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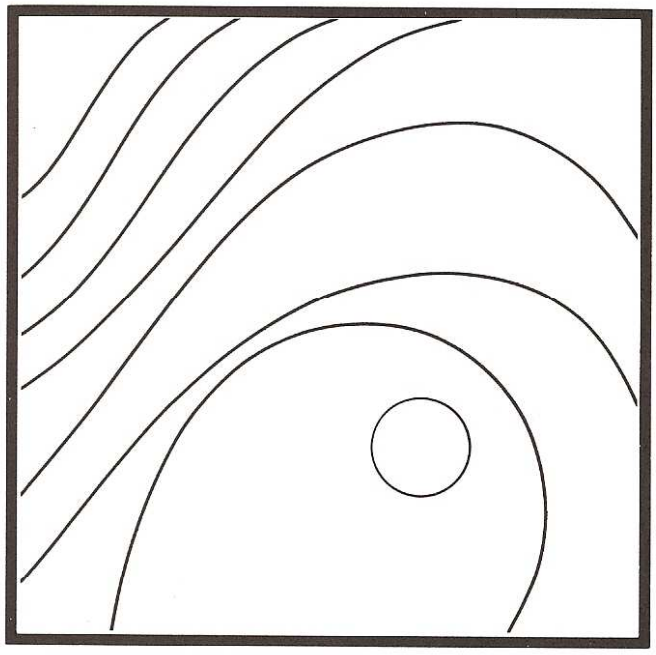

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New Dimensions in Guided Tissue Regeneration Treatment Modalities for Profound Marginal Periodontitis

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This article presents two methods of guided tissue regeneration with polytetrafluoroethylene membranes that promote extensive regeneration of periodontal supporting tissue around several adjacent teeth. These techniques are effective in patients with profound marginal periodontitis and advanced horizontal and vertical bony defects affecting large areas of the mouth. In method A, the goal of regeneration is reached by covering the defect with a row of several overlapping membranes. However, the favorable results obtained with this method had to be weighed against various problems concerning the surgical procedure and wound healing. These unsolved difficulties prompted the development of method B, in which only one large membrane is used. After appropriate relieving incisions are made in the membrane, it is placed into the interdental space and thus able to cover an extensive periodontal defect. During the last 4 years, favorable results have been obtained with both new methods of guided tissue regeneration. (Int J Periodont Rest Dent 1995;15:284–297.)

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Nyman et al[1] and Gottlow et al[2,3] described the use of the guided tissue regeneration (GTR) method for restoration of single-tooth defects. According to the manufacturer's guidelines, the membrane technique should be used for treatment of single-tooth defects or single interdental spaces,[4] because optimal adaptation of the membrane and flow of sufficient blood supply to the mucoperiosteal flap covering the membranes during the approximately 4-week maintenance phase will only be guaranteed in those circumstances.

This method is thus not suited for treatment of complex cases of patients with profound marginal periodontitis and extensive vertical and horizontal periodontal tissue defects in large areas of the mouth or in the entire mouth. Placement of the membrane around a single tooth or into a single interdental space would only promote limited amounts of tissue

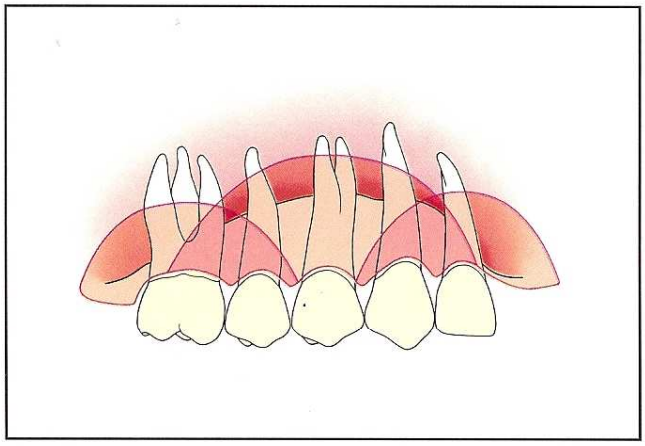


Fig 1 *In method A, several membranes are overlapped to cover the entire defect.*

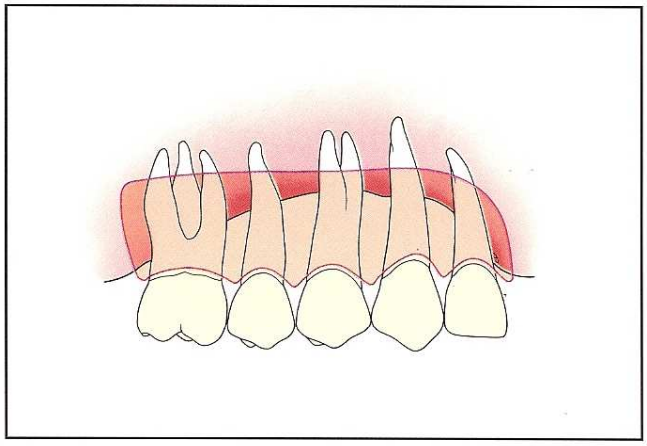


Fig 2 *In method B, one large membrane is used to cover the entire defect.*

regeneration, because the lack of lateral coverage—especially in the mesiodistal direction—necessitates deep placement of the membranes.

