Synthetic bone grafts

Miracle materials or mighty marketing?

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I have been disturbed by the misleading marketing claims concerning the alleged efficacy of snythograft and periograf. For example, "clinical results with synthograft have been outstanding in studies conducted over five years". (To my knowledge, no such published studies in a referred journal exist.) (ii) . . . "if you haven't already . . you will soon try synthograft and find that it can truly revolutionize important aspects of your practice". (Really? I'm not aware of anyone's practice that has been revolutionized.) The periograf group (Sterling-Winthrop Research Institute – distributors Cooke-Waite Laboratories) very carefully choose the wording used in their ads. For example: (i) "a valuable adjunct in the management of osseous defects" (ii) "restores periodontal defects and supports new bone growth" (Restores them to what? Certainly not the periodontal tissues that were there initially.) (iii) "success judged by (amongst other modalities) "mobility analysis". (Mobility analysis has never been published as being one of the measured parameters in any of the periograf studies I have seen.)

We are pleased to present the first publication of this article, written by Dr. Arlin especially for *Oral Health.*

Dr. Arlin has a private periodontics practice in Toronto.

There are two basic types of synthetic bone grafting material: basic tricalcium phosphate (hydroxylapatite) and beta tricalcium phosphate. Periograf (also called "durapatite") and calcitite are both beta tricalcium phosphates while Synthograft is a beta tricalcium phosphate. Periograf and calcitite are considered non-resorbable while Synthograft has been shown to be reasonable, although somewhat unpredictably. The particles in Periograf are sharp; calcitite particles are rounded (supposedly less irritating to the soft tissue) and Synthograft's are irregular.

The following position statement was made by the Committee on Research in Periodontology (developed

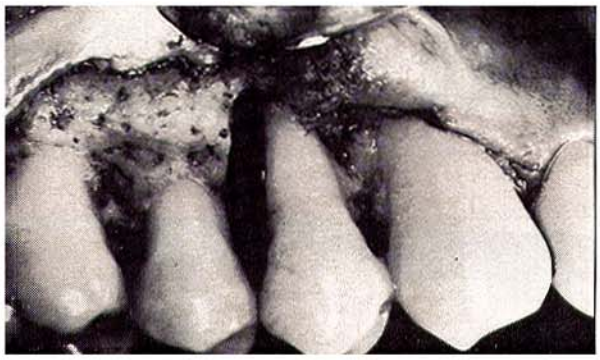

Figure 1

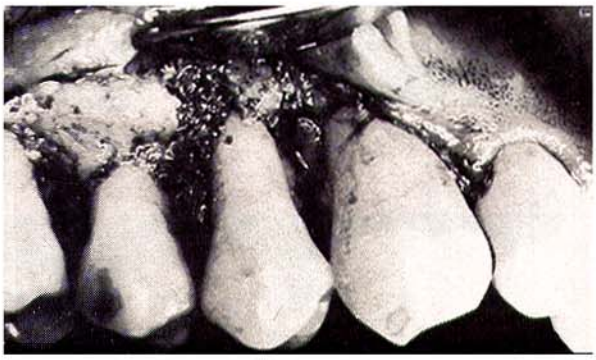

Figure 2

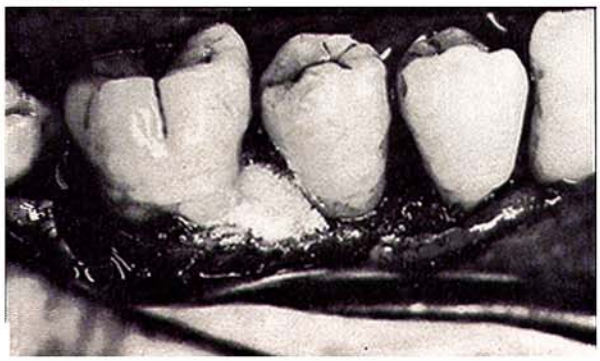

Figure 3

Fig. 1: Defect — pre-implantation with distal and palatal bony walls intact. **Fig. 2:** Defect — post-implantation with an allograft (perifill). **Fig. 3:** Clinical appearance of Synthograft on mesial of first molar. **Fig. 4:** Radiographic appearance of Synthograft on mesial of first molar.

