

Immediate implant placement in fresh extraction sites in the maxillary esthetic zone: a case series with 2-years' follow-up

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Abstract. – OBJECTIVE: The objective of the present case series with 24 months of follow-up was to document the clinicoradiographic status of IDI placed in fresh extraction sockets (FES) in the maxillary esthetic zone (MEZ).

PATIENTS AND METHODS: Immediate implants were placed in the FES of three adult patients. Medical history and demographics of these patients were retrieved from their respective healthcare records. All extractions were done using atraumatic techniques and performed in the MEZ. Diameter and lengths of IDI ranged between 4-4.1 mm and 14-16 mm, respectively. Osseous drilling was done at 2000 rpm and implants were inserted using an insertion torque of 45 Ncm. All implants were restored with screw-retained ceramic restorations. Follow-up clinicoradiographic investigations were done after 2-years. At follow-up, peri-implant plaque and gingival indices were measured and peri-implant probing depth was measured. Marginal bone loss was also measured.

RESULTS: The two-year follow-up clinical and radiographic results from all cases showed that the implant success and survival rates were 100% and 100%, respectively. There was no clinical evidence of peri-implant soft tissue inflammation in all cases. Scores of peri-implant plaque index, bleeding on probing, probing depth and crestal bone loss showed no evidence of peri-implant inflammation at 2-years' follow-up. All implants and their prostheses were clinically stable.

CONCLUSIONS: It is concluded that IDI can osseointegrate and remain functionally and esthetically stable when placed in FES located in the MEZ.

Key Words:

Alveolar bone loss, Esthetic zone, Fresh extraction socket, Immediate implant, Maxilla.

Abbreviations

BoP: Bleeding on probing; CBL: Crestal bone loss; FES: Fresh extraction sockets; IDI: Immediate dental implants; MEZ: Maxillary esthetic zone; PD: Probing depth; PI: Plaque index.

Introduction

Dental implants have emerged as a modern and dependable solution for replacing missing teeth, offering significant advantages over conventional resin-based dentures and ceramic bridges¹⁻⁴. Studies⁵⁻¹⁰ have shown that dental implants placed in healed alveolar ridges can demonstrate success and survival rates of up to 100%. However, immediate placement of an implant in a fresh extraction socket is often inevitable, particularly when extraction of a permanent tooth is performed in the maxillary esthetic zone (MEZ)¹¹. Such a decision is often necessary as missing a tooth in the MEZ may be a debilitating experience exposing patients to anxiety related to their aesthetics and speech. In a prospective clinical study on 15 patients, Ganeles et al¹² assessed the survival of threaded tapered implants (n=15) placed in the MEZ. The 24-month follow-up results on 11 patients showed a survival rate of 100%. This study¹² concluded that immediate dental implants (IDI) placed in fresh extraction sockets (FES) in the MEZ demonstrate a healthy tissue response and favorable esthetic outcomes. Similarly, Bruno et al¹³ investigated the effect of immediate implant placement and provisional loading on interproximal papillae in the MEZ. In this study, 28 individuals received 36 IDI in the MEZ. The results of the 12-month follow-up demonstrated a statistically significant improvement in the scores of both mesial and distal papilla indices¹³. It has been reported that IDI have success rates comparable to implants placed in healed sockets¹³. Despite such promising outcomes in regard to placement of IDI in MEZ, controversial results have also been documented. In a multi-center randomized controlled trial (RCT), Tonetti et al¹⁴ compared the surgical complications and

radiographic, periodontal, and esthetic outcomes in regard to immediate implant placement in FES in the MEZ. The one-year follow-up results showed higher probing depths compared with implants placed in healed sockets. In this study¹⁴, wound healing was compromised in approximately 26% and 5% patients who received implants placed in FES and healed sites, respectively. The results further showed that crestal bone loss is higher around IDI than in implants placed in healed extraction sockets¹⁴. In summary, results by Tonetti et al¹⁴ discouraged clinicians from placing IDI in the MEZ as these implants compromise esthetics. These findings strongly indicate that there is no clear agreement or consensus regarding the appropriateness of placing IDI in the MEZ.

