Residual Roots as an Anatomical Guide for Implant Placement: Case Series With Two-Year Follow-up

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As placement of implants into immediate sites involves management of the remaining root structure, these residual roots may be used as a guide for the development of osteotomy. This aids in implant positioning and prevents drill slippage into the residual root spaces during osteotomy drilling. Following completion of the osteotomy, the remaining root structure is extracted prior to implant placement into the site. The aim of this study is to assess the success rate of implants when the residual roots were used as anatomical guides for osteotomy. One hundred implants were placed in 57 patients, and 4 different types of implants were used: 47 Bioner TOP DM implants, 20 Nobel Biocare Replace implants, 25 Biohorizons Tapered Internal implants (Birmingham, Ala), and 8 Alpha-Bio Tec SPI Implants. The implants were placed into 57 patients. Osteotomies were placed through intact residual roots, which acted as anatomical guides for implant surgical placement. Patients had a follow-up period of 2 years, and in that time none reported discomfort after implant placement. There were no signs of peri-implantitis observed in any of the patients. Of all the implants placed, the Bioner TOP DM implant showed the least amount of crestal bone loss. Placing implants through residual roots as an anatomical guide is a useful technique that shows good results over a 2-year follow-up period.

Key Words: residual roots, immediate implant, anatomical guide

Introduction

Since the placement of an immediate implant into a freshly extracted socket, immediate implant treatment has become a well-accepted alternative to the past protocol of extraction, socket healing, and then delayed implant placement. This is especially so in cases of maxillary anterior missing teeth. It has been demonstrated in histological studies that after tooth extraction, a cascade of healing events takes place that leads to resorption of the residual alveolar ridge, making the placement of implants difficult without bone grafting. Thus, placement of immediate implants not only preserves the dimensions of alveolar ridge[1] but also saves time, reduces the cost of treatment, the need for a second surgery, and the chances of bone graft–related problems such as rejection or infection. It also aids in the placement of an ideally orientated implant,[2,3] and optimal soft-tissue esthetics[2] may be more easily achieved.

However, infection of the remaining tooth leads to issues such as periapical radiolucency, which may affect the immediate implant placement. It may also cause a lack of soft-tissue closure and flap dehiscence over the extraction site,[4] particularly when barrier membranes and bone grafts are used to cover the jumping distance and achieve primary site closure. Implant bed preparation is also a challenge as the osteotomy drill may deflect from the ridge or surface of the bone septa and attempt to follow the residual root space. This can make ideal implant positioning with respect to prosthetics as well as hygienic aspects difficult.[5] Also, the treatment outcomes for both submerged and nonsubmerged placements may be affected by lack of tissue volume[6] and thin tissue biotypes. If, during extraction, 1 or more of the bony walls is damaged, the rate and pattern of bone resorption may be altered by the formation of fibrous tissue, which may occupy a part of the socket. This may prevent normal healing and osseous regeneration from taking place,[7] affecting osseointegration and prognosis of the immediate implants. However, this can only be hypothesized, as there is insufficient data on the differences in rates and patterns of the healing of intact vs damaged extraction sockets. Such cases can be treated through a novel approach of implant bed preparation, wherein the osteotomy is performed directly through the tooth's initially retained root complex.[5] This article discusses data of 100 implants placed in 57 patients and how this technique affects treatment outcome.

Materials and Methods

One hundred implants were placed in 57 patients. Patients selected were healthy without any uncontrolled medical conditions, and older than 20 years. Those patients selected for surgery had grossly carious teeth or root canal–treated

