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1042-3699/94 $0.00 + .20

GUIDED BONE REGENERATION AROUND TITANIUM SCREW IMPLANTS USING A RESORBABLE MEMBRANE

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The topography of edentulous parts of the jaw or local pathological bone defects often render the insertion of implants impossible without adjunctive surgical procedures. In these cases, surgical reshaping of the jaws, including bone grafts, is often indicated. As first published by Nyman and his team in 1986, guided tissue regeneration using membranes leads to the elimination of bone cavities without additional bone grafting.[2, 4] The next step in reducing the number of surgical procedures consists of the combination of filling minor bone cavities using this membrane simultaneously with the insertion of dental implants.

To obtain osseointegration along the total length of the implant, guided tissue regeneration is indicated when an implant is inserted into a pre-existing bone cavity with a marginal diameter that exceeds that of the implant or when the implant exceeds the height of the residual ridge.

A secondary procedure to remove the membrane is still necessary; however, the use of resorbable material specially designed for such purposes avoids this second procedure. The results reported with the Gore-tex membrane (W. L. Gore and Associates, Newark, DE) and the evidence that resorbable membranes also can lead to guided tissue generation[1, 6, 7] encouraged us to set up a clinical study to investigate guided tissue regeneration after the simultaneous insertion of a resorbable membrane and dental implants.[4, 9]

MATERIAL AND METHODS

The resorbable membrane material that we used is Biofix (Bioscience Ltd., Tampere, Finland), a synthetic self-reinforced polyglycolid membrane with a thickness of 0.15 mm[10] (Fig. 1). For many years, polyglycolic acid has been known as a resorbable suture material (Dexon).[3] The membrane keeps its form and stability for 3 to 4 weeks and is resorbed within approximately 6 months. The metabolism of the material begins with its hydrolyzation to glycolic acid, which is transformed into glyoxylate and glycine. The latter molecule is then used in the prothein synthesis or in the citric acid cycle[5] (Fig. 2).

The membrane can be cut easily with scissors or bent manually, and it can be sutured

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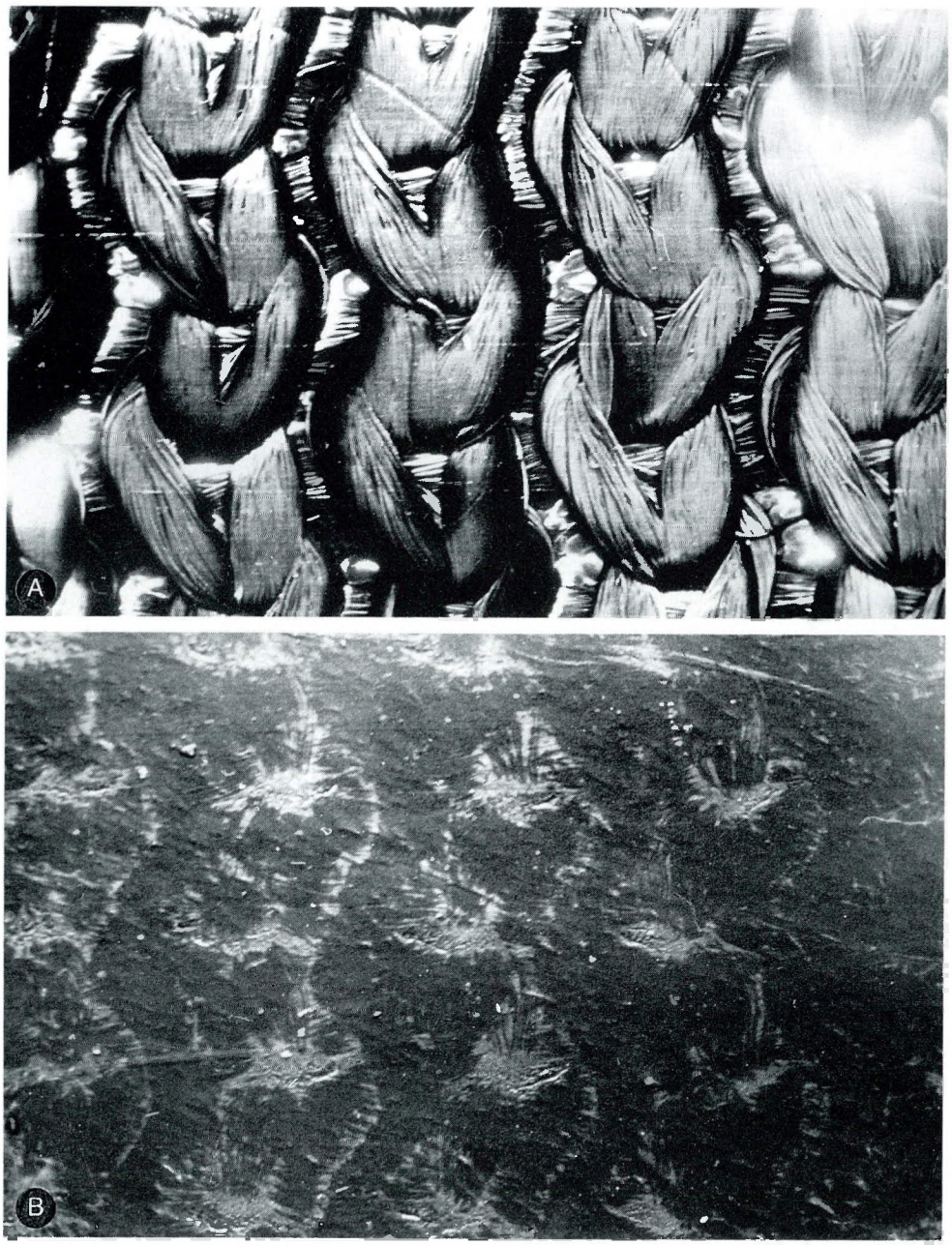