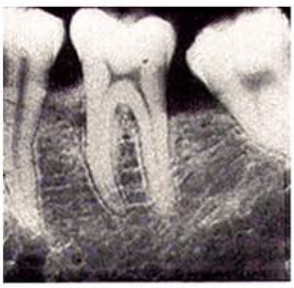

Figure 4

Case One

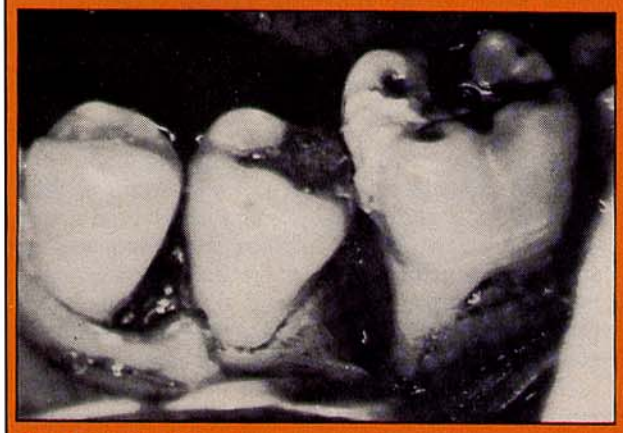

Fig. 5: Pre-op defect.

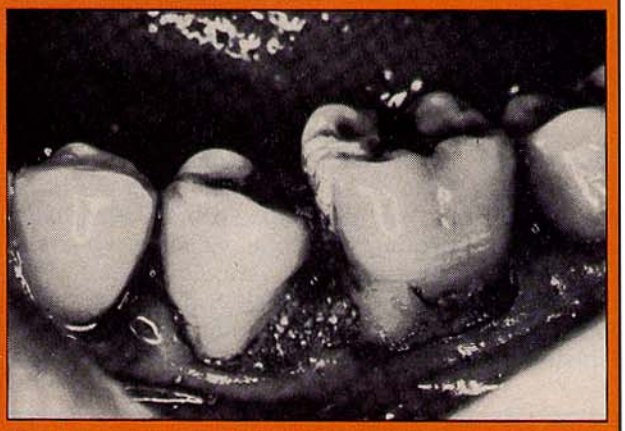

Fig. 6: Immediate post Periograf implantation.

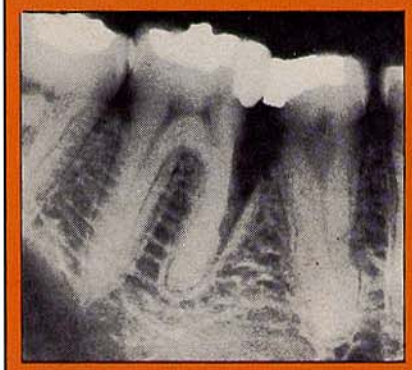

Fig. 7: Pre-op radiographic defect.

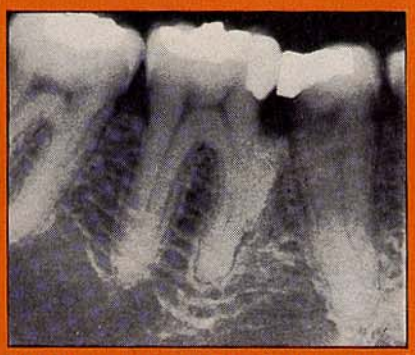

Fig. 8: Immediate post Periograf implantation.

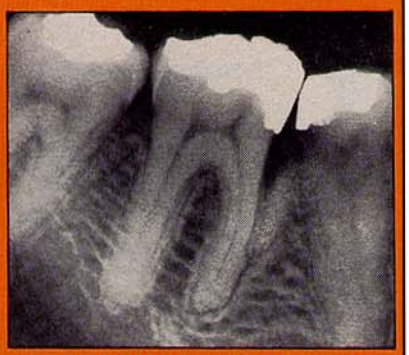

Fig. 9: Six weeks post Periograf implantation.