The objective of the present case series with 24 months of follow-up was to document the clinicoradiographic status of IDI placed in FES in the MEZ.

Patients and Methods

Informed Consent

Patients' whose cases are presented in the present case series signed a written informed consent stating that they do not have any objection in regard to their radiographs and/or clinical intra-oral images being used and prospectively being published on a scientific indexed platform. All patients were also aware that their personal information, such as name, date of birth, address and/or contact details, will be kept confidential. All participants were aware they reserved the right to withdraw their participation at any stage, and that withdrawal was not associated with any form of penalty and/or consequence.

Study Location

The present study was performed at the Dental Office of Oral Surgery and Implantology Dr. Seymur Gurbanov in Bergisch Gladbach, Germany, between March 2020 and September 2022.

Case 1

Patient demographics and presenting complaint

A 67-year-old self-reported systemically healthy and non-smoking male patient presented with the following chief complaint "My front tooth broke yesterday". The patient reported no known drug allergies (NKDA).

Clinical and radiologic examination

Upon clinical oral examination, the maxillary left central incisor (tooth #21) demonstrated a fracture of clinical crown at the gingival margin. There was no clinical evidence of extra and/or intra-oral swelling/abscess formation/pus discharge on the facial and palatal soft tissues in relation to #21. A preoperative digital panoramic radiograph (Planmeca ProMax 3D plus) demonstrated root fracture in the middle-third of the remaining root of #21. The treatment plan (TP) comprised of extraction of #21 followed by immediate implant placement in the FES. The patient accepted the TP and signed a consent form.

Surgical protocol

Under local anesthesia (LA) (2% lidocaine with 1: 100,000 epinephrine), the remaining root of #21 was atraumatically extracted using the Benex axial extraction system (BAES)¹⁵. Visual assessment of the FES showed that all osseous walls were intact. The extraction socket was debrided, and after sequential drilling at 2000 rpm an immediate implant (4.1 mm x 16 mm) was inserted at an insertion torque of 45 Ncm. The gap (approximately 2 mm) between the implant and socket walls was filled with a xenograft (Bio-Oss®, Geistlich Wolhusen Switzerland); and simultaneously, soft tissue augmentation was using a connective tissue graft (CTG) from the hard palate using the harvesting technique¹⁶. The CTG was placed subperiosteally without tension using the modified tunnel technique; and fixed with resorbable sutures. Post-operative antibiotics (Amoxicillin 500 mg p. o. 8 hrs for 7 days) and analgesics (Ibuprofen 600 mg every 12 hrs for 2 days and then as needed) were prescribed. The implant was loaded with a cement-retained restoration after 3 months (Figure 1a to 1k). Figures 1j and 1k show the clinical and radiographic presentation of the implant at 2 years of follow-up.

Case 2

Patient demographics and presenting complaint

A 61-year-old female with a history of breast cancer presented with the following chief complaint "I want the upper left front broken tooth replaced with an implant". As per medical records, the patient was diagnosed with BC two years ago and, since then, has been on oral RANK ligand inhibitor (Denosumab) therapy. Medical records also showed that the patient does not have a history of osteonecrosis. The patient reported NKDA.