Figure 1. Hundredfold magnification of the membrane, showing the textile structure on one side *(A)* and the smooth surface on the opposite side, where the fibers are melted together *(B)*.

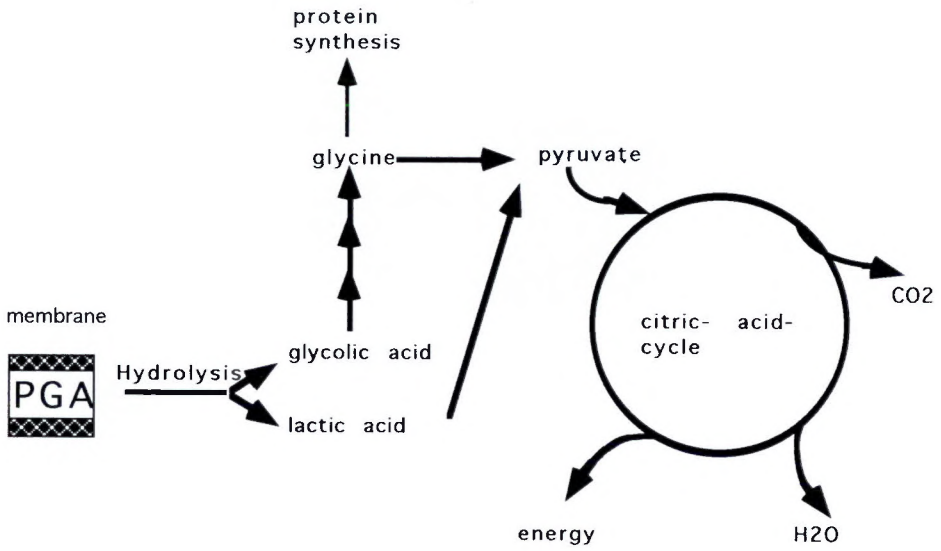


Figure 2. Metabolism of polyglycolide (PGA) in living tissues.

if necessary. In our cases, it was sufficient to fix the membrane either with the cover screw or by excising a hole to position it around the implant (Fig. 3). If necessary, a space maintainer of the same material (Microtack; Bioscience Ltd, Tampere, Finland) is used (Fig. 4). The margin of the membrane must be adapted precisely to the bone surface to prevent the proliferation of fibrous tissue within the bone cavity. This adaptation is normally achieved by repositioning the mucoperiosteal flap.

