Immediate post-extraction implants in the anterior maxilla

The importance of a high-resolution CBCT system in patient selection

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Introduction

Placement of an immediate post-extraction implant in the aesthetic zone is a sound and well-documented approach.1–3 Yet the success of this procedure calls for careful selection of the candidate patient; if not performed following a precise decision tree, the risk of aesthetic and prosthetic failure is high.4 Consequent to tooth extraction, the alveolar process undergoes a well-known sequence of events leading to progressive bone atrophy.5–7 These 3D changes in the alveolar bone cannot be prevented by placing an implant immediately.

Immediate implant placement creates a condition that, conversely, may enhance bone resorption and accelerate the apical migration of soft tissue, mainly on the buccal side.8, 9 These consequences may be prevented only by means of a careful preoperative diagnosis that involves assessment of the alveolar bone characteristics at the implant site and positioning the implant accordingly.10, 11

Figs. 1a & b: (a) The initial clinical situation and (b) the intra-oral radiograph taken when the patient presented. Tooth #12, which had been endodontically treated, had lost its crown because of a traumatic fracture. Fig. 2: The patient provided a CBCT scan obtained at another centre. On this scan, the buccal bone plate was measured with difficulty because of the background noise and therefore of the lack of sharpness of the scan images. It was found to be approximately 2.4 mm thick. Figs. 3a–d: Implant positioning. (a) The implant site underwent no flap elevation nor any bone or tissue regeneration. (b & c) The implant was placed according to the manufacturer’s instructions and (d) at bone level.
Some authors suggest routine regeneration of the hard and/or soft tissue using guided bone regeneration (GBR) and guided tissue regeneration (GTR) techniques to prevent resorption. Some even suggest abstaining from immediate post-extraction implant placement in the aesthetic area (such as Quirynen et al.: “When clinicians operate in the aesthetic zone it may be reasonable to allow soft- and hard-tissue healing before implant surgery to be able to compensate for the resorption at the buccal site.”). Yet both the periodontal biotype and the initial bone thickness may strongly influence buccal bone remodelling after tooth extraction, and patients presenting with specific anatomical features, that is, a thick gingival biotype and a high-density and a coronal buccal bone plate that is more than 2 mm thick, show little or no tendency to alveolar bone resorption.

Additionally, the thickness of the periodontal ligament may be a predictor of the probability of fracture of the vestibular bone plate. Precise and reliable information about the gingival biotype, the cortical bone width and the periodontal ligament thickness are consequently of paramount importance when planning immediate post-extraction implant placement followed possibly by immediate implant loading. Beyond performing a careful clinical examination, the quality of the cone beam computed tomography (CBCT) scans recorded is crucial in collecting reliable information about the thickness of the periodontal ligament and of the buccal plate. Accordingly, the surgeon should use devices that provide high-quality, high-resolution scans, possibly measuring bone density in absolute Hounsfield units. Given the small amount of radiation to which the patient is subjected when undergoing a CBCT examination, this may be safely applied even when planning the extraction and replacement of a single tooth. The following case illustrates such an approach.

Case report

A 74-year-old male patient presented at the Dentalnarco dental centre in Trezzano Sul Naviglio in Milan in Italy with a coronal fracture of tooth #12 (Figs. 1a & b). He had already under-
gone a CBCT examination (using a 6 × 6 cm field of view) some days before at a different dental clinic (Fig. 2). Examination showed that the fractured tooth, previously devitalised, presented with a reduced ferrule because of the coronal fracture. The periodontal tissue was slightly inflamed because of marginal gingivitis. No significant pockets were detected with probing, and the gingival biotype appeared to be thick and flat. The CBCT scan provided by the patient showed a residual root of about 16 mm long, no bone defects and no endodontic lesions. The coronal buccal bone was a 2.0–2.5 mm thick dense cortical plate (Fig. 2).

The patient was first presented with a plan that would involve the orthodontic extrusion of the damaged tooth in order to allow for restoration with a prosthetic crown. The patient refused, however, and the alternative plan presented would involve extraction of the damaged tooth followed by immediate implant placement and possible delivery of an immediate screw-retained provisional prosthesis. Given the patient’s apparently low risk of bone resorption, this plan did not call for any GBR or GTR procedures involving connective tissue grafting. The patient provided informed consent.

The patient underwent thorough professional cleaning four days before surgery. Antibiotic prophylaxis (amoxicillin and clavulanic acid, Augmentin, GlaxoSmithKline; 2 g 1 hour before surgery and then every 12 hours for eight to ten days) was initiated, and the patient was subjected to mouth rinsing with 0.2% chlorhexidine (Corsodyl, GlaxoSmithKline) and given instructions to continue this for two weeks after surgery. Nimesulide (100 mg; Aulin, Roche) was also administered 1 hour before surgery. The surgical area was anaesthetised using 40 mg/ml articaine hydrochloride with 1:100,000 epinephrine. No flap was elevated. The root was extracted atraumatically (Fig. 3a).