Case 1

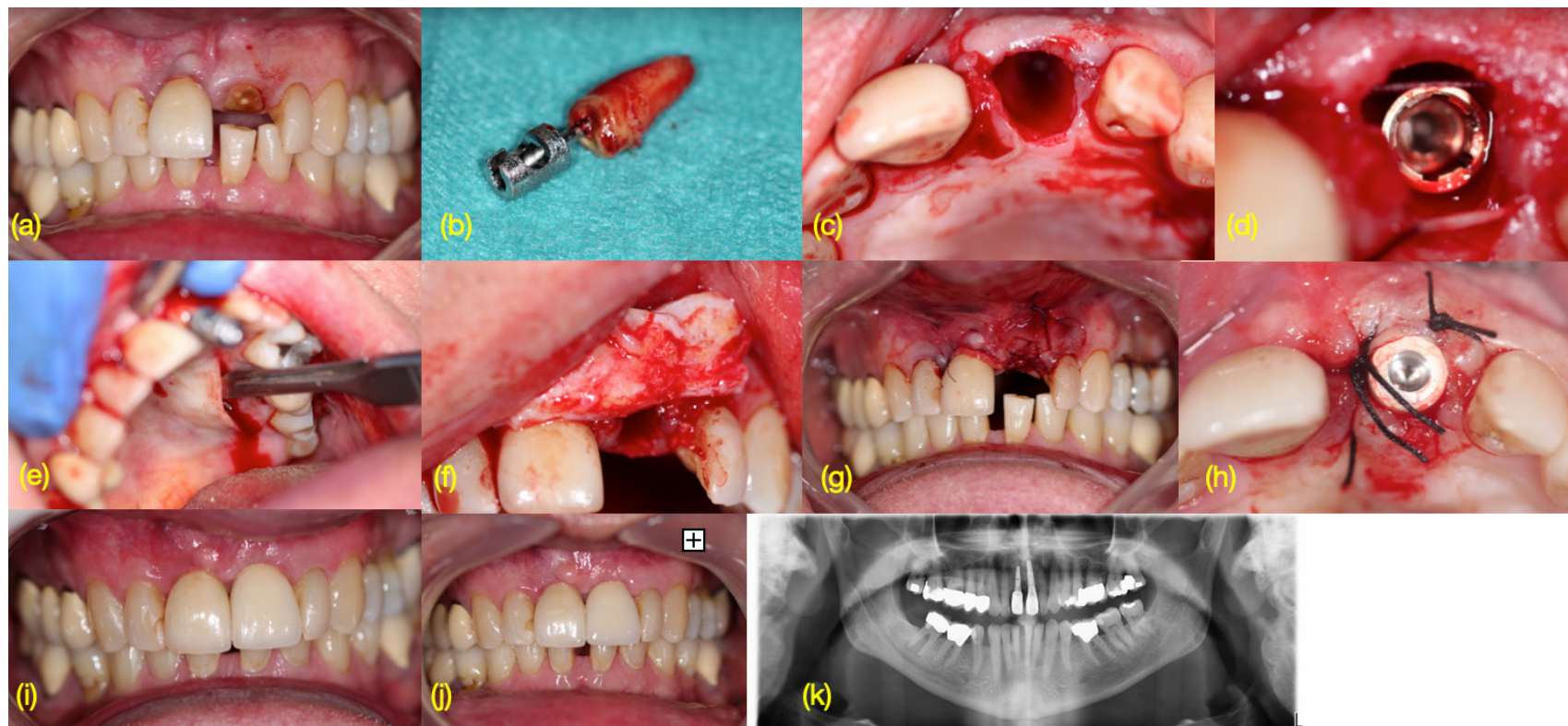


Figure 1. (a) Preoperative clinical photo; (b) Extraction of maxillary central incisor using the Bennex system; (c) Fresh extraction socket with intact buccal bone; (d) immediate implant placement in fresh extraction socket; (e) palatal donor site for soft tissue graft; (f) Placement of soft tissue flap over the fresh extraction socket; (g) immediate implant placement in fresh extraction socket; (h) Primary closure; (i) postoperative clinical image at 1-years follow-up; (j) postoperative clinical image at 2-years' follow-up; and (k) postoperative panoramic radiograph at 2-years' follow-up.

Clinical and radiologic examination

Upon clinical oral examination, patient had multiple missing teeth restored with dental implants. Overall, the patient had a satisfactory oral hygiene status. A preoperative digital panoramic radiograph (Planmeca ProMax 3D plus) demonstrated the remaining root of the maxillary left canine (#23). The tooth #23 was treatment planned for extraction and replacement with an immediate implant. The patient accepted the TP and signed a consent form. Preoperative prophylactic antibiotics (Amoxicillin 750 mg, 3 times a day for 2 days) and oral rinses with 0.12% chlorhexidine gluconate twice daily for 2 days were prescribed.

