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Endodontic Endosseous Implants: Case Reports and Update of Materials

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Two cases are presented with 5-yr follow-ups in which Vitallium endodontic implants were used successfully to improve the crown-root ratio of central incisors compromised by trauma. A review of recent developments in endodontic implant materials and designs indicates that new materials should provide greater biocompatibility and retention.

Endodontic endosseous implants were first reported in the literature 45 yr ago (1). Since then, several studies have shown them to be of considerable benefit in improving the crown-root ratio by increasing root stability (2–6). In 1972, Cranin and Rabkin (3) reported on the evaluation of 952 endosteal implants in humans. The endodontic implant was the most successful of all of the endosteal implants, with a 91% success rate after 5 yr. This high success rate is attributed to the implant functioning in a totally closed system since there is no contact with the oral epithelium (3).

Frank (4) and others (5–8) have listed several indications and contraindications for endodontic implants.

The indications for endodontic implants are:

1. Abutment teeth in which inadequate root length is present.
2. Horizontal root fractures where the removal of the apical fragment is indicated, thereby reducing the crown-root ratio.
3. Fixed prosthodontic patients in whom removal and replacement of an isolated, periodontally involved tooth would involve a considerable restorative effort.
4. Severe internal resorption with an associated external perforation requiring removal of the involved portion of the root.
5. Apicoectomies in which a large portion of the root is lost.
6. Periodontally involved incisors where the adjacent teeth would not serve as satisfactory abutments.
7. Primary molars with no permanent successor.
8. Teeth which have been avulsed, reimplanted, and are still excessively mobile.
9. Hemisectioned teeth which are excessively mobile.

Contraindications for the use of endodontic implants are:

1. Debilitating systemic conditions.
2. Previous radiation or bone infection in the region.
3. Periodontal pockets which communicate with the apex of the tooth.
4. Teeth in which previous endodontic therapy has failed.
5. Less than 7 mm of vertical bone beyond the apex of the tooth.
6. Anatomical structures such as the maxillary sinus, nasal vestibulum, inferior alveolar canal, or mental foramen which would be violated.
7. Roots with excessive curvature or severe angulation.

Two cases are presented in which Vitallium implants were used. Five-year recall evaluations showed both cases to be functioning successfully.

CASE 1

A 15-yr-old male who had been hit in the mouth with a baseball 4 days earlier presented for treatment. The maxillary right central incisor was partially avulsed and in lingual version. Radiographic examination showed a horizontal midroot fracture with the apical segment intruded (Fig. 1). The coronal segment was aligned and stabilized. Three weeks later a fistula was noted at midroot. Following surgical removal of the apical segment a #140 Vitallium implant (Austenal Dental, Inc., Chicago, IL) was placed utilizing Roth Root Canal Cement (Roth International Ltd., Chicago, IL) on the portion within the tooth followed by lateral and vertical condensation of gutta-percha around the implant (Fig. 2). This patient has been seen at yearly recall intervals (Figs. 3 and 4), with the most recent being 5 yr postoperative (Fig. 5). The tooth remains very stable and asymptomatic. A radiograph taken at the most recent recall shows good bone fill around the implant and no evidence of periapical pathosis.

CASE 2

A 53-yr-old female was referred by her general dentist for further treatment. She related that she had fallen 6 days earlier and intruded the maxillary right central incisor (radiograph not available). The referring general dentist had repositioned the central incisor with forceps and splinted the traumatized tooth to the adjacent teeth. The apical radiolucency on the right central incisor (Fig. 6) is thought to be the result of the traumatic intrusion following repositioning. Moderate periodontal bone loss of all of the maxillary anterior teeth was present, but there was no evidence of crown or root fracture. The central incisor was sensitive to percussion and tested negative to the electric pulp tester and to thermal tests. After 2 wk of stabilization, calcium hydroxide was placed in the canal (Fig. 7). Two months later the splint was removed and

FIG 1. Radiograph shows horizontal midroot fracture of maxillary right central incisor.

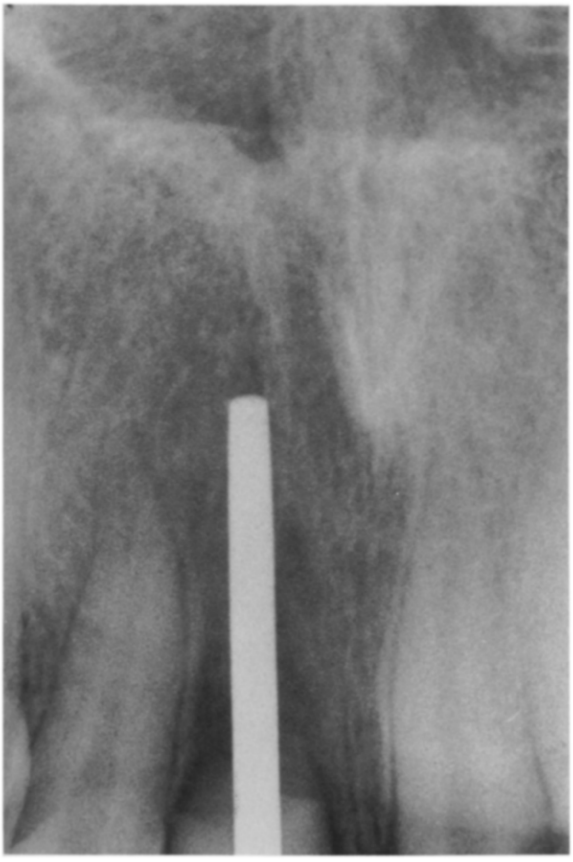

FIG 2. Three weeks later the apical segment was removed and the endodontic implant is in place.

