Immediate Provisionalization of Single Narrow Implants in Fresh Extraction Sockets and Healed Sites: Clinical and Radiographic Outcomes of 2 Years Follow-up

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The purpose of this clinical study was to evaluate, through clinical and radiographic parameters, the 2-year implant survival and success rates of single, narrow, immediately loaded implants (3.1-mm diameter) placed in fresh extraction sockets or healed sites in the anterior region. A total of 16 patients were treated with 16 narrow single implants in fresh extraction sockets and healed sites, and restored immediately with temporary crowns. After 3 months, the implants were finally restored with screw-retained or cemented lithium disilicate crowns. Implant success and survival rates were both 100% due to stable marginal bone levels and shallow probing pocket depths after 2 years of follow-up. Within the limits of this clinical study, narrow 3.1-mm dental implants can be used successfully as a minimally invasive alternative in healed sites with a thin bone crest and in the presence of a reduced interdental space. Provided that stability of soft and hard peri-implant tissues were obtained in postextraction sites of mandibular incisors and maxillary lateral incisors with immediate provisional restoration, the 2-year results can be successfully maintained over time. Int J Periodontics Restorative Dent 2020;40:417–424. doi: 10.11607/prd.4622

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It has been shown that standard-diameter implants (between 3.75 and 4.1 mm) can be loaded immediately and have excellent long-term results, satisfying the criteria for implant success.1,2 One of the disadvantages of the conventional-diameter implants is their use in the presence of a reduced alveolar ridge width as well as limitations in space between adjacent teeth. This situation often presents itself in areas of the mandibular and maxillary incisors, where the lateral incisors are the smallest teeth in the mesiodistal aspect.3–5 In fact, the current guidelines on the three-dimensional positioning of dental implants indicate a minimum distance of 1.5 mm between the implant and adjacent teeth to avoid clinical complications, like resorption of the proximal marginal bone, exposing the implant threads, and loss of gingival papilla volume;6 this implies that in order to use a standard-diameter implant, the interproximal distance of the crestal bone must be greater than 6 mm.7–10 In the same way, in the anterior region where esthetics are of fundamental importance, the use of standard-diameter implants is not indicated in the presence of a reduced horizontal alveolar ridge (without bone grafting or orthodontic treatment). Implants must be placed 2 mm from the buccal bone wall, ensuring stability of the wall.
implant therapy with reduced surgica invasiveness, or patients who decline offered bone grafting or orthodontic treatment. The definition of a narrow-diameter implant is taken to have a diameter ≤ 3.5 mm. Narrow implants are divided following the manufacturers’ indication for use into three categories: Category 1: < 3.0 mm (“mini-implants”); Category 2: 3.0 to 3.25 mm; and Category 3: 3.30 to 3.50 mm. The aim of this retrospective clinical study was to determine the survival and success rates of single narrow implants placed in fresh extraction sockets and healed sites, loaded with an immediate provisional restoration and a follow-up of loading of 2 years.

Material and Methods

Nonrandomized, uncontrolled, prospective clinical cases were conducted, and patient records were reviewed to identify all subjects who had been treated with single narrow implants (Eztetic, Zimmer Biomet) in the maxilla and/or mandible with immediate functional loading placed in fresh extraction sockets and in healed sites. To ensure patient privacy, an anonymization of the patients’ data was performed with the following rules: A number was assigned to each patient and inserted into a file (Excel, Microsoft) for data collection. Clinical and radiographic examinations were performed at implant insertion, 6 months thereafter, and are ongoing. Marginal bone levels and changes, complications, the peri-implant probing depth, plaque and bleeding indices, and the pink esthetic score (PES) were evaluated at each follow-up visit. In all cases, patient oral and systemic health histories were reviewed and recorded. The surgical planning was preceded by a clinical and radiographic evaluation of the case and by taking a dental impression for the realization of master models. Each diagnostic cast was also used to fabricate a surgical template as a prosthetic guide for ideal placement of the implant and for fabrication of the provisional restoration. All dental pathologies were treated before implant surgery. In addition to panoramic radiographs, standardized periapical radiographs with Rinn holders (Dentsply Sirona) and long-cone paralleling technique were taken to assess bone volume and locations of anatomical landmarks. Selection of implant lengths was based on the dimensions and volume of available bone measured during radiographic assessments. Antibiotic prophylaxis consisted of 2 g of amoxicillin plus clavulanic acid, or 600 mg clindamycin, 1 hour prior to surgery. On the day of surgery, anesthesia 4% articaine with 1:100,000 adrenaline was administered via local infiltration at the base of the vestibule, in the palate and near the papillae adjacent to the compromised tooth.

