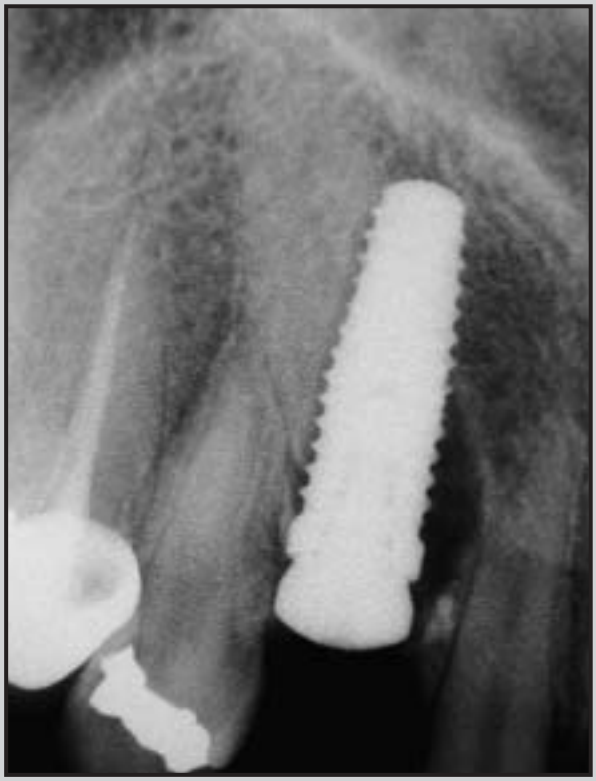

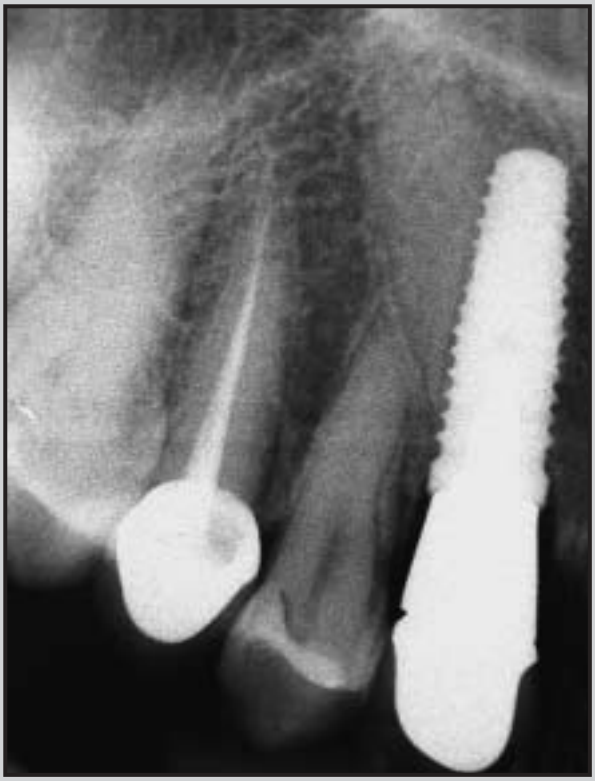

Unconventional Implant Placement. 2: Placement of Implants Through Impacted Teeth. Three Case Reports

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The aim of this paper is to report on three patients who received unconventional implant treatment because of the presence of impacted teeth. To avoid invasive surgical removal of the impacted teeth and delayed implant treatment, implants 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. One and three implants now have been loaded for 3.5 and 2 years, respectively. The two other implants were removed after 6 months of uneventful healing. These cases, although limited in number, suggest that implant placement through an impacted tooth might not interfere with implant integration or harm occlusal function, at least in the short term. More 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. (Int J Periodontics Restorative Dent 2009;29:405–413.)

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Epidemiologic data show that, after the third molars, the canines, followed by the premolars, are the most frequently impacted teeth.[1–3] Impacted canines are rarer in the mandible than in the maxilla,[2,3] but their respective frequencies vary widely from country to country and from center to center.[4,5] The impaction rate ranges from 0.07% to 1.3% for the mandibular canine[2,5,6] and 1% to 3% for the maxillary canines.[3,7] The location of the impacted canine is typically palatal in the maxilla and labial in the mandible. Overall, up to 3.6% of the population is affected by impacted canines[4]; this occurrence might be as high as 9.3% in patients with malocclusion.[8] Therefore, canine impaction cannot be considered an uncommon finding.[2]

When impacted teeth are asymptomatic, surgical removal might not be necessary.[9] 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. Treatment usually requires that either the canine be moved orthodontically to the ridge, when feasible,[1,3,10] or the impacted tooth be surgically removed before an

implant is placed.[1,11,12] In both cases, the treatment is usually lengthy[13] and associated with high treatment costs. 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.