Between June 1990 and April 1991, 21 implants (6 Brånemark titanium screws and 15 Hati implants [Mathys Dental, Switzerland]) were inserted simultaneously with Biofix membranes in 16 patients. There were 6 female and 10 male patients. Their average age was 38 years, with a minimum of 18 and a maximum of 75 years (Fig. 5). Fifteen implants were inserted in the anterior maxilla, and 6 in the anterior mandible. The procedure was performed in cases of an alveolar bone defect following traumatic dental luxation or periodontal osteolysis, in which a primary stable implant insertion could not be achieved. In all cases, informed consent was obtained from the patient. The average period

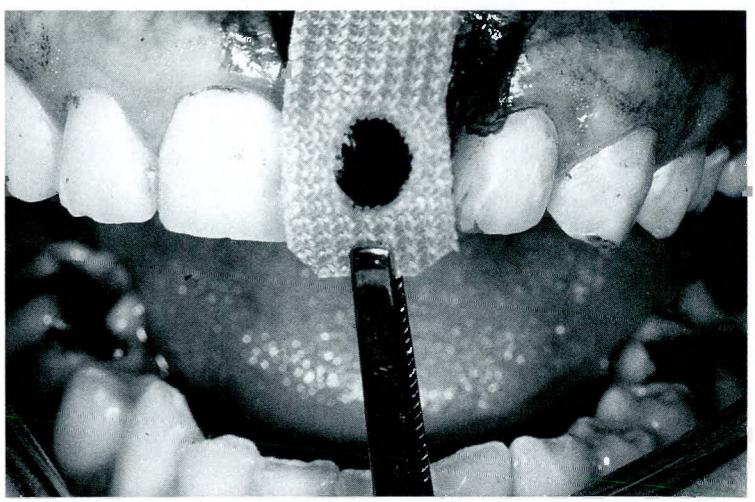


Figure 3. Intraoperative view showing the adaptation and placement of the membrane after insertion of the implant.

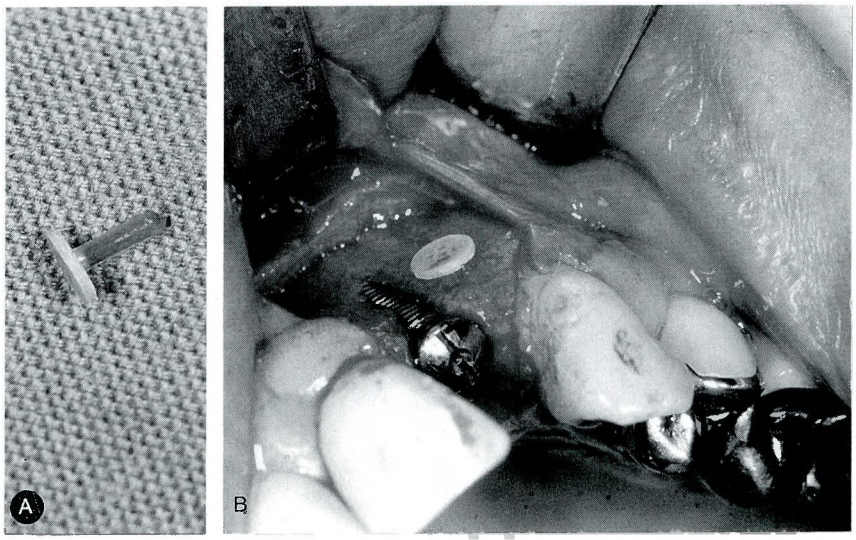


Figure 4. To create space for the guided tissue formation between the implant and the membrane, a space maintainer is placed near the implant site.

between implantation and the abutment operation was 137 days (minimum 88, maximum 305). In all cases, surgery was carried out under local anesthesia on an outpatient basis. Antibiotic coverage was not provided. The follow-up period ranged from 290 to 1002 days, with an average of 698 days (1 year, 11 months) (Fig. 6).

The clinical examination consisted of pocket-depth measurement with a graduated periodontal probe. Bone regeneration was assessed by counting the free-lying screw threads both clinically during the implant procedure and radiologically. Radiologic assessment was carried out immediately postoperatively, 1 month prior to the abutment procedure, and every 6 months subsequently. Radiologic examination was limited to dental radiographs (long cone technique). Because the bony defect was mostly positioned in the shadow of the x-ray beam, digitalized subtraction analysis could be carried out in only

