Single- and Partial Multiple-Unit Provisional Restorations in the Esthetic Area

Rubén Agustín-Panadero, Arturo Llobell-Cortell, Blanca Serra-Pastor, David Peñarrocha-Oltra, and Miguel Peñarrocha-Diago

Abbreviations

3D	Three-dimensional image
BOPT	Biologically oriented preparation technique
CAD/CAM	Computer-aided design/Computer-aided manufacturing
CaP	Calcium/phosphate bioceramics
CBCT	Cone beam computed tomography
HA	Hydroxyapatite
STL	Standard template library

Chapter Resume

This chapter seeks to provide a concise description of the importance and types of provisional restorations available when following an immediate provisionalization approach in the esthetic area and also includes a series of cases described in a step-by-step sequence. These cases are intended to allow the reader to follow the steps understanding the reasons behind them in a continuous and focused way, with a total of 59 images describing the clinical scenarios from the initial situation to final outcome.

Take-Home Messages

Provisional restorations are described as interim prosthesis placed to provide both esthetic and functional benefits until the moment of delivery of the final prosthesis.

Benefits, limitations, and nomenclature regarding the different types of provisional restorations can seem cumbersome. However, their knowledge is important in order to achieve the desired optimum outcome.

Different clinical approaches can be followed in the design and fabrication of the provisional restorations. When indicated, immediate implant-supported provisional restorations are considered the first choice under the different steps of the selection process as they will provide the greater esthetic and functional benefits.

The provisional restoration can also be used as a diagnostic tool that will help the patient, clinician, and dental technician evaluate the future outcome of the definitive restoration.

The influence of the subgingival portion in implant-supported provisional restorations on the final outcome must not be underestimated as it will be able to define both the anatomy of the clinical crown and the appearance of the underlying soft tissues.

Introduction

The immediate implant-supported provisional restoration in the partially or totally edentulous patients is a predictable and well-accepted procedure in dentistry. The Glossary of Prosthodontic Terms defines a provisional prosthesis as a prosthesis designed to improve or evaluate esthetics, speech, and occlusal function in a period of time between implant placement and final restoration with a definitive prosthesis (Driscoll et al. 2017). Planning and design should always take place during the pre-surgical phase of treatment and constitute a tool for communication among the members of the team, which in most cases is of a multidisciplinary nature (prosthodontist, surgeon, dental technician, and patient).

The requirements of a provisional prosthesis are the same as those of any other dental prosthesis, i.e., it should be functional and esthetic and must not create problems for the

R. Agustín-Panadero · B. Serra-Pastor
Prosthodontics and Occlusion Unit, Department of Stomatology, Faculty of Medicine and Dentistry, University of Valencia, Valencia, Spain
e-mail: ruben.agustin@uv.es

A. Llobell-Cortell · D. Peñarrocha-Oltra · M. Peñarrocha-Diago (✉)
Oral Surgery Unit, Department of Stomatology, Faculty of Medicine and Dentistry, University of Valencia, Valencia, Spain
e-mail: david.penarrocha@uv.es; Miguel.penarrocha@uv.es

M. Peñarrocha-Diago et al. (eds.), *Atlas of Immediate Dental Implant Loading*, https://doi.org/10.1007/978-3-030-05546-2_9

correct osseointegration of the dental implant. The material chosen for the provisional prosthesis depends on its physical properties, handling characteristics, esthetics, durability, and costs among others. In selecting one design or another, Priest (2006) considered that eight criteria must be taken into account in order to offer the best solution for each individual case: esthetics, patient comfort, treatment time, laboratory costs, occlusal space, easy removal, durability, and easy modification.

In seeking to improve esthetics, the provisional prosthesis moreover allows us to guide the conformation of the gingival tissue contour during the different healing phases after tooth extraction and/or implant placement. This conformation should allow a good transition between the gums and the prosthetic reconstruction, with the purpose of ensuring an outcome as natural as possible. The provisional prosthesis is most often ovoid in shape, maintaining or improving soft tissue morphology, but this does not imply that such a design is to be used on a systematic basis.

Classification of Provisional Restorations

In implantology, provisionalization can be classified according to the timing of placement, function, type of edentulism, and the ability of the patient to remove the prosthesis:

Timing of Placement

The classification of provisionalization according to the timing of placement refers to whether it is performed before or after the surgery in which the dental implants are placed—though it must be remembered that planning must always be made before surgery.

Provisional prostheses placed before implant surgery are used until the time of implant placement by patients due to esthetic purposes or in order to preserve a correct gingival contour in the event of recent extractions. The prostheses may be removable or fixed to the teeth located adjacent to the edentulous segment.

Postsurgical provisional restorations in turn are placed after implant placement. Thus, conditioned to the surgical and loading protocol involved, the design of the provisional prosthesis will differ depending on the clinical situation.

In turn, when provisionalization is performed after the placement of dental implants and the prosthesis is retained by them, fitting of the provisional restoration may be immediate, early, or deferred. Immediate provisionalization is defined as fitting of the provisional prosthesis until 7 days after implant placement, while early provisionalization is defined as fitting of the prosthesis after this period but before the osseointegration is complete. Deferred provisionalization is consistent with the conventional loading protocol, in which the implant remains free from loading for over 2 months (Esposito et al. 2013), and is therefore performed after the implant osseointegration period.

The decision to perform immediate, early, or deferred provisionalization is conditioned to the primary implant stability achieved at surgery, the position of the peri-implant gingival tissue, and the morphology of the bone surrounding the implant site.

