# REMOVABLE PROSTHODONTICS

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# Vital root retention in humans: A final report

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L he success of the complete denture service is predicated on the maintenance of integrity of the supportive oral tissues.<sup>1</sup> Alveolar bone maintenance depends on the presence of healthy roots and periodontal ligaments which transmit functional and parafunctional forces to the surrounding bone. The loss of teeth and periodontal ligaments, and their replacement by complete dentures, inevitably changes the pattern of force distribution. Force resolution to the alveolar bone from the complete denture base is now in the form of pressure,<sup>2</sup> which is unfavorably tolerated by the alveolar bone. The technique of tooth-root retention under complete dentures appears to militate against such a bone resolution. In previous reports<sup>3, 4</sup> we described a study in which we sought to determine whether submucossally retained vital roots under complete dentures would help preserve alveolar ridge form. The method consisted of clinical crown removal from selected teeth at a level even with the crest of alveolar bone in 10 patients. The operated areas were covered with mucoperiosteal flaps, and complete dentures in balanced occlusion were made for the 10 patients. The purpose of this third report is to describe the vitality and position of the sectioned roots, the surface integrity of soft tissue coverage, and

the osseous tissue character surrounding the roots of the sectioned teeth following a 36-month observation period.

## **REVIEW OF DESIGN AND UPDATE** Criteria for tooth selection

The evaluation of individual teeth for presence or absence of pulpal involvement is essential to the success of vital root sectioning and submucosal burial. In our experience, pulpally compromised teeth due to previously placed restorations or unexcavated gross decay prior to surgery created problems during postsurgical treatment. A pulp tissue evaluation is best accomplished by using clinical methods,<sup>5</sup> by removing the existing restorations for total clinical crown evaluation, and by closely observing the pulpal hemorrhage at time of surgical sectioning. Any departure from normal pulpal response or appearance is a challenge to the feasibility of submucosal vital root retention. The presence of negative pulpal findings indicates a need for alternative methods for tooth retention other than vital root retention.3

#### Periodontal preparation

Periodontal considerations include tooth mobility, the amount of alveolar bone support for an individual tooth, and tooth position within the arch. The presurgical periodontal preparation of individual teeth is also very important. In some patients where soft tissue dehiscences occurred over sectioned roots in the postsurgical treatment phase, a review of presurgical diagnostic radiographs and 35 mm intraoral color transparencies showed moderate-tosmall calcular deposits around the sectioned teeth. It is possible that calcular "tags" may remain following periodonal currettage during the surgical phase of root sectioning. Cook and associates<sup>6</sup> stated that these remaining calcular deposits created problems in their studies on the regeneration potential of

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**Fig. 1.** *Right,* Sectioned roots with straight horizontal-cut root surface as done by original tooth-sectioning techniques. *Left,* The root shows present root/bone contouring design to eliminate dehiscences as much as possible.

periodontal tissues in infrabony defects around submerged vital root segments. Subgingival currettage and root planing should be performed prior to surgical procedures necessary to prepare selected teeth for all overdentures, especially for those patients selected for submucosal vital root retention.<sup>7</sup>

#### Surgical procedure

Relaxing incisions in the vertical plane, as originally discussed in the preliminary report of this project,3 have not been necessary to prepare the mucoperiosteal flaps for wound closure with minimal tissue tension in the mucobuccal fold. A beveled incision similar to that used in the excisional new attachment procedure<sup>8</sup> is used to remove unwanted tissue at the gingival crest surrounding the teeth to be retained. This incision provides clean wound edges for adequate healing by primary intention. Deep subperiosteal dissection allows sufficient relaxation of the mucogingival tissues to yield good wound edge approximation for water-tight suturing. Original surgical tooth-sectioning techniques were altered when dehiscences occurred over some of the sharp angles created by horizontal one-plane surgical sectioning of selected teeth. It was further noted that all dehiscences occurred on the lingual side of the sectioned teeth. Because of these findings, we suggest that tooth root surface and adjacent bony contouring should be accomplished to provide a well-rounded root surface that is confluent with the adjacent bony ridge (Fig. 1).

#### **Denture technique**

The prosthetic management of the patients involved in the project demanded the following steps to ensure a successful service: (1) preliminary impressions; (2) border (muscle) molding of a custom



Fig. 2. Tooth selection criteria for vital root burial.

impression tray; (3) accurate, controlled-pressure, master impressions; (4) arbitrary face-bow recording and transfer to an articulator; (5) laboratory remount of processed complete dentures for removing processing changes; (6) determination of pressure spots prior to insertion of dentures at the time of surgery; (7) tissue treatment material placement in the denture over surgical sites at insertion; (8) articulator remount of dentures after initial healing to harmonize the denture occlusion with gnathostomatic system; and (9) reline, rebase, or remake of dentures when oral tissues have healed completely or the dentures are no longer correctly adapted to the supporting hard and soft tissues.