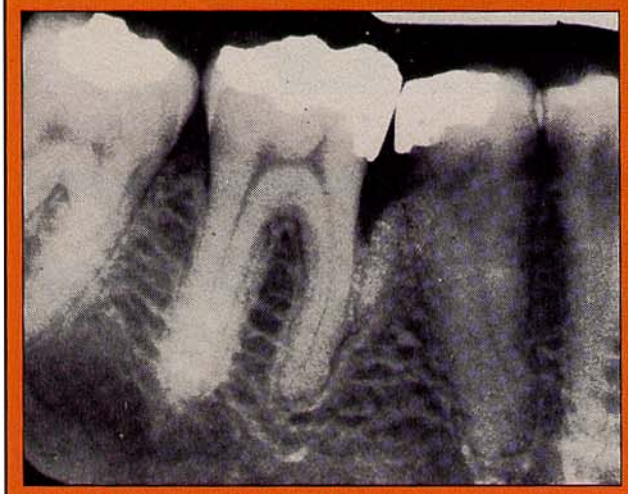

Fig. 10: One year post Periograf implantation.

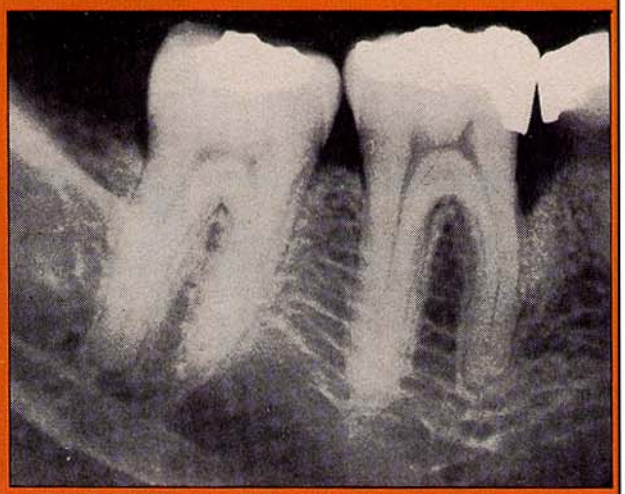

Fig. 11: Two years post Periograf implantation.

Fast track

Concern should be expressed about the use of synthetic graft materials by dentists with limited experience in periodontics.

in October 1983):

"Synthetic grafting materials have received significant publicity during the last few years. Alleged claims of success have been expressed regarding non-resorable hydroxylapatite and resorbable beta tricalcium phosphate periograf and synthograft implants. From the available literature it is evident that synthetic implant materials can be used as fillers of bony defects since they are well tolerated and seem to produce no foreign body reaction in short-term studies. However, any claims of increased bony regenerations, effectiveness in defect resolution, or predictability seem generally unsubstantiated at this time. The potential environment is questionable since most of the reports have shown only connective tissue encapsulation of the implanted particles. Furthermore, the objective of new attachment procedures is not only to regenerate alvolar bone, but also the attachment apparatus. Claims of regeneration of the periodontium cannot be substantiated from the reported literature at this time."

Concern should be expressed about the use of synthetic graft materials used by dental practitioners who have limited experience in periodontics. No currently available synthetic grafting material is a substitute for properly executed periodontal therapy. The synthetic materials deserve further investigation with long-term clinical and histological evaluations, but it is premature to present them to the general dental

