

COMPUTER ASSISTED CONNECTIVE TISSUE HARVESTING AND FULL-DIGITAL WORK-FLOW FOR AN IMMEDIATELY LOADED CENTRAL INCISOR POST EXTRACTION IMPLANT ON A MORSE-CONE TISSUE LEVEL CONNECTOR. A CASE REPORT



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PURPOSE. The aim of this case report was to describe an immediate post-extraction central upper incisor implant installation with a full-guided computer assisted approach and immediate temporization on morse-cone tissue level connector through a full-digital workflow, with a customized 3D connective tissue graft harvesting to boost the thin gingival biotype.

MATERIALS AND METHODS. An healthy 49-year-old female with a vertical root fracture on left upper jaw central incisor was treated with an immediate post-extraction implant immediately loaded with a temporary crown on a morse-cone tissue level connector with a full-digital work-flow. A connective tissue graft was harvested to boost facial and papillae tissues with a new computerized and customized connective tissue harvesting technique.

RESULTS. One year after final prosthesis delivery no biological and prosthetic complications were recorded. Healthy peri-implant tissues were recorded with not bleeding on probing, symmetric cervical zenith with the natural right central incisor and natural looking full papillae.

CONCLUSIONS. The good results of this case should prompt randomized controlled trials to verify the potential clinical advantages of this novel approach in treating immediate post-extractive aesthetic implant cases.

CONFLICT OF INTEREST STATEMENT

This case report was not supported by any company. Silvio Mario Meloni and Milena Pisano are scientific consultant of 3P Smart Devices (Scalegne, Italy) and Ubgen (Vigonza, Italy). Marco Tallarico is scientific consultant for Ubgen Company.

INTRODUCTION

The full-digital workflow in single-tooth implant rehabilitation is an approach that seems to simplify clinical procedures with predictable results, nevertheless, there are possible inaccuracies that can result in prosthesis misfitting^{1,2}. The concept of digital workflow includes digital impressions, 3D radiographic scanning, digital planning and the digital design and of the prostheses³. The digital workflow in dental implantology has been mainly combined with computer guided implant surgery procedures, potentially allowing clinicians to be more accurate and precise⁴.

Immediate post extraction implant placement and provisionalization have obtained considerable clinical interest over the last 20 years^{5,6}. The potential advantages are the elimination of the edentulism period and a reduced number of surgical procedures⁵. This procedure is predictable in term of implant prosthesis success but more failures were found by Felice et al. when compared with delayed implants⁶. The same authors found that bone loss was significantly smaller at immediate implants, and aesthetic evaluation scores were higher for immediate and early implants⁶, despite this favorable results immediate implant installation is not able to completely avoid hard and soft tissue remodeling following tooth extraction, pos-

sibly resulting in unsatisfactory aesthetic results in single-tooth replacement^{7,8}. The most common complication following immediate post-extraction implant is the mid-facial recession⁹.

According to Chen and Buser⁹ more than 26% of immediately installed implants displayed advanced recession of the mid-facial mucosa (≥ 1 mm). Also, the initial aesthetic good results observed during the first year of function may be followed by progressive soft tissue recession¹⁰. Seyssens et al. in a 10-year prospective study, affirmed that 33% of the cases presented advanced mid-facial recession¹¹. Apart from vestibular alveolar crest dimensions, the gingival biotype seems to play a role in the soft tissue collapse and the risk for mid-facial recession¹². Since a thin gingival biotype is frequently found in the anterior maxillary teeth, the use of connective tissue grafts to boost the vestibular cervical tissues has been considered a useful procedure¹³. It is author opinion that a right approach to soft tissue in term of periodontal surgery procedures as described by Zucchelli and De Sanctis¹⁴, could lead to a predictable aesthetic results.