Function

Two types of immediate loading have been described in the literature: (a) functional or occlusal immediate loading and (b) nonfunctional or non-occlusal immediate loading. Functional or occlusal immediate loading refers to the use of a provisional or definitive prosthesis placed on the day of surgery and in contact with the opposing or antagonist arch (Degidi and Piattelli 2003). In contrast, nonfunctional or non-occlusal immediate loading involves modification of the immediate provisional restoration in order to prevent occlusal contacts in centric and lateral excursive movements—thus avoiding the risk of mechanical overloading by functional or parafunctional forces (Misch 1998) although it should also be stated that these terms can be misleading, however, since "immediate provisionalization" does not prevent the restoration from being functional (Roccuzzo et al. 2018). Nonfunctional immediate loading is suggested by the authors for single anterior restorations, while functional immediate provisionals are suggested for partial and full arch clinical scenarios. However, Lideboom et al. observed no radiological or esthetic differences after 1 year of follow-up between single maxillary implants subjected to "immediate provisionalization" and implants subjected to "immediate loading."

Depending on the clinical situation, both types of immediate restoration serve to maximize esthetics and help secure an adequate prosthetic emergence profile, particularly at post-extraction implant sites (Locante 2001). In this regard, it must be taken into account that careful optimization of the emergence profile at the abutment/restoration interface is decisive for ensuring a good definitive appearance of the prosthesis (Steigmann et al. 2014).

Type of Edentulism

Depending on the type of edentulism involved, provisionalization can be defined as full arch (fully edentulous arch), partial (partially edentulous arch), or single (a subgroup of partial provisionalization in which a single implant is provisionalized). In line with the objectives of this chapter, we

will exclusively focus on the provisionalization of partially edentulous arches and single units.

Ability of the Patient to Remove the Prosthesis

Depending on the ability of the patient to remove the prosthesis, provisional restorations are classified as either removable or fixed.

Removable Provisional Restoration

Traditional removable provisional restorations are made of conventional acrylic or composite resins. Their advantages include particularly low costs and easy fabrication and fitting. Their disadvantages include an inherent risk of negatively affecting the osseointegration process, esthetic limitations and probable patient discomfort, and functional limitations. The reason why provisional restorations of this kind can affect osseointegration is because their gingival portion may transmit uncontrolled loading forces to the implants in situations where the prosthesis comes too much in contact with the soft tissues, giving rise to peri-implant tissue loss (Bergkvist et al. 2008).

An alternative to the use of a conventional removable partial prosthesis is the application of an Essix retainer (Moskowitz et al. 1997). This design consists of an acetate splint made in the laboratory using a vacuum technique, where a composite filling or acrylic tooth is placed in the edentulous zone, avoiding excessive contact with the gingival tissue. Such removable prostheses are usually indicated for short periods of time and/or in cases of limited interocclusal space.

Fixed Provisional Prosthesis

Fixed provisional prostheses are prostheses that cannot be intentionally removed by the patient. Two subgroups can be established: implant-supported fixed provisional prostheses and tooth-supported (i.e., non-implant-supported) fixed provisional prostheses.

Implant-Supported Restoration

Provisional fixed implant-supported restorations are provisional prostheses directly fixed onto the implant by means of a provisional abutment. Priest (2006) considered that although peri-implant soft tissue maturation can be achieved with ovoid pontics, direct provisional restoration over implants is the most effective strategy. We consider this type of provisional restoration to be the first-choice option in cases characterized by strong esthetic demands. Nevertheless, a number of criteria must be met in order to ensure success with these restorations: sufficient primary implant stability must be ensured (Becker et al. 2011), with adequate general health of the tissues in the zone and with no important initial discrepancy between the height of the gingival margin and the adjacent teeth (Santosa 2007).

Correct occlusal fit of the prosthesis over implants is essential for implant-based treatment success. Some authors advise light occlusal contact in cases of immediate loading of multiple splinted implants. However, in the case of immediate loading of single implants, occlusal contacts in centric and excursive movements (protrusive and lateral) are to be avoided (Siadat et al. 2017). For this reason, provisional restorations in infraocclusion are recommended (Schnitman et al. 1997).

Depending on the way in which the prosthesis is placed on the provisional abutments, fixed implant-supported restorations can be subdivided into cement-retained or screw-retained prostheses according to the clinical situation of the patient and the preferences of the clinician.

Cement-Retained Restoration

Cemented provisional restorations are advised for esthetic reasons in clinical situations where implant angulation does not allow the fitting of a screw-retained provisional prosthesis with palatine/lingual access (Chee et al. 2018). Special care is required with these provisional restorations to not leave traces of cement in the subgingival zone and/or in contact with other tissues such as bone graft or connective tissue, since this could favor increased bacterial contamination of the peri-implant sulcus and adversely affect the final outcome. Subgingival margins are therefore to be avoided.

Screw-Retained Restoration

Screw-retained provisional restorations eliminate the risk of cement accumulation in the subgingival portion (Wittneben et al. 2013) and make it easier to place and remove the implant—this being very important for the conformation of an adequate emergence profile. In contrast, the use of a screw-retained provisional prosthesis implies increased bacterial contamination in the internal portion of the connection compared with a cement-retained provisional restoration (Penarrocha-Oltra et al. 2016).

Tooth-Supported Restoration

Following implant placement we can fit a Maryland (Livaditis and Thompson 1982) provisional prosthesis with an ovoid pontic (Liu 2004), or, when having to crown the teeth adjacent to the implant (Zitzmann et al. 2002), a fixed partial bridge over the previously trimmed abutments can be fitted. As commented above, the surface of the prosthesis should not establish too much contact with the peri-implant soft tissues or healing abutment during the osseointegration period. With regard to the Maryland bridge, its minimally invasive character constitutes an advantage, though its strong tendency toward decementation and its limitations for use in

Table 1 Modification of crown contour to optimize the soft tissue profile (Priest 2006)

Emergence profile	Crown contour
Raise gingival margin apical	Increase buccal convexity
Lower gingival margin coronal	Reduce buccal convexity
Raise papilla apical	Reduce proximal contours
Lower papilla coronal	Increase proximal contours

patients with excessive overbite or parafunctional habits are regarded as disadvantages.

