

Any exposure of implants was measured and recorded in millimetres.

Adaptation of saddles to mucosa

The adaptation of the saddles to the mucosa was examined by applying to the vestibular and lingual aspects of the saddle a rubber-base compound spread on a piece of gauze. From the appearance of the compound at the border of the saddle the adaptation was classed as follows:

(a) *Good adaptation:* no space between saddle and mucosa at the periphery of the saddle.

(b) *Poor adaptation:* other states.

Occlusion and articulation

The occlusion and articulation were checked in the mouth with blue articulation paper (Mark-rite).

Occlusion

(a) *Correct:* if on repeated habitual closure there was correct intercuspation without terminal gliding movements, and if at the same time there was at least one contact point on each side in the molar regions, and at least one contact in the anterior region (from canine to canine, incl.) on both sides. (In the absence of all molars, the occlusion was classed as good if there was contact bilaterally in the anterior region and bilaterally in the premolar segment.)

(b) *Incorrect:* other states.

Articulation

(a) *Correct:* if during lateral movements of the mandible there was visible contact in the molar and premolar and anterior segments on the working side. (The patient was instructed to perform lateral movements repeatedly. The magnitude of the lateral movement: one-half of the width of a premolar or the buccal cusps of the molars on the working side in contact. If there were no molars, the procedure was that mentioned for *Occlusion.*)

(b) *Incorrect:* other conditions.

Dental caries

Caries was diagnosed for all teeth by means of a mirror and explorer after drying with air. A loss of substance and/or softening of the surface was recorded as a carious lesion; chalky enamel was not included.

Other registrations

Palpation of the tissues of the arches provided with superplants was performed to discover any anomalies.

An attempt was made to determine the *habitual chewing side* by having the patient chew on soft wax.

The patient was questioned on any known *parafunctions* of the masticatory muscles. Any attrition facets on the teeth were also noted.

Any *local complications* appearing between the two examinations were recorded.

The *general health* of the patient at the initial and follow-up examinations and in the intervening period was noted.

The *patient's opinion* of the superplant with respect to function (comparison with "the natural teeth"), comfort, physiognomy and phonetics was noted.

Statistical method

In testing whether the difference between two percentages could be considered due to the play of chance the χ^2-analysis with one degree of freedom was used (*Snedecor* 1956). The following expression was formed

$$\frac{\left[|p_1 - p_2| - \frac{100}{2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)\right]^2}{\frac{n_1 p_1 + n_2 p_2}{n_1 + n_2}\left[100 - \left(\frac{n_1 p_1 + n_2 p_2}{n_1 + n_2}\right)\right]\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

where p_1 and p_2 denote the percentages for the first and second groups, respectively, and n_1 and n_2 the number of persons (units) in these groups.

The significance analyses are given in conjunction with the tables. As a rule, however, only "significant" results are presented. The term "significant" is used in accordance with the following convention: If an observed difference between two percentages (or two means) is of such a magnitude that the probability P of obtaining a difference at least as great as the observed value is greater than 0.05 (where the null hypothesis is assumed to hold), then that observed difference is said to be non-significant.

The levels of significance recognized were

$0.01 < P \leq 0.05$ (probably) significant.

$0.001 < P \leq 0.01$ significant.

$0.001 \geq P$ (highly) significant.

Results

As mentioned earlier, 2 of the 17 patients (O and R) who were checked by the author both at the initial and the follow-up examinations both had upper and lower superplants supplied on different occasions (nos. 16 and 20; 19 and 22). These 2 patients (one man and one woman) were therefore recorded as 4 cases. Accordingly, 19 examinations were performed on 17 patients at each examination. One patient (A) had 2 unilateral superplants made simultaneously for her lower jaw (nos. 1 and

2). Thus, altogether 20 restorations were followed up. The results of the examinations are shown in Tables VII—X and Figs. 22—24.

Oral hygiene (Table VII)

Discrepancies between the patient's and the investigator's evaluations were found on 3 occasions (2 patients) at the initial examination and on 4 occasions (the same 2 patients and one

Table VII.

Evaluation of oral hygiene by investigator and patients at the initial examination and the follow-up.

Examination	Patient's evaluation				Investigator's evaluation			
	Good	Fairly good	Poor	Total	Good	Fairly good	Poor	Total
Initial examination								
Number	16	3	—	19	13	5	1	19
Per cent	84	16	0	100	69	26	5	100
Follow-up								
Number	18	1	—	19	14	3	2	19
Per cent	95	5	0	100	74	16	10	100

additional) at the initial registration 5 patients (D, J, L, P, R) displayed fairly good or poor oral hygiene (investigator's assessment) and for all but one (J) the assessment was the same at the follow-up. For the series as a whole there was thus no significant change in oral hygiene.

Dental calculus

Dental calculus had been removed in all cases at outset and during the course of the treatment. For this purp the patients were recalled on an average twice between t gistrations, except for one male patient (R) with a superp in both upper and lower jaws. This patient had received t it for dental calculus and soft deposits every month, and at xaminations the oral hygiene was classed by the investig poor.

At the initial registration the quantity of calculus was recorded as "little" in 5 cases (all men). In the remaining 14 no calculus was found. At the follow-up, on the other hand, there was "more than a little" in 2 cases (1 man, no. 22; 1 woman, no. 13), "little" in 11 cases (6 men, 5 women) and "none" in 6 cases (1 man, 5 women). In spite of the regular treatment, therefore, there was a significant increase in the amount of calculus between the 2 examinations.

Mobility of teeth and stability of saddles

At the initial examination there was no mobility of the abutments of the full or unilateral superplants. At the follow-up, however, grade 1 mobility was recorded for 2 central incisors included in a full upper restoration (the other abutments were + 5 and + 3). This superplant was provided with a stress-distributing bar and 2 saddles, one of which carried 4 teeth (2 + ... 5 +) and the other, one tooth (+ 6, no. 22).

There was instability of the saddles at the first examination in only one case, viz. that described above. The longer saddle in this superplant showed instability of grade 1 when the pressure was applied in the vestibular direction 3 centimetres from the point at which the saddle was soldered to the abutment. This instability increased gradually and at the follow-up was classed as grade 1 both in vestibular and palatal directions 0.5 cm from the nearest abutment, and as grade 2 when the load was applied 1.5 or 3 cm from this tooth.

The other 22 saddles displayed no instability at the follow-up examination.

Of the teeth in the same jaws as the unilateral superplants and not included in them, grade 1 mobility was recorded in 3 cases at the initial registration. In one (mandible, no. 17) 3 incisors were mobile to both the labial and lingual pressures; in one maxilla (no. 11) an incisor was recorded as mobile in the labial direction; and in one third (maxilla, no. 15) all 4 incisors were mobile to pressure in both labial and palatal directions.

At the follow-up there was no change in mobility of the lower teeth. In another case, however, there was grade 1 mobility of one lower incisor in labial direction (no. 12). In one of the

2 maxillary cases 3 of the 4 upper incisors were no longer mobile, while the fourth was now classed as grade 1 only in the labial direction. A short time before the superplant was placed this patient had been provided with a conventional 5-unit bridge in the other quadrant (no. 15). The other maxillary case (no. 11) with one mobile incisor displayed no change in mobility at the follow-up.

Exposure of the cemento-enamel junction (Table VIII; Fig. 22)

At the initial registration there was exposure of the cemento-enamel junction in only one of the 85 abutments included in the restorations (vestibular surface, no. 19). At the follow-up the number of exposures had increased to 11 in a total of 7 full superplants (nos. 5–7, 16, 19, 21, 22), all on vestibular surfaces. Seven of the 11 exposed junctions were situated next to the saddles, while 4 were located at intermediate supports within the bridges. On the other hand, none of the abutments in the unilateral superplants displayed exposure. Of the other 50 teeth in

Table VIII.

Exposure of cemento-enamel junction (2 surfaces on each tooth).

Examination	Mandible			Maxilla			Both jaws		
	Full	Unilateral		Full	Unilateral		Full	Unilateral	
	A	A	O	A	A	O	A	A	O
Initial examination									
Group 1	51	22	26	78	18	43	129	40	69
Group 2	1	—	22	—	—	9	1	—	31
Total root surfaces	52	22	48	78	18	52	130	40	100
Follow up									
Group 1	46	22	26	73	18	43	119	40	69
Group 2	6		22	5	—	9	11	—	
Total root surfaces	52	22	48	78	18	52	130	40	100

Group 1 Junction not exposed
Group 2 Junction exposed
A = Abutments *O* = Other teeth

Change in exposure of cemento-enamel junction of abutments between the two registrations, (buccal and lingual surfaces only.)

Percentage of number of surfaces.

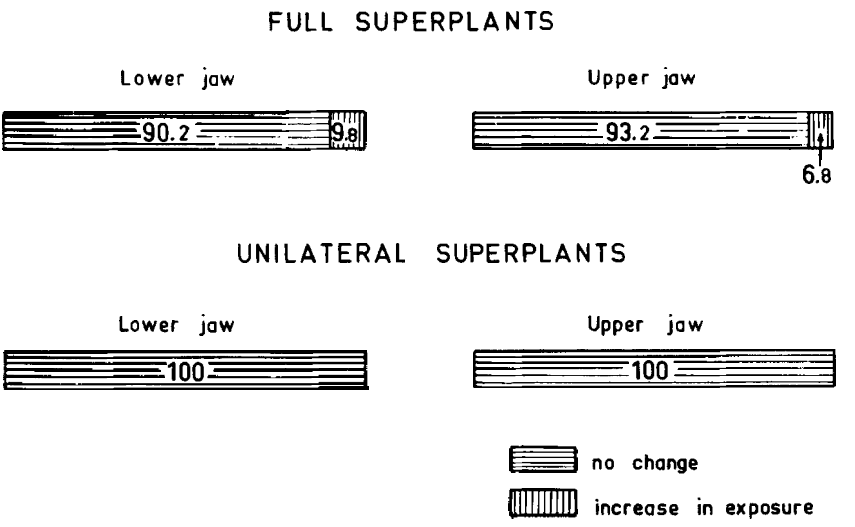


Fig. 22.

arches with unilateral superplants 20 (in 6 arches) had one or two exposed junctions. On 5 teeth the vestibular cemento-enamel junction was visible, on 4 the lingual, while the remaining 11 had exposures on both surfaces. The recordings for these teeth were the same at both examinations.