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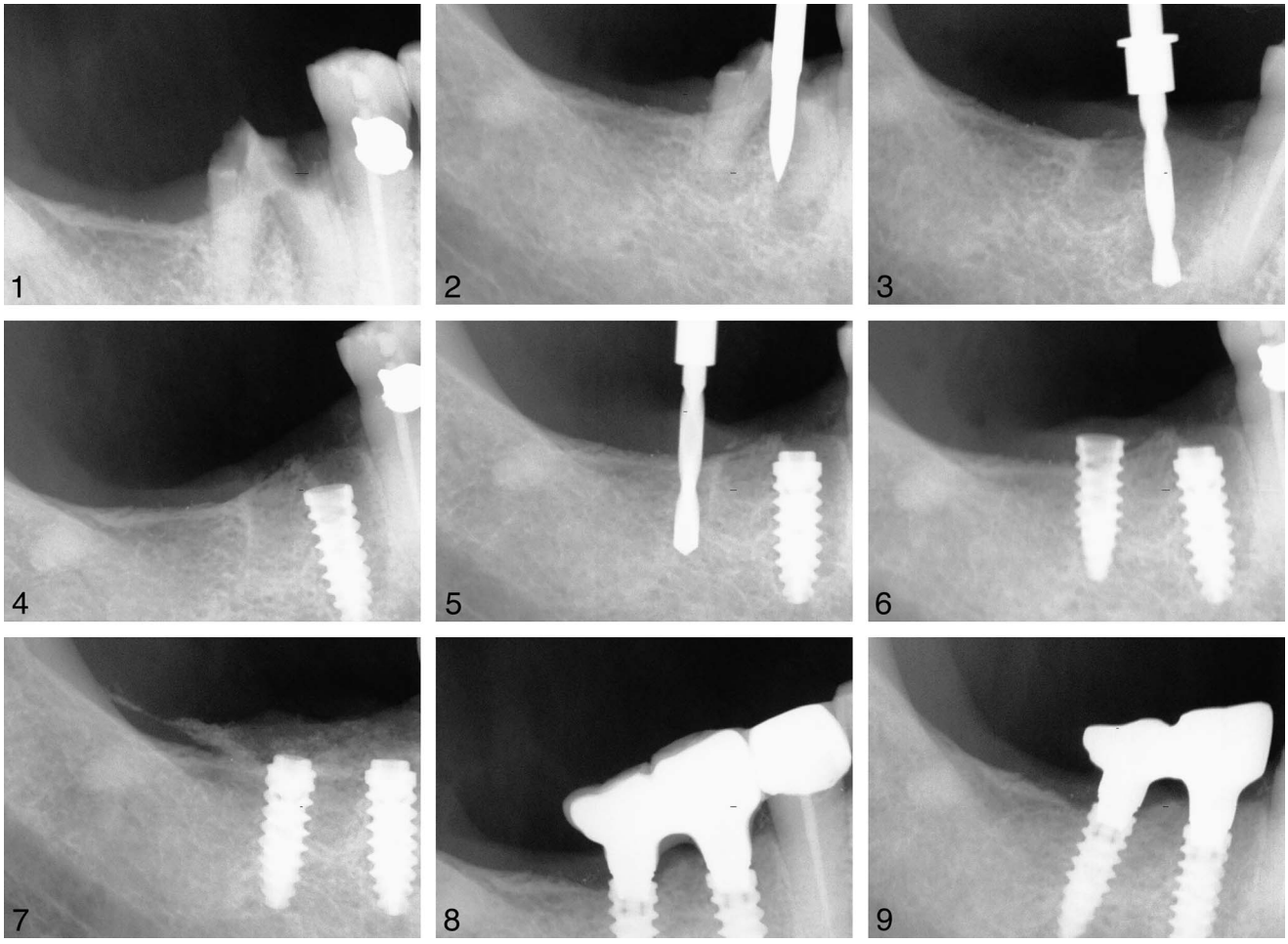