In a previous paper,[14] five patients were treated with the following unconventional implant placement scheme: in the anterior maxilla, implants were inserted transradicularly through the root canal of nonvital ankylosed teeth and were left in contact with root fragments. The aim was to avoid an invasive surgical extraction leading to gross bone damage.[14] In the same way, the present authors sought to avoid removing vital impacted canines through invasive surgery. The aim of the present paper was therefore to report on three patients with implants placed through impacted teeth. The patients and their treatments are described and the results are discussed.

Method and materials

Inclusion criteria and general requirements

To undergo this unconventional treatment, the following conditions had to be met:

1. Patients had to be healthy and able to maintain good hygiene.
2. Implant therapy was indicated.
3. The impacted teeth had to be asymptomatic and free of surrounding pathology.
4. When treatment planning was discussed with the patient, it was explained that extraction might be complex and invasive and would necessitate additional augmentation procedures before implant placement.
5. The patient had to request an alternative that was less invasive and promoted earlier delivery of the implant-supported prosthesis.
6. After the protocol and its deviation from standard care were explained, the patient had to accept the risk of implant failure. In case of implant failure, traditional treatment with an augmentation procedure was warranted at no additional cost.
7. An informed consent document had to be signed.

Case presentations

Patient 1

The first patient (Fig 1) was a 62-year-old woman who sought rehabilitation of the maxilla. Bilaterally, horizontally impacted canines were present in sites intended to host implants (Figs 1a to 1c). Seven Osseotite implants (Biomet 3i) were placed. Three osteotomies among them were drilled into the impacted canines (Figs 1d and 1e), and implants were placed as follows: 3.75 × 11.5 mm at the right canine, 3.75 × 8.5 mm at the left canine, and XP 4/5 × 15 mm at the left first premolar.



Figs 1a to 1c *Patient 1. Pretreatment periapical radiographs. (*left*) Right side with impacted canine; (*center*) mesial migration of both impacted teeth; (*right*) left side and impacted canine. Note the failing premolar on the left side, which had provided retention for a removable posterior prosthesis.*

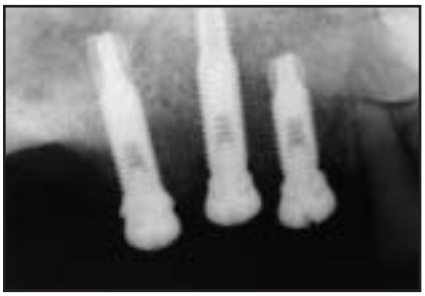
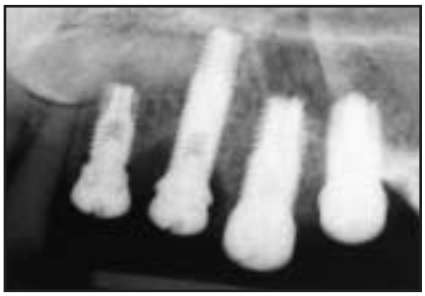


Fig 1d (left) *Postplacement periapical radiograph of the right side. The mesial implant has been placed through the impacted canine.*

Fig 1e (right) *Periapical radiograph of the left side after implant placement. The two mesial implants have been placed through the impacted canine. The mesial implant is short (8.5 mm long); it failed after 4 months of healing.*



Figs 1f and 1g *Periapical radiographs following removal of the impacted canine. (*left*) Right side; (*right*) left side.*

Patient 2

A 31-year-old woman (Fig 2) who sought replacement of her lost maxillary primary right canine (Fig 2a) showed the presence of an impacted canine (Fig 2b). The patient refused both orthodontic treatment and invasive extraction of the impacted canine with subsequent implant placement after 6 months of healing. An alternative noninvasive treatment was therefore proposed. Drilling through the crown of the impacted canine was performed with a 3.25-mm squad drill (Fig 2c), followed by 4-mm and 5-mm squad drills (Fig 2d), following the traditional drilling sequence. A 6-mm squad drill was used in only the coronal half of the osteotomy to prevent the implant from contacting the root of the canine. The implant was then placed (Fig 2e). Primary stability was achieved through the apical portion of the implant, which was not drilled with the 6-mm drill. An Osseotite NT 5 × 15-mm implant was placed, with a bone defect remaining on the palatal side of the implant. The defect was filled with Bio-Oss (Geistlich) and the implant was left to heal in a submerged fashion for 6 months.