Changes in exposure of the cemento-enamel junction between the two registrations were thus significantly more common for teeth in full superplants than for those in unilateral restorations.

Before the prosthetic restorations were made, deepened gingival pockets at the abutments were reduced to normal depth. Hence at the initial examination all the pockets of the abutments were normal. Of the other teeth in the arches with unilateral

Table IX.

Distribution of abutments and other teeth according to depths of gingival pockets.

Examination	Mandible			Maxilla			Both jaws		
	Full	Unilateral		Full	Unilateral		Full	Unilateral	
	A	A	O	A	A	O	A	A	O
Initial examination									
Group 1	26	11	18	39	9	19	65	20	37
Group 2	—	—	6	—	—	7	—	—	13
Total teeth	26	11	24	39	9	26	65	20	50
Follow-up									
Group 1	21	11	21	34	7	20	55	18	41
Group 2	5	—	3	5	2	6	10	2	9
Total teeth	26	11	24	39	9	26	65	20	50

Group 1 Normal depth *Group 2* Deepened pocket

A = Abutments O = Other teeth

Change in depth of gingival pockets at abutments and other teeth between the two registrations.

Percentage of number of teeth.

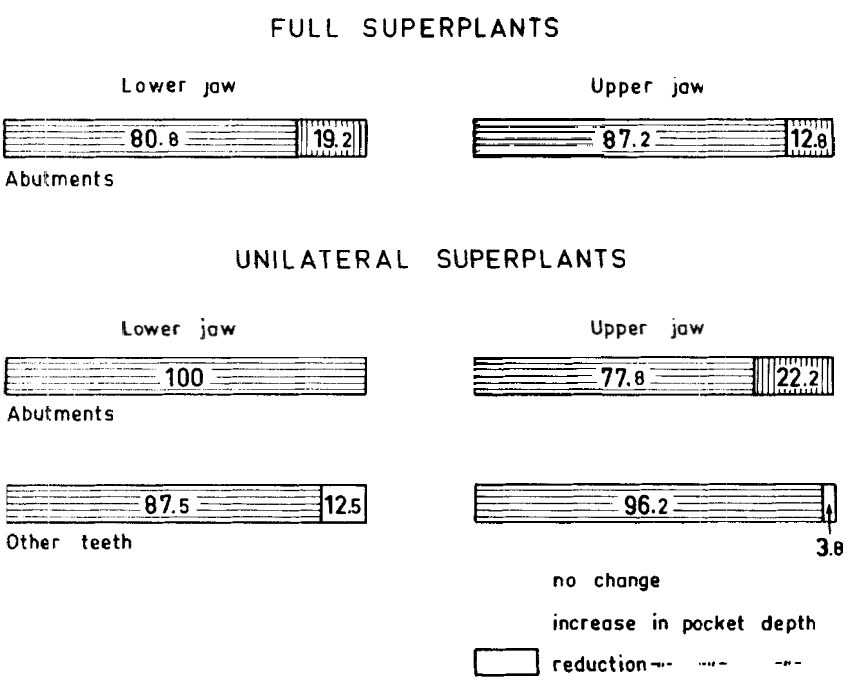


Fig. 23

superplants 25 per cent in the lower arches and 26.9 per cent in the upper arches had deepened pockets.

At the follow-up examination the proportion of abutments with deepened pockets in the case of the full superplants had increased from 0 to 15.4 per cent (deepened pockets in nos. 5, 7, 10, 13, 14, 16, 19, 22). There were no differences between the teeth situated adjacent to saddles and those more remote. Only two teeth included in unilateral superplants were observed to have deepened pockets (no. 4). As regards teeth outside the unilateral superplants there was a reduction in the proportion with deepened pockets to 12.5 per cent for the lower and 23.1 per cent for the upper teeth.

State of the gingiva around all teeth in the relevant arch and of the mucosa around the saddles, implants and palatal bar

Gingival status (Table X; Fig. 24)

At the initial registration, grade 1 inflammation of the gingiva was observed at 7 abutments, or at 10.8 per cent (nos. 7,

Table X.

State of oral mucosa around teeth, saddles, and implants.

Examination	Mandible							Maxilla							Both jaws							
	Full			Unilateral				Full			Unilateral				Full			Unilateral				
	A	Sa	I	A	O	Sa	I	A	Sa	I	A	O	Sa	I	A	Sa	I	A	O	Sa	I	
Initial examination																						
Grade 0	23	6	2	11	24	5	1	35	7	1	7	26	4	1	58	13	3	18	50	9	2	
Grade 1	3	1	1	—	—	—	1	4	—	—	2	—	—	—	7	1	1	2	—	—	1	
Grade 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Total teeth	26	7	3	11	24	5	2	39	7	1	9	26	4	1	65	14	4	20	50	9	3	
Follow-up																						
Grade 0	14	7	3	9	19	5	1	20	6	1	9	26	4	1	34	13	4	18	45	9	2	
Grade 1	12	—	—	2	5	—	—	19	1	—	—	—	—	—	31	1	—	2	5	—	—	
Grade 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Total teeth	26	7	3	11	24	5	1	39	7	1	9	26	4	1	65	14	4	20	50	9	2	

Grade 2 Severely inflamed. *Grade 0* Healthy. *Grade 1* Slightly inflamed.
A = Abutments *O* = Other teeth. *Sa* = Saddles *I* = Implants

Change in gingival status around abutments and other teeth between the two registrations.

Percentage of number of teeth.

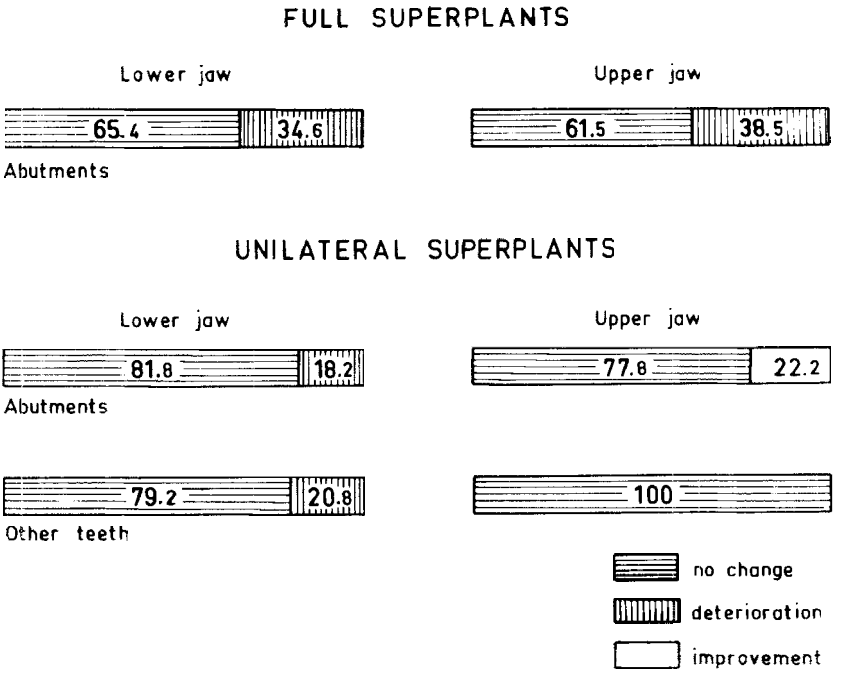


Fig. 24.

19, 22), for full superplants. Grade 1 inflammation was also noted around two abutments included in one upper unilateral superplant (no. 11). No abutments for lower unilateral superplants displayed inflamed gingiva, nor did other teeth in the same arches.

At the follow-up, grade 1 inflammation was observed at 47.7 per cent of the abutments for full superplants (31 teeth; nos. 5—7, 10, 13, 16, 19, 22); this represents an increase of 36.9 per cent. In this respect, abutments for full superplants situated adjacent to saddles differed slightly from the other abutments in the restorations (56.3 and 44.9 per cent, respectively).

As regards unilateral superplants no inflammation was ob-

served at the two upper abutments the gingiva at which had been recorded as inflamed at the outset. On the other hand, two other abutments for one lower superplant displayed grade 1 inflammation (no. 3).

Five lower teeth other than abutments displayed grade 1 inflammation (nos. 3 and 17).

The deterioration in the state of the gingiva was considerably more common at the abutments of full than of unilateral restorations (statistically significant difference).

Mucosa around saddles (Table X)

At the initial examination the mucosa around the saddles was assessed as "healthy", grade 0, with one exception, in which there was slight reddening around the extreme distal part of a full lower superplant with a saddle carrying two premolars (no. 19). At the follow-up the inflammation had disappeared. At a full upper restoration with a saddle carrying two molars there was hyperplasia of the mucosa extending about one millimetre over the distobuccal margin of the saddle; there were no other visible changes.

