Gingival fluid and tissues around successful titanium and ceramic implants

A comparative clinical, laboratory, and morphologic study

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The gingival tissue reactions around 19 titanium implants (Brånemark System®) and 6 ceramic implants (Frialit®) were studied by using established variables for monitoring periodontal status. Natural teeth in the same or the opposite jaw served as controls. Both clinical and laboratory examinations showed healthy gingival status. No differences in soft-tissue reactions between the two types of implant or between the implants and the natural teeth were registered. □ *Biopsy; crevicular fluid; darkfield microscopy; gingival index; periodontology; plaque index; pocket depth*

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The prognosis for successful oral rehabilitation of partially and totally edentulous patients has been greatly improved by implantology. The Brånemark system with titanium implants (Brånemark System®) is well documented, and the predictable long-term prognosis is positive (1–4). The Tübingen aluminium ceramic implant (Al_2O_3) (Frialit®) for the replacement of individual mandibular or maxillary teeth is also well documented (5, 6).

The interface between the implant surface and hard tissue has been described in detail (7–9), but less attention appears to have been paid to the response of the soft tissues. In some studies (10–12) conventional clinical periodontal examination of the gingival–implant junction has been combined with serial identical radiography.

The aim of the present study was to examine the gingival-implant junction, crevicular fluid, and gingival tissue reactions around clinically successful titanium implants and ceramic implants.

Materials and methods

Eleven patients participated in the study. Five patients, three women and two men aged between 46 and 72 years, had two to five titanium implants (Brånemark System). Six patients, two women and four men aged between 22 and 43 years, had one ceramic implant (Frialit) each.

At the time of examination the implants had been in function for 8 to 48 months.

The material comprised 25 implants (19 titanium and 6 ceramic). Natural teeth in the same or the opposite jaw served as controls.

Clinical examinations

Plaque index (PlI) (13), gingival index (GI) (14), and pocket depth were determined around implants and control teeth.

Laboratory examination

Gingival sulcus fluid flow rate was determined by collecting sulcus fluid on filter strips

Table 1. The mean number (and range) of total and differential leukocyte counts from gingival fluid in titanium implants (Brånemark System®), ceramic implants (Frialit®), and natural teeth

	Titanium implants (Brånemark System)	Ceramic implants (Frialit)	Natural teeth
Total leukocyte count (mean no.)	20 (7–38)	79 (2–180)	46 (1–142)
Polymorphonuclear leukocytes (%)	82 (71–87)	92 (75–100)	89 (67–100)
Mononuclear leukocytes (%)	18 (13–29)	8 (0–25)	11 (0–33)

for 1 min. One strip was placed at the orifice of the mesiobuccal crevice and the other at the distobuccal crevice. The strips were then stained in a ninhydrin solution and measured under 12-fold magnification.

Crevicular fluid from the test sites was collected in accordance with the washing technique described by Skapski & Lehner (15), and the number of polymorphonuclear leukocytes and mononuclear cells per unit volume was counted.

Darkfield microscopy was performed on pocket content from the test sites, in accordance with Listgarten & Helldén (16). Supragingival plaque was removed and subgingival material was collected with a curette. It was homogenized in 0.1 ml saline before counting. At least 100 microorganisms were counted and classified as spirochetes, other motile organisms, nonmotile filaments, and rods or as cocci.

An excisional biopsy specimen of marginal gingival tissue was obtained from the titanium and ceramic implants and from the control teeth. The excised tissue was immediately fixed in 10% neutral buffered formalin for 48 h. After being embedded in paraffin, the specimens were serially sectioned. The sections, 5 µm thick, were then stained with hematoxylin and eosin and van

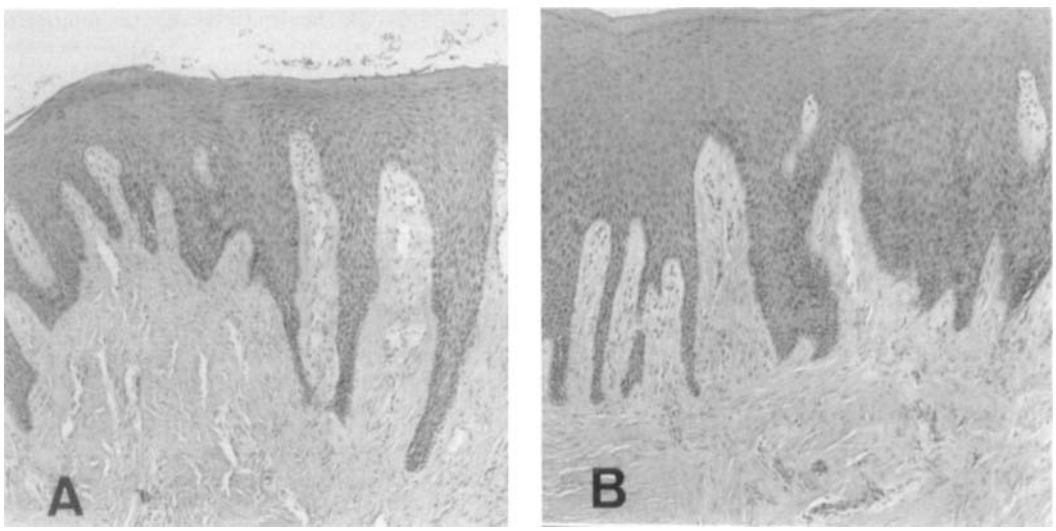

Fig. 1A. Biopsy specimen from marginal gingiva around a titanium implant, showing normal gingival epithelium with underlying connective tissue free from inflammatory reaction. 1B. Biopsy specimen from marginal gingiva around tooth 13 from the same patient as in Fig. 1A (control); normal gingival epithelium and connective tissue. (Hematoxylin–eosin staining.)

