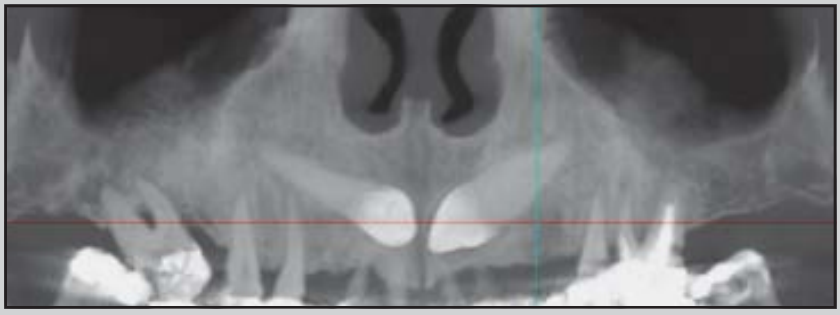
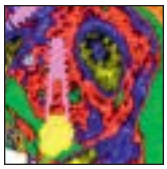


Computer-Guided Implant Placement for Rehabilitation of the Edentulous Maxilla with Two Impacted Canines: An Approach Without Extraction of the Impacted Teeth



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The aim of this report was to suggest an alternative approach to avoid impacted canine extraction by utilizing computer-guided implant placement for providing an implant adjacent to the impacted canine without contact to the impacted tooth. In cases when the adjacent area is available for implant placement, a computerized three-dimensional (3D) planning system can be used to place implants in a way that avoids the impacted canine. Tilted implants could be used to achieve the proper support for implant-supported fixed dentures without damaging the impacted teeth. Following careful 3D planning, a computer-derived surgical stent is used to guide the surgical placement of the implants in the proper place. Since the position of the implants is known prior to the surgical procedure, a prefabricated provisional restoration is delivered immediately at the end of the surgery. Following a waiting period of 6 months, the implant-supported definitive restoration is fabricated using the same technique and delivered to the patient, making sure that proper maintenance and oral home care hygiene are feasible. This suggested treatment modality, when suitable, could provide a relatively short treatment time, a less invasive procedure, and fewer potential complications compared to the extraction of an impacted canine, massive bone grafting, and implant placement. Also, it might be assumed that the use of the native bone, as suggested here, rather than an augmented bone could lead to better long-term results. (Int J Periodontics Restorative Dent 2015;35:93–97. doi: 10.11607/prd.2062)

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The maxillary canine is the second most frequently encountered impacted tooth after the third molar mainly due to a complex pattern of eruption.[1,2] The management of impacted maxillary canines in adults is challenging because teeth that have been impacted for many years usually undergo pathologic changes that prevent their eruption even when all other factors are favorable.[3] The prognosis for a successful orthodontic resolution of an impacted canine in an adult is uncertain and worsens with age.[4,5] The high frequency of failures in the orthodontic treatment of impacted canines in adult patients should be considered in the decision-making process from the beginning. Surgical extraction followed by implant therapy, conventional fixed dental prostheses, or removable prostheses might also serve as a valid alternative for adults.[3,5] If apical and ridge crest bone remains after the extraction of the maxillary canines, an implant can be placed immediately and anchored bicortically with good primary stability.[6]

Immediate implant placement following extraction of erupted teeth is a well-studied technique with