Mucosa around implants (Table X)

In two cases slight inflammation was observed at the initial registration. In one of them (no. 1) — a unilateral lower superplant fitted 6 days before the examination — slight inflammation was seen at the perforation on inspection with a magnifying glass. A few days after the first examination this implant was removed at the patient's urgent request. The other case (no. 19) — a full lower restoration — displayed slight reddening at the perforation 13 days after the operation; neither around this (Fig. 25) nor around the 5 remaining implants was there inflammation at the follow-up.

At one (no. 17) of the 7 implants included in the initial examination there was exposure of about one millimetre at the perforation. The other 6 were completely covered by tissue. At the second registration this implant, too, was completely covered. The same applied to all but one of the other implants. The ex-

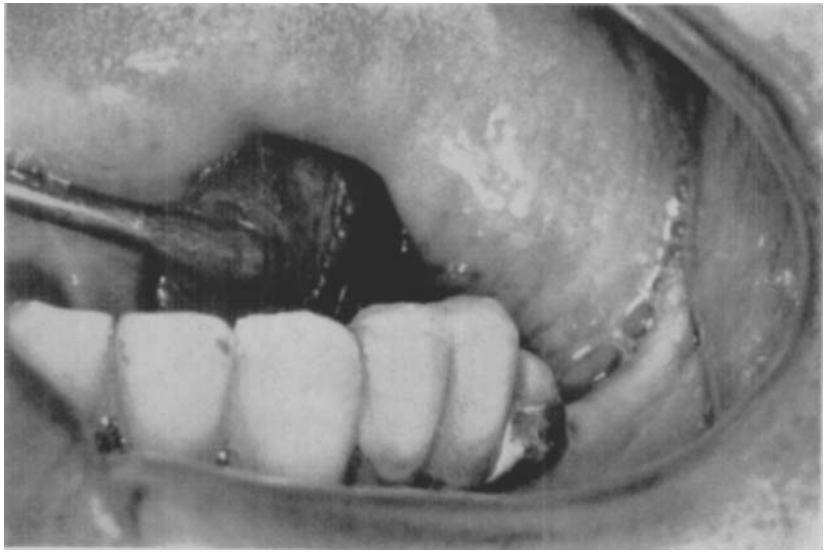


Fig. 25. Implant region at follow-up, no changes visible.

ception was a total upper superplant serving as a retention for a 4-tooth saddle (no. 22); here there was a 4 mm exposure beginning about 5 mm from the perforation but with the distal part of the implant covered by tissue (Fig. 26).

Mucosa around the palatal bar

This mucosa was assessed as clinically normal at both examinations (no. 22).

Adaptation of saddle to mucosa

At the initial registration narrow spaces were observed at 4 saddles belonging to 3 full superplants and in the rubber-base impression they had the form of blade-thin strips. In 2 cases (nos. 13 and 5) — one upper and one lower — these spaces were visible only on the vestibular sides. The third case (no. 16) — a lower restoration — was provided with 2 saddles, one free-end and one intermediary. At both of them this space was observed on the vestibular and lingual sides.

In unilateral superplants no such spaces were seen between the saddles and the mucosae.

At the follow-up it was found that the tissue at the upper superplant had proliferated and was well adapted to the saddle.

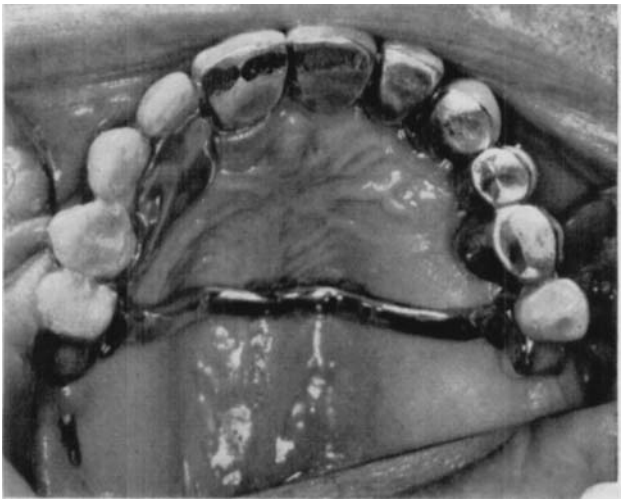


Fig. 26. Upper implant partially exposed.

Around 2 of the saddles on the 2 lower superplants (no. 5; no. 6, left side) there was still a gap, which, however, was smaller than before. A small gap was noted on the lingual side of a lower saddle (no. 19). On the vestibular side of an upper superplant (no. 22, same patient) with 2 saddles there was a small gap bilaterally. At one saddle included in the unilateral superplant group a fine gap was observed on the vestibular side (no. 15).

Occlusion and articulation

At both examinations the occlusion was assessed as good in all cases but one (no. 11). In only one case (no. 6) was the articulation classed as good on both sides, and there was no evident difference on the 2 occasions of examination.

Caries

Before the superplant restorations were made, the usual caries registration had been carried out and lesions filled. The caries

status was therefore good at the initial examination and only one tooth surface had a carious lesion which was left unfilled.

Between the 2 examinations 15 carious lesions were recorded and filled. At the follow-up caries was found on only one surface.

All the above carious surfaces belonged to teeth outside the superplants.

Other registrations

Palpation of the tissues of arches with superplants disclosed no abnormalities at either examination.

As regards the *habitual chewing side* no difference was found between the two examinations.

In respect of *parafunctions* of the masticatory muscles 5 patients (D, G, L, M, R) stated at the initial examination that they clenched their teeth occasionally. At the follow-up one of these patients thought he had stopped doing so (M). (One of these 5 patients was the only one in which instability of the saddle had been recorded.)

Local complications

One patient (A) with 2 unilateral superplants, one of which had had the implant that was removed, showed inflammation of the mucosa on the vestibular side at the borders of both saddles. The borders were probably not properly rounded. The tissue at one of the saddles healed after the saddle border had been ground and surgical packing had been applied. The same procedure was used for the other side, where the saddle with the earlier implant was situated. Since the result was not satisfactory a buccal plastic operation was performed and after prolonged treatment the mucosa recovered.

Patients' opinion of the superplants

Function

Two patients stated that they were "cautious when chewing". One of these, the one undergoing the buccal plastic operation, "was cautious when chewing on that side". The other patient (R) had full superplants in the upper and lower jaws. The lon-

ger upper saddle was unstable and the periodontal state of the remaining teeth was poor.

Comfort

In the region where the above buccal plastic operation had been performed the patient occasionally felt a prickling sensation. Another patient, also one with a unilateral lower superplant, found the restoration "somewhat strange", because it felt a little too bulky on the lingual side.

Physiognomy

One patient criticized the appearance of the teeth, objecting that they were compact and not sufficiently transparent.

Phonetics

The patient with the unstable upper saddle stated that the speech had become "a little lisping" when he was tired and thought that this might be due to the palatal bar.

No other objections were heard.

II. RADIOLOGIC STUDY

by

LENNART IZIKOWITZ & GUNNAR LEIJON

Method

The radiologic examinations were performed at the Department of Roentgenology, the School of Dentistry, Karolinska Institutet, Stockholm, by Gunnar Leijon, a short time after the superplants had been made and again about one year later.

The technique was the same at the initial and the follow-up examinations: in addition to a complete intra-oral status of the arch containing the superplant, extra-oral oblique-lateral radiographs were taken of the lateral segments.

A Schönander X-ray apparatus was used and the factors were 60 kV and 10 mA. Single intra-oral radiographs were taken with Berghagen's apparatus (*Berghagen* 1951). For premolars, canines and incisors 23 by 36 mm films were used, and for the molar region, 31 by 41 mm. The films were "Kodak Radiatized". In some cases bite-wing films were used. In one case of unilateral upper superplant intraoral radiographs were not taken of the part of the jaw not covered by the restoration.

The analysis of the radiographs was performed in accordance with a scheme drawn up by the 2 investigators. Special attention was devoted to:

The implants: position in relation to the bone margin, and changes in the underlying bone.

The saddles: position in relation to the supporting structures, any changes in the underlying bone and the presence of calculus.

The teeth: the structure and level of the marginal bone, the periodontal space, and the periapical conditions were examined. Any changes in the part of the arches not covered by the restorations were also noted. Carious lesions were recorded. The radiographs were read by the authors independently of each other. Discrepancies in their findings were all of a minor nature.

In view of the close agreement between the investigators the evaluation was considered sufficiently reliable for the purpose of the study. When opinions differed on any point, a further examination was carried out by the investigators together, and in one case after consultation with a third person.

Results

Implants

At the initial examination none of the 8 implants displayed abnormalities. Between the examinations one implant had been removed (no. 1), and one patient with an implant was unable to attend the follow-up (no. 9).

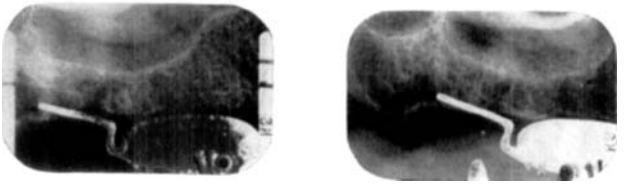
In the case of 2 out of the 6 remaining implants at the follow-up (Figs. 27—32) — one lower (no. 19; Fig. 33) and one upper (no. 22 of the same patient) — there was possibly a widening of the space between the implant and the bone.

In the case of one lower superplant (no. 20) there was resorption under the right one of the 2 implants (Fig. 34), which appeared to have sunken into the bone. Around 3 lower implants there was possibly a slightly denser structure of the compact bone (nos. 17, 19 and 20).