Patient 3

An 80-year-old man who sought a global prosthetic solution in the mandible (Fig 3) showed a horizontally impacted left premolar (Fig 3a) that was classified as level C.[5] The patient refused invasive surgery of the impacted tooth and a protracted healing period prior to implant placement. Seven implants were inserted; three were placed in contact with the impacted premolar. At the left first premolar site, an Osseotite Certain 4/5 × 13-mm implant had its apical extremity left in contact with bone (Figs 3b and 3c). At the left canine site, an Osseotite NT 5 × 11.5-mm implant had its apical extremity remaining within the limits of the crown of the impacted premolar (Figs 3b and 3d). At the left lateral incisor site, the placed Osseotite NT 4 × 13-mm implant was in contact with the coronal part of the crown on its distal side only (Figs 3b and 3c). The drilling sequence was not altered, and close tooth-implant contact was sought to ensure primary stability.

Evaluation of the implants

Implants were evaluated clinically and radiographically at the end of the healing period, at 6 months, and at an annual recall. The success criteria were applied according to Buser et al[15] and Cochran et al.[16] Clinical criteria for success included *(1)* absence of clinically detectable implant mobility, *(2)* absence of pain or any subjective sensation, and *(3)* absence of recurrent peri-implant infection. Radiographic success, as judged according to periapical images, included *(1)* absence of continuous radiolucency around the implant, *(2)* observation of any abnormal reaction at the bone-implant interface, *(3)* observation of any specific reaction at the root-implant interface, *(4)* determination of resorption of the remaining root fragment.

Fig 2a (left) *Patient 2. Facial view before implant treatment. The primary canine was lost, and the patient had been wearing a removable appliance for 2 months.*

Fig 2b (right) *Radiograph of the impacted right canine before implant treatment.*

Fig 2c *Periapical radiograph with the 2-mm drill in place through the impacted canine.*

Fig 2d *Periapical radiograph following removal of the drills.*

Fig 2e *Periapical radiograph after implant placement. Note the space left on the mesial side of the implant after removal of the crown.*

Fig 2f (left) *Clinical view of the rehabilitated canine at the 4-year recall. Stability of the gingival margin and the papillae has been maintained.*

Fig 2g (right) *Periapical radiograph obtained at the 4-year recall. Bone has filled the previously empty space corresponding to the crown of the canine. Because of platform switching, the bone level was maintained coronal to the level of the first implant thread. No abnormal bone response or root resorption was noticed.*

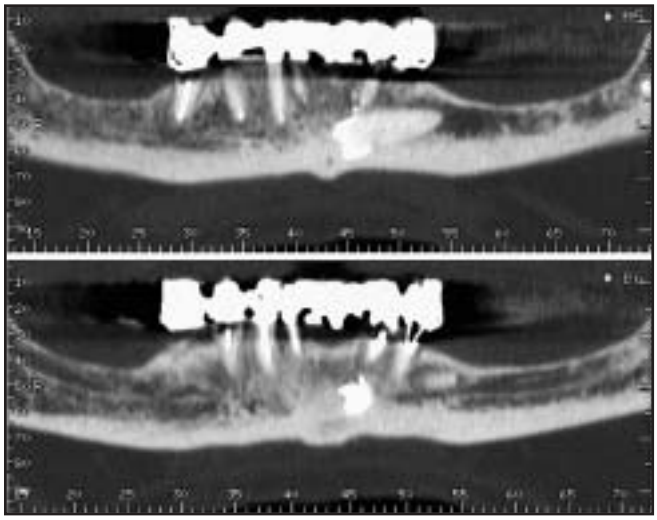


Fig 3a *Patient 3. Panoramic sections of a computed tomographic (CT) scan showing the orientation of the impacted premolar.*

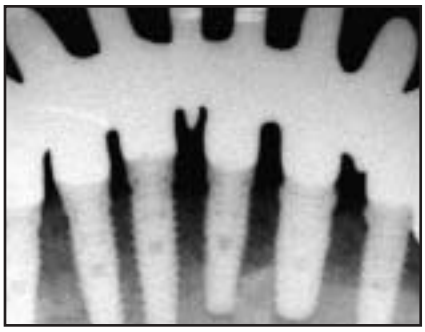


Fig 3b *Radiograph of the implants placed through the impacted left premolar after placement of the definitive prosthesis. The implant in the left canine site crossed over the root, while the implant in the lateral incisor site did not. The implant in the central incisor position is only in contact with the coronal part of the crown on its distal side.*