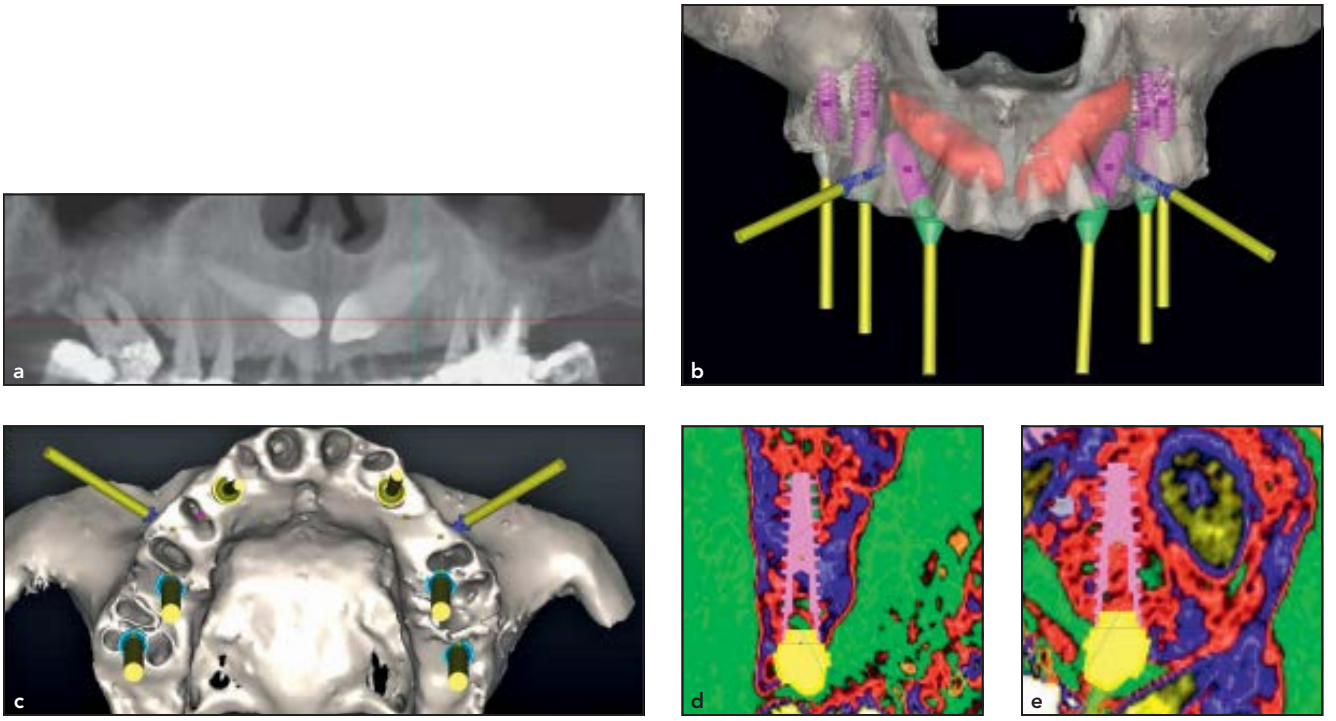

Fig 1 *Three-dimensional planning of implants in the maxillary arch (Simplant, Materialise Dental) using tilted implants to avoid contact with the impacted canines.* (a) *Panoramic view of the case.* (b) *Three-dimensional reconstruction with the planned implants.* (c) *Three-dimensional reconstruction with the planned implant angulation from an occlusal view.* (d) *Transversal reconstruction showing the planned implant and the surrounding alveolar bone.* (e) *Reconstruction showing the planned implant and the surrounding alveolar bone as well as the relation to the impacted canine.*

rather high success rates.[7] However, few studies exist on single immediate implants placed following the extraction of impacted canines.[6,8,9] Mazor et al[8] described the removal of impacted canines with immediate implant placement. After the extractions were completed, two implants were inserted; the apical portions were devoid of osseous support because the lingual bone was missing. The unfilled areas in the extraction sites around the dental implants were packed and covered with demineralized freeze-dried bone allograft in conjunction with a collagen barrier membrane. Six months after placement, the implants were uncovered, and porcelain-fused-to-metal restorations were prepared and placed. Cardaropoli et al[9] placed an implant immediately following extraction of an impacted maxillary canine and filled the bone defect with mineral bovine bone. The implant was immediately restored with a provisional acrylic resin crown, and after 6 months the definitive crown was placed. No signs of radiolucency were apparent at the 1-year evaluation. Peñarrocha et al[6] placed two immediate implants after extracting both impacted maxillary canines using bone shavings collected from the filter of the surgical aspirator to fill the bone defect. After 1 year, the implants remained in good condition.

Nevertheless, the surgical procedure of extracting an impacted canine and replacing it with a dental implant usually requires major bone augmentation and might cause significant morbidity and complications.[3,6,8,9]

To avoid invasive surgical removal of the impacted teeth and delayed implant treatment, Davarpahah and Szmukler-Moncler[10] described several cases of implants that were placed through the impacted teeth. Of the seven implants placed into four impacted teeth, all healed uneventfully except a short (8.5-mm) implant that became mobile after 4 months. Two other implants were removed after 6 months of uneventful

Fig 2 *Following careful 3D planning, a computer-derived surgical stent is used to guide the surgical placement of the implants.* (a) *Computerized reconstruction of the surgical stent.* (b) *The surgical stent printed in 3D.* (c) *The surgical bone supports the stent intraorally.*

healing. They suggested that implant placement through an impacted tooth might not interfere with implant integration or harm occlusal function, at least in the short term, but also stated that further study is warranted before this unconventional procedure might be considered as a possible clinical option when, at an impacted tooth site, clinicians seek to avoid invasive surgery.

Nowadays, with the available computer-guided techniques, implants can be placed without jeopardizing impacted canines in some cases.