Case Two

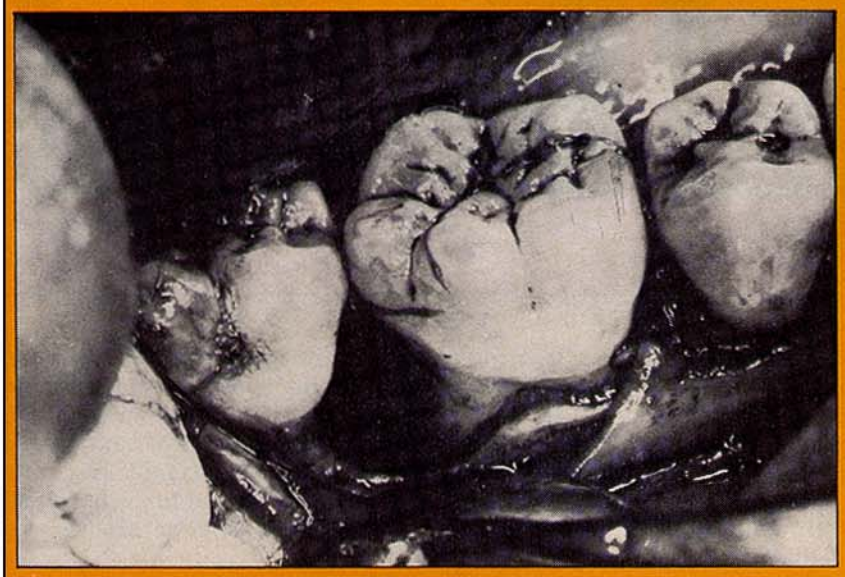

Fig. 12: Pre-op defect.

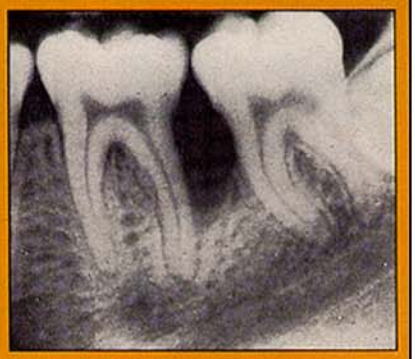

Fig. 13: Pre-op radiograph.

Fig. 14: Two weeks post Periograf implantation.

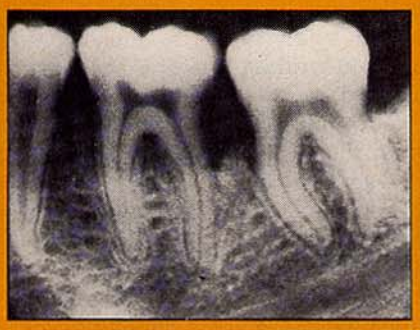

Fig. 15: Six months post Periograf implantation.

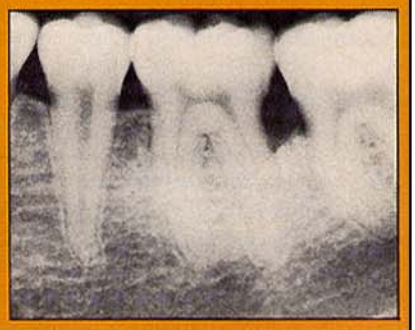

Fig. 16: Two years post Periograf implantation.

Case Three

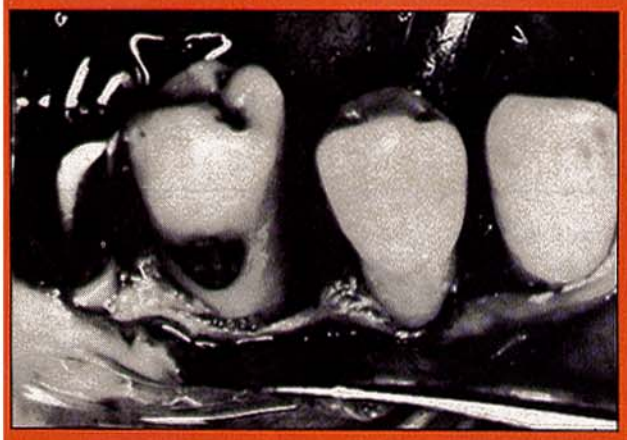

Fig. 17: Pre-op defect.