Saddles

(1) Position in relation to the supporting tissues

In one case (no. 1) — a saddle included in a unilateral lower superplant — where the implant had been removed, the space between the saddle and the bone was wider at the follow-up than at the initial examination. This may have been due to healing, with accompanying resorption, after an extraction.



A B

Fig. 27. Implant at the initial (A) and follow-up (B) examinations.

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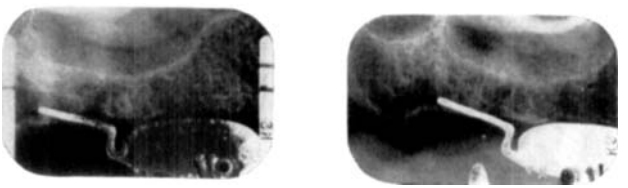
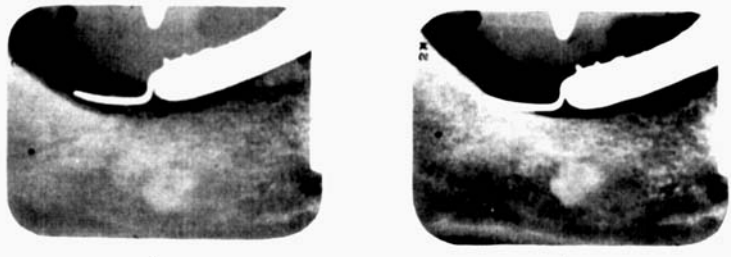


A B

Fig. 27. Implant at the initial (A) and follow-up (B) examinations.

A B

Fig. 29. Implant at the initial (A) and follow-up (B) examinations.



A B

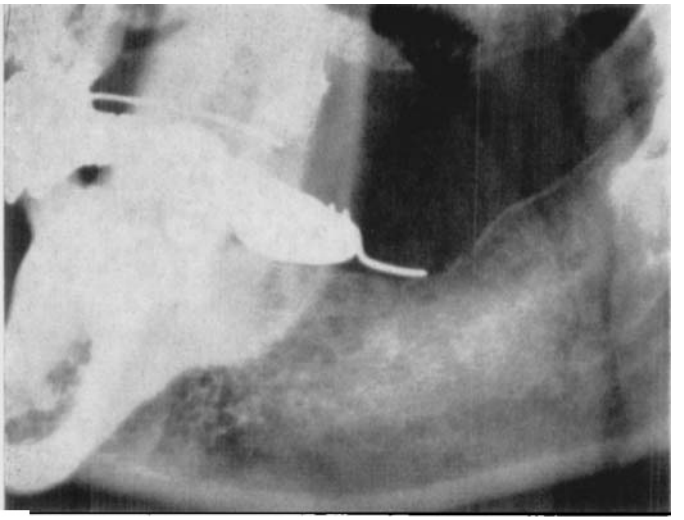
Fig. 30. Implant at the initial (A) and follow-up (B) examinations.

A B

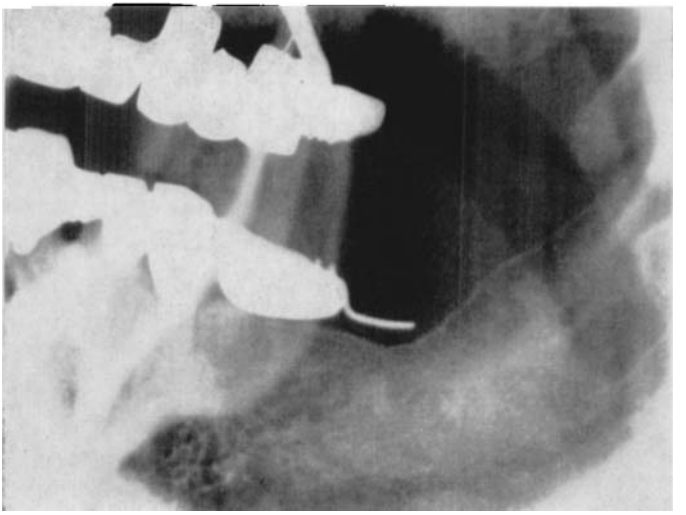
Fig. 31. Implant at the initial (A) and follow-up (B) examinations.

A B

Fig. 32. Implant at the initial (A) and follow-up (B) examinations.

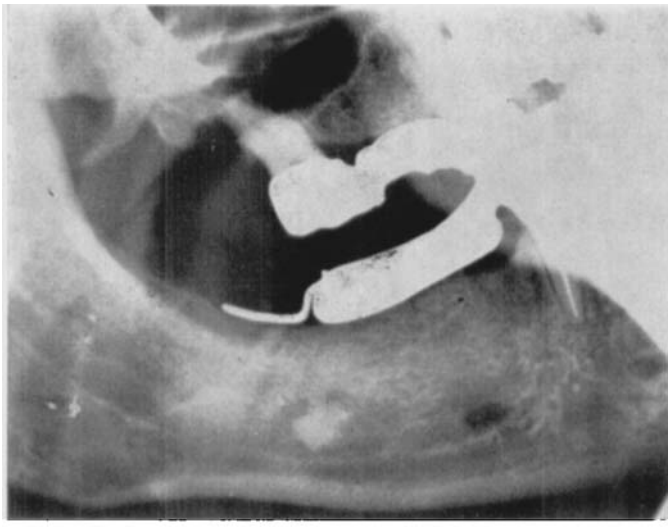


A

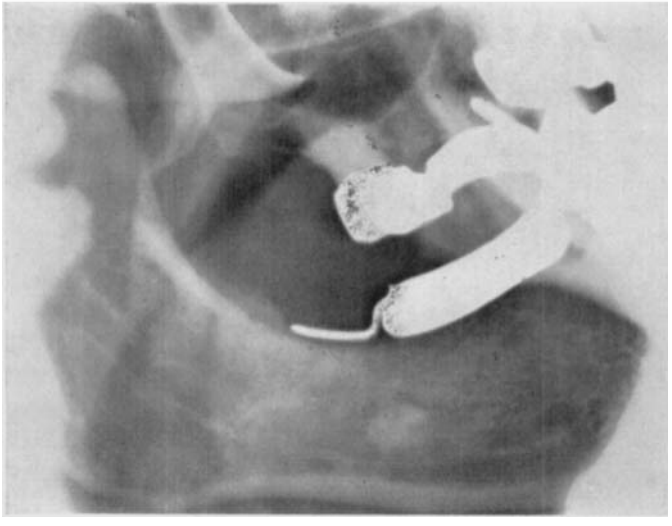


B

Fig. 33. Increase in distance between implant and bone at follow-up.

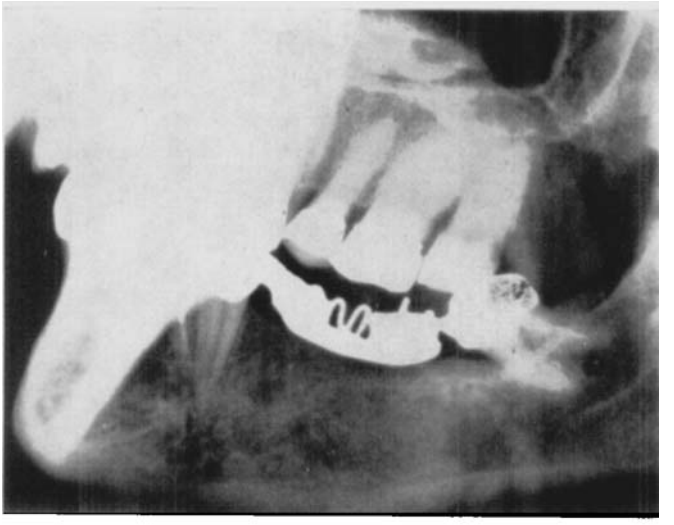


A

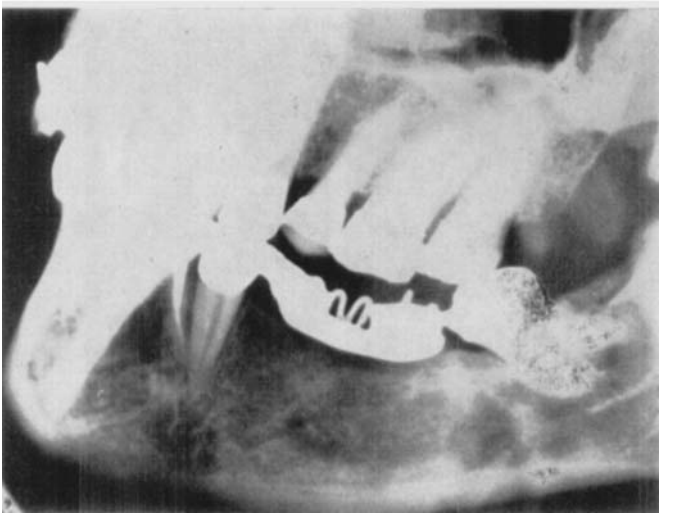


B

Fig. 34. Resorption of bone under the implant and sinking of implant as seen at follow-up.