Importance of the Provisional Restoration

In recent years esthetics have become a primary concern in dental treatments for both clinicians and patients. Provisional restorations may serve as diagnostic prostheses to evaluate the outcome of the definitive restoration. They allow the patient and clinician to visualize a condition very similar to the final outcome and thus establish an opinion. However, esthetic success in implantology is not only conditioned by the shape, color, contour, and naturalness of the prosthesis as such but also by the topography and appearance of the soft tissues. One of the most important functions of provisional restorations in implantology is therefore to serve as a guide for conformation of the soft tissue contour. In order to understand the role of the provisional prosthesis over implants in relation to the soft tissue contour, we first must describe terms such as the emergence profile and the interdental papilla.

The emergence profile is the part of the prosthesis that will define the gingival contour of the restoration and extends from the gingival margin to the most coronal portion of the implant neck. Because of its location, this portion largely conditions the final esthetic outcome of the individualized restoration; it is therefore advisable to conform and remodel it through personalization of the provisional prosthesis. Personalization requires us to define two zones along the emergence profile: the critical contour and the subcritical contour (Su et al. 2010). The critical profile is defined as the profile close to the gingival margin. Alterations of the critical profile will modify the morphology of the clinical crown. The subcritical contour in turn extends between the critical profile and the coronal portion of the implant neck. Alterations of the subcritical profile will modify gingival tissue tone and may help us to simulate the presence of the root of the tooth we are replacing (Table 1).

The interdental papilla was described by Cohen (1967) as a series of buccal and lingual peaks of keratinized tissue with interproximal zones of nonkeratinized or parakeratinized tissue. The interdental papilla is not only regarded as a biological barrier that protects the periodontal structures but also as a marker of dental esthetics, since a deficient or missing papilla gives rise to a black tone that poses a great esthetic problem. At present, preservation of the morphology of the interdental papilla in the anterior sector poses an esthetic challenge in implant-supported restoration treatments. Tarnow et al. (2003) reported that the average height of the papilla between two implants is less than that found between natural teeth and that the height is moreover influenced by the presence and dimensions of the interproximal bone.

Treatment Sequence in Immediate Provisionalization

Cement-Retained Single-Unit Provisional Restoration: Dr. Rubén Agustín

See Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, and 28.

Fig. 1 Pre-treatment view showing the erythematous and retracted gingival zone corresponding to the left upper central incisor (2.1) carrying a buccal ceramic veneer

Fig. 2 Pre-treatment occlusal view. The palatine mucosa corresponding to the left upper central incisor appears edematous and inflamed

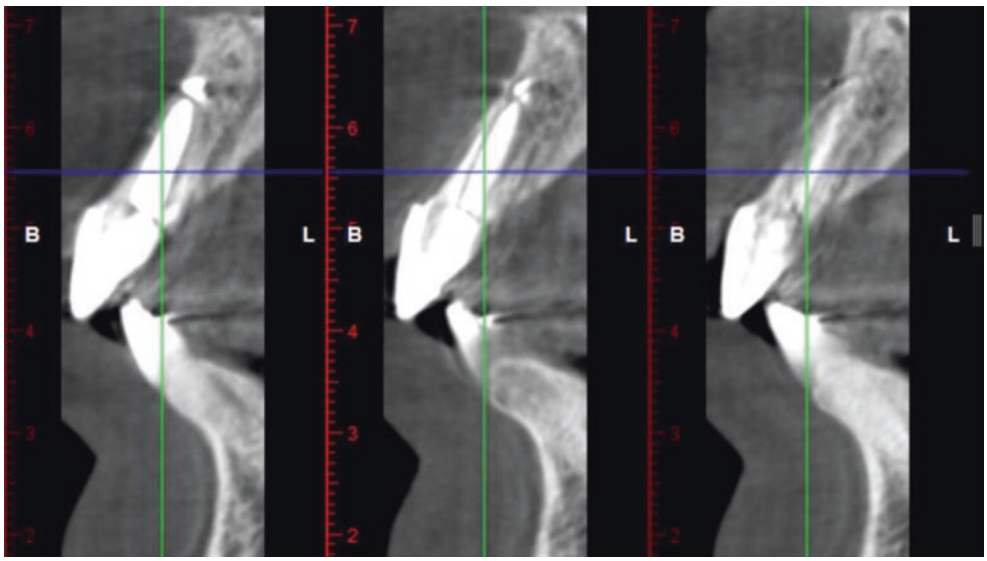

Fig. 3 Pre-treatment cone beam computed tomography (CBCT) view. Vertical root fracture of 2.1 is observed, with absence of the buccal cortical component

Fig. 4 View of the fractured tooth after removal

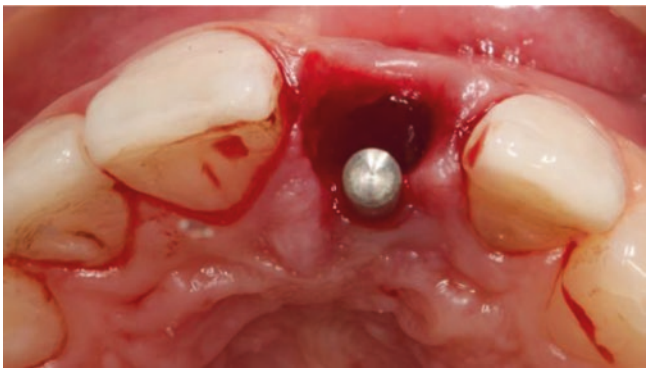

Fig. 6 Occlusal view of the surgical implant bed

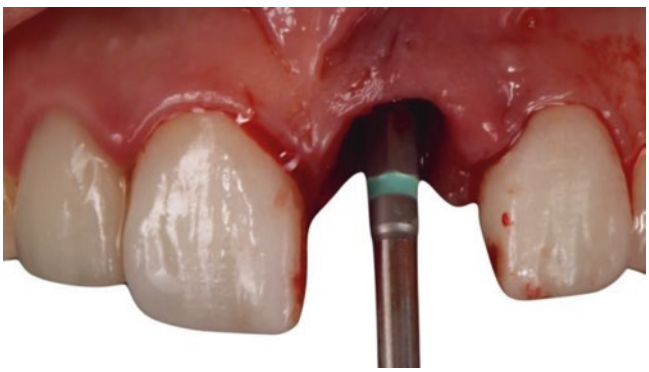

Fig. 5 Buccal view of the surgical positioner for checking bone drilling to secure correct implant placement

