SINGLE TOOTH IMPLANT RESTORATION IN THE ESTHETIC ZONE WITH IMMEDIATE PROVISIONALIZATION: A CLINICAL REPORT.

ROBERTO SORRENTINO[1], ALESSANDRO QUARANTA[2], RANIERI MARTUSCELLI[3], FERNANDO ZARONE[4]

Abstract

Objectives: This clinical report describes a single-tooth implant restoration in a fresh extraction socket in the anterior maxilla, with immediate provisionalization and CAD-CAM zirconia final prosthesis.

Methods and Materials: Due to a traumatic injury, an esthetically concerned 40 year-old female patient was treated with an atraumatic extraction of a maxillary central incisor, which was immediately substituted with a single implant. Immediate provisionalization was performed using a screw-retained resin crown. Two months after surgery, the patient was fitted with a final all-ceramic single crown cemented on a CAD-CAM customized zirconia abutment.

Results: Healing was predictable, with the implant neither showing mobility nor presenting pain. The zirconia crown was undamaged. The patient was pleased with treatment time and esthetic result.

Discussion: Implant treatment with immediate provisionalization offers several advantages: optimal esthetics is achievable as bone and soft tissue architecture is maintained; patients are provided with a fixed temporary restoration at the time of surgery; treatment time is shortened, as second stage surgery is eliminated. Furthermore, the fresh extraction socket is a metabolically active region with good potential for bone repair and successful implant placement.

Conclusions: Optimal mechanical performances and excellent esthetics were achieved in the anterior sites by means of a CAD-CAM zirconia customized abutment and crown.

Clinical Significance: In cases where clinical conditions are favourable to the placement of an implant into a fresh post-extraction socket, such a treatment modality offers several advantages over a conventional approach.

Key words: immediate implant, prosthodontics, CAD-Cam, zirconia, esthetics.

Introduction

Several studies have shown the efficacy and long-term predictability of implant treatment (Adell et al., 1981; Attard & Zarb, 2005; Dhanrajani & Al-Rafee, 2005; Becker, 2005; Turkyilmaz, 2006; De Kok et al., 2006; del Castillo, 2006; Zeren, 2006; Tselios et al., 2006; Zarone et al., 2006). However, the replacement of missing teeth in anterior esthetic sites remains challenging. Careful consideration of residual bone volume, soft tissue architecture and their preservation by implant-prosthetic components are paramount factors in treatment planning (Becker, 2005; Zeren, 2006; Tselios et al., 2006; Zarone et al., 2006; Park et al., 2005; Wheeler et al., 2000; Josefovici, 2001; Maksoud, 2001; Locante, 2004). Nowadays, when local anatomy is favourable, osseointegration is an easily achievable goal (Dhanrajani & Al-Rafee, 2005; De Kok et al., 2006; Zarone et al., 2006; Wheeler et al., 2000; Maksoud, 2001). Delayed implants allow for the healing of both soft and hard tissues before surgery, with threedimensional resorption of the alveolar ridge occurring at the same time (Wheeler et al., 2000; Maksoud, 2001). Such resorption could significantly affect the position of the implant and the esthetic success of the restoration. To overcome these problems, guided tissue regeneration techniques are necessary (Wheeler et al., 2000; Maksoud, 2001). Conversely, the placement of implants in fresh post-extraction sockets presents difficulties in the initial mechanical anchorage to the

1. DDS, MSc, PhD. Department of Oral and Maxillofacial Sciences, University of Naples "Federico II"; Naples, Italy
2 DDS. Department of Oral and Maxillofacial Sciences – University of Rome "La Sapienza"; Rome, Italy
3. MD, DDS. Department of Oral and Maxillofacial Sciences – University of Naples "Federico II"; Naples, Italy
4. MD, DDS. Department of Oral and Maxillofacial Sciences, University of Naples "Federico II"; Naples, Italy

Corresponding Author:
Dr. Roberto Sorrentino
c/o Prof. Fernando Zarone, Azienda Universitaria Policlinico "Federico II", Dipartimento di Scienze Odontostomatologiche e Maxillo-Facciali, Edificio 14, Via S. Pansini nr. 5, 80131, Napoli, Italy.
Phone number: 0039.081.7463018
Fax number: 0039.081.7463018
e-mail address: errestino@libero.it

surrounding bone, but allows for preservation of both hard and soft periimplant tissues (Park et al., 2005; Wheeler et al., 2000; Josefovici, 2001; Maksoud, 2001; Locante, 2004).