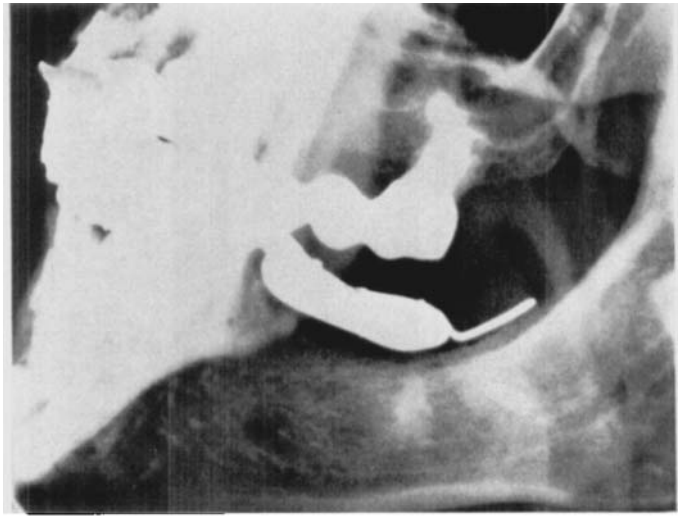


A

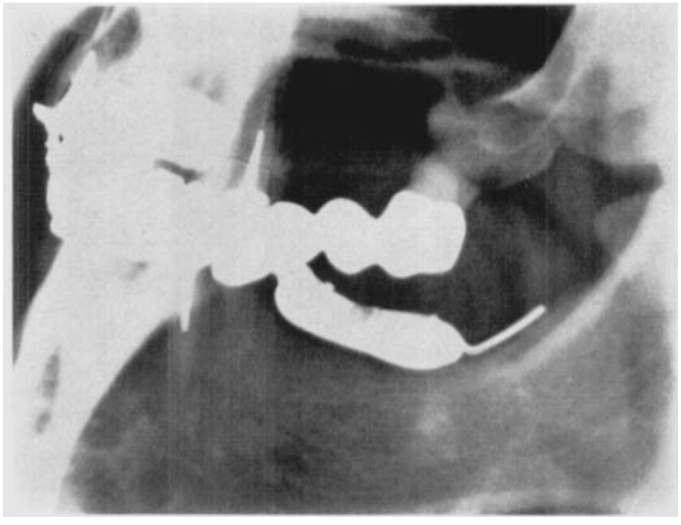


B

Fig. 35. Intermediary saddle; no visible alterations in bone.

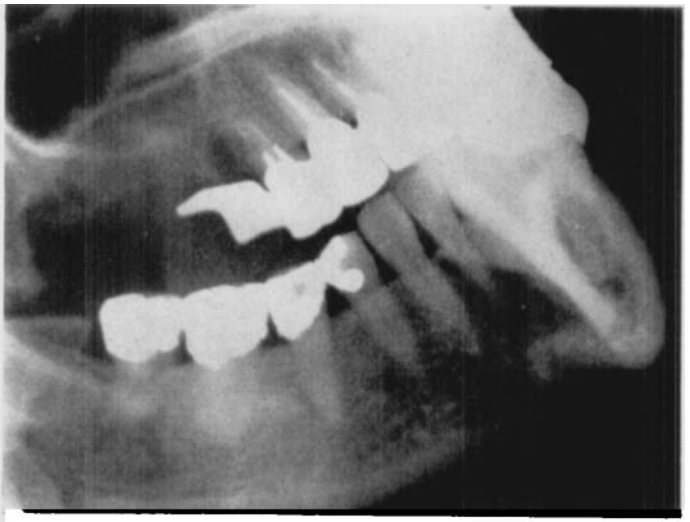


A

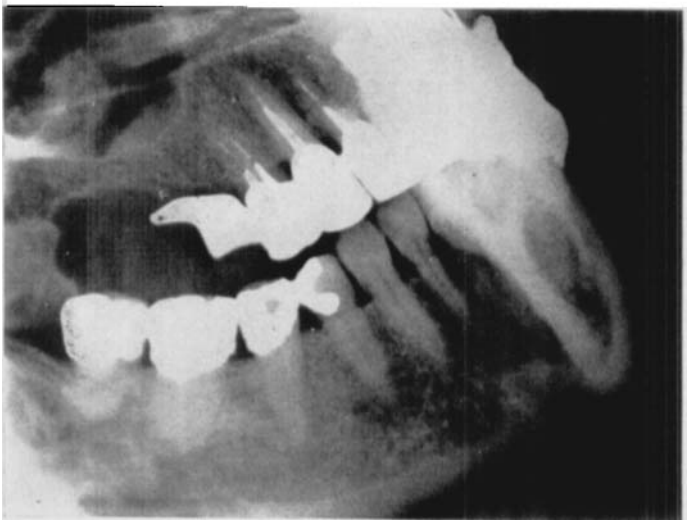


B

Fig. 36. Free-end saddle; no visible alterations in bone.



A



B

Fig. 37. (A) Dec. 1961, socket not healed. (B) Jan. 1963, bone structure indicating healing.

In no other case was there a definite change in the distance between the saddles and the bone (Figs. 35 and 36).

(2) Changes in the underlying bone

At the initial examination incomplete consolidation of the bone following extraction was found in 6 sockets under 5 saddles. At the follow-up, the bone structure in all these cases displayed evidence of healing (Fig. 37).

At one lower saddle (no. 17) a slight increase in the density of the marginal bone was noted.

The bone at the other saddles had not changed visibly since the initial examination.

(3) Calculus

No calculus was observed at any of the saddles.

Remaining teeth

(1) Marginal conditions

(a) Demarcation of the bone margin (Table XI). The demarcation of the bone margin at the abutments in the full superplants was estimated to be "even" in 4 cases, "fairly even" in one and "uneven" in 6.

As regards the unilateral superplants, the marginal bone structure was classified as "even" in 7 arches, "fairly even" in one and "uneven" in one case.

Table XI.

Condition of marginal bone in the 20 superplants. (The findings at the initial and follow-up examinations were identical).

Condition of marginal bone	Mandible		Maxilla		Both jaws	
	Full	Unilat.	Full	Unilat.	Full	Unilat.
Even	2	4	2	3	4	7
Fairly even	—	—	1	1	1	1
Uneven	3	1	3	—	6	1
Total	5	5	6	4	11	9

In all cases the findings were the same at both examinations.

(b) Level of bone margin. The bone margin was more or less resorbed in 7 arches with full superplants (3 lower, 4 upper) and in 5 jaws with unilateral restorations (3 lower and 2 upper). In the other 8 cases, the level of the bone margin was normal. In all cases the findings were the same at both examinations.

(c) Periodontal space. At 9 teeth the periodontal space was judged to be abnormally wide at the first examination. Seven of these were abutments for full upper superplants, one was included in a full and one in a unilateral lower restoration.

At the follow-up examination the periodontal space at one of the above upper teeth was recorded as normal in width; otherwise there was no change.

(2) Periapical conditions

(a) Periodontal contour. At the initial examination the periodontal space was diffusely demarcated or abnormally wide at 5 teeth; 3 of these were included in full upper superplants and the 2 others were in the same arch as a unilateral upper restoration.

After about one year, widening of the periodontal space was found at only one abutment, viz. in a full superplant.

(b) Destruction. At the initial examination bone resorption was noted periapically at 6 teeth; 4 of these were abutments for full superplants and 2 were included in unilateral restorations.

At the follow-up there was a reduction in the extent of the resorption at 3 teeth. At the others there were no changes.

(3) Caries

On one surface secondary caries was observed. The tooth was not included in a superplant restoration.

III. HISTOLOGIC STUDY

Method

When, at the clinical examination, there was reason to suspect pathologic alterations, biopsy specimens were taken. They were fixed in 7 per cent formalin solution, and 5-micron sections were cut and stained by the method of van Gieson and by haematoxylin and eosin (Ehrlich's method).

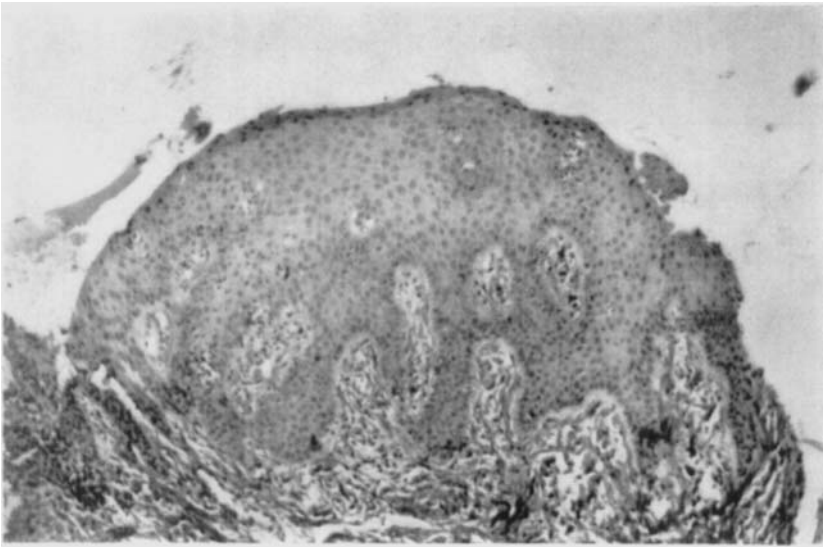


Fig. 38. Slight epithelial hyperplasia and subepithelial infiltration of inflammatory cells. No appreciable inflammation.

Results

In one case biopsy specimens were taken: at an upper saddle (no. 21) the mucosa had proliferated and extended partly over the saddle in the distobuccal direction. The histologic picture (Fig. 38) showed slight epithelial hyperplasia with slight subepithelial infiltration of inflammatory cells.