Clinical Procedures in Fresh Extraction Sockets

To preserve the integrity of the alveolar bone and gingiva, atraumatic tooth removal was performed using an ultrasonic bone cutting unit with an insert (EX1 and/or EX2 Piezosurgery inserts extraction, Mectron) and/or periotome and an incision-free, flapless technique. The ultrasonic-assisted osteotomy was performed via insert (Mectron), subsequently used with a surgical spoon to debride the extraction socket. Clinical cases with a lack of buccal bone were excluded from this study. The surgical guide based on the prosthetic guidelines allows the correct implant placement in the three dimensions of the space. The osteotomy was performed according to the protocol recommended by the manufacturer by sequential drilling with irrigated drills in graduated diameters with a palatal inclination inside the socket. To avoid esthetic complications, especially in those patients with a thin gingival biotype, the implant placement was palatal and 3 mm to 4 mm apically from the buccal gingival margin to ensure 2-mm (buccal and lingual) bone thickness. Required primary stability for immediate loading was confirmed with a micromotor torque (minimum torque of 40 Ncm) and implant stability quotient (ISQ; > 70). The gap between the implant and the buccal wall of the socket was filled and compressed with a cancellous particulate xenograft (CopiOs, Zimmer Biomet) to minimize the gap distance. A screw-retained provisional restoration...
was placed immediately, and the implant was out of occlusion. The construction of the provisional restoration took place on a pre-designed model-master to create a correct emergence profile of the crown to support the gingival tissue vestibular at the level of interdental papillae.\textsuperscript{16}

Soft tissue levels were measured over time to determine the gingival margin position and papilla height based on the line, connecting the middle of the facial surfaces of the two adjacent teeth (Fig 1).

Clinical Procedures in Healed Sites

Through a flapless surgical technique and with the use of microsurgical instruments, a minimally invasive surgery is performed to preserve as much as possible the soft and hard tissues around the tooth before

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Fig 1  Clinical case 1. (a) Facial and (b) occlusal views of severe caries under the gingival margin on the mandibular left central incisor. (c) Preoperative radiograph with a periapical lesion. (d) Lingually placed implant with bone grafting material up to the gingival margin to fill the gap of the buccal bone wall. (e) Clinical and (f) radiographic views of the screw-retained temporary crown immediately placed on a narrow implant (3.1-mm diameter, 11.5-mm length), placed 4 mm apical to the free gingival margin. (g) Excellent soft tissue healing guided by an immediate provisional restoration. This is a fundamental requirement for stability and the maintenance of peri-implant tissues in the long-term. (h) Clinical and (i) radiographic views of the final screw-retained restoration in lithium disilicate. There was stability of marginal bone levels at 2 years after loading.
extraction. The surgical, prostheti-
cally driven guide allows the cor-
rect implant placement in the three
dimensions of the space. Implant
placement occurs below the bone
crest, and when the correct im-
plant insertion torque is reached, a
screw-retained platform-switching
abutment is positioned immediately
and will remain in place. The provi-
sional restoration, previously built
on the master model, is cemented
on the abutment and removed after
3 months. A polyether impression
is taken with the tear-off technique,
and a cemented, definitive restaura-
tion in lithium disilicate is delivered
(Figs 2 and 3).