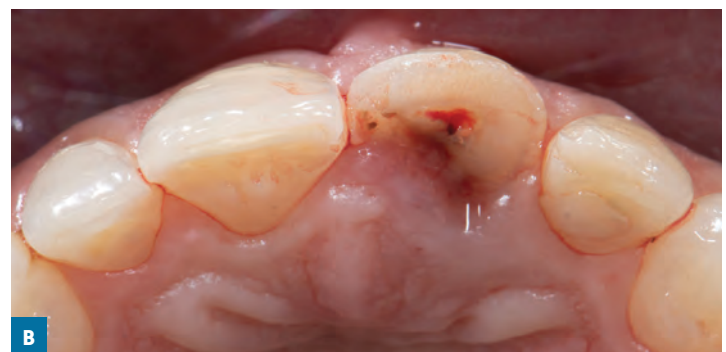
The aim of this case report is to describe an immediate post-extraction central upper incisor implant installation with a full-guided computer assisted approach and immediate temporization on a morse-cone tissue level connector through a full-digital workflow, with a customized 3d connective tissue graft harvesting to boost the thin gingival biotype.

MATERIALS AND METHODS

An healthy non-smoker 49-year-old female with no relevant medical, family or psychosocial history was treated in a private clinic (M.P.) in Arzachena, Italy. The patient underwent to accidental crown-root fracture of the left central maxillary incisor (**FIGS. 1A, B**). Unfortunately after root canal therapy and gluing of the fractured teeth fragment, to solve the emergency pain and aesthetic discomfort, it was evident that a conservative treatment could not have a favorable prognosis due to the deep vertical root fracture. The possibility to perform an immediate loading procedure in a fresh post-extraction socket was explained and the patient accepted.

After clinical examination, an intra-oral scanning was performed (Carestream 8600, Carestream Dental LLC 3625 Atlanta, GA, USA) and STL files were exported. A cone-beam computed tomography (CBCT), (Rayscan, Meersburg, Germany) scan was obtained and combined with the preoperative STL files, (3P Guide, 3diemme, Serenza Como, Italy).

A virtual wax-up was generated to evaluate the ideal implant position; and with the use of a dedicate software (3P Guide) a 12 mm long implant of 3.8 mm diameter (Cono-In, 3P Implafavourite, Scalenghe, Italy) was planned with a 3.8 mm diameter for 1.5 mm long morse-cone abutment (Tissue Level Connector TLC base 3P Implafavourite) (**FIG. 2**). From the virtual planning following a full-digital work flow a screw retained resin temporary crown on titanium temporary abutment was planned on the morse-cone tissue level connector. The CBCT images were converted from a DICOM to STL file to create a digital model of the upper jaw (Relu, Leuven, Belgium) and a virtual left maxillary central incisor extraction was performed to better analyze the



FIGS. 1A, B: Pre operative frontal and occlusal views



FIG. 2: Virtual planning of post extraction implant guided installation

papillary bony peaks and the vestibule cervical bone plate. After virtual analysis, a virtual connective tissue graft was simulated drawing exactly the width and height hypothetically needed (3D Clinical Guide, Sassari, Italy) (FIGS. 3A-C).

From this planning a customized template to harvest the connective tissue graft from the premolar-molar right palatal mucosa was fabricated by a medical resin printer (Formlabs, Somerville, USA) (FIG. 4A). To try to have the same thickness of the harvested tissue, a customized blade holder was fabricated, by a medical resin printer (Formlabs) to be able to harvest a palatal graft 3 mm thick. Preoperative assessment also included study photographs and models.

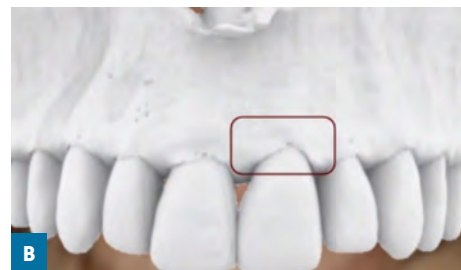
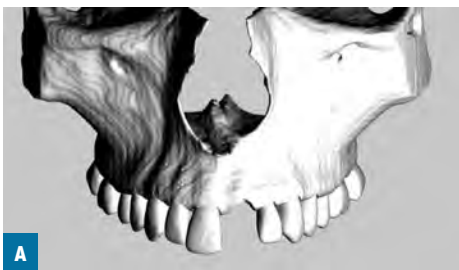
Clinical procedures