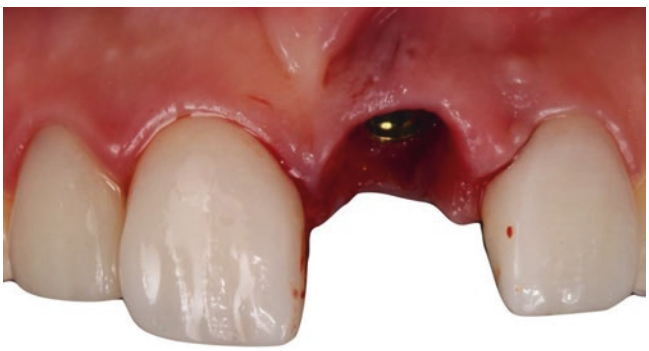

Fig. 7 Buccal view of the tissue level of the converging collar implant (PRAMA. Sweden & Martina) placed in the post-extraction site

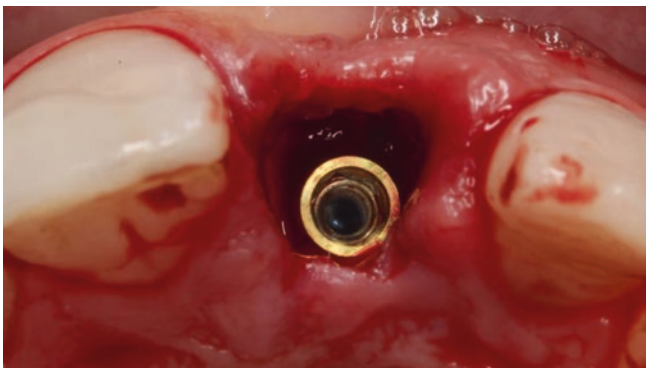

Fig. 8 Occlusal view of the implant placed in the palatine zone of the post-extraction site

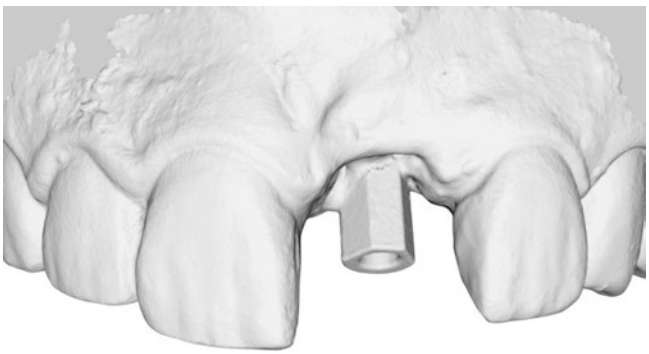

Fig. 9 Digital scan (STL) of the scan body over implant after placement of the latter

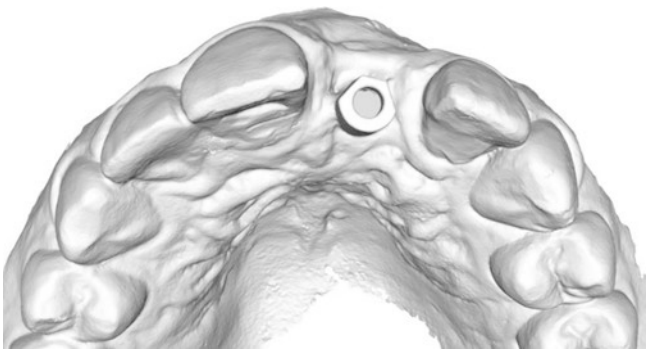

Fig. 10 Occlusal view of the digital scan of the implant to fabricate the immediate loading provisional cement-retained crown and abutment

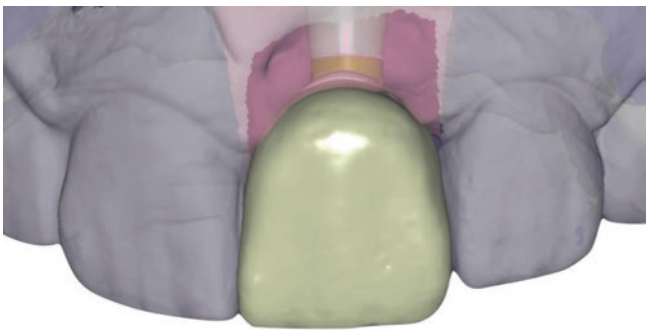

Fig. 11 Virtual design of the resin crown and titanium abutment of the immediate loading provisional cement-retained prosthesis

Fig. 12 Stereolithographic resin model after fabrication with a 3D printer

Fig. 13 Titanium abutment without finishing line (BOPT), fabricated using CAD/CAM technology

Fig. 14 Immediate loading provisional cement-retained resin crown (fabricated from resin blocks drilled with the CAM machine)