Different clinical reports have proved that, in the absence of infection, immediately placed implants yield success rates comparable to those achieved with delayed implants inserted into healed bone tissue (Wheeler et al., 2000; Maksoud, 2001; Sudbrink, 2005). Different investigators have documented a success rate 93.6% higher from that of 2 to 5 years of follow-up (Tolman & Keller, 1991; Rosenquist & Grenthe, 1996).

The development of tapered implant morphologies have reduced the incongruency between the shape of standard implants and the alveoli, encouraging the immediate placement of implants in anterior esthetic sites as well (Wheeler et al., 2000). Furthermore, wider implant diameters allow contact between the fixture and the socket walls, preventing cortical bone resorption (Wheeler et al., 2000). CAD-CAM technologies allow clinicians and dental technicians to shorten the working time needed to create traditional prostheses (Zarone et al., 2005). Furthermore, the possibility of customizing the abutments offers the advantage of achieving optimal adaptation of periimplant soft tissues (Tselios et al., 2006; Zarone et al., 2005). The homogeneous structure of the zirconia gives the material high mechanical strength to withstand static and dynamic loads in all sites of dental arches (Kohal et al., 2006; Vult von Steyern et al., 2006; Palacios et al., 2006; Tinschert et al., 2006; Raigrodski, 2004). Moreover, several studies have demonstrated that the translucency and opalescence characteristics of this material offer good prospects of achieving a natural appearance without any interference with the shade of restorations in esthetic sites (Raigrodski, 2004; Little & Graham, 2004; Suttor, 2004; Tan & Dunne, 2004; Kugel et al., 2003).

The present clinical report describes a single-tooth implant restoration in a fresh extraction socket in the anterior maxilla with immediate provisionalization and a CAD-CAM zirconia final prosthesis.

Materials and Methods

Patient selection and presurgical treatment planning

An esthetically concerned 40-year-old female patient presented to the authors with a traumatic injury of the maxillary left central and lateral incisors. The patient was healthy and a non-smoker. A review of her medical history revealed no significant medical problems or medications. Radiographic examination, as well as visual inspection and periodontal probing, revealed a fracture of the apical region of the lateral incisor and a root

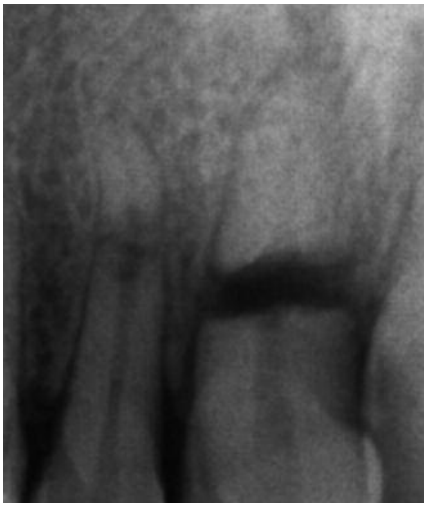

Figure 1. Presurgical radiographic control.

horizontal fracture of the central incisor at level of the middle third (Figure 1). The latter was diagnosed as a hopeless tooth. Consequently, its removal was necessary before treatment of the lateral incisor, due to mobility and functional reasons. In the case of the lateral incisor, according to the patient's requirements, the decision was made to extract the apical fragment, endodontically treat the proximal portion of the tooth and seal the tooth by a retrograde obturation. The central incisor was considered for single implant therapy with immediate loading. The patient was screened for any possible contraindications for implant placement and advised as to the benefits, risks and alternatives to the proposed treatment plan with a written consent form.