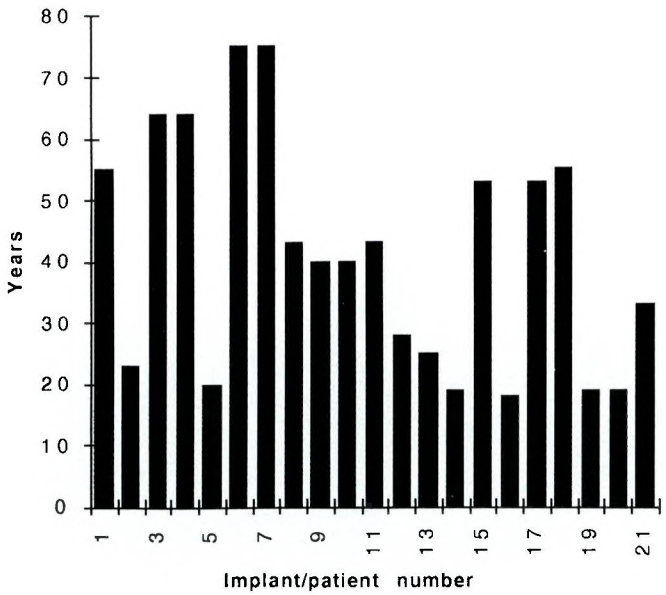


Figure 5. The age distribution of the 16 patients with 21 implants. The average age is 38 years.

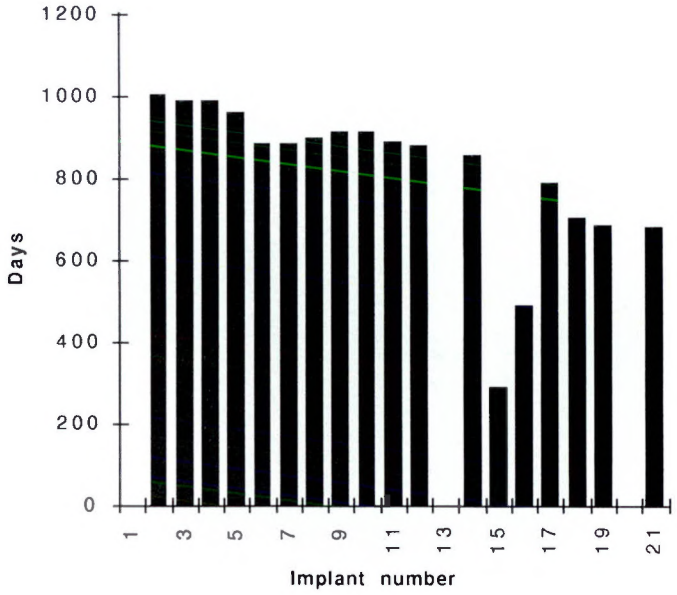


Figure 6. Follow-up period (in days) of the 21 implants. Eighteen implants are still functioning after an average follow-up period of 23 months (maximum 1002 days); 3 failed.

a few cases. Photographs of the implant site were taken before, during, and after the insertion as well as during the abutment operation.

All cases of single-tooth replacement were treated at the department of fixed and removable prostodontics and dental materials (Figs. 7–10).

RESULTS

In 8 cases, the implants were exposed after 1 week, and in 4 of them the membrane was partially visible. Although inflammation was observed in all cases, infection with pus formation did not occur. During the abutment operation, a pocket depth of less then 3 mm was measured around 10 implants. In 1 case, a pocket of 8 mm and in a further case a pocket along the whole implant length, causing instability, was present. In these 2 cases, the implants had to be removed. A further implant was primarily stable but was lost after the superstructure had been finished. In 16 cases, it was possible to quantify the results of bone gain by counting radiologically the

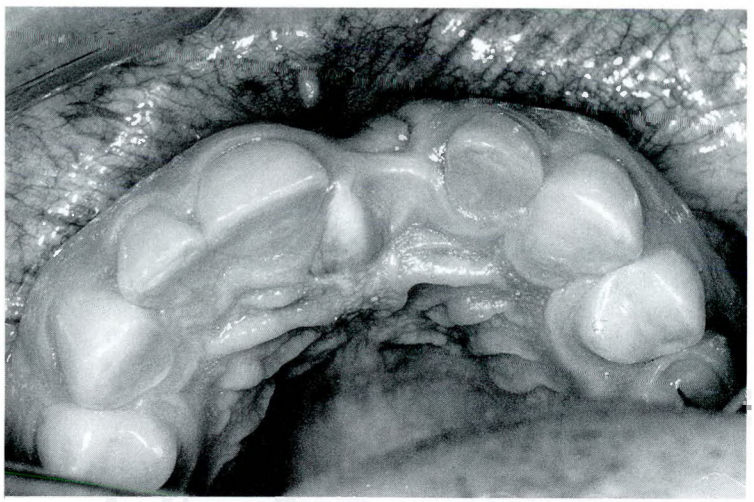


Figure 7. Preoperative view showing the missing central incisor and the lack of buccal alveolar bone.