Figures 1–9. Figure 1. Periapical radiograph of a nonrestorable carious lower first molar and missing second molar. **Figure 2.** Periapical radiograph of the pilot drill using the residual roots as a guide in placement, preventing the drill from deflecting into the mesial root space. **Figure 3.** Periapical radiograph of the final osteotomy drill into the immediate site following removal of the residual roots shell. **Figure 4.** Periapical radiograph of the implant placed into the immediate site following osteotomy using the residual roots to guide the drills and then root removal prior to implant placement. **Figure 5.** Periapical radiograph of the osteotomy drill to verify parallelism to the implant placed into the immediate site. **Figure 6.** Periapical radiograph demonstrating implant placement into the immediate site (L) and a healed site (R) prior to placement of osseous graft material over the fixtures. **Figure 7.** Radiograph following osseous graft placement over the implants and site closure. **Figure 8.** Periapical radiograph taken to verify fit of prosthetics demonstrating crestal bone levels in relation to the implant plateforms. **Figure 9.** Periapical radiograph 2 years postrestoration demonstrating bone-level maintenance and lack of bone loss crestally.

fractured crowns. Three to 4 weeks after complete prophylaxis, patients were appointed for surgery.

Four types of implants were used for this study: 47 Bioner TOP DM (Barcelona, Spain) implants with a diameter of 4 mm, 20 Nobel Biocare Replace (Yorba Linda, Calif) implants with a diameter of 4.3 mm, 25 Biohorizons (Birmingham, Ala) implants with a diameter of 4.6 mm, and 8 Alpha-Bio Tec (Tel Aviv, Israel) implants with a diameter of 4.2 mm. Implants were chosen according to the available bone width present.

Osteotomy was done with roots intact in the alveolar ridge (Figures 1 and 2). Any loose fragment of the root was removed prior to osteotomy initiation, but if a small fragment was seen still intact in the apical region even after implant bed preparation, no attempt was made to remove it. Clinically visible remnants of the root shell are removed from the socket using elevators and periotomes, and the final drill completes the osteotomy. Following extraction of the remaining portions of root that may not have been obliterated by the osteotomy drills, the socket is curetted to remove any residual material related to the process. Then the socket and the osteotomy are thoroughly irrigated to remove any debris that may be sitting in the site (Figure 3). The implant is placed into the site following the manufacturer's protocol. However, as observed in the radiograph, no root fragment is visible after the implant placement (Figure 4). In the case illustrated, an additional implant site is prepared distal to the immediate implant (Figure 5). All implants received a 2-stage submerged healing protocol (Figure 6). The jumping distance was grafted with NoveBone graft putty (Jacksonville, Fla) because of the ease of handling and fast bone turnover of the product. Sites were then closed with a Collagen Plug (Zimmer Dental, Carlsbad, Calif) over the implant, and flap closed with 4-0 Cytoplast sutures (Osteoge-

necis Biomedical, Lubbock, Tex) sutures with PeriAcryl90 tissue adhesive (GluStitch Inc, Delta, BC, Canada) over the sutures to create a seal of the site (Figure 7). Following 3 months of site healing to allow integration of the implant and maturation of the osseous graft, the implants were uncovered and prosthetics fabricated. At prosthetic insertion, a radiograph was taken to check the fit of the prosthetics to the implants and have an initial crestal bone level in relation to the implant plateform (Figure 8). A radiograph taken at the routine prophylaxis appointment at 2 years postrestoration demonstrated a lack of bone loss at the crestal level and maintenance of the implants and surrounding bone (Figure 9).

Results

All patients included in this study reported no discomfort indicative of an infection or failing implant, and healing was uneventful. Patients were followed for a period of 2 years. No signs of peri-implantitis were observed in any of the studies' patients. Even those patients in whom small apical root fragments were left did not demonstrate any signs of peri-implantitis or radio-opacity in the apical region of the implant. Of the different implants placed in this study, Bioner implants demonstrated the least crestal bone loss.