During the prosthodontic consultation, impressions were made to fabricate a resin guide to insert the implant in mesial-distal and buccal-palatal directions correctly. Furthermore, a diagnostic wax-up was performed and used in the fabrication of a temporary acrylic resin crown to be worn for esthetic reasons after the extraction of the tooth .

Before the surgical procedures, both the quantity and the quality of the bone tissue were analysed by means of clinical examination, standardized periapical radiographs (Irix 70, Trophy Radiologie, Vincennes, France) and CT Dental Scan, which revealed a D2 bone tissue according to the classification of Misch.

Surgical procedures

To ensure a high antibiotic blood level at the time of surgery, the patient was given preoperative antibiotics consisting of amoxicillin 2 g one hour before the intervention.

In addition, she rinsed for 1 minute with chlorhexidine solution 0.12% before the anesthetic was injected. After the administration of local anesthetic, an atraumatic flapless extraction was performed. Once the extraction was completed, the integrity of the socket was evaluated by probing the buccal

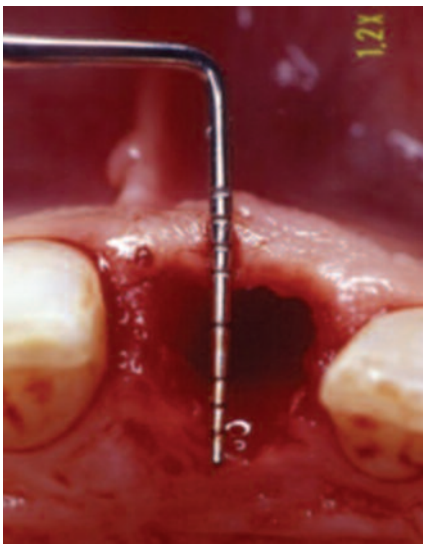

Figure 2. Fresh postextraction socket: evaluation of the buccal-palatal width and of the residual bone buccal plate.

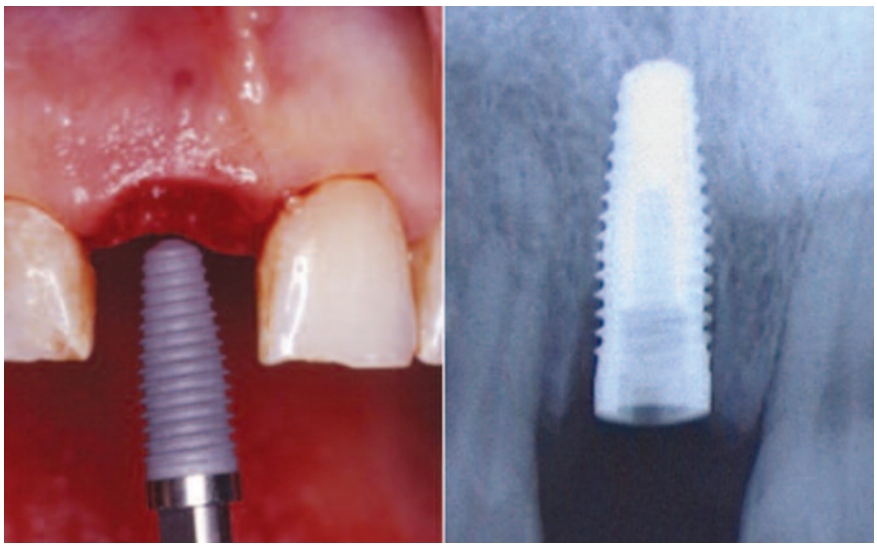

Figure 3. Implant insertion (left) and postsurgical radiographic control (right).