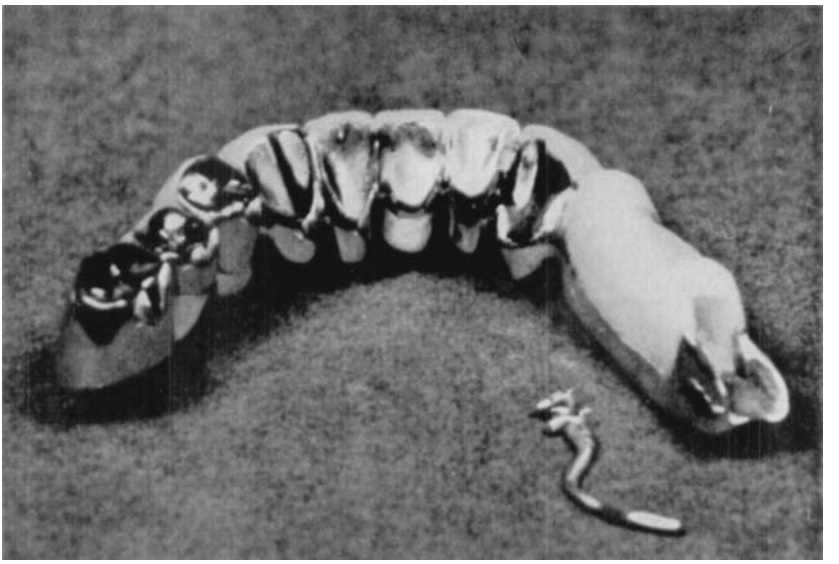
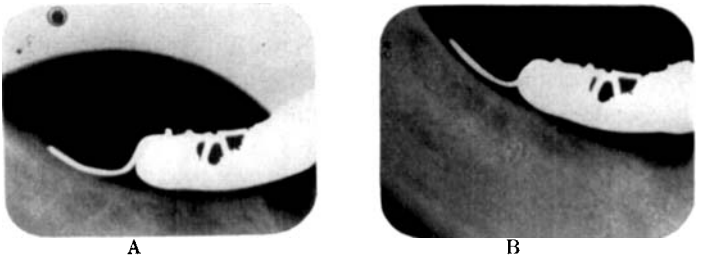


Fig. 39. Superplant, lingual view, with 3-tooth saddle and implant.

Fig. 40. Superplant seen from below.



A B

Fig. 41. Possible increase in space between saddle and bone.

ADDENDUM

Of the 2 patients not attending the follow-up, one (H) was in the United States at the time. This patient was examined by an American dentist according to instructions given by the author, and the radiographs were analysed by the two investigators who analysed those of the other cases.

The restoration was a full lower superplant with 6 abutments, one saddle 26 mm in length provided with 3 teeth and one implant (Figs. 39 and 40).

At the initial clinical examination the papilla between 2— and 3— displayed grade 1 inflammation, the articulation was classed as poor, but otherwise there were no adverse observations.

At the follow-up the clinical scheme compiled by the author was followed except for the mobility test, where pressing with the finger tip was used instead of the spring balance method; the same classification was applied, however.

The only changes noted were in the state of the gingiva, which was classed as grade 0, and in the articulation, which was judged good. The patient's views were wholly positive, and no local complications had arisen during the period between the two examinations.

There was no definite change in the radiologic status (Fig. 41).

DISCUSSION

In an investigation of the present type it is of prime importance that as many of the patients as possible should attend the follow-up examination so as to avoid bias in the composition of the group. The absence of 2 patients out of 19, however, was probably of no major significance in this respect.

It is also important to minimize the subjective element in the evaluations. The fact that, for practical reasons, only one clinical investigator (the author) could participate constitutes a factor of uncertainty. To test the investigator in relation to other observers a further clinical investigator was included in the next phase of this longitudinal study now in progress, i.e. a follow-up 2 to 3 years after the superplants were made.

Notwithstanding the loss of 2 patients to the follow-up and the participation of only one clinical investigator, the fact that the study is of the longitudinal type permits certain conclusions, if only tentative ones, to be drawn from its results. For comparisons were made between observations on 2 occasions, the former just after the treatment was completed and the latter one year or so after the restorations had been placed.

While it has been shown that individual reactions may vary – for instance with differences in the tissue tolerance, general health, age and sex (*Koivumaa, Hedegard & Carlsson*, 1961) – it is unlikely that these were factors of significance in this study. Because of the shortness of the follow-up period and the small number of patients no break-down was made with respect to age or sex.

Oral hygiene is considered to be of the greatest importance in the case of superplants since, in addition to the goldwork, the restorations contain saddles that rest on the mucosa. Deficient oral hygiene might thus result in an accumulation of soft deposits. Before the treatment was begun the patients were therefore carefully instructed regarding oral hygiene. In spite of these measures, 4 out of the 5 patients with fairly good or poor oral hygiene at the initial examination scored the same grades at the follow-up (D, L, P and R).

The inflammation tendency around the teeth was more pronounced in the patients with deficient oral hygiene than in the others (Table XII). As regards the adaptation of the saddles to the mucosa there also seemed to be some difference between the patients with good oral hygiene and the others (Table XIII).

These findings underline the importance of oral hygiene in the case of superplant restorations. For this reason the planning of

Table XII.

Evaluation of oral hygiene in relation to state of gingiva around the teeth in the jaw in question.

Gingival status	Oral hygiene																							
	Good								Fairly good								Poor							
	Mandible			Maxilla			Both jaws		Mandible			Maxilla			Both jaws		Mandible			Maxilla			Both jaws	
	Full	Unil.		Full	Unil.		Full	Unil.	Full	Unil.		Full	Unil.		Full	Unil.	Full	Unil.		Full	Unil.		Full	Unil.
	A	A	O	A	A	O	A	A	O	A	A	O	A	A	O	A	O	A	A	O	A	A	O	A	A	O
Initial examination																										
Grade 0	13	9	19	29	7	21	42	16	40	10	2	5	6	—	5	16	2	10	—	—	—	—	—	—	—	—
Grade 1	2	—	—	—	—	—	2	—	—	1	—	—	—	2	—	1	2	—	—	—	—	4	—	—	4	—	—
Grade 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	15	9	19	29	7	21	44	16	40	11	2	5	6	2	5	17	4	10	—	—	—	4	—	—	4	—	—
Follow-up																										
Grade 0	8	7	16	19	9	26	27	16	42	5	2	3	—	—	—	5	2	7	3	—	—	1	—	—	4	—	—
Grade 1	7	2	3	10	—	—	17	2	3	1	—	2	6	—	—	7	—	2	2	—	—	3	—	—	5	—	—
Grade 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	15	9	19	29	9	26	44	18	45	6	2	5	6	—	—	12	2	5	5	—	—	4	—	—	9	—	—

Grade 0 Healthy *Grade 1* Slightly inflamed *Grade 2* Severely inflamed

A = Abutments *O* = Other teeth

Table XIII.

Evaluation of oral hygiene in relation to adaptation of saddle to mucosa.

Adaptation of saddle to mucosa	Oral hygiene																	
	Good						Fairly good						Poor					
	Mandible		Maxilla		Both jaws		Mandible		Maxilla		Both jaws		Mandible		Maxilla		Both jaws	
	Full	Unil.	Full	Unil.	Full	Unil.	Full	Unil.	Full	Unil.	Full	Unil.	Full	Unil.	Full	Unil.	Full	Unil.
Initial examination																		
Good	3	4	4	3	7	7	1	1	—	1	1	2	—	—	2	—	2	—
Poor	2	—	—	—	2	—	1	—	1	—	2	—	—	—	—	—	—	—
Total	5	4	4	3	9	7	2	1	1	1	3	2	—	—	2	—	2	—
Follow-up																		
Good	4	4	4	3	8	7	—	1	1	—	1	1	—	—	—	—	—	—
Poor	1	—	—	1	1	1	1	—	—	—	1	—	1	—	2	—	3	—
Total	5	4	4	4	9	8	1	1	1	—	2	1	1	—	2	—	3	—

the work should include not only instruction and demonstration of suitable measures of oral hygiene, but the patient's willingness and ability to carry out a correct oral hygiene programme should be checked.

An increase in the percentage of *exposed cemento-enamel junctions* was noted in the cases of full superplants, and especially for teeth adjacent to the saddles, where trauma was probably the cause. As regards the unilateral superplants, no exposure of the cemento-enamel junction was found at either examination, and the observations for the teeth outside the restorations were the same on both occasions.

Depth of gingival pockets and inflammation of the marginal gingiva: The gingiva around all the abutments included in the restorations was treated before the prosthetic treatment, and in consequence all the gingival pockets were recorded as of normal depth at the first examination. Conversely, 26 per cent of "the other teeth" had deepened gingival pockets.

At the follow-up the proportion of abutments with deepened pockets had increased from 0 to 15 per cent for the full superplants and from 0 to 10 per cent for the unilateral ones. On the other hand, there was a reduction in the proportion of teeth outside the restorations with deepened pockets, viz. from 26 to about 18 per cent. The deterioration of the state at the abutments may be due to local irritation caused by the gold alloy in combination with the changed distribution of the load.

At the initial examination there was slight inflammation of the gingiva around the abutments, while the gingiva around "the other teeth" was classed as "healthy".

As regards the condition of the gingiva around the abutments at the follow-up there was a deterioration in the case of the full superplants, and especially in respect of teeth adjacent to a saddle. The difference in the inflammatory picture was less marked around teeth in arches with unilateral restorations.

The increase in the proportion of exposed cemento-enamel junctions and in the depths of the gingival pockets, as well as the higher incidence of inflammation in the case of the full superplants, may have been due to the position of the preparation bor-

ders down in the gingival pockets. Other factors may have been parafunctions of the masticatory muscles and defective oral hygiene, both of which were more frequent in the full superplant cases.

The changes in *mobility of the teeth* were small.

The absence among the remaining teeth of appreciable radiographic differences on the two occasions of examination can have been due to the rigidity of the superplant, its firm anchorage and the shortness of the follow-up period.