After probing the socket walls to check their integrity, a cylindrical 3.75 × 17.00 mm implant (Aries, IDI evolution) was placed (Figs. 3b–d, 4a & b). The maximum torque at insertion was 55 Ncm. After connecting a pick-up impression coping to the implant, an impression was taken with elastomeric impression material. The dental technician used this to prepare a cast and manufacture a screw-retained provisional crown (Fig. 5a). A screw-retained healing abutment was then connected to the implant, and the patient was dismissed.

Approximately 24 hours later, the provisional crown was connected (Fig. 5b). After checking all the interproximal contacts and unloading all the static and dynamic occlusal contacts, the retaining screw was tightened at 15 Ncm. The patient underwent no anaesthesia for this. He was advised to abstain from biting hard food with his incisors for eight weeks.

Five months later, the provisional prosthesis was removed and placed on the hard- and soft-tissue cast used for its manufacture. As no changes were observed involving either the soft tissue (Figs. 6a–c) or the interproximal contacts, a...
definitive cement-retained prosthesis was manufactured using a commercial titanium abutment and a metal-ceramic crown. The abutment was connected to the implant by tightening the retaining screw to 25 Ncm, using a torque wrench, and the definitive prosthesis was connected using a temporary cement (Figs. 7a–c). Radiographs were taken and they confirmed a good fit of the prosthetic components and preservation of the peri-implant bone level.

Twenty-five months later, the patient presented asking to have his mandibular arch rehabilitated. Consequently, a new set of CBCT scans was obtained, and this enabled assessment of the peri-implant bone levels at position #12 (Fig. 8a). The CBCT examination was performed using a high-resolution CBCT device (X-Mind trium, ACTEON) with a 12 × 8 cm field of view. This system employs an acquisition and reconstruction algorithm that ensures a uniform and high-quality image on all visual axes, and the system employs 3D software with advanced functionalities. The high-quality CBCT scans made it possible to assess the peri-implant alveolar bone at position #12 with a very high degree of precision. They showed complete preservation of the alveolar bone, in both the buccopalatal dimension and the apicocoronal dimension when compared with the initial CBCT scan (Fig. 8b). This result confirmed the suitability of the preoperative treatment plan proposed to the patient.

Discussion

Patients like the one described here represent the ideal candidates for immediate implant placement without elevation of a flap or performance of any tissue regeneration procedures. Such patients (i.e. those with both a thick, flat periodontal biotype and more than 2 mm of thick cortical bone plate) are seldom encountered, as the association between gingival thickness and type and bone thickness is low.\textsuperscript{23, 24} Identifying such relatively rare cases spares the patients longer, more expensive surgical procedures that do not offer any additional benefits but do increase morbidity.

In the presented case, a careful preoperative diagnosis made it possible to develop an adequate treatment plan. This spared the patient additional surgeries, possible infective complications, worse postoperative progress and additional costs. A misdiagnosis that called for additional procedures, such as bone grafting, to preserve the alveolar bone from resorption could have increased the risk of bone resorption as a result of disconnecting the periosteum\textsuperscript{25} and, according to the outcome actually observed, would have meant overtreating the patient.

This case thus underscores the importance of a correct preoperative diagnosis. As this must be based on objective and precise data, using high-quality, high-resolution CBCT devices such as the X-Mind trium system to acquire high-definition scans can make a significant difference; the higher the quality of the scans, the greater the diagnostic power of the surgeon will be.

The difference between scans with high and low background noise, and thus different sharpness, may be easily appreciated by comparing the initial CBCT scan provided by the patient in the present case, which allowed assessment of the thickness of the buccal bone plate only with great difficulty, to that taken after 25 months. In the latter, virtually no metal artifacts can be observed and all the anatomical elements surrounding the implant, that is, the alveolar cancellous and cortical bone layer, the soft tissue and the empty spaces, could easily be distinguished and their dimensional parameters carefully measured. This confirms that high-quality, high-resolution CBCT devices are a necessary tool for gaining reliable information and identifying sound, proper therapeutic alternatives.

Conclusion

When planning immediate post-extraction implant placement in the aesthetic zone, a proper preoperative diagnosis is essential. Thick and flat gingival biotype patients who have more than 2 mm of buccal bone may be safely rehabilitated without elevating flaps or performing other procedures aimed at preserving the alveolar bone. Under certain conditions, it may be possible to immediately load the implant. Conversely, misdiagnosis may expose the patient to additional discomfort, expense and overtreatment. Using only high-quality, high-resolution CBCT devices can help to prevent such misdiagnosis.

Editorial note: A list of references is available from the publisher.

about

Dr Gian Battista Greco graduated from the University of Trieste in Italy in 2000. In 2007–2008, he completed a biennial master’s degree in prosthetics and implantology at the University of Milan in Italy under the direction of Dr Stefano Gracis. He is in private practice in Trezzano Sul Naviglio at the Dentalnaro dental centre, of which he is co-owner, and concentrates his activity mainly in the field of prosthetics and implant prosthetics. He is the author of scientific publications and has lectured at national and international courses and conferences.

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133