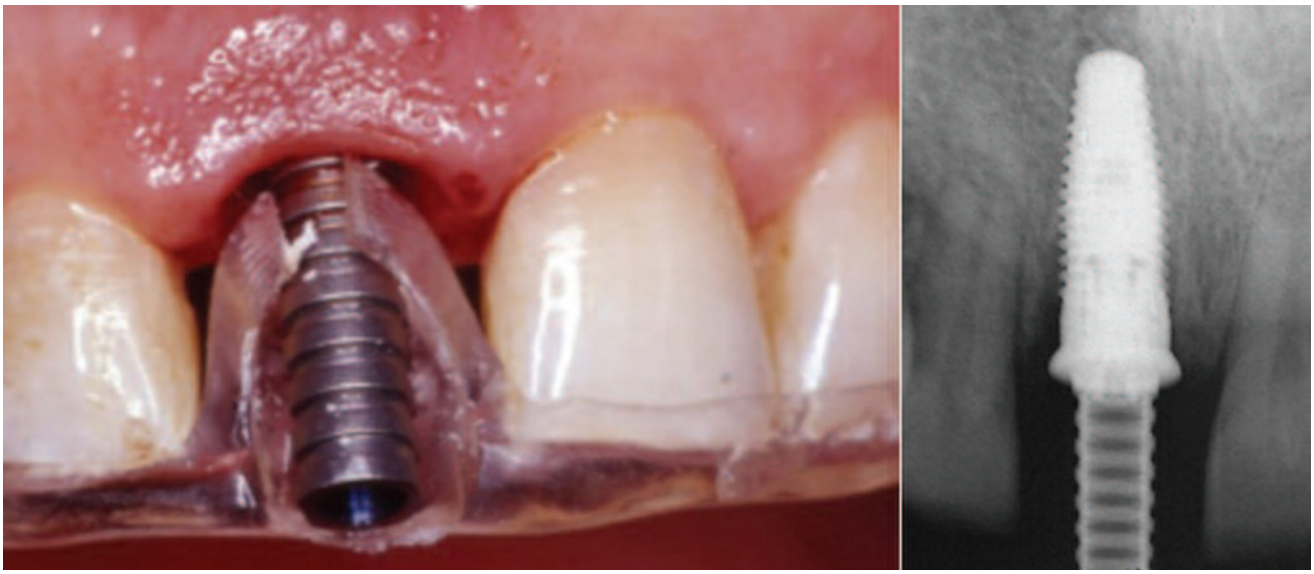

Figure 4. Registration of the position of the implant neck by means of an acrylic template (left). Radiographic control of the fit of the teflon cylinder screwed onto the implant (right).

plate with a smooth instrument and the region was debrided (Figure 2).

Calibrated implant burs were used at 900 r.p.m. speed under constant irrigation of 0.9% sodium chloride physiological solution to prepare the surgical site. The implant site preparation began in the palatal aspect of the socket to prevent buccal perforation. The site was widened until the preparation filled the extraction socket up to the buccal plate, taking care not to damage it. Furthermore, site preparation was extended beyond the apex by approximately 1 mm in order to improve primary stability. The implant dimensions were chosen to fill the extraction socket correctly, contacting the mesial and distal walls without overcompressing the bony buccal plate. Based on available bone volume, a Nobel Replace Tapered implant, (Nobel Biocare AB, Göteborg, Sweden) 5 mm in diameter and 13 mm in length, was placed with almost no gap between implant and bone. Care was taken not to damage the adjacent vital structures. The final placement of the implant was performed with a torque controlled hand ratchet. Insertion torque was 32 Ncm.