The *tissue reaction around the saddles* was extremely mild. In the one case (no. 21) — a full upper superplant with a saddle provided with 2 teeth — in which hyperplasia of the mucosa was observed at the follow-up there was no histologic evidence of appreciable inflammation.

The *adaptation* to the mucosa at the initial examination was poor for 4 saddles (three lower, one upper) in 3 full superplants (nos. 5, 6 and 13). This was probably due to the fact that the saddles were made on plaster casts which were scratched according to the resilience of the mucosa, a technique that cannot reproduce accurately the form of the soft tissues.

At the follow-up the space had disappeared between the mucosa and the upper saddle (no. 13) and between the mucosa and one of the lower saddles (no. 6, right); at the other 2 saddles the space was slightly smaller than a year earlier (no. 5, and no. 6 left). In one patient (R) with both upper and lower superplants a small space had appeared between all 3 saddles and the mucosae, and the same applied to a unilateral upper superplant (no. 15). Two of the 4 patients (D and R) displaying a poor adaptation of the saddles at the follow-up examination stated that occasionally they clenched their teeth. For neither of these patients was good oral hygiene recorded. As regards one of them (R), viz., the patient with both upper and lower superplants, there was an increase in the original instability of the longer upper saddle with 4 teeth. All the other saddles in the present material appeared to be stable on both occasions of examination.

There was no appreciable radiologic change in the position of the saddles in relation to the underlying tissues, and alterations

in the underlying bone were limited to an increase in the trabeculation in the sockets, indicative of healing after extraction.

The absence of any appreciable tissue reaction around the saddles was probably also due not only to the rigidity and firm anchorage of the restorations but also to the limited vestibulolingual extent of the saddles, which consequently had little influence on the mobile tissue.

While the observation period was too short to enable the significance of these factors to be established, it would seem as if poor oral hygiene and parafunctions of the masticatory muscles have a deleterious effect on the tissues.

The healing in of the *implants* appeared to follow a normal course. One implant (no. 1) made from tantalum and affixed to a unilateral saddle was, however, removed only 8 days after the operation, because the patient showed signs of hyperirritability and anxiety. In this case the mental attitude of the patient had been wrongly assessed before the work was begun. In spite of the removal of the implant the stability of the saddle was classed as grade 0 at the follow-up examination.

No inflammatory changes were observed around the other implants during the observation period. Exposure of an implant was observed in only one case, viz. at the upper saddle with 4 teeth (no. 22); the adaptation of the saddle to the mucosa was poor, the saddle was unstable, the patient was negligent about oral hygiene, and there were parafunctions of the masticatory muscles. The superplant restoration should have been considered contraindicated in this case. The radiographs showed a slight increase in distance between implant and bone. This patient also had an implant connected to a lower 2-tooth saddle (no. 19). There were no clinical changes around this implant, but here too the radiographs disclosed an increase in distance between implant and jawbone.

The radiologic examination also showed minor resorption under a mandibular implant which had sunken into the bone (no. 20, right), and at 3 mandibular implants a slightly more distinct demarcation was observed. The causes of these changes can only be found by following the cases over a longer period of time.

As regards the *occlusion* and the *articulation* no changes occurred between the two examinations.

The *carious lesions* that appeared during the observation period were all situated in teeth outside the restorations. The abutments had been provided with full crowns and the preparation borders were extended subgingivally so as to minimize the risk of secondary caries. All the patients had a high caries susceptibility.

The *preferred chewing side* was apparently unchanged during the follow-up year. However, the method of examination was probably not wholly reliable.

As regards two unilateral lower superplants *local complications* had arisen on the vestibular sides of the saddles. This appeared to be due to irritation of the mucosa because the saddle edges had not been properly rounded.

The *opinions of the patients* were asked. In the great majority of cases the attitude of the patients to the restorations was highly positive. It cannot be ruled out, of course, that the patients tended to adopt a falsely positive attitude in the presence of the investigator. It would therefore perhaps have been better if a questionnaire had been drawn up which the patients had been required to fill in anonymously. This is the method adopted by the author in a descriptive study of superplants at present being performed.

CONCLUSIONS

The results and experience gained in the present study suggest the following tentative conclusions:

(1) Before commencing the superplant treatment careful tests should be carried out to establish whether this form of restoration is a suitable one for the individual patient. Care should be taken to ascertain the mental attitude of the patient and his reliability as regards correct and meticulous oral hygiene.

Moreover, the presence of any major parafunctions of the masticatory muscles should be revealed and corrected; otherwise the superplant is contraindicated.

(2) The patient must be recalled regularly for re-examination, for tissue damage of which the patient is unaware may exist even after 12—14 months. Furthermore, owing to the fixed saddles, continuous checks of the oral hygiene are even more important in the case of a superplant than in case of the other types of prosthetic restorations.

(3) In the case of fixed saddles careful rounding of the saddle borders is of prime importance to prevent irritation of the adjacent tissues.

(4) In the present study most patients were extremely satisfied with their restorations and the criticisms that were expressed were negligible and lacked substance.

The follow-up period was too short to judge whether the changes observed between the two examinations were of a transitory nature or whether they would progress. For this reason a further follow-up of this series of patients is at present being performed, viz. 2—3 years after the initial examination.

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SUMMARY

The present longitudinal clinical and radiographic study is part of an investigation on the superplant and covers 19 patients, viz. all those for whom the author executed superplants (22) between May 1961 and December 1962.

All 19 patients (average age 54 years) attended for an examination of the restoration 3—17 days after the superplant had been placed (the initial examination). The follow-up—carried out 12—14 months later— was attended by 17 of the patients (10 women, 7 men).

There were now 20 superplants (10 lower, 10 upper)—11 full and 9 unilateral. Four to 8 abutments were used for the former and 2—3 for the latter.

Twenty-three saddles were made, 20 of them free-end and 3 intermediary. Seven of the free-end saddles were provided with an implant at its free end.

In the clinical study special attention was devoted to the following factors: (1) Oral hygiene and calculus; (2) mobility of the teeth and stability of the saddles; (3) exposure of the cemento-enamel junction; (4) depth of the gingival pockets; (5) condition of the gingiva around the teeth, and of the mucosa around the saddles and implants; (6) adaptation of the saddles to the mucosa; (7) exposure of the implants; (8) occlusal and articulation contacts in the examined superplants; (9) carious lesions.

At the examination of the radiographs special attention was devoted to the following: (1) implants: their position in relation to the bone margin and the changes in the underlying bone: (2) saddles: their position in relation to the underlying tissues, changes in the underlying bone and the presence of calculus: (3) teeth: the structure and level of the marginal bone, the periodontal space, and the periapical conditions. Carious lesions were also recorded.

The clinical examinations were performed only by the author, and the radiographic examination was carried out by Dr. Gunnar Leijon at the School of Dentistry, Stockholm. The radiographs were interpreted by both investigators.

The results of this study emphasize the importance of effi-

cient oral hygiene in the case of the superplant; where this was neglected there appeared to be a greater tendency for inflammation around the teeth, and poorer adaptation of the saddles to the mucosa.

Changes in the mobility of the teeth between the initial and follow-up examinations were small and the radiographs disclosed no appreciable differences.

Between the examination there was a noticeable increase in exposure of the cemento-enamel junction of the teeth included in the full superplants, but not of the abutments and "the other teeth" in arches with unilateral superplants.

At the follow-up the frequency of deepened pockets of the abutments had increased for both unilateral and full superplants, but decreased for "the other teeth".

An increase of 36.9 per cent in the inflammation around the abutments was observed for the full superplants. For unilateral restorations the difference was smaller.

The tissue reaction around the saddles was negligible, as was the change in the adaptation of the saddles to the mucosa. There were no definite radiologic changes in the positions of the saddles in relation to the underlying tissues. One saddle was unstable at the initial examination and more so the following year. Other saddles appeared to be stable at both examinations. The healing of the implants ran a normal course. On account of one patient's mental condition an implant was removed.

No inflammatory changes were noted around the implants at the follow-up. One implant was incompletely covered by tissue. The radiographs showed a slight increase in the distance to the jawbone in 2 implants and one lower implant had sunken into the bone.

There were no evident changes in occlusion or articulation. Caries lesions appearing in the course of the follow-up period were restricted to teeth outside the superplants.

Most of the patients were highly satisfied with their superplant and the criticisms expressed were trivial and vague.

The follow-up time was too short to judge whether the changes noted were of a temporary nature or whether they might progress with time. A further follow-up is at present being conducted —that is, 2—3 years after the superplants were executed.

RÉSUMÉ

"SUPERPLANTS". ÉTUDE LONGITUDINALE.

La présente étude longitudinale clinique et radiographique est une partie d'un travail de recherche sur les superplants, et concerne 19 patients — c'est-à-dire la totalité des patients sur lesquels l'auteur a exécuté des superplants (22) entre mai 1961 et décembre 1962.

Tous ces patients (âge moyen 54 ans) se sont présentés à un examen concernant cette reconstruction 3–17 jours après la mise en place du superplant (examen initial). Le contrôle — effectué 12—14 mois plus tard — a pu être effectué sur 17 des patients (10 femmes et 7 hommes).

Il y avait alors 20 superplants (10 du haut, 10 du bas) — 11 complets et 9 unilatéraux. Quatre à 8 piliers avaient été utilisés pour les premiers, 2—3 pour ces derniers.

Vingt-trois selles avaient été faites, dont 20 en extension et 3 intermédiaires. Sept des selles en extension étaient pourvues d'un implant à l'extrémité distale.