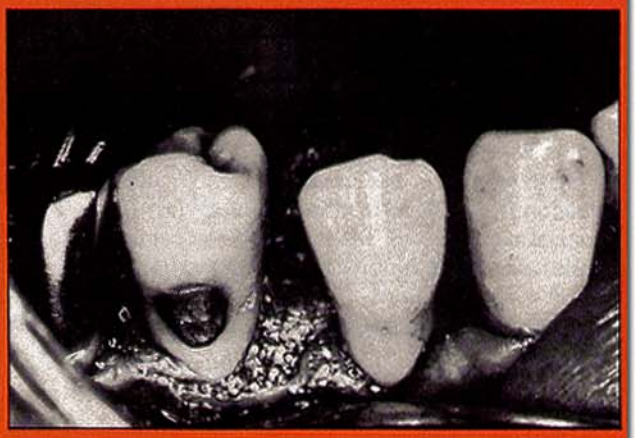

Fig. 18: Immediate post Periograf implantation.

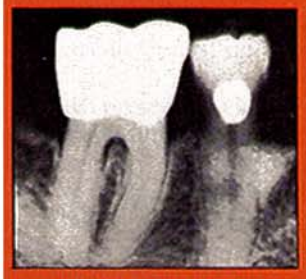

Fig. 19: Immediate post Periograf implantation.

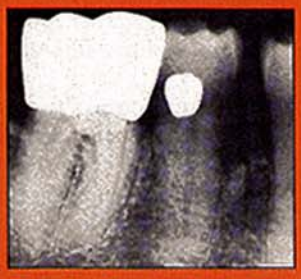

Fig. 20: Four months post Periograf implantation.

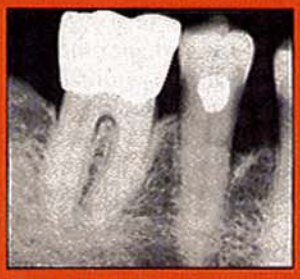

Fig. 21: Eight months post Periograf implantation.

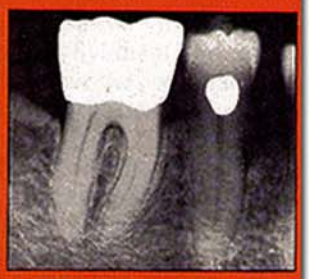

Fig. 22: Eighteen months post Periograf implantation.

profession without reservations. Their use must be considered experimental since their effectiveness and predictability have not yet been substantianted. At the present time, synthetic grafting materials promoted for use in periodontics should only be considered as fillers in the treatment of intrabody defects. The potential value or drawbacks of "fillers" is currently unknown.

Clinical and biological considerations

It is disturbing to hear the widespread misconceptions amongst many dentists concerning the indications and surgical techniques in using these materials. A common mistake is to assume that the lost support associated with periodontally terminal teeth can be restored with these grafts. As an extreme illustration, I have heard on several occasions of dentists who thought the material was to be condensed with a plugger into the soft tissue pocket without having to raise a flap. Perhaps these examples demonstrate what can happen when "mighty media markets miracle materials".

The indications for considering these materials are:

- with defects not correctable by resection techniques due to esthetics and/or anatomical reasons;
- where osseous resection can cause undue loss of support of adjacent teeth;
- where there exists insufficient bone support on a strategic abutment;
- and where the osseous defect is amenable to graft containment (vertical defects).

This last point is important. A tooth with extensive horizontal bone loss is not amenable to a graft as "crestal opposition" is not generally possible (nor do furcations respond well). Usually a minimum of two bony walls are required for adequate containment, as illustrated in figures 1 and 2.

A surgical protocol as outlined below must be carefully adhered to when performing an osseous grafting procedure.

1. Oral hygiene and effective plaque control.
2. Removal of all etiological factors.
3. Stabilization of teeth (if necessary).
4. Incision on health tissue away from defect.
5. Complete removal of all pathologic tissue.
6. Do not overfill or underfill defect with grafting material.
7. Place material in close proximity to the host bone.
8. Encourage bleeding into the defect.
9. Pack graft into the defect.
10. Achieve good tissue coverage.
11. Provide antibiotic coverage.

Fast track

Claims of increased bony regenerations or effectiveness in defect resolution with synthetic grafting materials seem generally unsubstantiated.