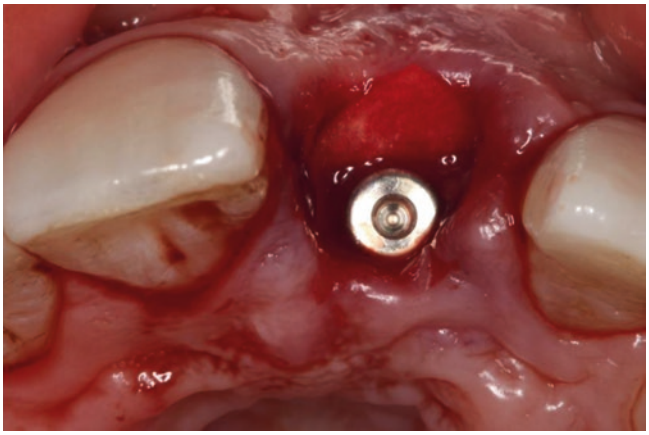

Fig. 17 View of the collagen membrane positioned palatine to the connective tissue graft, acting as a barrier between the soft tissue graft and bone. This allows placement of the synthetic bone graft in the buccal area of the exposed implant in order to regenerate the lost buccal bone

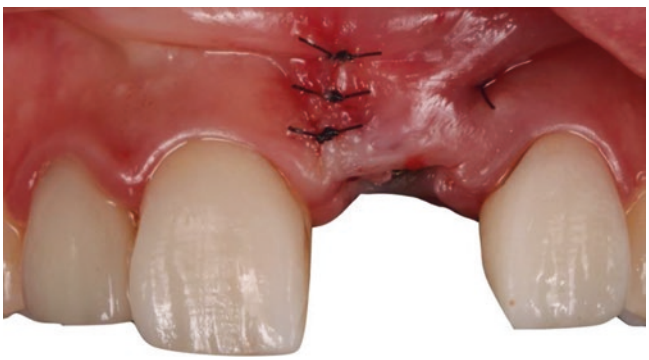

Fig. 15 Placement of a connective tissue graft buccal to the socket to correct the volume defect in the buccal area

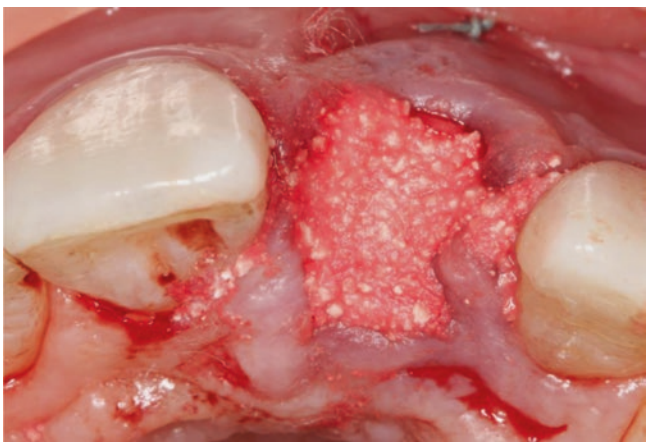

Fig. 18 Occlusal view of the synthetic bone graft (Maxresorb® Inject. Active nano-HA, Biphasic Ca/P and HA)

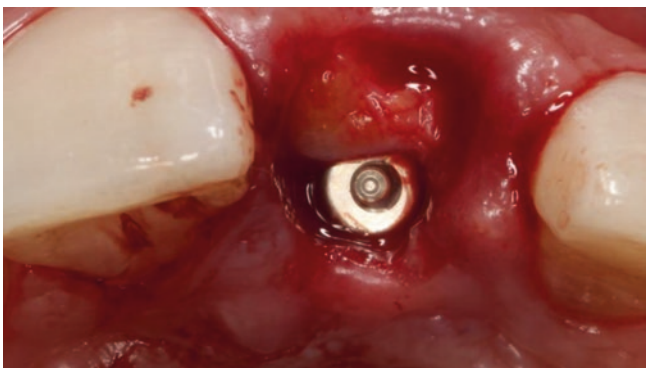

Fig. 16 Occlusal view of the location of the connective tissue graft

Fig. 19 Placement of an esthetic immediate loading implant-supported fixed Maryland bridge carried by the patient during the first 48 h until the CAD/CAM immediate loading prosthesis has been prepared

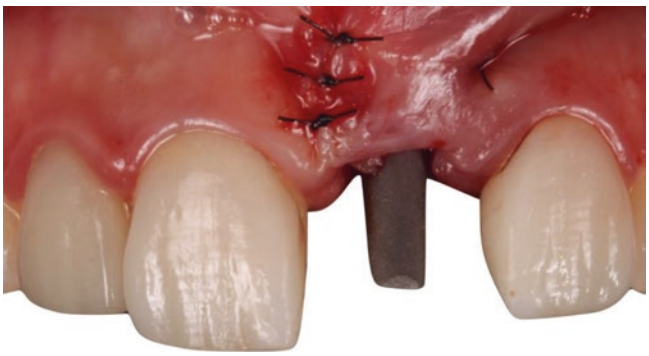

Fig. 20 Buccal view of the titanium abutment 48 h after implant placement surgery

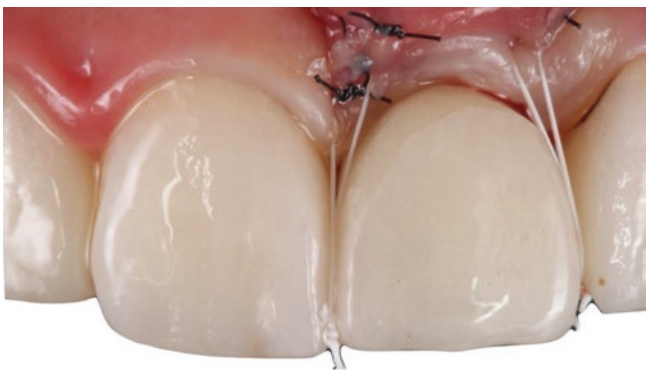

Fig. 21 Buccal view of the cement-retained provisional resin crown on the titanium abutment using TempBond Clear™ (Kerr Dental) provisional cement