Fig 2 Clinical case 2. (a) Clinical and (b) radiographic
preoperative condition of a reduced mesiodistal
dentulous space and a distance of less than 6 mm.
(c) Finishing and adaptation of the immediately
placed, cemented provisional restoration.
(d) Radiographic view of the narrow implant (3.1-mm
diameter; 13-mm length). The definitive abutment
was screwed on immediately after inserting the
narrow implant and will remain in place. (e) Excellent
healing of the soft tissues after removal of the
provisional restoration, 3 months after loading.
(f) Clinical and (g) radiographic views of the final
restoration in lithium disilicate after 2 years, showing
stability of soft and hard peri-implant tissues.
Results

All statistical analyses were performed using SAS for Windows 2000 dual microprocessor server, version 9.1 (SAS Institute). Calculations of bone levels were made on standardized periapical radiographs of each patient taken before surgery, at the time of provisional restoration (baseline), and after 12 and 24 months of functional loading. Periapical radiographs were provided in high-resolution JPEG format to an independent evaluator (G.R.), and each image was opened using imagine analysis software (OsiriX MD, Pixmeo) on a personal computer. Bone levels were measured by calculating the distance from the implant shoulder to the location of the first bone-to-implant contact.

A total of 16 patients (6 men, 10 women) with a mean age of 46.3 ± 11.2 years (range: 30.0 to 69.0 years) were included in this study. Patients were treated with an immediate provisionalization of single narrow implants placed in fresh extraction sockets (n = 6) and healed sites (n = 10). Implants were monitored for a mean follow-up time of 24 months. Patient treatment and outcome data are summarized in Table 1. All implants exhibited insertion torque values greater than 40 Ncm. Resonance frequency analysis demonstrated mean ISQ values of 72.1 ± 2.7 immediately after implant placement. After 24 months, survival and success rates of 100% were reported. The mean change in marginal bone level was 0.12 ± 0.25 mm in healed sites and 0.21 ± 0.22 mm in fresh extraction sites. No statistically significant changes in the full-mouth plaque and bleeding scores were observed from baseline to 24 months. The mean probing depth, measured at six sites per implant, was 2.14 ± 0.34 mm. The PES was used to evaluate the esthetic outcome of the soft tissues around each implant-supported single crown by a numeric value from 0 to 2, for seven clinical variables: mesial and distal papillae, soft tissue levels, contour, color, texture, and alveolar process deficiency. The highest achievable PES value was 14. The mean PES was 13.4 at the 24-month
follow-up, demonstrating excellent healing of peri-implant soft tissues.

Discussion

Based on the scientific literature, narrow dental implants are implants with a diameter between 3 to 3.5 mm. In the present retrospective clinical study, the cumulative narrow implant survival and success rates were 100% for an average 2 years of follow-up after implant placement. Narrow dental implants are commonly used in cases of restricted mesiodistal anatomy (less than 6 mm) and/or a thin alveolar crest (such as lateral maxillary and mandibular incisors) as a viable alternative to bone augmentation, as they require a simple, less expensive and faster alternative surgical procedure. In several studies, narrow implants presented lower survival rates when compared to standard-diameter implants. In a systematic review, other studies reported higher survival rates, and narrow-implant results appear similar to those of regular-diameter implants (>95%, with no survival rates below 88%). The results of this study were comparable to other studies reporting low marginal bone loss with other implant systems. Immediate provisional restoration and functional loading have shown high success rates in a different clinical study. All implants obtained a primary stability (ISQ > 70; insertion torque > 40 Ncm), which is essential for the insertion of an immediate provisional restoration. Patient preference for minimally invasive treatment options, such as prosthetic rehabilitation without bone augmentation and/or flap elevation, are generally better tolerated. The use of this contour abutment profile on the narrow implants offers important advantages, especially in narrow alveolar ridges, supporting soft and hard peri-implant tissue stability due to the concave shape, thus allowing the tissue to grow. Additionally, platform switching and subcrestal implant placement allow placement of implants when distances between tooth-to-implant and implant-to-implant are smaller. The maintenance of peri-implant bone in the present case series is

