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Clinical Paper
Dental Implants

Immediate implant placement: the fate of the buccal crest. A retrospective cone beam computed tomography study

E. Groenendijk[1], T. A. Staas[2], F. E. J. Graauwmans[3], E. Bronkhorst[4], L. Verhamme[5,6], T. Maal[5], G. J. Meijer[3,4,5,6]

[1]Dental Implant Clinic, Den Haag, The Netherlands; [2]Dental Implant Clinic, 's-Hertogenbosch, The Netherlands; [3]Section Implantology & Periodontology, Department of Dentistry, Radboudumc, Nijmegen, The Netherlands; [4]Department of Preventive and Curative Dentistry, Radboudumc, Nijmegen, The Netherlands; [5]Department of Oral and Maxillofacial Surgery, Radboudumc, Nijmegen, The Netherlands; [6]3D Facial Imaging research Group, Radboudumc, Nijmegen, The Netherlands

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Abstract. This retrospective study aimed to analyse the fate of the buccal crest after immediate implant placement (IIP) through the use of cone beam computed tomography (CBCT). In 16 consecutive patients, an implant was placed in a more palatal position after extraction, thereby creating a gap of at least 2 mm between the implant and the buccal crest. Subsequently, this gap was filled with a bone substitute. Preoperatively, immediate postoperatively, and late postoperatively, a CBCT was made to measure the thickness of the buccal crest. After application of the bone substitute, the buccal crest increased in thickness from 0.9 mm to 2.4 mm (mean). At a mean of 103 weeks after IIP, late postoperative CBCT scans showed that the thickness of the buccal crest was compacted to 1.8 mm. In the same period, the height of the buccal crest increased by 1.6 mm (mean) to, on average, 1.2 mm above the implant shoulder. The aesthetic outcome was analysed using the White and Pink Esthetic Score (WES and PES). Both scored high: 8.4 and 11.8, respectively. Within the limitations of this study, the results of this IIP protocol are promising. Long-term prospective research on this topic on a large number of patients is necessary.

Key words: dental implant; immediate implant placement; implant position; cone beam computer tomography; buccal gap; buccal crest; aesthetics in dentistry.

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To achieve optimal functional and aesthetic results after implant installation in the anterior maxilla, correct implant positioning and establishment of an optimum volume of hard- and soft-tissues are crucial[1–3]. After tooth extraction, the socket walls collapse. In a horizontal direction, the reduction of the alveolar socket (3.79 ± 0.23 mm) is higher than vertically (1.24 ± 0.11 mm) at 6 months[4]. As a consequence, the oral mucosa retracts, thereby compromising aesthetics.

Current consensus is that immediate implant placement (IIP) itself does not prevent reported horizontal and vertical resorption of the buccal crest[5]. Applying bone substitutes is reported to be effective in limiting both horizontal and vertical ridge alterations. As a barrier material, they preserve the ridge volume in a maximal way[6–10]. Obviously, these measures

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should also be performed during IIP[11,12]. Even during bone augmentation procedures, the role of bone substitutes as barriers and stabilizers is indisputable[13–15].

Compared with the conventional approach, in which the socket is allowed to collapse over a 6- to 12-week period before implant installation, IIP allows immediate restoration, is less invasive and more cost effective, resulting in reduced overall treatment time and higher patient comfort. However, IIP is often associated with buccal bone loss and midfacial recession[3,16,17]. New insights advocate installing the implant in a more palatal position, as crestal bone resorption and midfacial soft-tissue recession are correlated with an implant placed too close to the buccal crest[18,19]. Creating a buccal gap of at least 2 mm results in new bone formation, coronal to the receding buccal bone wall[20,21]. Also, the thickness of the buccal crest itself plays an important role: the thinner it is, the more resorption occurs[22,23]. To create a gap of at least 2 mm, the use of implants with a smaller diameter is advocated. As radiographic data that give insight into the process of buccal bone remodelling after IIP are still lacking[24], the aim of this retrospective study was to analyse the fate of the buccal crest and the aesthetic outcome following IIP.

Materials and methods

In this retrospective study, 16 consecutive patients with one failing maxillary incisor in between natural neighbouring teeth were treated by one surgeon. Ethical approval for this retrospective evaluation was given.