The 10th annual University of Southern California periodontal symposium addressed the current state of the art of these materials. One of the speakers, Dr. Yukna, has been heavily involved in research on two synthetic grafting materials. He cautioned "do not forget that good periodontal surgical techniques are necessary to the success of all bone grafting procedures. There is no synthetic substitute for qualified and thorough periodontal surgical techniques." Dr. Yukna discussed in detail the importance of patient selection, plaque control, good flap design, root preparation, graft condensation, post-op dressings and antibiotic coverage.

When presenting clinical cases, it's important to show a representative cross-section of the results to be expected. It is also important to examine the long term as well as the short term results. This is especially critical with bone grafts where a minimum of one to two years follow-up is essential. The predictability of the synthetic bone grafts have not been established, as was made clear in the position statement by the "Committee on Research in Periodontology" in October 1983. Indeed it will be only with valid statistical analysis of well controlled studies that the efficacy of these grafts may be established.

The three clinical cases presented in this article represent a cross-section of what I consider fairly good to poor results that I have experienced with Periograf. These results are not necessarily indicative of what other practitioners using these materials should expect, although a survey of the published case reports have shown a similar range of results. In particular, the continued loss of material at the graft-root interface is a consistent feeling. Proper flap design in achieving good soft tissue coverage is one of the important aspects of the proper surgical protocol in attempting to minimize the exfoliation phenomena.

Ideally, an osseous graft should be one that "induces" the host to produce its own new bone, periodontal ligament, cementum and gingiva while resorbing the graft material. However, by virtue of the composition of the synthetic grafts, this "induction principle" is not possible. At best, they are "osteoconductive"; that is the only function as a biologically acceptable scaffold upon which host bone may grow.

The "bone/graft" and "graft/root" interfaces have been investigated histologically. The Periograf "ad" displays a histological section demonstrating a biologically tolerated graft particle at the "bone/graft" interface. Other independent histological studies have shown however, that there is no true attachment at the "graft/root" interface and this may be of tremendous significance.

To play the devil's advocate, I would hypothesize that the space between the graft and root is narrow enough to obstruct a periodontal probe but not the ingress of bacterial plaque. If this were true, then the plaque would be inaccessible to the currette by virtue of the graft obstruction. We might, therefore, be better off at least leaving ourselves access to the roots if we cannot achieve an attachment or "seal" at the graft/root interface.

The ideal osseous graft should have the following properties:

1. Readily available in large quantities.
2. Easy to handle.
3. Safe – biocompatable.
4. Storage stable.
5. Osteoinductive and osteoconductive.
6. Rapidly replaced by host tissues.

Periograf and synthograft satisfy the first four conditions but not the last two. Synthetics are osseous substitutes and as such do not have the potential to send any biological "messengers" into the host tissues. Other types of "true osseous" grafts might provide a better potential for true regeneration in the periodontium. There have been many clinical studies done on autografts (i.e., bone from the same individual) and allografts (i.e., bone from another human) with variable results. As yet, all bone grafting procedures are somewhat unpredictable but deserve continued study. It must be emphasized that the most important aspect of periodontal therapy are the pre-treatment diagnostic and planning phases. We must not lose sight of the overall plan, proper sequence and options of treatment available to us. If osseous grafting is decided upon as the treatment of choice, the procedure protocol must be carefully followed to increase the chances of success.

As can be seen from the cases presented, results are unpredictable and very disappointing at times. One may ask why bone grafts fare poorly in the periodontium while at the same time do well in other areas, for example, in orthopaedic surgery? The answer lies in the fact that "principles of osseous grafting into closed cavities may not apply in the periodontal milieu because of (1) a lack of an adequate seal at the tooth/soft tissue interface, (2) saliva and bacteria may penetrate from down along the root surface, (3) epithelial cells may proliferate into the defect.

Ideally, future research should be directed at periodontal "regeneration" rather than "repair". With non-resorbable synthetics, the end result, at best is "*repair*". The synthetic grafting materials have not been shown to have bone-inductive capacity but they could act as an expander for autogenous grafts or as a space filler to help "plump out" an area for esthetic reasons. At present, bone grafting does have a place in periodontal therapy but only in very specific situations and should still be considered somewhat experimental.