Surgical protocol

Under local anesthesia (2% lidocaine with 1: 100,000 epinephrine), a split flap was raised, and the remaining root of #23 was atraumatically extracted using forceps and elevators. Visual assessment of the FES showed that all osseous walls were intact. The extraction socket was debrided, and after sequential drilling at 2000 rpm an immediate implant (4.0 x 14 mm) was placed in the FES. The flaps were repositioned and suturing was done with interrupted non-resorbable sutures. The sutures were removed after one-week. After three-months of healing, the implant was uncovered and restored (Figures 2a to 2j).

Case 3

Patient demographics and presenting complaint

A 66-year-old non-smoking and systemically healthy male patient with the following chief complaint "I want to replace my loose teeth with implants". Bilateral maxillary canines had Grade-II mobility that also resulted in the loosening of the patient's existing maxillary prosthesis. The patient reported NKDA.

Surgical protocol

Atraumatic extraction of the bilateral maxillary canines followed by placement of IDI in fresh extraction sockets was treatment planned under LA (2% lidocaine with 1: 100,000 epinephrine). A preoperative CBCT assessment was done, which showed a thin buccal lamellar bone around the bilateral maxillary canines. To minimize the risk of buccal bone fracture, extraction of bilateral maxillary canines was performed using the BA-ES¹⁵. The extraction socket was debrided, and after sequential drilling at 2000 rpm an immediate

implant (4.1 mm x 16 mm) was inserted at an insertion torque of 45 Ncm. The gap (approximately 2 mm) between the implant and socket walls was filled with a xenograft (Bio-Oss®, Geistlich Wolhusen Switzerland). Primary closure was done using resorbable silk sutures; and post-operative antibiotics (Amoxicillin 500mg p. o. 8 hrs for 7 days) and analgesics (Ibuprofen 600 mg every 12 hrs for 2 days and then as needed) were prescribed. The implant was loaded with a cement-retained restoration after 3 months (Figure 3).

Follow-Up Evaluation

In all patients, the following peri-implant plaque index (PI)¹⁷, bleeding on probing (BoP)¹⁸ and probing depth (PD)¹⁹ were recorded. All recordings were measured at six sites per implant (mesiobuccal, mid-buccal, distobuccal, distolingual/palatal, mid-lingual/palatal, and mesiolingual/palatal) and presented as mean percentages per individual. PD was measured to the nearest millimeter using a manual graded probe (UNC-15 Hu-Friedy, Chicago, IL, USA). Digital peri-apical radiographs were taken and viewed on a calibrated computer screen (Samsung SyncMaster digital TV monitor, Korea) using a software program (Image Tool 3.0 Program, Department of Dental Diagnostic Science, University of Texas Health Science Center, San Antonio, TX, USA). Crestal bone loss (CBL) was defined as the distance from the widest supra-crestal part of the implant to the alveolar crest. These parameters were assessed at 2 years' follow-up. Implant survival rate (ISR) was also assessed.

Results

The two-year follow-up clinical and radiographic results from all cases showed that the implant success and survival rates were 100% and 100%, respectively. There was no clinical evidence of peri-implant soft tissue inflammation in all cases. Scores of peri-implant PI, BoP, PD and mesial and distal CBL are shown in Table I. All implants and their prostheses were clinically stable; and radiographic evaluation showed no evidence of crestal bone loss around immediate implant places in FES.

Discussion

Outcomes of the three cases presented in this case series clearly demonstrated that all implants