If the preceding regimes of tissue preservation and prostheses construction cannot be followed, alternate plans might be indicated to restore the oral cavity to health.<sup>9</sup>

#### RESULTS

Ten patients participated in this study. Forty-five teeth which met the criteria shown in Fig. 2 were selected and treated by surgical sectioning and submucosal submergence. At the time of preparation



Fig. 3. A, Presurgical complete mouth radiographs of first patient. B, Mandibular right premolar and canine roots 3 months postsurgery.

of this report, 36 of the sectioned vital roots were healthy and exhibited proprioceptive, preceptive, and physiologic responses. The psychologic status of nine of the patients appeared to be excellent. The remaining patient requested removal of mandibular retained roots due to feelings of discomfort at all times during the postsurgical phase of treatment. In general, patients expressed the feeling that they felt as though they had some of their own teeth which suggests more of an intact body image, as discussed by Swoope.<sup>10</sup>

Radiographically, most of the retained roots appeared to be normal with regard to surgical acceptance, periodontal ligament support, lamina dura presence, and an absence of periapical pathoses. Pre- and postsurgical grid radiography results of bony reduction in the first patient entered into the project are shown in Fig. 3. No presurgical debridement of periodontal sulcular tissues was performed, total calculus removal surrounding teeth to be sectioned was not accomplished, and the patient demonstrated a loss of 3.8 mm of bone at the 41-month postsurgical level. Recently Tallgren and



Fig. 4. A, Presurgical grid radiography of teeth selected for vital root burial. B, Roots 20 months following postsurgical sectioning and burial.

associates<sup>11</sup> reported that the initial postoperative period (3 months) exhibits the largest amount of residual alveolar bone loss in edentulous patients. In this study, residual bony tissue reduction, as measured by interproximal grid radiography, was minimal at the 3-month postoperative level and an average of 2.0 mm at a mean 28.1-month postsurgi-



**Fig. 5. A**, Presurgical complete mouth photograph of remaining teeth and residual alveolar ridges. **B**, Mandibular anterior teeth. **C**, Mandibular arch 20 months after vital root burial. **D**, Same arch as seen in **C**. Note height of residual ridge where vital root retention has been accomplished.

cally. Fig. 4 shows one patient's grid radiography examination of selected teeth before and after surgical sectioning. Little horizontal interproximal bone loss is demonstrated after 20 months of root submergence.

It is interesting to note that some bone loss did occur; however, primary structural change in the reduction of the residual ridge by bony loss appeared to be minimal. Clinical photographs of the patient discussed in Fig. 4 show that buccal and lingual bony plates are still intact, and the breadth of this same ridge is much greater than results usually seen following total tooth extraction (Fig. 5). Furthermore, the clinical appearance of residual soft tissues is favorable, and patient acceptance of the procedure and its functional results has been excellent.

# DISCUSSION

Atwood<sup>12</sup> observed that the "Reduction of residual ridges needs to be recognized for what it is: A major unsolved oral disease which causes physical, psychologic, and economic problems for millions of people all over the world." Both objective and subjective findings clearly indicate the significant benefits of tooth retention since even the extraction of a patient's few remaining teeth should be a serious



Fig. 6. Flowchart indicates suggested sequencing for treatment planning.

decision.<sup>13</sup> This research project enabled us to observe a sequence of treatment for a number of otherwise condemned teeth. Our findings suggest that oral cavities ravaged by periodontal disease and pulpal pathosis should be treatment planned as suggested in Fig. 6.

The proper diagnosis and adequate treatment of submucosally retained roots can lead to excellent tissue acceptance and ridge preservation. The elimination of pathologic or iatrogenic interference factors can be accomplished with ease. Pulpal pathosis can be treated by surgical intervention to the root surface and one-treatment root canal therapy followed by reburial of the retained root. Dehiscences caused by sharp root edges, abnormal denture pressures from ill-fitted denture bases, or inadequately balanced complete dentures can be treated by harmonizing the denture occlusion and by reducing sharp edges through surgical rounding of tooth or bony protuberances.

Soft tissue breakdown over retained roots does not necessitate root removal. Conventional overdenture abutments can be constructed on the exposed root after adequate pulpal and restorative preparation. The main reason for removal of a retained root after all avenues of suggested treatment have been utilized is the patient's inability to maintain the health of the gingival tissues surrounding the root. If the root is retained submucosally, this is not a problem.

## **FUTURE RESEARCH**

The dental profession is obliged to continue its search for a means of residual alveolar ridge preservation. Future studies in oral tissue preservation by submucosal vital root retention should consider; (1) pre- and postsurgical dental cast evaluation utilizing a surface comparator;<sup>14</sup> (2) histologic findings of retained roots and adjacent tissues by microscopic evaluation of block section specimens made at selected time intervals;6 (3) comparative radiographic bone loss evaluations of retained vital root areas and normal tooth extraction sites carried out on the same patients using ridge areas on opposite sides of the same arch; (4) proprioceptive responses using electronic transducers within the complete denture prostheses with and without submucosal vital roots;<sup>15</sup> (5) utilization of a constant position film holder adapted to the edentulous residual alveolar ridge;<sup>16</sup> (6) submucosal vital root retention, uncovering of roots for endodontic therapy, and abutment reconstruction for use in conventional fixed or removable prostheses when periodontal infection and bony resorption have been arrested; and (7) placement of a dentinal tissue stimulator such as calcium hydroxide over sectioned root and pulpal tissue surface.17

Findings in these studies might enable the prosthodontist to respond to the challenge of meticulously preserving what remains, rather than simply restoring what is missing.<sup>18</sup>

#### SUMMARY AND CONCLUSION

A research protocol for submucosal vital root retention in humans has been developed based on laboratory animal studies. Procedures, patient management, and statistical results have been reported in a series of three articles. Changes in techniques have also been reported, along with explanation of a flowchart for tooth root retention and alveolar ridge preservation. Some ideas for future investigations are presented. *Vital* root retention in humans appears to be a valid means of retaining residual bony ridge tissues to a greater degree than when patients are rendered totally edentulous.

#### VITAL ROOT RETENTION

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