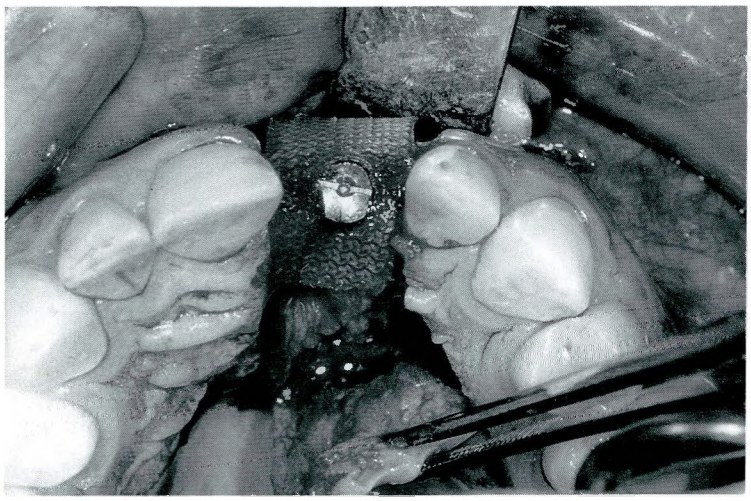


Figure 8. Intraoperative view after insertion of the implant and the membrane. Note that the membrane also covers the palatal aspect of the alveolar bone.

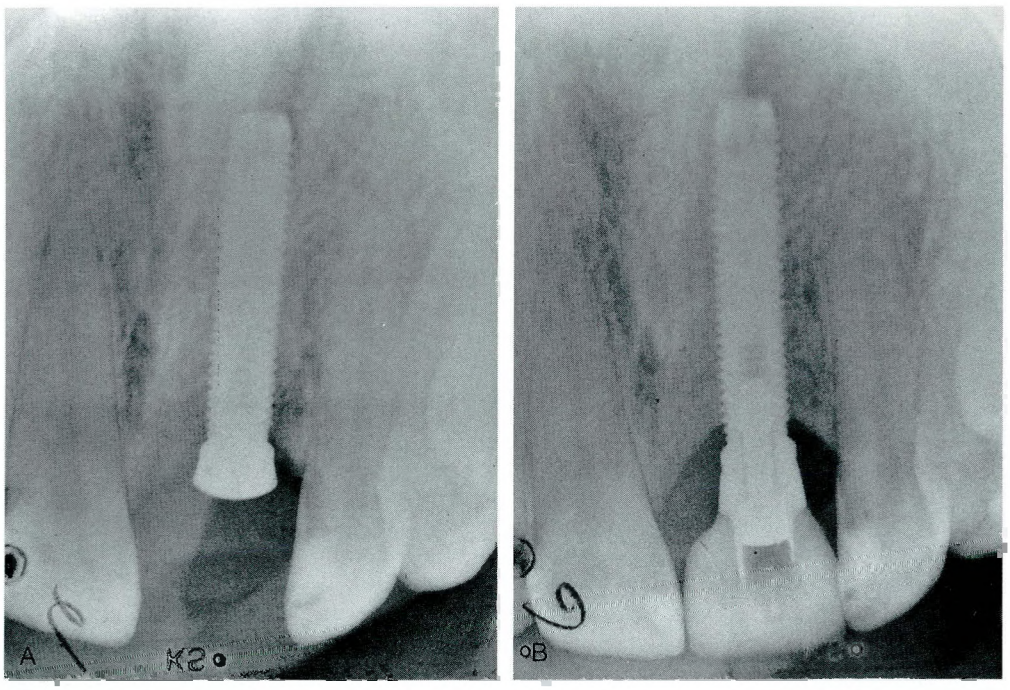


Figure 9. Dental radiographs taken immediately *(A)* and 2 years *(B)* postoperatively. Immediately after surgery, the limit of the bone defect reaches the fifth thread, but 2 years later bone regeneration with a homogeneous density is seen around the implant, with a sharp and corticalized boundary at the level of the second thread.