Fig. 22 Healing of the keratinized mucosa of the implant 15 days after surgery

Fig. 23 Lateral view of the keratinized mucosa of the implant 10 weeks after surgery

Fig. 24 Occlusal view of the keratinized mucosa after implant osseointegration

Fig. 25 Buccal view of the definitive lithium disilicate cement-retained prosthesis

Fig. 26 Posttreatment buccal view 2 weeks after placement of the ceramic cement-retained crown on the implant of 2.1 and replacement of the ceramic veneers on the rest of the upper incisors (1.1, 1.2, and 2.2)

Fig. 27 Occlusal view of the keratinized mucosa around the titanium abutment 2 weeks after placement of the definitive ceramic crown

Fig. 28 Radiographic view of the implant-abutment-crown unit 10 weeks after implant surgery

Screw-Retained Single-Unit Provisional Restoration: Dr. Arturo Llobell

See Figs. 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, and 50.

Fig. 29 Initial situation presents a fractured tooth #21 with a coronally positioned gingival margin as well as translucency of the darkened root portion through the gingival tissue

Fig. 30 Initial situation presents a fractured tooth #21 with a coronally positioned gingival margin as well as translucency of the darkened root portion through the gingival tissue

Fig. 31 Initial situation presents a fractured tooth #21 with a coronally positioned gingival margin as well as translucency of the darkened root portion through the gingival tissue

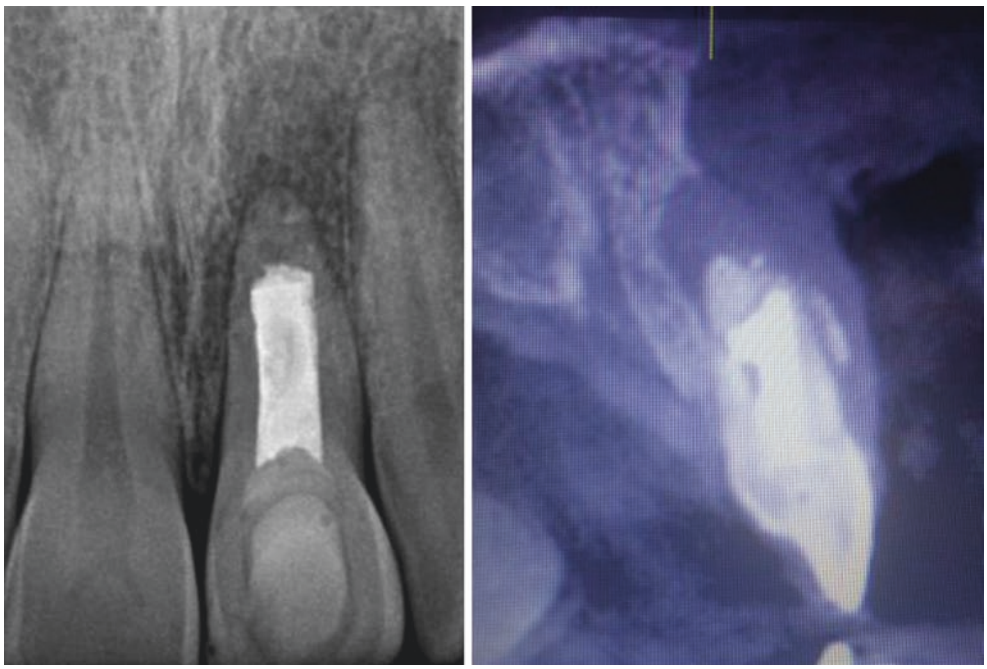

Fig. 32 Periapical radiograph and cone beam computed tomography (CBCT) reveal an alveolar defect (fenestration) on the apical position of the tooth root

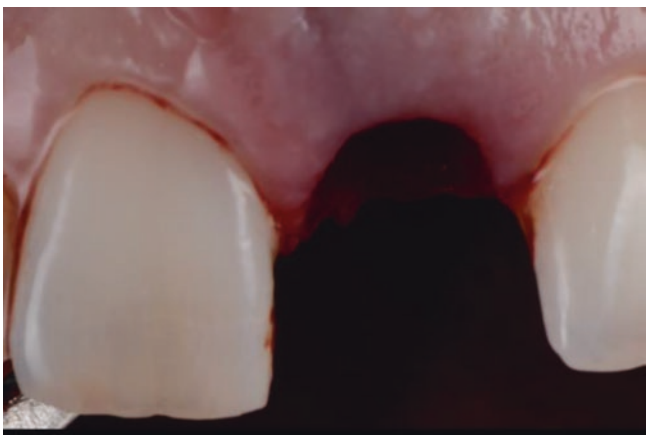

Fig. 33 Atraumatic extraction performed maintaining an intact gingival architecture and blood supply

Fig. 35 Fabrication of the screw-retained immediate implant provisional restoration with a slight concave subgingival profile

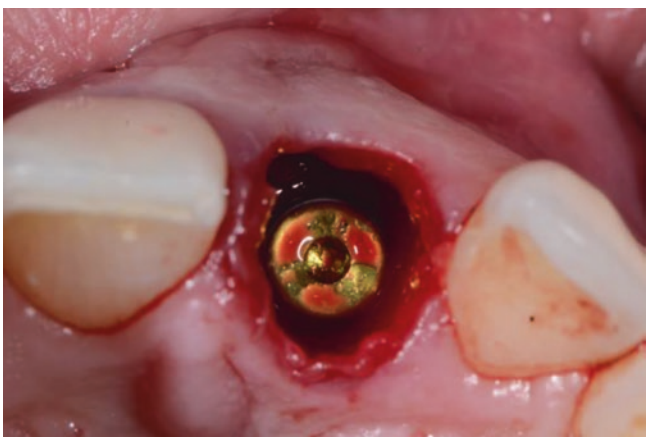

Fig. 34 Flapless implant placement (Nobel Active) in a palatal position leaving a buccal gap that will be filled with a xenograft