A periapical radiograph (Irix 70, Trophy, Kodak spa, Cinisello Balsamo, Italy) was taken according to the long cone technique, with parallel rays to check the implant placement (Figure 3). A teflon cylinder (Nobel Biocare) was carefully screwed onto the fixture and a second periapical radiograph taken to control the correct adaptation of the implant components (Figure 4). The teflon cylinder was splinted to the resin guide prefabricated before the surgery using pattern resin (Duralay, Dental Mfg. Co. Worth, IL, USA). The cylinder was then unscrewed and sent to the dental laboratory to transfer the position of the implant

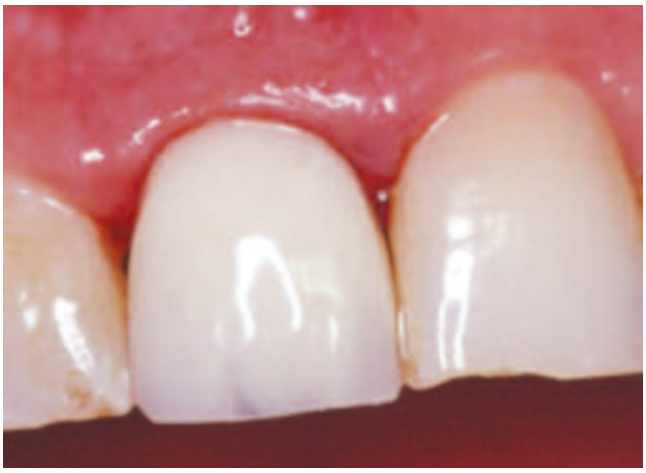

Figure 5. Buccal view of the screwed resin temporary crown in region 11.

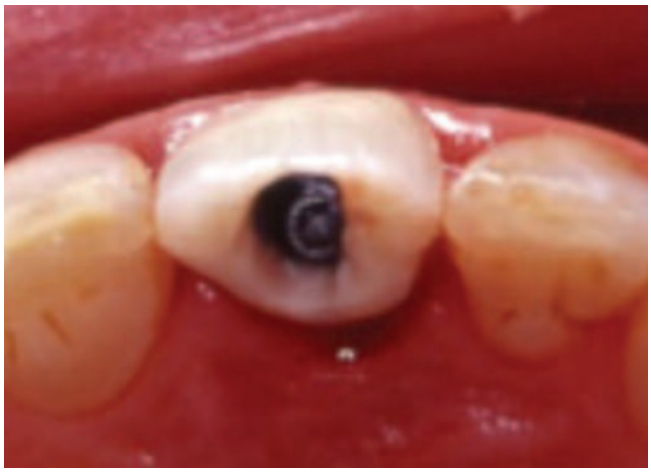

Figure 6. Occlusal view of the screwed resin temporary crown in region 11.

neck. A healing abutment (Nobel Biocare) was tightened onto the fixture for a few hours. Immediate provisionalization was performed using a screw-retained temporary acrylic resin crown, (Jet Kit, Lang Dental MFG. CO., Wheeling, IL, USA) (Figure 5) constructed in the dental laboratory no longer than 4 hours after surgery and screwed at 20 Ncm to minimize the risk of implant rotation. A periapical radiograph was taken as previously described to verify the correct adaptation of the implant screw. Minimal chairside adjustment was needed to fit the temporary crown perfectly on the implant. The provisional prosthesis was then highly polished and kept out of occlusal contact, using articulation paper markings (Figure 6). After seven days, the temporary crown was refined for optimal soft tissues esthetics.

Postsurgically the patient received amoxicillin and clavulanic acid 2 g/die for 5 days. Moreover, she was given nimesulide 200 mg/die for 2 days to help reduce inflammation and discomfort. The patient rinsed for 2 minutes daily with 0.12% chlorhexidine solution for 2 weeks and was instructed to follow a soft diet for 1 week.

Prosthodontic procedures

The patient wore the temporary acrylic resin crown replacing the missing tooth for two months while the site was healing. During this period the site was allowed to fill with mature osteoid, whereas the soft tissues were prevented from atrophying.