This article describes two methods that promote extensive regeneration of periodontal supporting tissue around several adjacent teeth in patients with profound marginal periodontitis, without requiring placement of filling material beneath the membranes.

Method and materials

In method A, regeneration is achieved by covering the entire defect with several membranes that overlap each other (Fig 1). Although this method has rendered favorable results, complications concerning the surgical procedure and wound healing led to the development of method B, in which only one large membrane is placed for coverage of the entire defect instead of several smaller membranes (Fig 2).

Fifty-two teeth in 10 patients (eight women and two men) with an age range of 26 to 62 years (mean age of 43.1 years) were treated according to the principles of method A. Method B was used for treatment of 47 teeth in nine patients (six women and three men), whose ages ranged from 32 to 62 years (mean age of 44.6 years).

Method A

Depending on the size of the periodontal defect, several appropriate polytetrafluoroethylene (PTFE) barrier membranes were chosen and trimmed individually. They were placed around the tooth or into the interdental space in an overlapping fashion and secured with sling sutures. It was thus possible to cover an extensive defect by using several membranes.

Method B

The entire defect was covered by one appropriately sized membrane, after the root cross sections were cut individually from the membrane. Relieving incisions were carried out in the membrane so that the membrane could either be positioned over the entire defect or pulled through interdentally. In larger periodontal defects, the intact part of the membrane should be placed over the most severely damaged portion of the defect. In the maxilla, the palatal aspect proved to be most affected by periodontitis in most cases; therefore, the intact membrane portion was positioned palatally, allowing full coverage of the interdental spaces. On the buccal side, the morphology of the alveolar process allowed overlapping or trimming of the membrane portions that had been pulled through interdentally.

Optimal stretching of the entire membrane was achieved by placement of sutures in various points, however, in some cases it was not necessary to apply sutures because the individually trimmed membrane showed excellent adaptation to the tooth. Because no microporous structures were used in this membrane technique, advantages or disadvantages related to their use do not apply to this method.[5,6]

Presurgical procedures

In accordance with the guidelines described by Kotschy,[7,8] detailed medical and dental histories were obtained. In addition, thorough dental examinations of each patient, including screening, inspection of the oral cavity, assessment of oral hygiene, initial periodontal and caries examination, occlusal assessment, functional examination of the stomatognathic system, neurologic facial examination, and clinical functional analysis, were carried out. After profound marginal periodontitis was established as the diagnosis and all possible treatment modalities were discussed in detail, GTR was selected as the appropriate treatment.

The same general procedure was applied to all patients. After a careful examination of the periodontal status, casts were produced and photographic documentation was prepared. Conservative periodontal treatment, including cleaning of the tooth surfaces, scaling, and removal of any residual calculus, was then started. Furthermore, the patients received oral hygiene instructions and nutritional consultation.

During the first 3 days of preoperative preparation, the patients were gradually led to cope with the psychological problems related to this type of treatment; a total of 12 to 18 hours was spent for this part of the treatment program.

Surgical procedures

To fully use the healing process following conservative periodontal treatment and, at the same time, prevent too-great shrinkage of the mucosal flap, surgery was performed on day 7.

The operative rehabilitation of the mouth was carried out in several stages, each lasting 2 to 3 hours per affected region. The treatment of two regions, each one characteristic of the specific method, will be described. The surgical procedure used to achieve GTR was based on personal communications with S. Nyman and T. Karring in 1988 and on the guidelines described in the manual supplied by the manufacturer.[4]

Two types of PTFE membranes (WL GORE) were used for flap surgery: for method A, "wraparounds " and a "wraparound x-large"; for method B, a 3 × 4-cm PTFE membrane ("free-standing bicuspid"). An atraumatic round needle and thread combination with a monofilamentary nonresorbable PTFE thread (WL GORE) was used to suture the membranes in position. Use of a round needle prevented the injuries to the PTFE membranes that may be caused by cutting needles. The mucosal sutures were carried out with atraumatic cutting or round needle and thread combinations made of the same material. Subsequently, the treated teeth were splinted with a synthetic adhesive.

Postsurgical procedures

During the first weeks following surgery, the patients were instructed to eat a soft diet and rinse the mouth three times daily with a 0.1% chlorhexidine solution. Professional tooth cleaning was carried out by a dental hygienist daily during the first postoperative week and every second or third day—depending on the condition of the mucoperiosteal flap—during the second, third, and fourth postoperative weeks. Depending on the condition of the surgical flap, the PTFE membranes were removed after 4 to 5 weeks.

All measurements of probing depth and probing attachment level were carried out by the same dental hygenist using the CP8 and CP10 (Hu-Freidy) periodontal probe to keep possible measuring errors within the same range. For each tooth, measurements were taken intermittently at each tooth surface.

For reasons of clarity, the graphs only include the highest values obtained for the mesial, buccal, distal, and palatal measurements of each tooth surface.

Results

The first two cases, each characteristic of one treatment method, are presented to illustrate the results.

Case A

On August 28, 1989, a 35-year-old woman suffering from extensive, profound marginal periodontitis underwent surgery in the posterior region of the maxilla (left first premolar to second molar), after having been subjected to 1 week of conservative preparatory treatment.