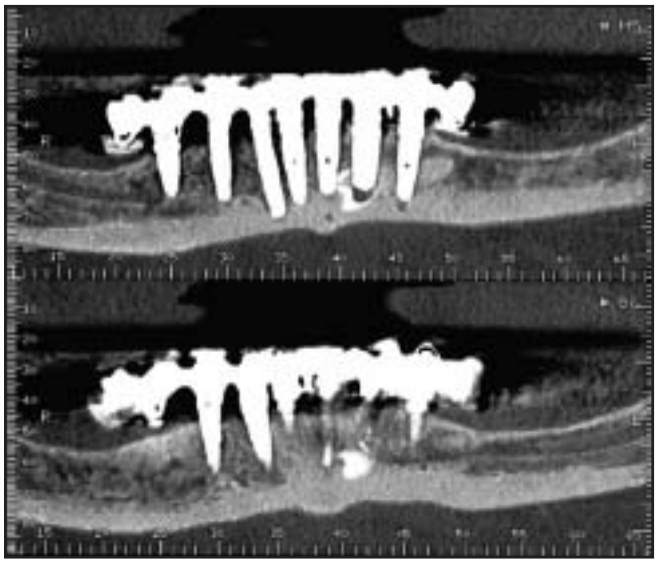


Fig 3c *Panoramic section of the CT scan at the 2-year recall. The section confirms that one implant's apex is in contact with bone, while the other is not. No abnormal bone reaction or root resorption could be detected.*

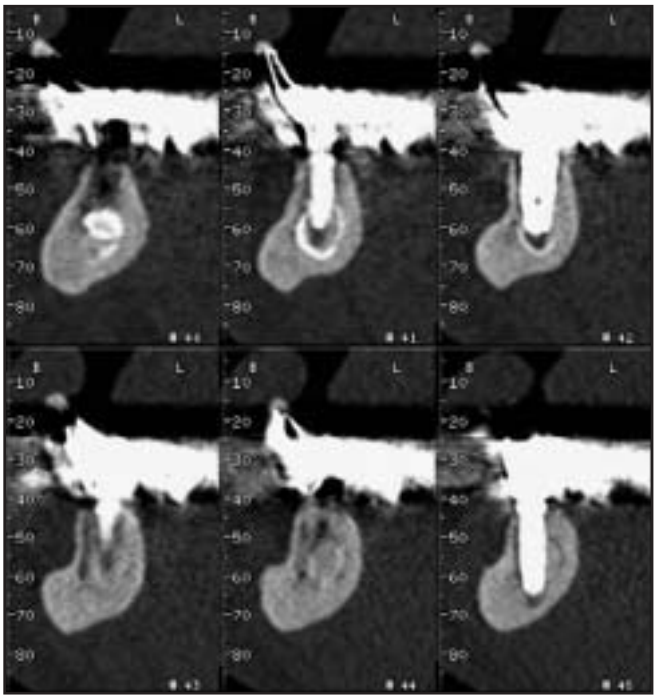


Fig 3d *Oblique section of the CT scan at the 2-year recall confirming the impacted tooth-implant relationship. No abnormal reaction was seen at any implant, whether placed in bone or through the impacted tooth.*

Results

Patient 1

Of the three implants placed through the impacted canines, the 8.5-mm-long implant placed in the region of the right canine became mobile after 4 months and was removed. This failure was caused, most likely, by the fact that the implant was not placed deep enough into the impacted canine (see Fig 1d); the other two implants healed uneventfully. After 6 months, the impacted teeth were removed from around the integrated implants through a palatal approach. A bone substitute (Bio-Oss, Geistlich) was placed around the implants to fill the remaining bone defects. Immediately afterward, a provisional prosthesis was placed over the six osseointegrated implants, and four additional implants were placed into fresh extraction sockets (see Figs 1e and 1f). The patient received the definitive prosthesis after 6 months; at the 4-year recall, all implants were stable and no deleterious events were recorded.

Patient 2

The patient did not report any postoperative pain after the crown was separated from the root (see Figs 2c to 2e). Submerged healing was uneventful; after 6 months, a healing abutment with platform switching was placed. Figures 2f and 2g show the clinical and radiographic situation at the 4-year recall. Bone filled the space previously occupied by the crown; close to the root, a material of lesser density, probably bone, was observed at the implant interface (see Fig 2g). On the periapical radiograph, no abnormal features such as bone or dentin resorption were observed. The single crown was clinically immobile and the levels of the marginal gingiva and the papillae were stable (see Fig 2f).