The patient received two grams of amoxicillin (Zimox, Pfizer, Rome, Italy) one hour before surgery, and then one gram twice a day for 6 days. Immediately before surgery, the patient rinsed with 0.2% chlorhexidine solution (Curasept, Curaden Healthcare, Saronno, Italy) for one minute. The surgery was performed under local anesthesia (Septanest with adrenaline 1/100,000, Septodont, Saint-Maur-des-Fossés, France).

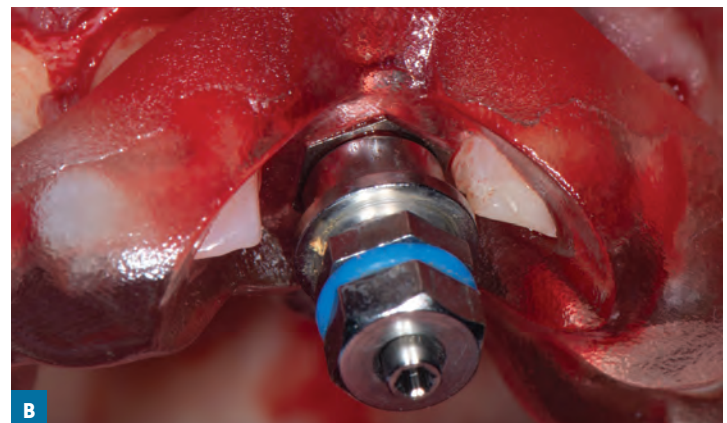
An envelope split-thickness flap was elevated at papilla level then a full thickness flap at alveolar crestal level and after 3-4 mm of full-thickness flap elevation a slight flap passivation was performed¹⁴.

After extraction and wound rinsing with saline one implant of 3.8 mm diameter and 12 mm length (Cono-in 3P Implafavourite) was fully guided installed (FIG. 4B). After guided template removal a morse-cone tissue-level-connector (TLC base 3P Implafavourite) was taped on (FIG. 5). The vestibular gap between the implant threads and the vestibular buccal plate was filled with bovine bone (Re-Bone Ubgen, Vigonza, Italy) (FIG. 6), and a temporary acrylic-resin crown, pre-fabricated from the virtual planning, was screwed to the morse-cone tissue level connector to analyze the fitting and then temporary removed (FIG. 7).

A connective tissue graft was then harvested from the right palatal side with the use of a customized tissue



FIGS. 3A-C: Virtual planning of connective tissue graft



FIGS. 4A, B: Template and fully guided computer guided implant installation

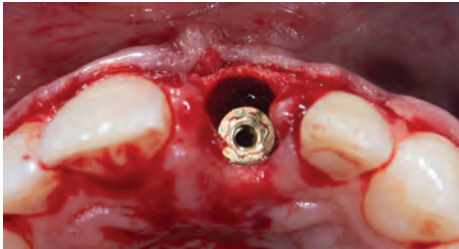


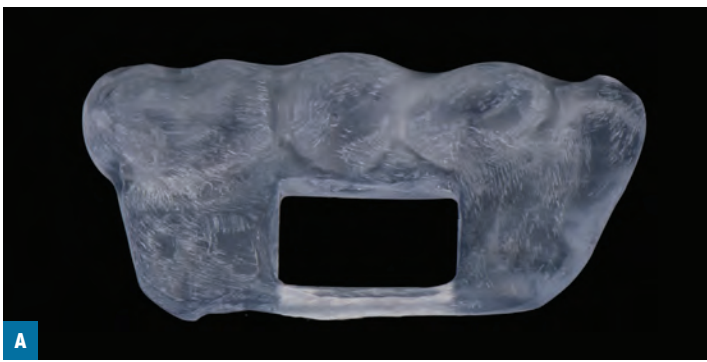
FIG. 5: Morse-cone tissue level connector