Following careful removal of all granulation tissue from the inner surface of the flap and from the bone, the root surfaces were inspected, and any remaining calculus was removed. Wraparound membranes were placed in an overlapping fashion around the left second premolar and first and second molars, braced, and secured with sutures. With placement of three wraparounds within the left quadrant, coverage of the area reaching from the distal aspect of the first premolar to the distal aspect of the second molar was achieved.

Following surgery, the patient was subjected to the postoperative treatment described earlier. The membranes were removed 5 weeks after the first operation. Probing attachment level and probing depth were measured prior to surgery and 6, 12, 24, and 48 months after reentry for membrane removal (Figs 3 and 4).

Until August 1990, the hygienic index[9] of this patient remained between 3% and 7% because of professional oral hygiene maintenance. After that, the patient decided not to attend some of the periodical recalls. In later recall examinations, the hygienic index was 10% to 17%. This may be regarded as an explanation for the slight worsening of the measurements.

Figures 5 to 8 show the clinical procedures and case documentation of method A.

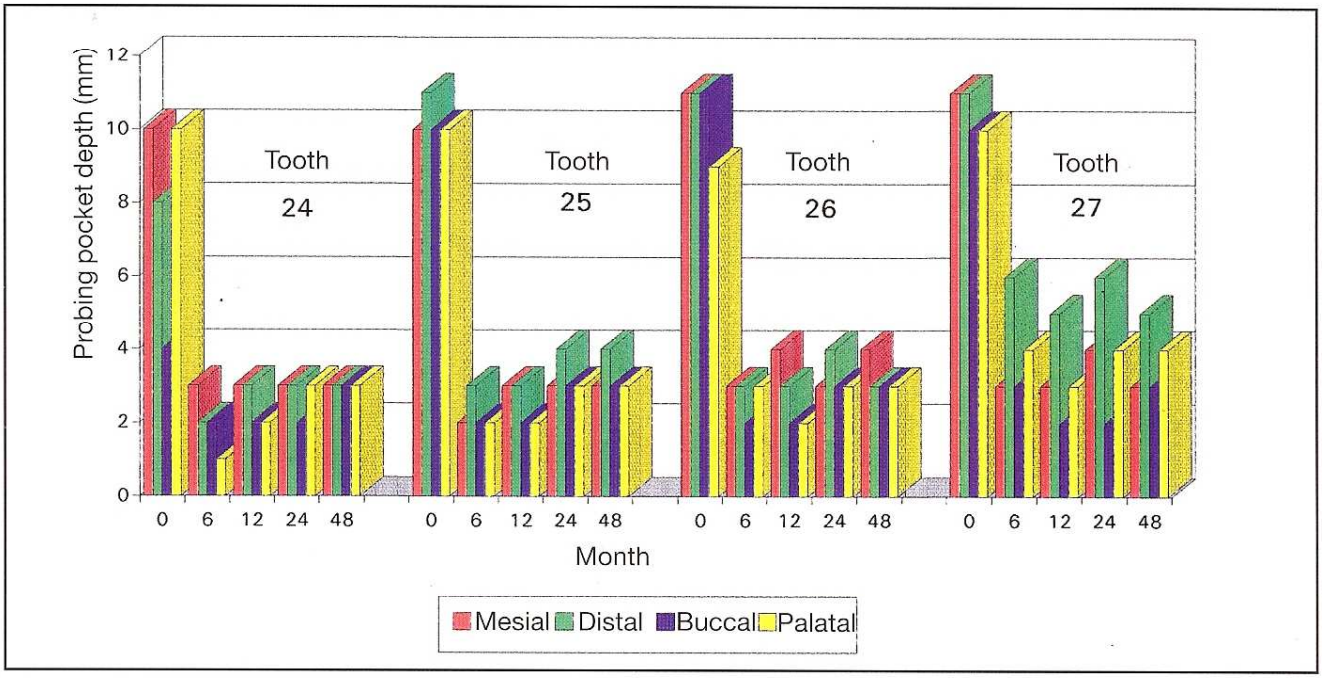


Fig 3 *Measurements of probing depth in a patient treated with method A (case A). Month 0 represents the preoperative measurements.*