Fig. 36 Placement of the xenograft (Bio-Oss, Geistligh Pharma AG) after implant placement and provisional fabrication on the buccal gap between the implant and remaining alveolar bone

Fig. 37 Placement of the immediate provisional restoration following the gingival contours of the pre-existing tooth that was extracted and a concave subgingival profile, sealing the extraction site with the implant and xenograft

Fig. 38 Clinical situation 3 months after the surgical phase was performed

Fig. 39 Gingival contours 3 months after the surgical phase was performed

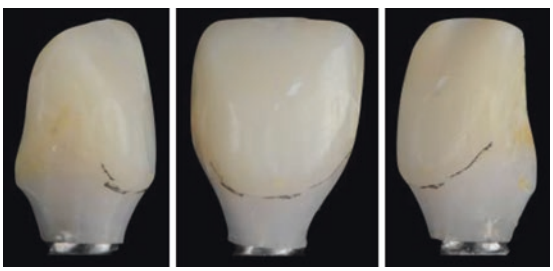

Fig. 40 Outline of the gingival margin

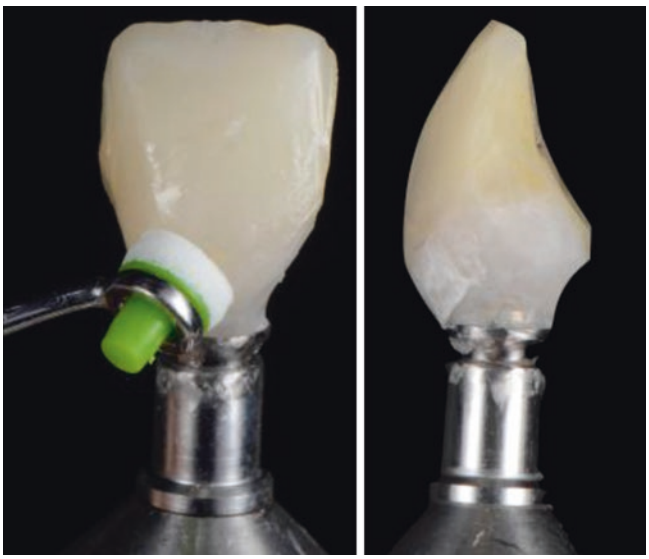

Fig. 41 Contour modifications using composite resin (Tetric EvoCeram Ivoclar Vivadent) in order to achieve a more desirable gingival morphology

Fig. 42 Clinical situation and gingival morphology after contour modifications

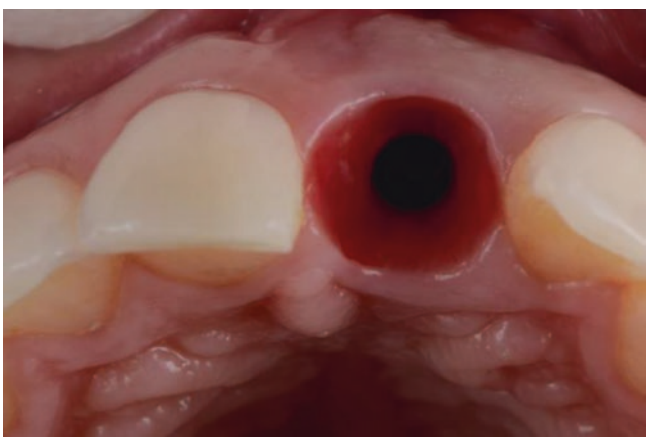

Fig. 43 Clinical situation and gingival morphology after contour modifications

Fig. 44 Fabrication of a customized impression coping following the contours achieved in the provisional restoration

Fig. 45 Fabrication of a customized impression coping following the contours achieved in the provisional restoration

Fig. 46 Fabrication of a customized impression coping following the contours achieved in the provisional restoration

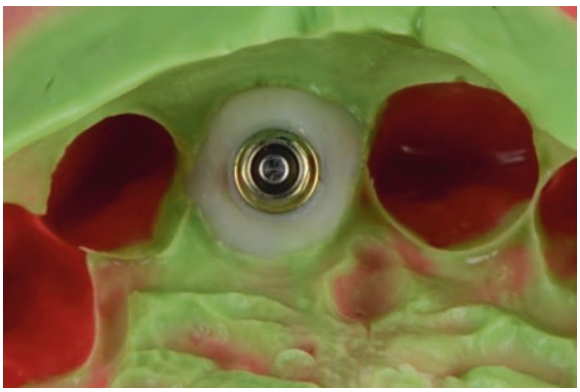

Fig. 47 Open tray final impression using an addition silicone (Elite HD+, Zermack)

Fig. 48 Final screw-retained prosthesis fabricated in zirconia with layered feldespathic porcelain in the buccal aspect to improve the esthetic outcome. Connection to the implant is made with the use of a titanium cylinder (Nobel Biocare)