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Table 1 Implant Data and Patient Treatment Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Outcome</th>
</tr>
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<tbody>
<tr>
<td>Implant placement (tooth location), % (n)</td>
<td></td>
</tr>
<tr>
<td>Central mandibular incisors</td>
<td>31.2% (5)</td>
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<tr>
<td>Lateral mandibular incisors</td>
<td>25% (4)</td>
</tr>
<tr>
<td>First premolar</td>
<td>18.8% (3)</td>
</tr>
<tr>
<td>Second premolar</td>
<td>25% (4)</td>
</tr>
<tr>
<td>Implant placement (arch location), % (n)</td>
<td></td>
</tr>
<tr>
<td>Mandible</td>
<td>43.8% (7)</td>
</tr>
<tr>
<td>Maxilla</td>
<td>56.2% (9)</td>
</tr>
<tr>
<td>Implant length, % (n)</td>
<td></td>
</tr>
<tr>
<td>10.0 mm</td>
<td>6.2% (1)</td>
</tr>
<tr>
<td>11.5 mm</td>
<td>56.2% (9)</td>
</tr>
<tr>
<td>13.0 mm</td>
<td>37.6% (6)</td>
</tr>
<tr>
<td>Final insertion torque, % (n)</td>
<td></td>
</tr>
<tr>
<td>&gt; 40 Ncm</td>
<td>50% (8)</td>
</tr>
<tr>
<td>&gt; 50 Ncm</td>
<td>50% (8)</td>
</tr>
<tr>
<td>Resonance frequency analysis (ISQ), mean ± SD</td>
<td>72.1 ± 2.7</td>
</tr>
<tr>
<td>Type of crown attachment, % (n)</td>
<td></td>
</tr>
<tr>
<td>Cement-retained</td>
<td>62.5% (10)</td>
</tr>
<tr>
<td>Screw-retained</td>
<td>37.5% (6)</td>
</tr>
<tr>
<td>Implant survival at 2 y, % (n)</td>
<td></td>
</tr>
<tr>
<td>Failure</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Survival</td>
<td>100% (16)</td>
</tr>
<tr>
<td>Success</td>
<td>100% (16)</td>
</tr>
<tr>
<td>Mean marginal bone loss at 2 y, mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Healed sites</td>
<td>0.12 ± 0.25 mm</td>
</tr>
<tr>
<td>Fresh extraction sockets</td>
<td>0.21 ± 0.22 mm</td>
</tr>
<tr>
<td>Mean PES at 2 y</td>
<td></td>
</tr>
<tr>
<td>1 y</td>
<td>13.4</td>
</tr>
<tr>
<td>2 y</td>
<td>13.3</td>
</tr>
<tr>
<td>Resolved prosthetic adverse events at 2 y, % (n)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>93.7% (15)</td>
</tr>
<tr>
<td>Decementation of the crown</td>
<td>6.3% (1)</td>
</tr>
<tr>
<td>Mean probing depth at 2 y, mean ± SD</td>
<td>2.14 ± 0.34 mm</td>
</tr>
</tbody>
</table>

ISQ = implant stability quotient; SD = standard deviation; PES = pink esthetic score. Total number of implants evaluated was 16.
comparable with another study as a result of a correct surgical and prosthetic clinical protocol and of an emergence profile guided by the anatomical and concave profile of the abutment on the narrow implant. The high value of the PES of the abutment on the narrow implant system, combining exceptional strength with reduced micromovements and microleakage. However, since the documentation is very limited, further studies involving longer periods of follow-up are needed in order to confirm these clinical outcomes.

Conclusions

Within the limits of the present case series, narrow-diameter implants can be used successfully with a provisional restoration as a minimally invasive alternative in healed sites with a thin bone crest and in the presence of reduced interdental spaces. Stability of soft and hard peri-implant tissues was obtained in the postextraction sites of central incisors, lateral incisors, and premolars with immediate provisional restorations. However, narrow-diameter implants are a viable alternative for mandibular and lateral maxillary incisors, where more space for implant placement is required.

Acknowledgments

The authors declare no conflicts of interest.

References