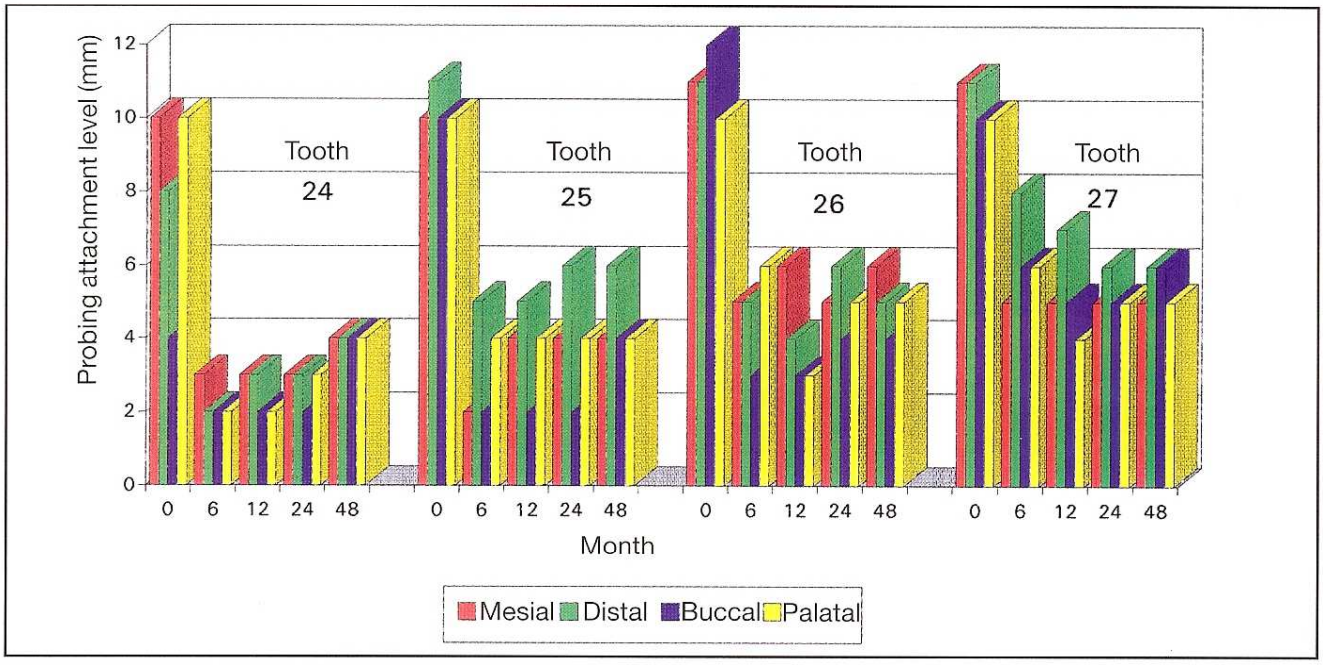
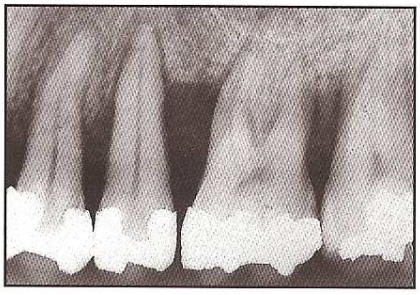
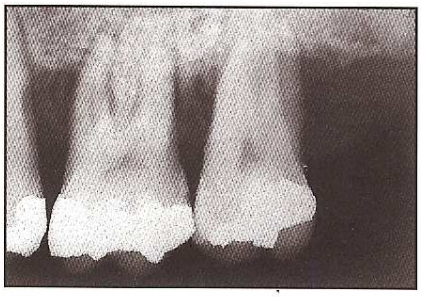
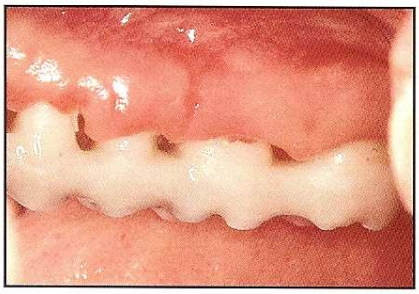


Fig 4 *Measurements of probing attachment level in a patient treated with method A (case A). Month 0 represents the preoperative measurements.*





Figs 5a and 5b *Radiographs taken before surgery show a massive recession of the periodontal structures.*



Figs 6a and 6b *Reentry, 5 weeks after the primary operation, reveals that fairly good flap management has been achieved, although no antibiotics were administered. However, especially in the palatal region, massive exposure of the microporous structures and an absence of all interdental papillae may be discerned.*

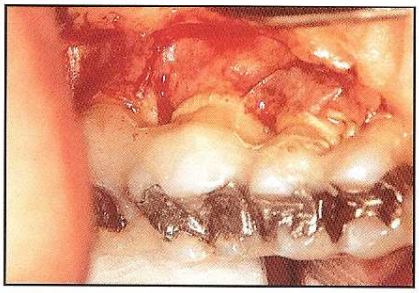
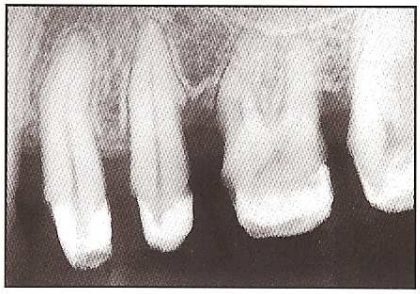
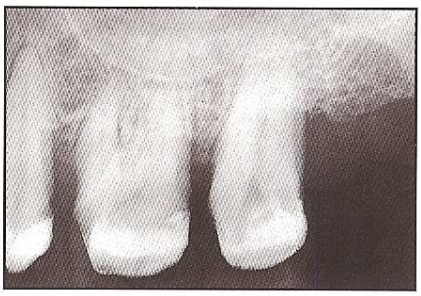


Fig 7 *Elevation of the mucoperiosteal flap reveals that the barrier membranes have become glassy and transparent during the maintenance phase.*





Figs 8a and 8b *Radiographs taken 42 months after the primary operation, when compared with Figs 5a and 5b, reveal the reconstruction of periodontal structures.*

Case B

The first operation according to the principles of method B was performed on October 15, 1990, in a 31-year-old woman who suffered from profound marginal periodontitis and extensive contiguous periodontal defects reaching from the maxillary right lateral incisor to the left canine. During conservative periodontal treatment, the maxillary teeth were splinted from the right canine to the left first premolar with synthetic material to stabilize the right and left central incisors and left lateral incisor, which were extremely mobile.