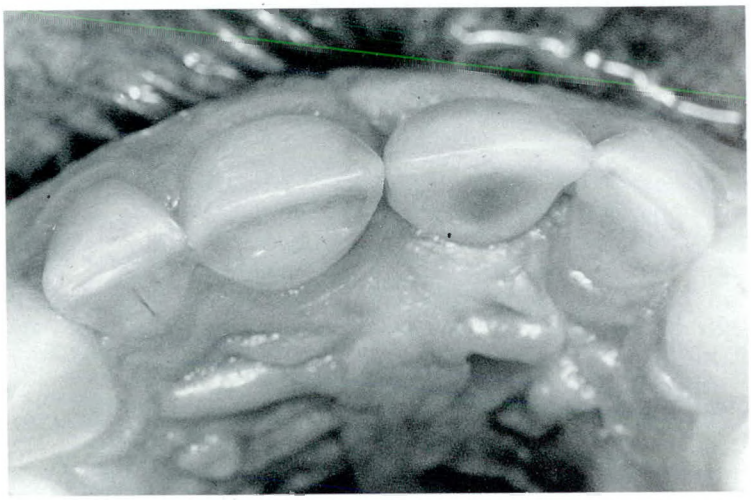


Figure 10. Intraoral view showing the superstructure as well as the gain of buccal contour of the alveolar crest.

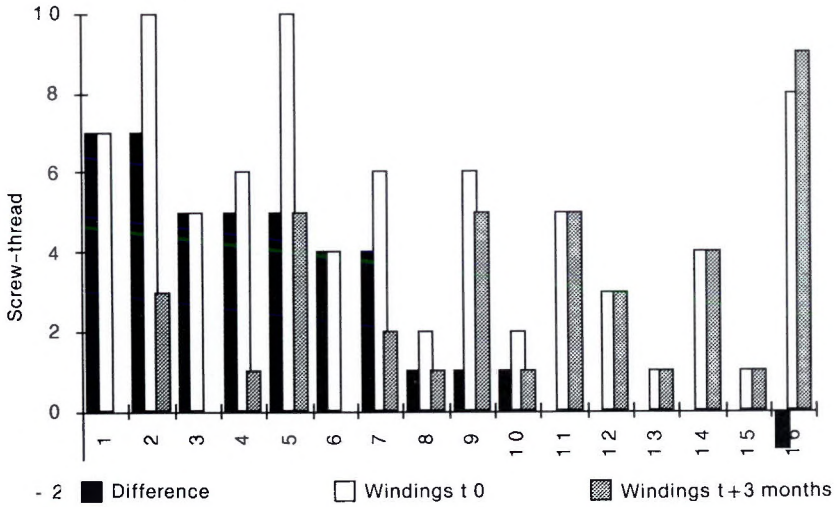


Figure 11. Analysis of the bone regeneration as indicated radiologically by the number of threads not covered by bone at the time of insertion (t0) and 3 months later (t+3). The difference shows the gain of bone contact around the implant. The only implant with bone loss was removed. Around the two other implants that failed, there was no radiologic difference in the number of free threads.

free screw threads. In 1 case, more free windings were counted, indicating a loss of bone contact rather than bone regeneration. This implant is among the aforementioned lost ones. In 5 cases, we could not find any difference. In a further 10 implants, an increase in bone contact was noticed. No failures were seen in this group.

DISCUSSION

Unfavorable local conditions prohibiting the insertion of dental implants because of poor bone quality and lack of bone volume but in which implants are nevertheless needed for prosthetic reasons constitute an ideal situation to test the feasibility of the method described. The results obtained by screening the screw threads correlate well with the clinical findings (Fig. 11). Because the bony defects are mostly situated on the vestibular or oral site of the implants and therefore digitalized subtraction radiology does not reveal the change in bone volume, the radiologically counted free screw threads are a more reliable parameter to measure the effectiveness of this method.

Other publications concerning bone regeneration around screw implants in resorbed jaws demonstrate that guided tissue regeneration can enable the insertion of implants in otherwise unfavorable conditions.[5,8]

The absence of postoperative infections is probably due to the production of glycolic acid, which is a disinfectant, during the metabolism of the polygalactid membrane.

The results observed (three failures) over a 3-year period with 18 of 21 osseointegrated implants, which were all used to support fixed devices, have encouraged us to continue with the simultaneous insertion of implants in bony defects and guided tissue regeneration using a resorbable membrane.

ACKNOWLEDGMENTS

We thank Prof. P. Törmälä, Institute of Plastics Technology, University of Technology, Tampere, Finland, for supplying the Biofix membrane and Prof. Dr. P. Schärer and his co-workers for their critical support and the treatment with the superstructure.

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