The final restoration was completed approximately 2 months after the surgical procedure. After the healing period, the temporary crown was removed in order to take a precision impression. A one-step impression was taken using polyether materials (Permadyne Penta H, Permadyne Penta L, 3M ESPE, Seefeld, Germany) (Figure 7) with custom autopolymerizing acrylic resin trays (SR-Ivolen, Ivoclar, Schaan, Liechtenstein) made by the technician at least 24 hours before the impression, to allow complete polymerization of the resin. A thin layer of adhesive, specifically for polyethers, was applied over the internal surface of such trays (Polyether Adhesive, 3M ESPE). The impression was then sent to a dental technician laboratory and poured using an extra-stone plaster type IV (Fuji Rock, GC, Tokyo, Japan) after 5 hours to allow the elastic return of the

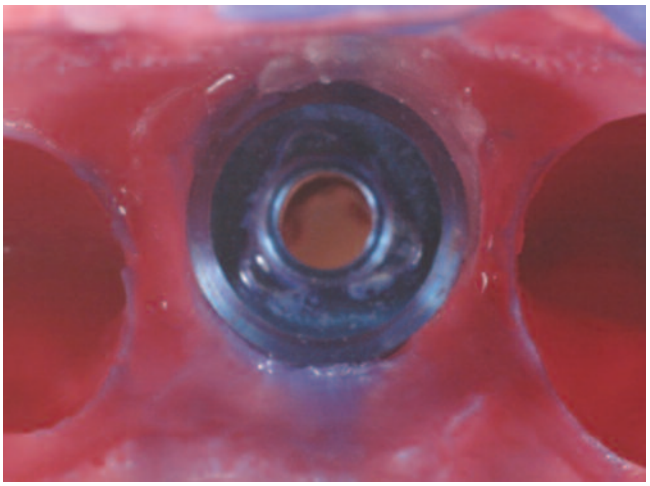

Figure 7. One-step precision impression.

Figure 8. CAD-CAM zirconia coping (left) and custom-made abutment (right).

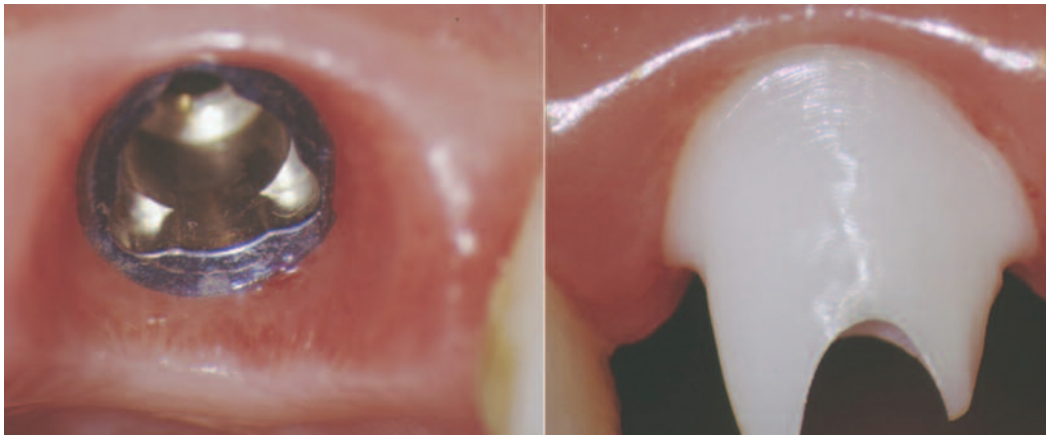

Figure 9. Stereomicroscopic view of periimplant soft tissues (left) and check of marginal adaptation of screwed zirconia abutment to periimplant soft tissues (right).

polyethers. The provisional restoration was carefully screwed intraorally.

The technician modelled a customized abutment using pattern resin, according to the clinical needs of the case . The abutment was then scanned according to the Procera Forte protocol (Procera Sandvik AB, Stockholm, Sweden). The same protocol was followed to make a zirconium oxide shell. Both the prosthodontic customized devices were designed using CAD-CAM technology (Figure 8). A 10x surgical stereomicroscope (Zeiss OpMi1, Zeiss, Oberkochen, Germany) was used to verify the good health of the periimplant soft tissues (Figure 9). The zirconia abutment was screwed intraorally onto the implant (Figure 9) at 32 Ncm with a torquecontrolled device and a periapical radiograph was taken to check its fit onto the implant (Figure 10). The zirconia coping was carefully seated onto the abutment and the final positional impression was taken using the same materials and procedure as previously described. The prosthodontist selected the shade of the final restoration according to the patients' needs. The porcelain veneering of the zirconia coping was produced using a ceramic material specifically developed for zirconium oxide shells (Nobel Rondo, Nobel Biocare) (Figure 11), characterized by a special adaptation to the coefficient of thermal expansion of the zirconium oxide frameworks.