After the phase of conservative preparation, the buccal and palatal aspects of all teeth from the right canine to the left first premolar were subjected to flap surgery. Following thorough removal of all granulation tissue from the inner surface of the flap and from the bone, inspection of the root surfaces, and removal of any remaining calculus, contiguous deep craters could be discerned, particularly in the interdental-palatal area.

To simplify the surgical procedure in this first case, a sterilized plaster cast of the maxilla was used to prepare the membrane for adaptation.

The teeth that were to be covered by the 3 × 4-cm membrane were ground off the cast so that the shape of the roots became clearly visible at the level of the mucous membrane. By applying this procedure, it was easier to excise the individual root cross sections from the membrane. In addition, the point of exit of the incisive nerve was excised palatally.

The stretched PTFE membrane was trimmed so that its intact part was positioned palatally over the largest bony defect, covering the buccomesiopalatal aspect of the right lateral incisor, the circumferential aspects of the right central and left central and lateral incisors, and the buccomesiopalatal aspect of the left canine. Buccal relieving incisions were made so that they were situated over the remaining bone. Subsequently, the membrane was placed subperiosteally in the palatal area, and the buccal portions of the membrane that had been separated by the relieving incisions were pulled through interdentally. For optimal placement of the membrane around the teeth, the stretched buccal portions were adapted anatomically and secured with buccal sutures.

Following surgery, the patient was subjected to the postoperative treatment described previously. Reentry was performed after 5 weeks, and the contiguous membrane portions were removed in toto. The probing depth and probing attachment level were measured prior to the operation and 6, 12, and 36 months after reentry (Figs 9 and 10).

Figures 11 to 18 illustrate the clinical procedures and case documentation of method B.

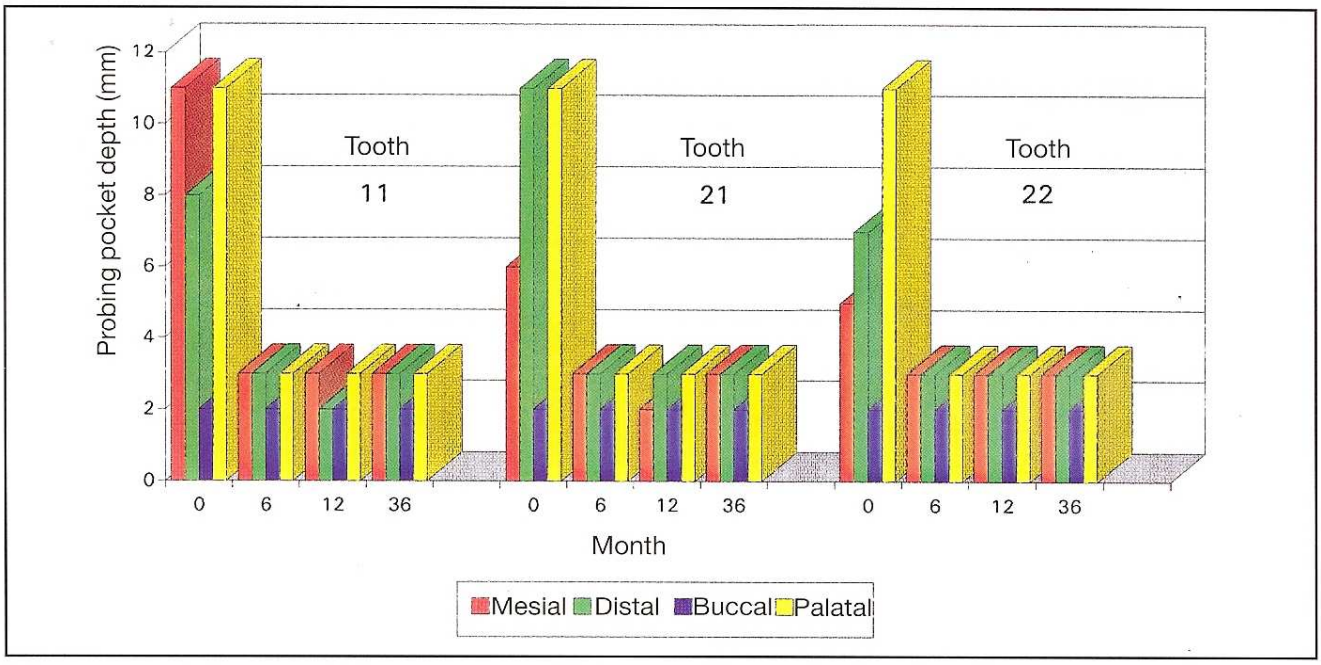


Fig 9 *Measurements of probing depth in a patient treated with method B (case B). Month 0 represents the preoperative measurement.*