FIG 3. The 1-yr postoperative radiograph shows good osseous healing.

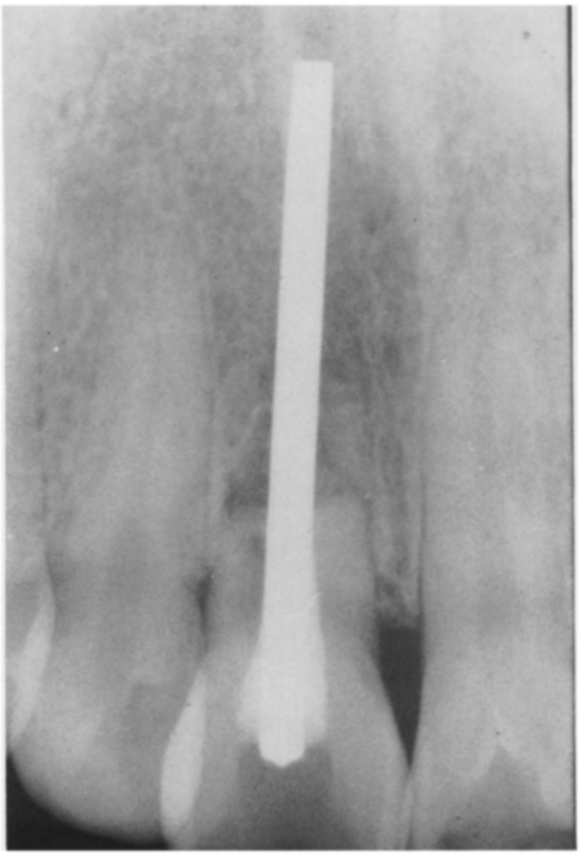

FIG 4. The 2-yr posttreatment radiograph shows that the Vitallium implant has been well accepted.

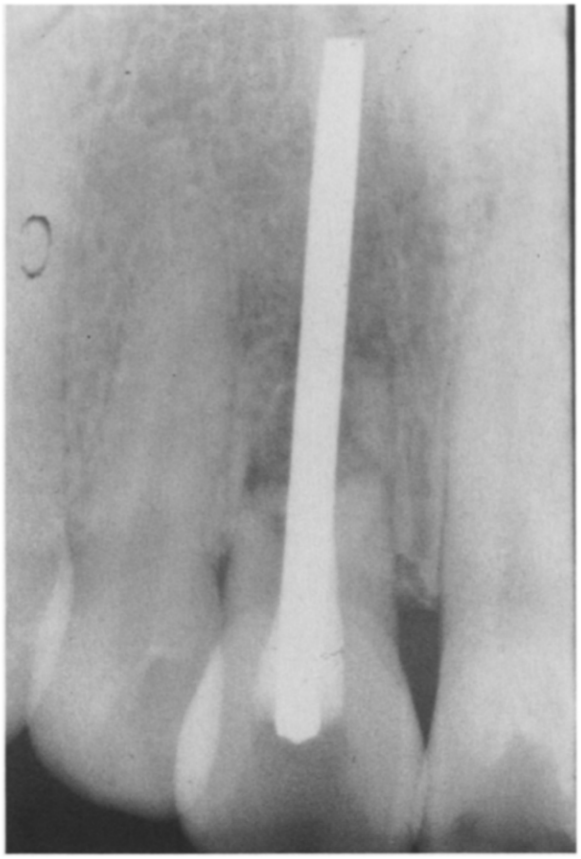

FIG 5. A 5-yr postoperative radiograph shows excellent osseous regeneration and healing.

FIG 6. The apical radiolucency seen on the maxillary right central incisor is a result of intrusion after the tooth was repositioned by the referring dentist.

FIG 7. Following 2 wk of stabilization the canal was filled with calcium hydroxide.

FIG 8. Due to severe mobility, the Vitallium implant was placed 3 months after the accident.