The final all-ceramic restoration was tried-in and cemented by means of a self-adhesive universal resin cement (RelyX Unicem™, 3M ESPE, Seefeld, Germany). The area was isolated with rubber dam and the cementation procedure was performed strictly in accordance with the manufacturers' instructions. The luting agent was inserted into the crown and the patient was requested to hold the crown under occlusal compression until cement polymerization. After 5 minutes, excess cement was removed by means of pumice slurry applied with a rotary bristle brush and a rubber cap under water irrigation. The occlusion was refined as needed and the occlusall surface was polished as previously described (Figure 12). A standardized periapical radiograph was taken to verify the seating of the restoration.

Follow-up procedures

The patient was recalled monthly for a total follow-up period of 6 months. After 6 months, standardized periapical radiographs were taken and bone levels were compared with those noted at the time of implant placement. Health and adaptation of soft tissues were observed and implant mobility and pain due to percussion were checked. The newly formed sulcus attachment was gently inspected with a Teflon periodontal probe to check for tissue adaptation on the implant platform and for any possible pocket formation. The same procedures were then performed at intervals of 6 months over a period of 48 months (Figure 12).

Results

Healing was uneventful. The site was free from infection with normal contours of both soft and hard tissues. Over the whole follow-up period, the implant showed no signs of failure. Neither mobility nor pain were noticed. No damage affected the all-ceramic crown and no technical adjustments were needed.

The patient was pleased with the treatment time and esthetic result.

Discussion

In cases where the structure of postextraction sockets can be preserved, implant treatment with immediate provisionalization offers several advantages. Optimal esthetics is achievable as bone and soft tissue architectures are maintained; patients are provided with a fixed temporary restoration at the time of surgery; treatment time is shortened since second stage surgery is eliminated and bone regeneration therapy is avoided (Attard & Zarb, 2005; Becker, 2005; De Kok et al., 2006; del Castillo,

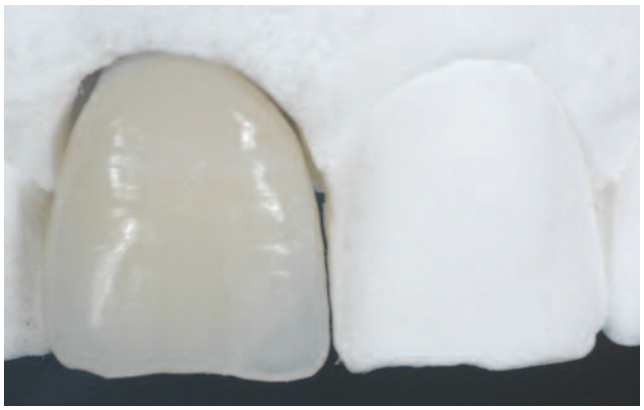

Figure 11. All-ceramic veneered zirconia crown.

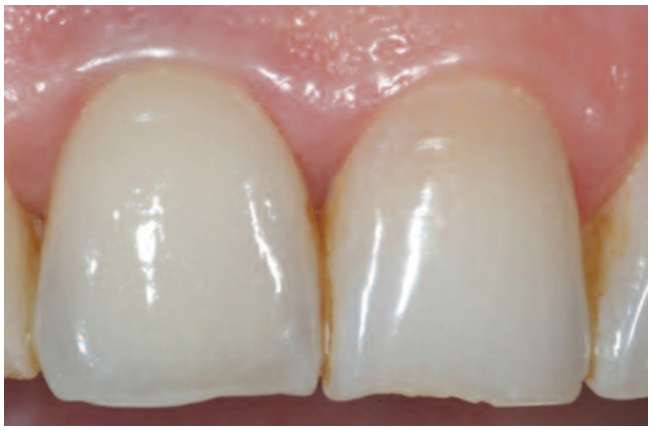

Figure 12. Case finalization.