Patient 3

No specific postoperative pain was reported following drilling into the impacted tooth. The three implants in contact with the impacted premolar integrated uneventfully. The definitive prosthesis (see Fig 3b) was placed 12 months after delivery of the provisional. At the 2-year recall, all implants were asymptomatic; radiographic examination displayed normal bone apposition at the bone-implant interface. At the root-implant interface, no signs of resorption were detected on periapical radiographs or a computed tomographic scan (see Figs 3c and 3d).

Discussion

Treatment planning of these three cases with impacted teeth evolved over time. For patient 1, placement of implants through the impacted canines was considered a temporary step before the impacted teeth were removed surgically at a later stage. The 8.5-mm (short) implant failed after 4 months, but the other two implants integrated despite violating the strict recommendations for implant osseointegration.[17]

For patient 2, surgical removal of the canine was not contemplated in the treatment plan. Drilling through the impacted canine was deliberate; however, direct contact with the implant was avoided by preparing a slightly wider osteotomy site in front of the root of the impacted tooth. At that point, observation of only bone at the implant interface was considered to provide the best implant prognosis.

Treatment of patient 3 followed a different scheme; the implants were placed through the impacted canine in intimate contact with it. This patient was treated after the authors had gained some positive clinical experience with transradicular implants placed into ankylosed teeth and left in deliberate contact with root fragments.[14]

The exact nature of the root-implant interface in patients 2 and 3 remains unknown since, according to the literature, a combination of three types of interface can be anticipated, ie: *(1)* a dentin-implant interface in contact with the root,[18–21] *(2)* a newly created ligament close to the ligament of the impacted tooth or at some distance from it when space is left around the implant,[18,19,21,22] and *(3)* a bone-implant interface, ie, osseointegration, where the implant is in contact with bone.[18,19,21]

In various animal experiments[18,19,21,22] it has been shown that periodontal ligament (PDL) cells can compete with local osteogenic cells and form a PDL structure at the implant surface, up to a distance of several millimeters from the original PDL. Therefore, it is possible that the small gap left between the implant

and the impacted canine in patient 2 has been colonized, at least partially, by a newly formed ligament that has been in function for 3.5 years. In patient 3, this structure is likely to be absent because of the intimate contact deliberately maintained between the dentin and the implant during implant placement.

If patients 1 and 2 were treated today, they would receive a standard drilling sequence to achieve intimate adaptation at the impacted tooth–implant interface, while the clinicians would ensure that approximately 50% of the implant surface is in contact with bone to obtain osseointegration and clinical stability in the longer term. The reasons for this approach are the following: *(1)* it increases primary stability; *(2)* histologic data have shown that implants placed in contact with root fragments can heal either in an animal model[19,22] up to 12 months[18] or in a human application[20]; *(3)* these histologic data have been confirmed by the authors' positive clinical experience with several implants placed in close contact with dentin over a 12- to 42-month loading period[14]; and *(4)* several authors[18,19,22] suggested that the space left around an implant allows migration of the cellular components of the PDL at the implant interface, which might lead to the creation of a new ligament around the implant. Instead, in places of intimate contact between the implant and dentin, newly formed cementum is deposited against the implant surface, and a new ligament is not created at the implant interface.[19,21]

Surprisingly, no patients complained about postoperative pain after penetration into the pulp chamber. There is no clear explanation for this, but a conjecture for this can be developed. Pulp pain or necrosis usually originates from infection[23] or nerve compression. In the present patients, large openings were created through the pulp and copious bleeding was allowed during surgery. The section of the pulp that was drilled was at the coronal part of the teeth. This could have left a viable apical pulp, similar to what is obtained during partial pulpotomy[24] or vital root retention.[25–27] Warrer et al[19] explicitly reported that the pulp of drilled roots left in contact with implants appeared normal after 3 months of healing in the monkey. Because surgery is performed under sterile conditions and the impacted roots usually remain away from contamination from the oral cavity, bacterial contamination and subsequent infection can be more easily prevented. This would be in line with Sabeti et al,[28] who reported that when contamination is circumvented, periapical complications and root obturation can be avoided following endodontic treatment.

In conclusion, implant placement through an impacted tooth was helpful as an alternative approach to invasive surgical extraction. In these three patients, one 8.5-mm short implant failed after 4 months, but the six other implants that were placed through impacted teeth integrated successfully. One and three implants have been functioning successfully for 3.5 and 2 years, respectively. The two other implants were removed after 6 months of uneventful healing. Radiographically, the bone-implant interface was similar to the interface of implants placed in contact with bone only. More cases are warranted to document this type of unconventional implant placement, but the technique remains an intriguing possibility for simplified treatment in the presence of impacted teeth.

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