This report suggests an alternative approach to avoid impacted canine extraction by utilizing computer-guided implant placement to provide an implant adjacent to the impacted canine, avoiding contact with the impacted tooth.

Method and materials

In cases when the adjacent area is available for implant placement, a computerized three-dimensional (3D) planning system can be used to place implants that avoid the impacted canine position (Fig 1). A tilted implant could be used to achieve the proper support for implant-supported fixed dentures without damaging the impacted teeth.

Following careful planning, from a 3D aspect, a computer-derived surgical stent is used to guide the surgical placement of the implants in the proper place according to the original plan (Fig 2). Because the position of the implants is known prior to the surgical procedure, a prefabricated provisional restoration is delivered immediately at the end of the surgery (Fig 3).

Following a waiting period of 6 months, an implant-supported definitive restoration is fabricated using the same technique and delivered to the patient, making sure that proper maintenance and oral home care hygiene are feasible (Fig 4).

Discussion

Unerupted permanent canines cause relatively few problems for patients, and some of these teeth remain unerupted and asymptomatic for many years.[11] The impaction rate ranges from 0.07% to 1.3% for the mandibular canines and 1% to 3% for the maxillary canines.[12–17] The location of the impacted canine is typically lingual in the maxilla and labial in the mandible. Overall, up to 3.6% of the population is affected by impacted canines; its prevalence might be as high as 9.3% in patients with malocclusion.[17,18]

When impacted teeth are asymptomatic, surgical removal might not be necessary.[10] Sometimes, however, patients seek rehabilitation of the site, eg, when the primary canine is lost, and the presence of the impacted tooth must be dealt with. When surgical removal is contemplated, implant placement is performed after completion of bone healing. Sometimes, however, removal of the impacted tooth is so invasive that the bony site must be reconstructed prior to implant placement; this is particularly common when the canine is labially impacted.[10]

Computer-guided planning and placement of dental implants has become widely used and has proven to be a rather reliable tool for

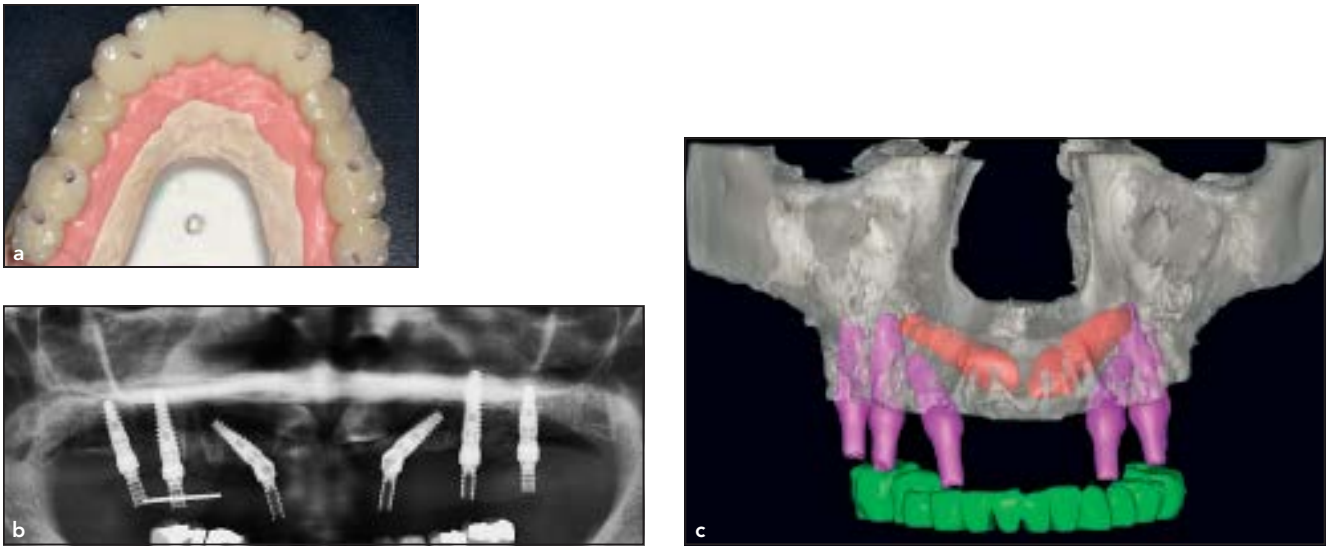

Fig 3 (a) *Since the position of the implants is known prior to the surgical procedure, a prefabricated provisional restoration is delivered immediately at the end of the surgery.* (b) *Panoramic view immediately after surgery.* (c) *Three-dimensional reconstruction of the post-operative CT scan.*