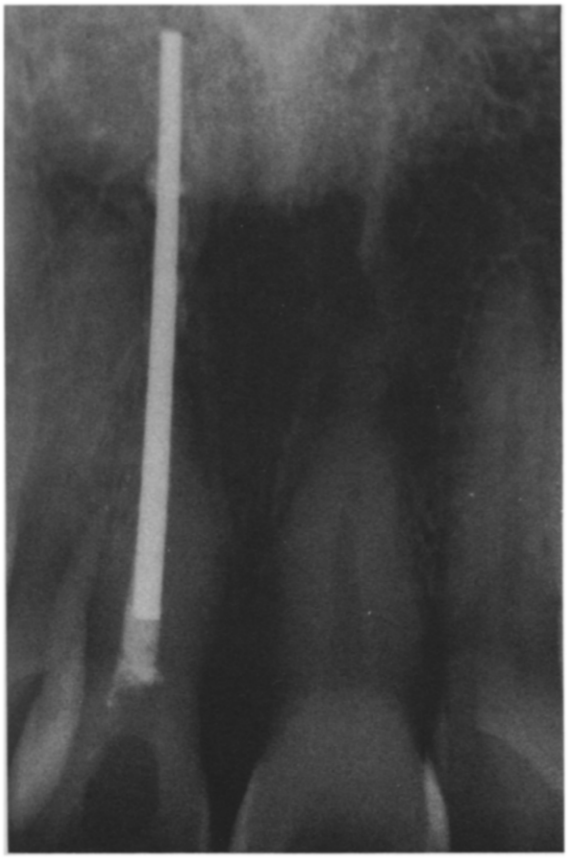

FIG 9. A 15-month recall radiograph shows a slight thickening of the periodontal ligament and that the Vitallium implant has been well tolerated.

FIG 10. Five-year recall shows some external resorption, but the tooth is stable and asymptomatic.

at this time the central incisor remained very mobile. The tooth was still mobile 2 wk later and was painful upon mastication. A #80 Vitallium implant was placed utilizing Roth Root Canal Cement on the portion within the tooth. Lateral and vertical condensation of gutta-percha around the implant was accomplished (Fig. 8). At a 15-month recall appointment, the tooth was asymptomatic and the patient had no dental complaints. The radiograph (Fig. 9) shows little if any apical resorption and there were no severe periodontal pockets. After 5 yr, this tooth remains very stable and asymptomatic. Radiographic analysis shows that the implant is well tolerated; however, a slight amount of external resorption is evident in the middle third of the root (Fig. 10). This is probably a result of the severe trauma to the tooth prior to the placement of the endosseous endodontic implant.

CURRENT IMPLANT DESIGNS AND MATERIALS

The implants utilized in the two cases presented here were Vitallium (an alloy of 65% cobalt, 30% chromium, and 5% molybdenum). Vitallium has been used extensively in the past because it was initially found to be inert and noncorrosive in body fluids (9, 10).

The inertness of Vitallium has been questioned in studies performed by Ferguson et al. in 1960 (11), Cohen in 1961 (12), and Zmener in 1983 (13). These studies have shown that Vitallium does undergo surface corrosion and that this could be an important factor in the success of an endodontic implant. As a result of this research, Vitallium implants have generally lost acceptance and are no longer available for purchase.

The two materials currently in use because of their superior biocompatibility are titanium (Orotronics, New York, NY and Park Dental Research, New York, NY) and aluminum oxide, which is a single crystal sapphire (Kyocera America, Inc., San Diego, CA).

The titanium and sapphire implant systems are available for clinical use in two basic design configurations, smooth tapering and threaded. Research performed by Judy and Weiss (14) suggest that smooth endodontic implants display undesirable motion in the soft tissue peri-implant sheath and that threaded, self-tapping endodontic implants transmit occlusal stresses to the surrounding bone more favorably. However, these findings have been disputed by Ichica and Caputo (15) who utilized photoelastic stress analysis to determine that both smooth and threaded designs provide substantial fixation and adequate stress distribution to the supporting structures. This allows design selection to be based more upon operator preference.

Our clinical experience has found that the sapphire crystal implants are too large for some smaller canals such as those found in the mandibular anterior teeth.

The newest endodontic implant design, showing possibly the greatest potential, is porous surfaced implants. This design has not been used in human studies yet due to a low mechanical strength which is a result of the heat-sintering used in fabrication. The implants consist of cobalt, chromium, and molybdenum alloy powder, which are the same components

of Vitallium, heat-sintered to cobalt alloy endodontic implants. It should follow that this mixed alloy system would corrode more easily because of the greater area of the porous surface. A fibrous connective tissue capsule would also be expected to develop as is the case with smooth and threaded implants of the same alloy. However, animal studies have shown these implants to undergo strong fixation by bony ingrowth (16). In addition to successful osseointegration, the porous surface design may provide strong retention within the canal and provide a reliable apical seal (C. Maniatopoulos, personal communication).

DISCUSSION

The use of endodontic implants has dropped significantly in recent years. This is unfortunate due to the many and varied situations in which they can be used effectively to improve the prognosis of mobile teeth compromised by trauma or pathological loss of bony support or root structure. According to the ADA Council on Dental Materials, Instruments, and Equipment: "With careful case selection, endodontic implants are safe and effective for use." (17). The success of this technique has been demonstrated by the clinical results reported here in the two patients in whom the older Vitallium implants were utilized. Considering the newer more biocompatible materials and the prospect of obtaining successful osseointegration with the porous surfaced design, endodontic endosseous implants should have an even greater chance of success in the future.

The opinions expressed herein are those of the authors and are not to be construed as reflecting the views of the United States Air Force or the Department of Defense.

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