Dans l'étude clinique, l'attention a porté spécialement sur les facteurs suivants: (1) hygiène buccale et tartre; (2) mobilité des dents et stabilité des selles; (3) dénudement de la jonction émail-cément; (4) profondeur des culs-de-sac gingivo-dentaires; (5) altérations de la gencive autour des dents et de la muqueuse autour des selles et des implants; (6) adaptation des selles à la muqueuse; (7) dénudement des implants; (8) contacts occluso-articulés des superplants; (9) caries dentaires.

A l'examen radiographique, l'intérêt s'est concentré sur les points suivants: (1) implants: leur position par rapport au rebord osseux et les altérations de l'os sous-jacent; (2) selles: leur position par rapport aux tissus sous-jacents, les modifications de l'os sous-jacent et la présence de tartre; (3) dents: la structure et le niveau de l'os marginal, l'espace desmodontal et l'état de péri-apex. Toutes les caries ont aussi été enregistrées.

Les examens cliniques ont tous été pratiqués par l'auteur lui-même, et l'examen radographique a été fait par le Dr Gunnar Leijon à l'École Dentaire de Stockholm. Les radiographies ont été interprétées par les deux examinateurs.

Les résultats de cette étude soulignent l'importance de l'efficacité de l'hygiène buccale dans les cas de superplants; lorsque celle-ci était négligée, on pouvait constater une tendance plus grande à l'inflammation autour des dents et à une adaptation insuffisante des selles à la muqueuses.

Les modifications dans la mobilité dentaire entre l'examen initial et les contrôles étaient peu marquées et les radiographies ne révélaient pas de différences appréciables.

Entre les examens, il se produisait une augmentation apparente du dénudement de la jonction émail-cément des dents comprises dans les superplants complets, mais non pour les dents piliers et "les autres dents" sur les arcades portant un superplant unilatéral.

Lors du contrôle, la fréquence des cas d'augmentation de la profondeur des culs-de-sac au niveau des piliers avait augmenté tant pour les superplants unilatéraux que pour les superplants complets, mais diminué pour "les autres dents".

Une augmentation de 36,9 p. 100 de l'inflammation autour des piliers a été constatée pour les superplants complets. Pour les reconstructions unilatérales, la différence était moins grande.

La réaction des tissus autour des selles était négligeable, de même que les modifications de l'adaptation des selles à la muqueuse. Il n'existait pas de modifications radiographiques nettes de la position des selles par rapport aux tissus sous-jacents. Une des selles était instable à l'examen initial, et encore plus l'année suivante. D'autres selles étaient stables lors des deux examens.

La cicatrisation des implants avait une évolution normale. En raison de l'état mental d'un des patients, un des implants a dû être enlevé.

Il n'a pas été constaté d'altérations inflammatoires autour des implants lors du contrôle. Un des implants était insuffisamment recouvert par les tissus. Les radiographies ont montré une légère augmentation de la distance entre l'os et deux des implants, tandis qu'un des implants du bas s'était enfoncé dans l'os.

Il n'y avait pas de modification apparente de l'occlusion ni de l'articulation.

Les caries apparues au cours de la période de contrôle étaient limitées aux dents situées en dehors des superplants.

La plupart des patients étaient extrêmement satisfaits de leurs superplants, et les critiques exprimées étaient insignifiantes et vagues.

La période de contrôle était trop courte pour qu'on puisse juger si les altérations notées étaient de nature temporaire ou si elles pouvaient progresser avec le temps. Un contrôle ultérieur est en cours actuellement, c'est-à-dire 2—3 ans après l'exécution des superplants.

ZUSAMMENFASSUNG

SUPERPLANTATE. EINE LONGITUDINALE UNTERSUCHUNG

Die vorliegende Studie, eine longitudinale klinische und röntgenologische Untersuchung, ist ein Teil einer grösseren Untersuchung, die die Superplantatmethode prüfen soll. Das ursprüngliche Untersuchungsmaterial besteht aus all den Personen (durchschnittliches Alter 54 Jahre), bei denen der Verfasser selbst in der Zeit vom Mai 1961 bis zum Ende des Jahres 1962 Superplantate ausgeführt hat. Das bedeutet 19 Personen mit insgesamt 22 Superplantaten. Die erste Untersuchung ist 3—17 Tage nach der Befestigung der Superplantate in der Mundhöhle gemacht worden, wozu sich alle Patienten einfanden. An der zweiten Untersuchung, die nach weiteren 12—14 Monaten ausgeführt wurde, nahmen 17 Patienten (10 Frauen, 7 Männer) teil.

Es waren jetzt 20 Superplantate (10 im Unterkiefer, 10 im Oberkiefer) — 11 totale und 9 unilaterale. Vier bis 8 Pfeilerzähne wurden für die ersteren benutzt und 2 bis 3 für die letzteren.

Es wurden 23 Sättel gemacht, 20 davon als Endsättel und 3 als Zwischensättel. Sieben der Endsättel waren an ihrem freien Ende mit einem Implantat versehen.

Was die klinischen Untersuchungen anbelangt, sind folgende Punkte besonders beachtet worden:

1) Die Mundhygiene der Patienten und das Vorhandensein von Zahnstein.
2) Veränderungen der Beweglichkeit der Zähne und Sättel.
3) Veränderungen der Freilegung der anatomischen Wurzelfläche.

4) Veränderungen der Tiefe der Zahnfleischtaschen.
5) Veränderungen des Zustandes der Gingiva um die Zähne herum und des Zustandes der Schleimhaut in der Nähe von Sätteln und Implantaten.
6) Veränderungen des Kontaktes zwischen Sätteln und Mukosa.
7) Die Freilegung der Implantate.
8) Veränderungen der Okklusions- und Artikulationskontakte der untersuchten Superplantate.
9) Das Auftreten von kariösen Angriffen.

Bei der röntgenologischen Untersuchung ist folgendes besonders beachtet worden:

1) Implantate: Die Lage im Verhältnis zur Knochenkante und Veränderungen des unterliegenden Knochens.
2) Sättel: Die Lage im Verhältnis zur Unterlage, Veränderungen des unterliegenden Knochens sowie das Vorkommen von Konkrementen.
3) Zähne: Die marginalen Verhältnisse, was die Struktur der Knochenkante, deren Niveau und den Periodontalraum des Zahnes betrifft. Weiterhin wurden die periapikalen Verhältnisse untersucht sowie kariöse Defekte.

Sämtliche klinische Untersuchungen wurden vom Verfasser ausgeführt. Die Röntgenaufnahmen machte der Zahnarzt Dr. Gunnar Leijon an der Zahnärztlichen Hochschule von Stockholm. Die Auswertung wurde von den beiden Verfassern des Röntgenabschnittes vorgenommen.

Die Resultate dieser Untersuchung betonen die Bedeutung der Mundhygiene bei Superplantaten. Die Tendenz zu Entzündungen um die Zähne herum schien bei Patienten mit schlechterer Mundhygiene grösser zu sein, und der Kontakt zwischen Sätteln und Schleimhaut war in diesen Fällen schlechter.

Die Veränderung der Beweglichkeit der Zähne war gering und röntgenologisch konnten keine besonderen Unterschiede beobachtet werden.

Die Vermehrung der freigelegten anatomischen Wurzelflächen war bei den Zähnen in den totalen Superplantaten deutlich, was

jedoch bei Pfeilerzähnen und „übrigen Zähnen" in den Kiefern mit unilateralen Superplantaten nicht der Fall war.

Bei der zweiten Nachuntersuchung wurde eine vergrösserte Frekvenz von vertieften Zahnfleischtaschen an Pfeilerzähnen, die sowohl zu den totalen als zu den unilateralen Konstruktionen gehörten, festgestellt. Bei den „übrigen Zähnen" wurde das Gegenteil beobachtet.

Eine Vergrösserung der entzündlichen Reaktionen (36,9%) um die Pfeilerzähne herum konnte bei den totalen Superplantaten festgestellt werden. Bei den unilateralen Konstruktionen waren die Unterschiede kleiner.

Die Reaktion des Gewebes um die Sättel herum sowie die Veränderungen im Kontakt zwischen Sätteln und Schleimhaut waren unbedeutend. Röntgenologisch konnten in der Lage der Sättel im Verhältnis zur Unterlage nicht mit Bestimmtheit irgendwelche Unterschiede beobachtet werden. Ein einziger Sattel zeigte bei der ersten Registrierung eine Beweglichkeit, die sich während des nachfolgenden Jahres vergrösserte. Die anderen Sättel schienen bei beiden Untersuchungen unbeweglich zu sein. Die Heilung der Implantate verlief normal. Aus Gründen des mentalen Zustandes einer Patientin wurde ein Implantat entfernt. Bei der zweiten Nachuntersuchung wurden um die Implantate keine Entzündungen notiert. Ein Implantat war nur unvollständig von Gewebe bedeckt. Die Röntgenaufnahmen zeigten in zwei Fällen einen etwas vergrösserten Abstand zwischen Knochen und Implantat, und ein Unterkieferimplantat war in den Knochen hinein gesunken. Die Okklusion und Artikulation änderten sich in keinem der Fälle. Es wurden während der Kontrollzeit nur Zähne ausserhalb der Konstruktionen von Karies angegriffen.

Die meisten Patienten waren mit ihren Superplantaten sehr zufrieden und die geäusserte Kritik war zurückhaltend und ungenau.

Die Kontrollzeit ist zu kurz um die Frage, ob die entstandenen Veränderungen abklingen oder sich weiter entwickeln werden, beantworten zu können. Diese longitudinale Untersuchung wird deshalb zur Zeit, d.h. 2—3 Jahre nach der Befestigung der Superplantate, durch noch einer Nachkontrolle komplettiert.

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