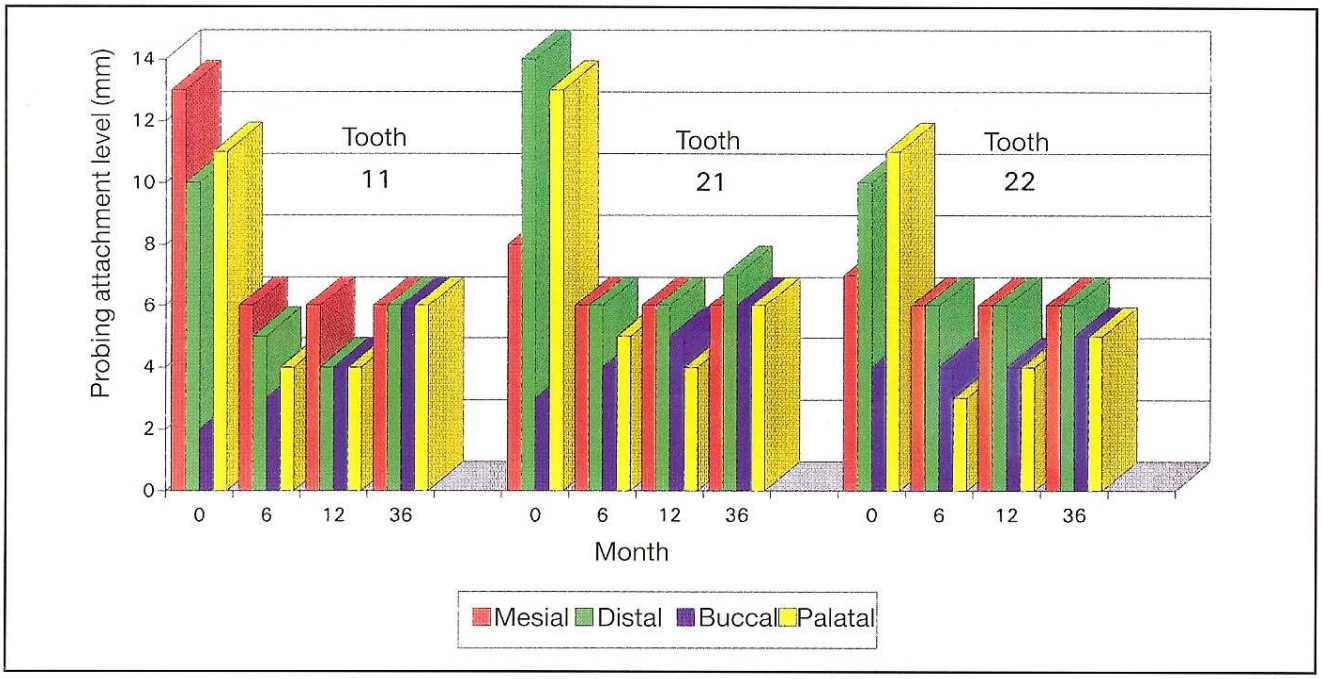


Fig 10 *Measurements of probing attachment level in a patient treated with method B (case B). Month 0 represents the preoperative measurement.*

Fig 11 *The preoperative radiograph shows the absence of intact periodontal structures around the maxillary left central and lateral incisors.*

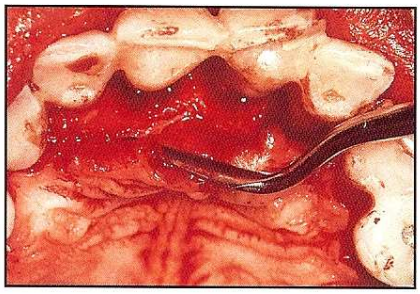


Fig 12 *Elevation of the palatal flap and careful curettage of the wound reveals the total absence of the interdental and palatal periodontal structures around the maxillary right central incisor and left central and lateral incisors to the apical region.*

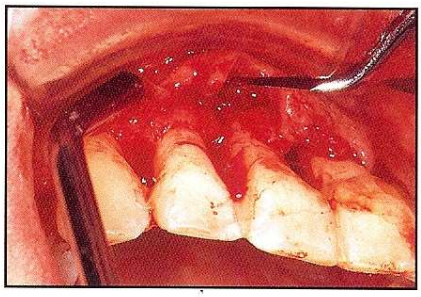


Fig 13 *Only the remains of the partially preserved buccal bone lamella at the right central incisor secure bony attachment of the patient's tooth. The same is true of the left central and lateral incisors.*

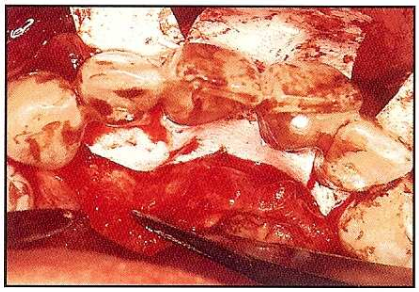


Fig 14 *Palatally, the PTFE membrane covers the entire defect, from the right lateral incisor to the left canine, except for the incisive nerve. If the root cross sections are cut out precisely, palatal adaptation of the membrane without wrinkling may be achieved. The individual membrane portions are pulled through interdentally and placed buccally over the defects. If necessary, they are sutured in position after anatomic adaptation so that optimal tent like spreading of the membrane is achieved.*

Fig 15 *During the entire period of membrane retention, special attention should be paid to the management of the covering mucosal flaps. Intensive patient care may allow long-term management of dehiscences in the interdental space; however, this risk should always be weighed against the individual treatment prognosis.*

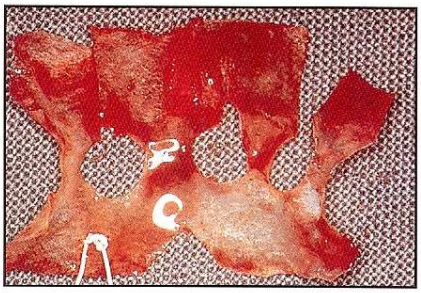


Fig 16 *Removal of the PTFE membrane reveals that the membrane had adapted well, especially in the area of the root cross sections, "walling in" the cervix. Note the absence of a microporous structure.*