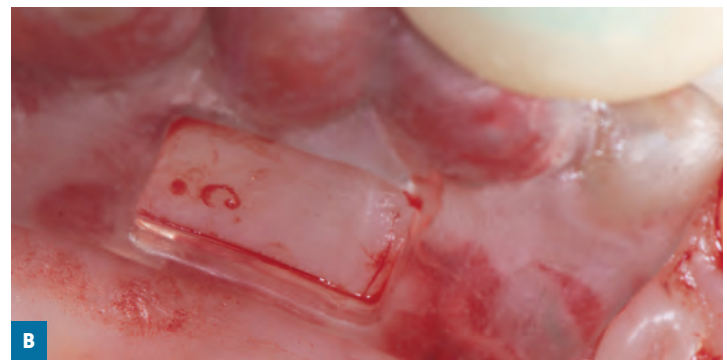
FIG. 6: Post extraction gap filled with bovine bone



FIG. 7: Temporary crown fitted on morse cone tissue level connector



A



B

FIGS. 8A, B: Computer guided template for connective tissue harvesting



A



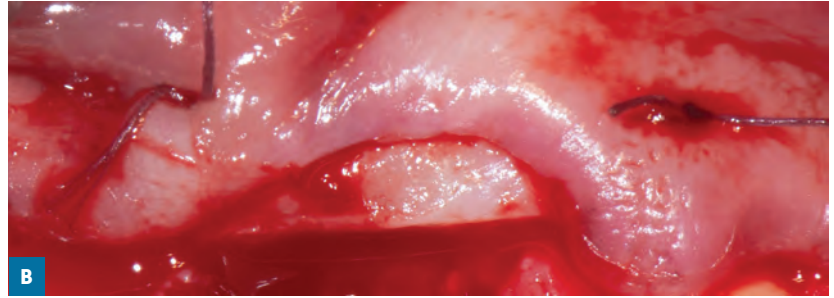
B

FIGS. 9A, B: Customized blade holder for 3 mm thick gingival graft harvesting

harvesting template shaped to harvest in length and width the virtual pre-planned graft (FIGS. 8A, B). After drawing with a n. 15 C blade (Swann-Morton Farnell Italy, Milano, Italy) the area of soft tissue to be harvested, a customized 3 mm long blade holder was used to harvest an epithelium-connective tissue graft (FIGS. 9A, B).

After suturing the palate wound with a e-PTFE 4-0 suture (Elastin, Braun Italia, Milano, Italy), the epithelium was cut-off with a new n. 15 C blade. After papillae epithelium removal, the connective tissue harvested was gently sutured where virtually planned to be grafted with Vicryl 6-0 suture (Simit-Dental, Mantua, Italy) (FIGS. 10A, B). The screw retained acrylic-resin crown on titanium abutment was finally screwed on morse-cone tissue level connector (FIG. 11). The vestibular flap was sutured at papillae level with suspended double-mattress sutures e-PTFE 5-0 suture (Elastin, Braun Italia, Milano, Italy).

Postoperatively, 80 mg of ketoprofen (Oki, Dompé, Milan, Italy) as needed was prescribed. The patient was



FIGS. 10A, B: Connective tissue graft in place



FIG. 11: Peri-apical radiograph after immediate loading

instructed to rinse with 0.2% chlorhexidine (Curasept) three times per day for one week, and to eat soft food for 30 days. Sutures were removed after 7 days.

Nine months later, an intra-oral scan impression was recorded and a screw retained zirconia-ceramic crown on titanium abutment was screwed on the Morse-cone tissue level connector. Clinical pictures and periapical radiographs were taken at prosthesis fitting and one year after loading (FIGS. 12A, B). Clinical follow-up evaluations were performed every three months during the first year of loading (FIG. 13).