Discussion

Implant success depends on proper implant placement and adherence to accepted surgical protocols. Success is also reflected in the survival rate and is determined by factors such as the fixture's proper placement in the oral cavity to avoid marginal bone loss, and providing a prosthetic design that can aid in sufficient oral home care and routine professional maintenance.[8] Therefore, ideal implant positioning is an important aspect of clinical relevance.[9] For this very purpose, templates are being used that help in terms of planning the optimal implant position.[10] In a systematic review regarding accuracy and clinical application of computer-guided template-based implants, some authors stated that the reliability of the computer-guided systems is insufficient and each step requires constant verification, especially in flapless procedures in which there is imminent risk of malpositioning the implant.[10]

These authors also noted some technology-related problems; perioperative surgical complications; limited interocclusal distance in posterior segments, which was the most often-reported complication and occurred in (23%) of the treated patients, making insertion of the drills through the surgical template impossible; fractures of surgical guides hampering the treatment as planned; and under- or overestimation of bone volume during computerized tomography data analysis, reducing the predictability of implant positioning.[10] The authors reported an unexpected dehiscence after implant placement because the incidence of bone perforations in flapless procedures are missing computer-guided technology; thus, it should be used with caution in connection with flapless implant placement.[10] They stated that all complications were encountered in connection with immediate restoration and prefabricated prostheses.[10] However, if an implant is placed through the root, such complications can be avoided. The tooth already present at the site would act as a template, avoiding problems such as reduced interocclusal distance in the posterior segment and exact placement of the implant, thus increasing its success.

Proper clinical practice in dental implantology rules out leaving any root fragment at the osteotomy site that comes in contact with an implant.[11] It is assumed that a durable osseointegration can be gained only through a direct bone–implant contact,[12] without interposition of fibrous tissue or any other root material. However, Guarnieri et al[13] provided the histology of a human root–implant interface after being loaded in the mandible and stated that the root strongly adhered to the implant after a loading period of 6–9 months. In fact, direct apposition of cementum was found at the porous titanium plasma-sprayed implant interface. The cementum was hypertrophic, devoid of inflammation, and without trace of a periodontal ligament component. The authors questioned whether neoformation of a ligament could occur in humans or if it is specific to the animal model.

Even if the operator wants to have direct bone-to-implant contact instead of implant-to-root contact, the remaining root fragment can be easily removed with copious amounts of irrigation and use of a curette. When the implant is placed through the root, roots get crushed into very small particles, after which their removal becomes easy via irrigation. Otherwise, the interface either remains asymptomatic or the dentin is resorbed with time and substituted by bone; however, what exactly happens is still unknown.[14] In the case of an ankylosed root, they become involved in local bone turnover.[15]

The disadvantage of this technique is that an infected root or mobile root cannot be used as a template. In addition, in the case of an infection the procedure of placement through the root is not possible as it might lead to spread of the infection beyond the immediate site. Thus, before implant placement, the entirety of the infected source should be removed to avoid complications.[5]

The authors of this study do not recommend this technique for all immediate placements, and advise avoiding teeth with frank infections. In this technique as outlined, after the site is prepared, the remaining roots are extracted before implant placement. The root spaces are aggressively curetted and irrigated. This approach is no different from a case in which the tooth is sectioned and removed prior to osteotomy with regard to immediate implant placement. A tooth that has fractured coronally and has not apically abscessed is a perfect candidate for this technique; as with most procedures performed in dentistry, case selection is key. Not every case should be treated with this technique, but it is handy in some situations and allows better placement of the implant in molar sites without the issue of the drill jumping into one of the root spaces, which may occur when osteotomy is initiated following extraction.

Conclusion

This novel approach can be regarded as a useful method for placement of implants. On the other hand, the remaining root fragments do not pose any risk in the process of oseointegration. The results of the present series of cases showed no

deleterious reaction during the healing period, during loading implant placement, or during the 2-year follow-up period. Radiographically, the bone–implant interface did not demonstrate any abnormal characteristics. Clinically, the reason for these positive results may be attributed to the fact that the sites were asymptomatic and free of inflammation before implant treatment. Otherwise, periapical inflammation can occur and endanger the implant.[16]

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