Fig 17 *The hollow space formed by the membrane has been completely filled with regenerated tissue. The total absence of abscess formation may be partially attributed to administration of the antibiotic amoxicillin trihydrate (augmentin) during the entire phase of membrane retention.*

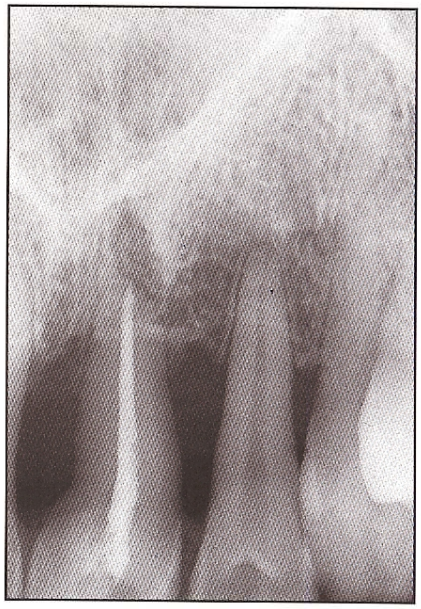


Fig 18 *The follow-up radiograph, taken 36 months postoperatively, reveals the partial restoration of periodontal structures.*

Discussion

The excellent results that were obtained with method A encouraged us to apply this surgical method in other similar cases. However, method A has complications:

1. In many cases, an individual adaptation of the single membranes for optimal alveolar ridge regeneration was not possible.
2. Because stretching of several single membranes required a vast number of sutures, it was very difficult to achieve mucosal coverage and maintain this coverage during the regenerative phase.
3. In extensive buccal and lingual periodontal defects, it proved to be extremely difficult or even impossible to maintain the proper position of several membranes placed on top of each other. It was thus possible that the lower portions covered by secondary membranes were pressed into the free space for the blood coagulum that had been developed intraoperatively, leading to uneven and limited tissue regeneration.
4. Because some of the membranes sagged, lateral ingrowth of granulation tissue into the spaces between the membranes could not be completely excluded.
5. Because of these complications, the primary surgical procedure proved to be extremely complex.

There was only one solution to most of the problems encountered when method A was used for treatment of profound marginal periodontitis: Instead of several membranes, coverage of these extensive

defects had to be achieved with one large membrane. Method B conveyed several advantages:

1. It was much easier to achieve an anatomically correct, individual adaptation of the membrane. The larger the membrane, the easier the preservation of a stable, free area for the blood coagulum.
2. Considerably fewer sutures were needed, and in many patients suturing was not necessary at all. This made soft tissue coverage and maintenance of the coverage during the regenerative phase easier.
3. It was much easier to maintain the proper position of one large membrane.
4. With the use of a single, large membrane, lateral ingrowth of granulation tissue could be prevented.
5. After several operations had been carried out according to this method, we stopped using the trimming procedure described in Case B, in which a plaster cast of the maxilla was used and the teeth that were to be covered by the membrane were ground until the shapes of the roots were discernible at the mucosal level, because it proved to be too complex. Instead, free-hand trimming of the membrane after careful study of the casts led to a further simplification of this procedure.
6. A considerable simplification of the primary surgical procedure was thus achieved.
7. In practice, the microporous structure of the PTFE membrane has proved to be advantageous if complete coverage with the palatal or buccal mucosal flap could be maintained during membrane retention, because it impedes and slows downgrowth of the covering epithelium.[5,6] However, if it was not possible to achieve or maintain coverage, the microporous structure proved to be disadvantageous, because it provides a good culture medium for bacteria[5,6] and is difficult for the patient to clean. As a consequence, the highest degree of flap recession was observed in the areas around the exposed parts of the microporous structure.

During the 5 weeks of membrane retention, dehiscences of the flaps covering the membranes were observed at both the palatal and buccal aspects. A complication encountered on the palatal side was that stretching of the elevated mucoperiosteal flap, which would have been very favorable in advanced profound

marginal periodontitis, proved to be impossible because of the anatomic situation of the flap. Slitting of the epithelium only allowed a minimum amount of stretching (Giovannoli I, personal communication, 1989). On the buccal side, displacement of the flap could be achieved by periosteal slitting.

Although no generally applicable rule could be established, we found that it was better not to thin the flap too much but only to remove the granulation tissue from the inner side of the flap to gain free space for guided tissue regeneration.

Unfortunately, most patients with extreme periodontal defects have a glassy, transparent mucosa that is easily injured, leading to complications in long-term coverage of the PTFE membranes in the interdental, buccal, and lingual regions. However, the problems related to partial exposure of the PTFE membranes during the phase between the primary and secondary operations could be solved satisfactorily by repeated recall examinations, including professional tooth cleaning, repeated daily rinsing with a 0.1% chlorhexidine solution, careful handling of the treated sites, an exclusively soft diet, and optimal cooperation between patient and therapist.

Administration of an antibiotic during the phase of membrane retention led to a considerable decrease in the operative risk and an enhancement of the flap management. In the case of more pronounced inflammation of the mucosa covering the membrane or imminent formation of an abscess beneath the membrane, the immediate examination, and if necessary, removal of pus beneath the membrane is indicated; rarely is the premature removal of the membrane indicated.