Study population

Patients were treated with IIP if they fulfilled the following criteria: presence of an intact extraction socket, sufficient occlusal support, absence of periodontal disease, and bruxism. Furthermore, adequate bone height apical from the socket of the failing tooth (at least 4 mm) must be present to ensure primary implant stability. IIP was contraindicated when smoking habits exceeded more than 10 units a day; pregnancy; drug or alcohol abuse; or when negative bone reactions could be inspected, such as in cases of severe osteoporosis, Paget's disease, renal osteodystrophy, immunosuppression, recent corticosteroid treatment, chemotherapy, or radiotherapy.

IIP Protocol

In cases of an empty socket immediately after avulsion, or if the failing tooth was still in situ, a CBCT scan (Scanora, Soredex, Tuusula, Finland) with a standard dose, 85 kV, 15 mA, and a small field of view (FOV) of 6 cm by 6 cm was made, to decide if IIP was feasible (Fig. 1A). An absolute prerequisite for IIP was the presence of sufficient palatal bone volume: (1) to offer the implant sufficient primary stability to allow immediate restoration; and (2) to create a minimum of 2 mm distance between the buccal implant contour and the inner buccal crest. Patients were instructed to take 2 g of amoxicillin 1 hour preoperative followed by 500 mg amoxicillin every 8 hours during 5 days postoperatively and to rinse with 0.12% chlorhexidine solution twice a day during 14 days post surgery. In addition, intact interdental septa and buccal crest had to be present. After atraumatic extraction, the socket was cleaned extensively using a bone excavator to remove remnants of the periodontal ligament and/or inflammation tissue and to promote bleeding. The keratinized gingiva remained intact as no flaps were raised. Then, the osteotomy was directed palato-apically in relation to the original apex. The drill protocol used was in accordance with the manufacturer's guidelines for NobelActive Internal implants (Nobel Biocare, Washington DC, USA). Before applying bone substitute with grain size 0.25–1.0 mm (Bio-Oss, Geistlich Pharma AG, Wolhusen, Switzerland), the last used drill was placed into the osteotomy in order to prevent congestion of the implant bed with bone substitute. After packing the granules, the drill was removed, creating a tunnel, through which the implant was installed (NobelActive™ Internal; Nobel Biocare, Washington DC, USA). The implant seat was positioned 3 mm deeper than the buccal gingival margin. Immediately after this flapless surgery a second small FOV, low-dose CBCT scan was made to evaluate the implant position (Fig. 1B). In case of inaccuracies in this stage corrections still could be made. Hereafter, a titanium temporary abutment (Nobel Biocare, Washington DC, USA) was positioned onto the implant that allowed the fabrication of a screw-retained temporary crown (Protemp, 3 M ESPE Dental Products, Delft, The Netherlands) under cofferdam. Six months later, either an individualized, screw-retained, zirconium-porcelain crown, or an individualized zirconium abutment (Procera, Nobel Biocare, Washington DC, USA) with a cemented porcelain facing, was placed. To evaluate the height and thickness of the buccal crest in time (Fig. 1C), also a late postoperative small FOV, low-dose CBCT scan was executed.

Radiographic measurements

Changes in buccal crest thickness and height were measured by importing the preoperative, immediate postoperative, and late postoperative CBCT data of each patient as Digital Imaging and Communications in Medicine (DICOM) files in the analysis software (version 2.3.0.3

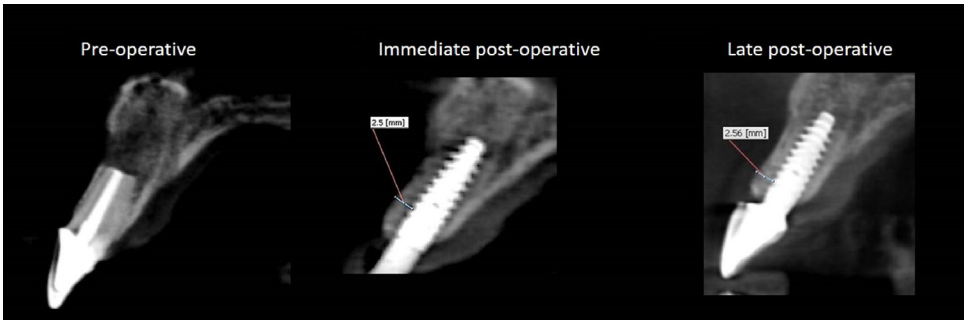

Fig. 1. (A) CBCT: the preoperative cross-section shows a root after apicoectomy; a thin buccal crest is still present. (B) CBCT: immediately postoperative cross-section; a clear, thickened, buccal bone crest can be observed. (C) CBCT: late postoperative cross-section; hard-tissue remodelling was performed at the buccal crest after incorporation of the bone substitute material.

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