Case 2

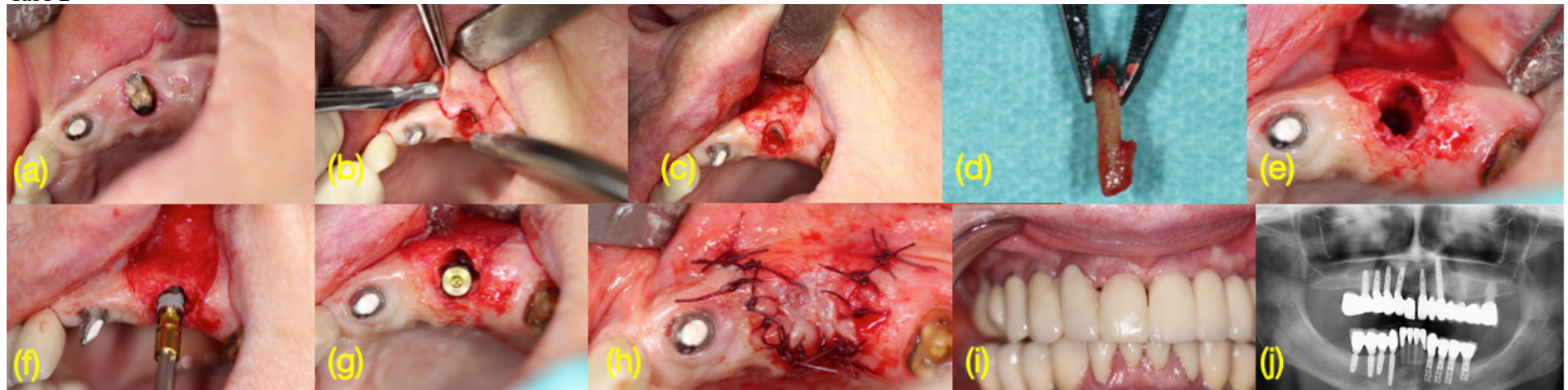


Figure 2. (a) Preoperative clinical photo; (b, c and d) elevation of periosteal flap and extraction of hopeless tooth; (e) Fresh extraction socket with intact buccal bone; (f and g): immediate implant placement in fresh extraction socket; (h) primary closure after immediate implant placement; (i) postoperative clinical image at 2-years' follow-up; and (j) postoperative panoramic radiograph at 2-years' follow-up.