Gieson stain and examined in a light microscope.

Results

The mean PII was less than 0.5 and the GI was less than 1.0 in all samples.

The gingival pocket depths did not exceed 4 mm for either type of implant or the natural teeth. The mean value for titanium implants was 2.7 mm (range, 2–4 mm), for ceramic implants 2.5 mm (range, 2–3 mm), and for natural teeth 2.0 mm (range, 1.5–3.0 mm).

The mean values for gingival sulcus fluid flow rate were low for all sites, varying between 1.3 and 1.7 mm. The mean number of total and differential leukocyte counts in gingival sulcus fluid was generally low, with a considerable range (Table 1).

Darkfield microscopy showed that coccoid cells and non-motile rods predominated: 95% in samples from titanium implants, 86% in ceramic implants, and 83% in natural teeth. A few spirochetes were seen in specimens from one ceramic implant and one natural tooth.

A layer of keratinized oral epithelium was observed in biopsy specimens. Parakeratinization of the epithelium was frequent in the crestal region. Of the 20 specimens retrieved for analysis, a few scattered lymphocytes and plasma cells were found in the connective tissue adjacent to the gingival pocket epithelium around one titanium and one ceramic implant and in one of the control specimens. In the other biopsy specimens no inflammatory reaction or other pathologic signs were seen (Figs. 1 and 2). Histologic examination of the marginal gingival tissue specimens showed no morphologic differences in tissue reactions to the respective implant materials or between the single implant and its corresponding control.

Discussion

The subjects in this study were not randomly selected, and therefore the material was unsuitable for statistical analysis. All patients had been carefully instructed in oral hygiene before and after implant treatment. Consequently, the mean values for PII and GI were low for both implants and natural teeth.

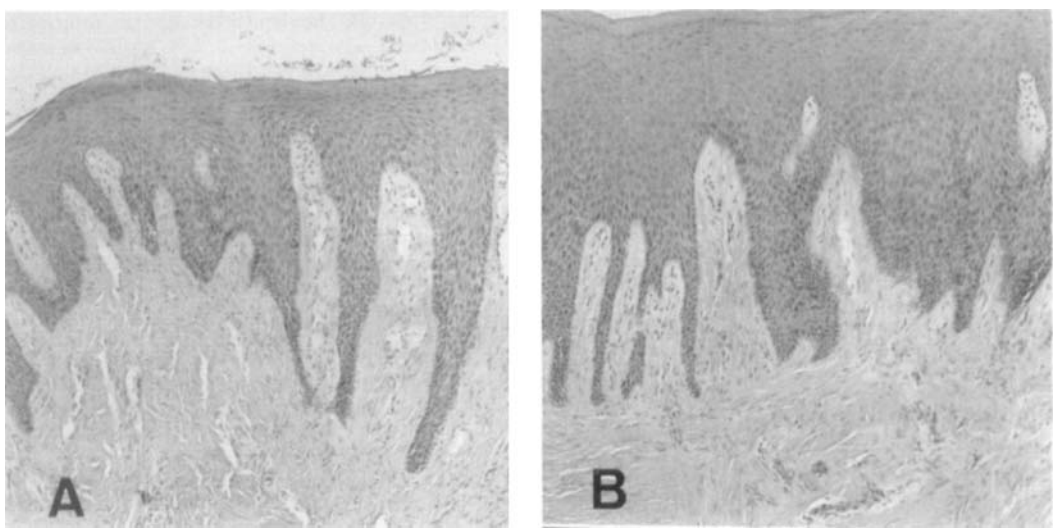

Fig. 2A. Biopsy specimen from marginal gingiva around a ceramic implant; normal gingival tissue with no inflammatory reaction. 2B. Biopsy specimen from marginal gingiva around the contralateral tooth from the same patient as in Fig. 2A; normal gingival tissue with no pathologic signs. (Hematoxylin–eosin staining.)

The gingival sulcus probing depths were about the same for titanium implants, ceramic implants, and natural teeth, supporting the statement of Ten Cate (10) that when the connective tissue is sound, the epithelial attachment will also be sound provided that the implants are osseointegrated and therefore immobile.

The flow rate of gingival sulcus fluid was studied to gain an insight into the response of the marginal tissues to implants. In the present series, however, when the marginal tissue was clinically healthy, there were no obvious differences between the two types of implants or between the implants and natural teeth. This supports the findings of a previous study (17).

In natural teeth there is continuous migration of immune competent cells from the gingival blood vessels to the gingival crevice (18). Dental plaque may influence the total and differential leukocyte counts in the gingival crevice. The low number of total leukocytes in the present material may reflect the low PII value. Because of the considerable individual variations in cell counts no further conclusion can be drawn from the present values.

Little is known about the relative importance of the subgingival bacterial populations around implants and their effects on marginal tissues. The subgingival sites at both types of implant and natural teeth were populated by high proportions of coccoid cells and non-motile rods. Very low numbers of spirochetes were observed, indicating that dental implants with clinically healthy marginal tissues may harbor a microflora similar to that of natural teeth with clinically healthy tissues.

The results of the histologic examination indicated that the marginal gingival tissue constituted a well-functioning mucoperiosteal barrier zone around both the titanium and the ceramic dental implants.

This study indicates that, provided the implant is osseointegrated and the oral hygiene good, there are no differences in soft-tissue reactions between titanium and ceramic dental implants or between the implants and the natural teeth.

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