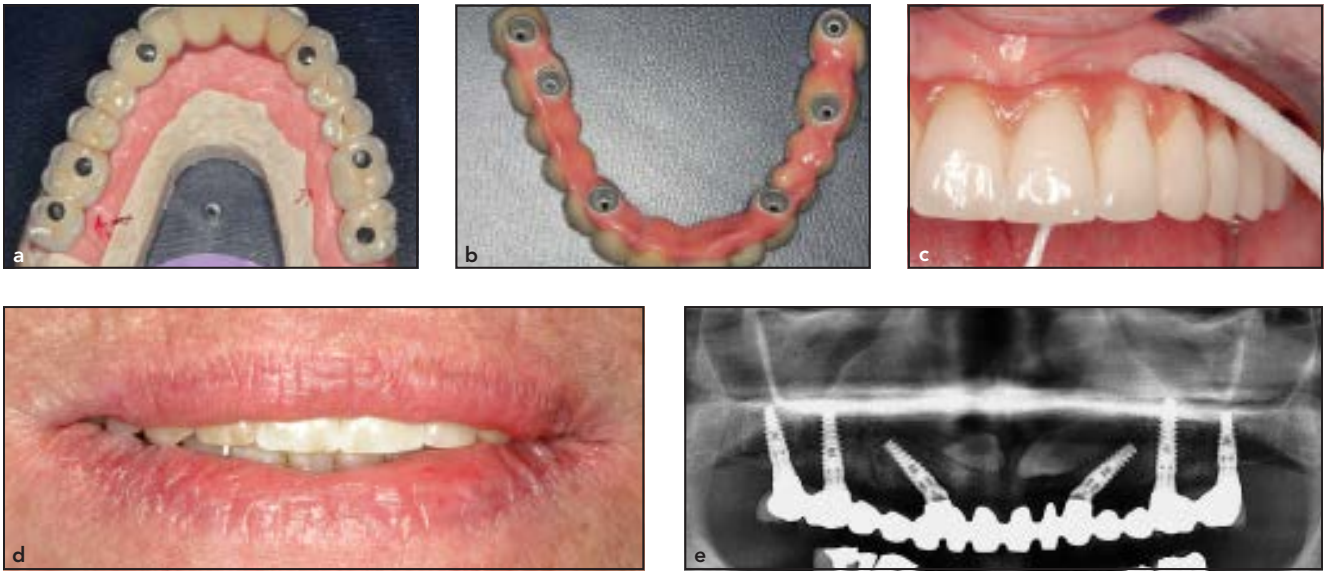

Fig 4 (a) *Following a waiting period of 6 months, an implant-supported definitive restoration (occlusal view) is fabricated using the same technique.* (b) *Gingival view.* (c) *Definitive restoration after placement—delivered after patient demonstrates ability for good home care oral hygiene.* (d) *Extraoral view after placement.* (e) *Panoramic view following final restoration.*

implant positioning without jeopardizing the adjacent anatomical structures.[19]

Virtual planning allows for better visualization of bone morphology previous to the positioning of implants and improves the fabrication of implant-supported prostheses according to a predictable planning of the implants.[20]

Based on the data analysis of a systematic review performed by Schneider et al, various systems for computer-guided template-based implant treatment are available.

Different types of software, template production, and template stabilization, as well as variations of the surgical and prosthetic protocol, are reported.[21] Meta-analysis of in vitro, cadaver, and clinical studies regarding accuracy revealed mean horizontal deviations of 1.1 to 1.6 mm, but also considerably higher maximum deviations. The survival rate of implants placed with computer-guided technology is comparable to that of conventionally placed implants, ranging from 91% to 100% after an observation period of 12 to 60 months.[21]

It is important to note that all types of computer-guided surgical planning has some degree of placement errors of the system and thus there is a need for security safety margins while planning the guided surgery. Moreover, it should be kept in mind that the reformatted panoramic views have a large slice thickness and reconstructed 3D views are the least accurate in an imaging study, so those are used only for demonstrational purposes after the computer-guided planning.

Conclusions

In appropriate cases, this computerized planning and execution system might help the clinician place implants adjacent to impacted teeth without interfering with the integrity of those structures. This suggested treatment modality, when suitable, could provide a relatively short treatment time, a less invasive procedure, and fewer potential complications compared to the extraction of an impacted canine, massive bone grafting, and implant placement. Also, it might be assumed that the use of the native bone as suggested here, rather than an augmented bone, could lead to better long-term results. As in all other treatment modalities, proper case selection, combined with meticulous oral hygiene and maintenance programs, are crucial for long-term success.

Acknowledgments

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