RESULTS

One year after final prosthesis delivery no biological and prosthetic complications were recorded. Healthy peri-implant tissues were observed without bleeding on probing, with symmetric cervical zenith with the natural right central incisor and naturally full papillae.

DISCUSSION

The aim of the present case report was to evaluate an implant-supported fully digital workflow for the single tooth replacement on fresh post-extraction socket and to describe a computer guided connective tissue harvesting with calibrated customized blade holder. The healthy peri-implant tissues and the good aesthetic appearance at 1-year follow-up reported in this case report suggests to design a randomized controlled trial with the aim to properly evaluate this approach. Different protocols have been proposed in the literature to transfer the information of the diagnostic wax-up of radiographic examinations¹⁵. A full digital prosthetic project can be carried out directly with the planning software or by matching a digital wax-up in STL format with the corresponding DICOM file^{2,16}.

The use of dental-supported surgical guides allows a greater stability and precision than all other templates with mixed or mucosa support¹⁶.

It is important to remember that each procedure contains its own margin of error, which becomes more relevant in more complex cases^{2,18,19}. According to Pisano et al. the digital work flow could have several drawbacks when performing immediate loading at fully edentulous ridges².

Immediate implant placement and immediate loading have reached considerable scientific evidence during the last two decades^{2,20,21}, while minimizing the surgical morbidity avoiding the edentulism discomfort³, immediate implant placement in fresh post extraction sockets is not able to completely avoid the buccal hard and soft tissue remodeling following tooth extraction⁷⁻⁹.

In a 10-year prospective study, up to 33% of the cases demonstrated advanced mid-facial recession¹¹. Over the vestibular plate thickness, the gingival biotype seems to play a role in the extent of soft tissue collapse and the risk for mid-facial recession around immediately installed implants²², but not solid scientific eviden-



FIGS. 12A, B: Final crown 1 year after loading



FIG. 13: Peri apical radiograph at 1 year after loading

ce is available. The use of soft tissue grafts to convert a thin-scalloped gingival biotype to a thick biotype when installing implants in the aesthetic zone has been first hypothesized by Thoma et al.¹⁵. However a systematic review about the use of connective tissue graft in aesthetic area²⁵ concluded that due to the lack of controlled clinical studies, no comparison could be made between immediately installed implants with or without soft tissue grafting.

Mid-facial recession has become a big concern following fresh socket immediate implant placement^{8,9}. Migliorati et al.²⁴, in a 2-year RCT reported a soft tissue remodeling of -10% in thickness and -18% in highness in the non-grafted group, whereas in the grafted group there was a gain of 35% in thickness and a slight reduction of -11% in highness. Test group reported an increase of aesthetic result (mean pink aesthetic score [PES] = 8) compared with control group (mean PES = 6.65). Yoshino et al.²⁵ in a RCT affirmed that mean facial gingival level changes in aesthetic areas were significantly more pronounced in the group of immediate implant placement without subepithelial connective tissue graft (-0.70 mm) than in the group receiving subepithelial connective tissue grafts (-0.25 mm) at 1 year. The Papilla Index indicated that more than 50% papilla fill was observed in 75% of the test sites and 80% of the control sites. Van Nimwegen et al.²⁶ in a randomized controlled trial reported that the mid-facial mucosa level was significantly different between implants installed in fresh extraction sockets with vestibular subepithelial connective tissue grafts (test group) versus implants augmented with vestibular subepithelial connective tissue graft (control group) both groups, with a mean (\pm SD) change of $+0.20 \pm 0.70$ mm (test group) and -0.48 ± 1.13 mm (control group). This is in accordance with a systematic reviewer of Thoma et al.²⁷ showing more favorable peri-implant health following soft tissue grafting.

According to the above described results we decided to develop a customized computer guided technique for connective tissue graft harvesting associated with immediate post-extraction socket implant installation and temporization with a fully digital workflow with the aim to standardize the clinical protocol.

CONCLUSIONS

The good result at one year after loading should prompt randomized controlled trials to verify the potential clinical advantages of this novel approach in treating challenging aesthetic cases.

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