Case 3

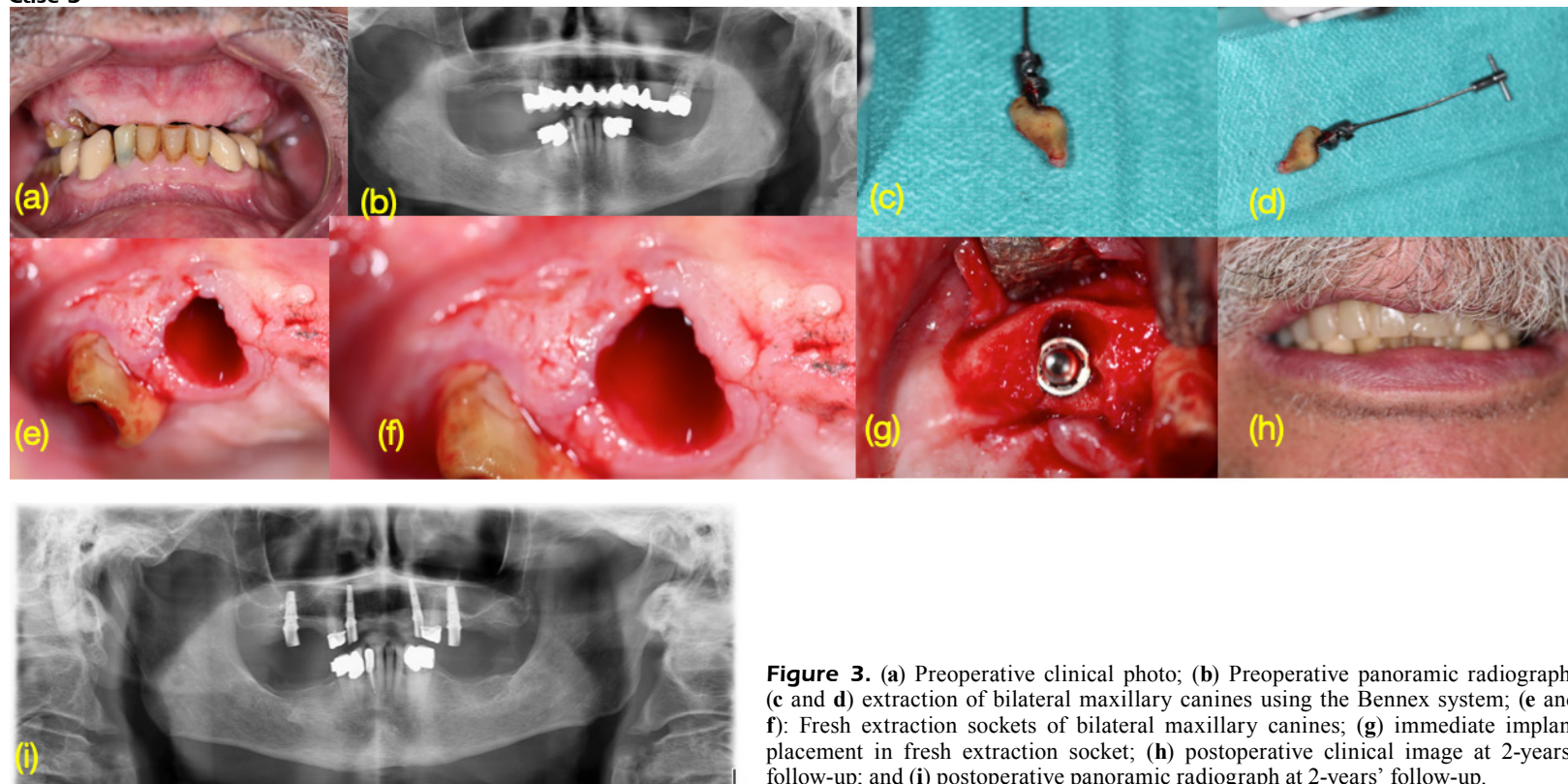


Figure 3. (a) Preoperative clinical photo; (b) Preoperative panoramic radiograph; (c and d) extraction of bilateral maxillary canines using the Bennex system; (e and f): Fresh extraction sockets of bilateral maxillary canines; (g) immediate implant placement in fresh extraction socket; (h) postoperative clinical image at 2-years' follow-up; and (i) postoperative panoramic radiograph at 2-years' follow-up.

Table 1. Peri-implant clinicoradiographic status at 2-years' follow-up.

Parameters	Case 1	Case 2	Case 3
Plaque index	0.16 ± 0.002	0.3 ± 0.004	0.16 ± 0.001
Bleeding on probing	None	0.17 ± 0.002	None
Probing depth	0.5 ± 0.03	0.6 ± 0.007	0.4 ± 0.002
Crestal bone loss (mesial)	0.16 ± 0.004 mm	0.18 ± 0.005 mm	0.17 ± 0.002 mm
Crestal bone loss (distal)	0.15 ± 0.003 mm	0.18 ± 0.003 mm	0.15 ± 0.001 mm

were esthetically and functionally stable at 2 years of follow-up. As indicated in the results section, the implants had success and survival rates of 100% and 100%, respectively. In this context, it is reasonable to contemplate that placement of IDI in FES located in the MEZ is a reliable and successful therapeutic protocol. It is, however, noteworthy that case selection is an important parameter that may potentially influence the overall outcome of implant therapy, irrespective of whether they are IDI or implants placed in healed sites. There is sufficient evidence in indexed literature which confirms that habitual use of nicotinic products such as cigarettes increases the risk of peri-implant soft tissue inflammation (peri-implant mucositis) and CBL (peri-implantitis) around otherwise fully osseointegrated dental implants^{9,20}. Habitual use of combustible nicotinic products has been associated with an increased production and accumulation of advanced glycation endproducts in periodontal tissues and peri-implant sulci, which in turn escalates activity of osteoclasts²¹. Moreover, habitual smoking has also been reported to delay healing after oral surgical interventions^{22,23}. All patients treated in the present case-series were non-smokers and this factor seems to have contributed towards a successful outcome in terms of esthetic and functional stability of IDI. We also presented one case of a female patient who was under treatment for osteoporosis. Here, it is pertinent to refer to the study by Javed and Almas²⁴ in which, oral bisphosphonates were shown to be less likely to be associated with complications such as osteonecrosis of the jaw. Up to two years of follow-up there was no clinical evidence of ONJ in the female patient (Case 2) reported in this study. Furthermore, according to Al-Amri et al²⁵ dental implants can osseointegrate and remain stable in medically-challenged patients as long as oral hygiene is stringently maintained.