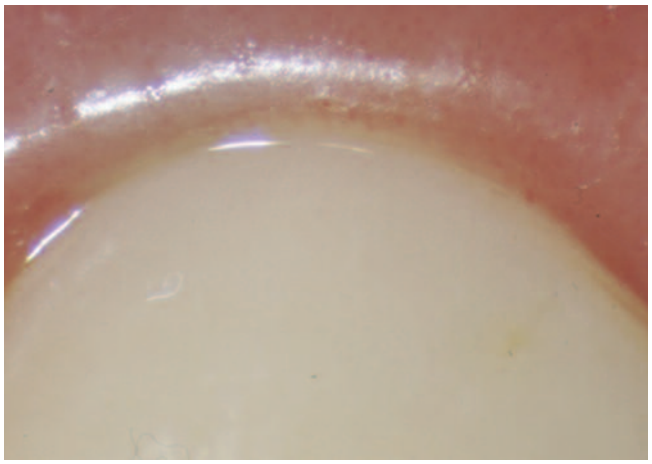

Figure 13. Stereomicroscopic control of the marginal adaptation of soft tissues 48 months after cementation.

2006; Zeren, 2006; Tselios et al., 2006; Park et al., 2005; Wheeler et al., 2000; Josefovici, 2001; Maksoud, 2001; Locante, 2004; Sudbrink, 2005). Moreover, the fresh socket is a metabolically active region with good potential for bone repair and successful implant placement (Josefovici, 2001). Nevertheless, the immediate placement of an implant into a postextraction socket is a technique dependent on the expertise and skill of the surgeon.

Dense bone tissue (i.e. D2 quality) is desirable to have maximum thread engagement and bone adaptation to the implant (Locante, 2004).

The placement of a tapered implant helped to preserve both the soft and hard tissues around the extraction socket significantly (Wheeler et al., 2000). Furthermore, root analog implants have reduced the need of extending the preparation of implant site apically to the extraction socket (Wheeler et al., 2000).

The radiographically evaluated bone level together with the clinical observations of no pain, absence of mobility and tight tissue attachment at level of the implant platform were sufficient evidence of good health at the implant-bone interface (Locante, 2004).

The results of the present study confirmed the well known data about the clinical and esthetic advantages of metal-free CAD-CAM restorations described in the literature (Zarone et al., 2005). Such a solution allowed the dental technician to customize the abutment according to the esthetic concerns of the patient as well as to shorten the laboratory working time, compared with the conventional procedures needed to make metal frameworks (Zarone et al., 2005; Tselios et al., 2006). The patient's demand for esthetics in the anterior region was accomplished.

Although there is still no consensus about the luting agent to be used with all-ceramic restorations, the resin cement used in the described clinical case proved to be reliable in the medium-term observation period. The resin-based composition improved the limited tensile strength of ceramics (Zarone et al., 2005). Furthermore, no interference with the shade of the restoration was noticed.

Conclusion

Within the limitations of the present clinical report, it is possible to affirm that, in the case of clinical conditions being favourable to the placement of an implant into a fresh post-extraction socket, such a treatment modality offers several advantages over a conventional approach: shortened treatment time, reduced need for additional surgery, better preservation of soft periimplant tissues, less potential morbidity, predictable functional and esthetic results, reduced discomfort and lower cost to the patient.

Regarding the prosthodontic solution, the zirconia abutment proved its mechanical effectiveness under load. The all-ceramic

crown provided excellent esthetics and color stability in the medium-term observation period.

Better understanding of bone physiology, surgical procedures and prosthetic biomaterials are necessary to further developments of the described implant-prosthetic technique.

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