If the reentry procedure for membrane removal shows that the buccal or lingual flaps do not allow complete coverage of the entire newly regenerated tissue, a thick free mucosal graft should be used to cover the exposed parts. If this procedure is applied, complete loss of this portion of the regenerated tissue may be avoided.

Conclusions

Four years of experience in applying the large PTFE membrane has shown that, with this technique, it is possible to prevent patients with extreme periodontal defects from losing their natural teeth. In the present state of the art, guided tissue regeneration in the entire maxilla may be achieved by

placement of three to four appropriately sized membranes. The good tissue compatibility of the PTFE membrane allows it to remain in situ for over 4 to 5 weeks without being too harmful to the covering mucosal flap.

Despite the surgical complications, the time-consuming patient management, and the strain for the patient and the treating physician, and although practical experiences as well as scientific long-term studies carried out by Ramfjord et al[10,11] have proved that most periodontal inflammation may be cured or stabilized with conservative measures, this new method of applying guided tissue regeneration opens new dimensions for patients with extreme periodontal defects. Instead of experiencing total loss of their teeth or extreme denudation of the roots, these patients may now hope for reconstruction of part of the attachment apparatus and long-term preservation of most of their teeth.

Acknowledgments

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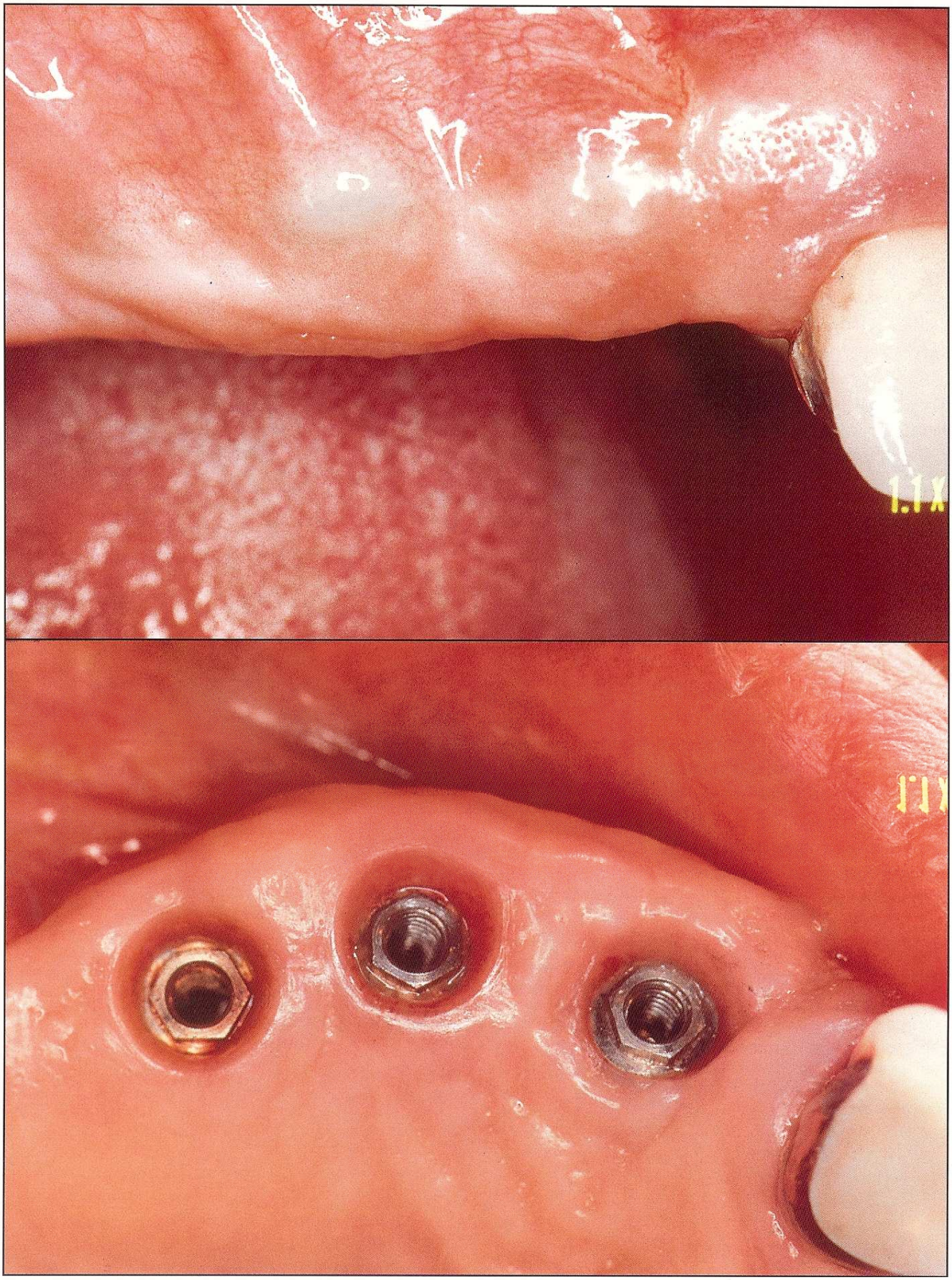
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