Studies²⁶⁻²⁹ have shown that implant surface rough plays a role in the osseointegration and long-term success and survival of dental implants. Implant surface roughness has also been reported

to attract bone forming cells (osteoblasts) towards the implant. In the present study, all IDI had moderately rough surfaces and the contribution of this potential factor towards implant stability and maintenance of crestal bone at 20 years' follow-up cannot be overlooked. It is well-known that achievement of primary stability (PS) at the time of implant placement plays an important role in osseointegration and long-term success and survival of dental implants³⁰⁻³³. In the present case-series, PS remained uninvestigated after placement of IDI, which is a potential limitation of the present study. However, based upon the two-year follow-up outcomes, it is tempting to speculate that there was sufficient PS after placement of IDI in FES located in the MEZ. One reason for this is that during extraction of hopeless teeth prior to implant placement vigilant efforts were made to minimize the risk of damage to the buccal lamellar bone. In order to achieve this objective, we used the BAES. Patients undergoing immediate implant placement in FES may present with inevitable yet manageable scenarios such as partial and/or complete buccal bone deficiency (BBD)^{6,34}. In a RCT, Makki et al¹⁵ compared post-extraction healing, signs and symptoms, and complications between the BAES and conventional protocols such as use of elevators and forceps (control-group). Post-operative follow-up was performed after 4-weeks of extraction of 38 single-rooted teeth. The results showed that extractions performed using BAES demonstrated early soft-tissue healing and decreased pain and wound-size in contrast to extractions performed in the control-group¹⁵. Authors of the present case-series support the results reported in the RCT by Makki et al¹⁵. In a prospective single cohort study Barone et al³⁴ investigated the effective use of xenograft and collagen membrane (CM) in treating buccal bone defects associated with fresh extraction sockets located in the MEZ. In this study³⁴, 33 patients needing exodontia in the MEZ and demonstrating a partial or absolute BBD (> 2 mm) were included. Porcine cortico-cancellous bone and platelet-rich fibrin (PRF) with a CM were

used for grafting FES. The CM were left exposed to the oral cavity with a secondary soft tissue healing. The one-year follow-up results showed an implant survival rate of 100% and that use of xenograft with adjunct PRF therapy is a promising therapeutic approach for the management of BBD particularly in the MEZ^{20,34}. In the present case-series, we used bone grafts to fill the gap between the implant and buccal bone; however, no adjunct therapies, such as use of growth factors, was no part of the therapeutic protocol. Osseous grafting is of particular interest in patients with peri-implant diseases, such as peri-implantitis; however, a consensus on whether peri-implantitis should be managed *via* surgical or non-surgical interventions is yet to be reached⁹. Based upon the 2-year follow-up outcomes it is demanding to speculate the beneficial effects of adjunct therapies such as PRF treatment on long-term success and survival of dental implants; however, such an approach could be beneficial for treatment of peri-implant diseases.

Conclusions

Based on the results of the present case series, it is concluded that IDI can osseointegrate and remain functionally and esthetically stable when placed in FES located in the MEZ.

Informed Consent

Patients whose cases are presented in the present case series signed a written informed consent stating that they do not have any objection in regard to their radiographs and/or clinical intra-oral images being used and prospectively being published on a scientific indexed platform. All patients were also aware that their personal information, such as name, date of birth, address and/or contact details, will be kept confidential. All participants were aware they reserved the right to withdraw their participation at any stage, and that withdrawal was not associated with any form of penalty and/or consequence.

Funding

There was no internal and/or external source of funding for the present study.

Ethics Approval

The present study was reviewed and approved by the Ethics committee at the Dental Office of Oral Surgery and Implantology, Bergisch Gladbach, Germany.

Availability of Data and Materials

Data is available on reasonable request.

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Conflict of Interest

The authors declare that they have no conflict of interest related to the present study.

Authors' Contribution

Seymur Gurbanov: Performed surgical procedures, writing original draft and reviewing before submission

Philipp Plugmann: Writing original draft and reviewing before submission.

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