Fig. 49 Final outcome, 20-month follow-up

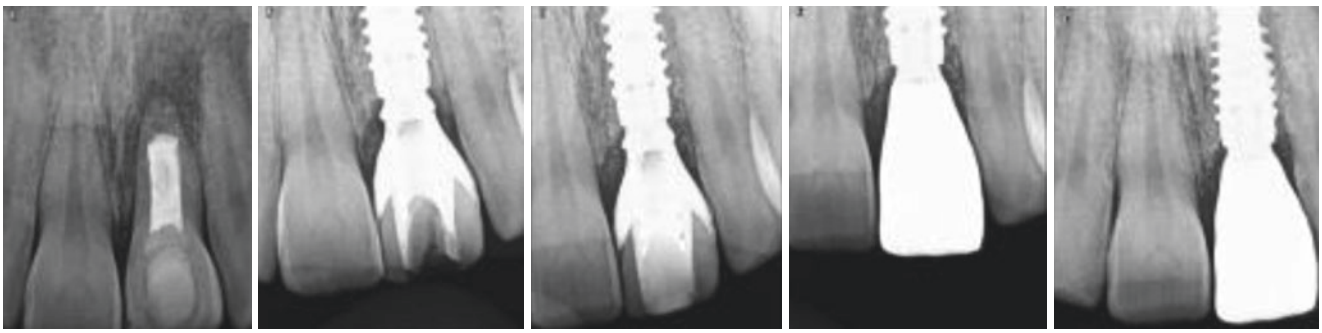

Fig. 50 Radiographic analysis through the different treatment phases

Fig. 51 Initial situation of the lower anterior teeth presenting significant bone loss and malposition

Fig. 53 Clinical situation after tooth extraction

Fig. 52 Initial situation of the lower anterior teeth presenting significant bone loss and malposition

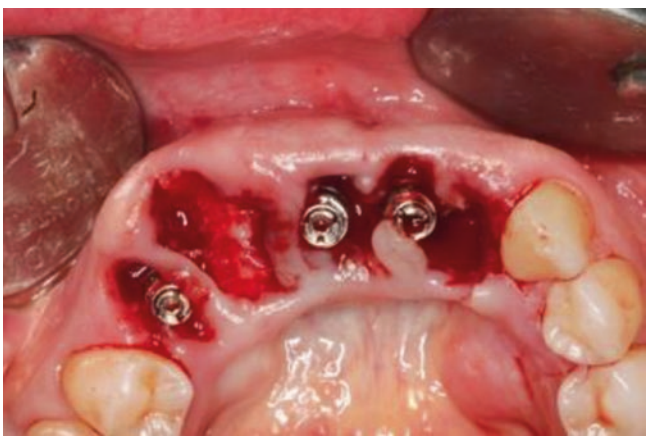

Fig. 54 Clinical situation after implant placement (Phibo TSA®)

Partial Multiple-Unit Immediate Provisional Restoration: Drs. Miguel and David Peñarrocha

See Figs. 51, 52, 53, 54, 55, 56, 57, 58, and 59.

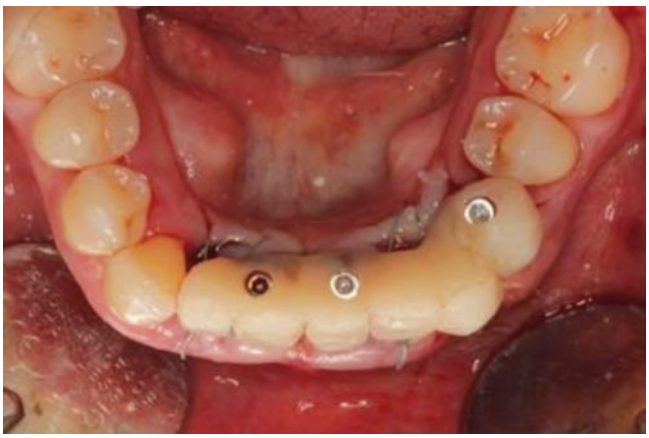

Fig. 55 Immediate fixed screw-retained provisional restoration on the day of surgery

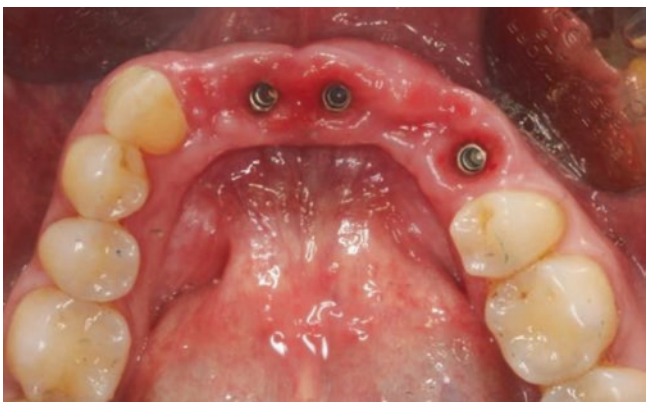

Fig. 56 Immediate fixed screw-retained provisional restoration after healing period

Fig. 57 Healing of the gingival tissue around the implants

Fig. 58 Clinical situation of the final restoration

Fig. 59 Clinical situation after delivery of the final restoration

References

Becker CM, Wilson TG, Jensen OT. Minimum criteria for immediate provisionalization of single-tooth dental implants in extraction sites: a 1-year retrospective study of 100 consecutive cases. J Oral Maxillofac Surg. 2011;69:491–7.

Bergkvist G, Simonsson K, Rydberg K, Johansson F, Dérand T. A finite element analysis of stress distribution in bone tissue surrounding uncoupled or splinted dental implants. Clin Implant Dent Relat Res. 2008;10:40–6.

Chee W, Felton DA, Johnson PF, Sullivan DY. Cemented versus screw-retained implant prostheses: which is better? Int J Oral Maxillofac Implants. 2018;14:137–41.

Cohen L. The types of keratinization occurring in the gingiva of Macaca irus. Periodontics. 1967;5(2):73–5.

Degidi M, Piattelli A. Immediate functional and non-functional loading of dental implants: a 2- to 60-month follow-up study of 646 titanium implants. J Periodontol. 2003;74:225–41.

Driscoll CF, Freilich MA, Guckes AD, Knoernschild KL, Mcgarry TJ. The glossary of prosthodontic terms. 2017. http://www.academyofprosthodontics.org/_Library/ap_articles_download/GPT9.pdf.

Esposito M, Grusovin MG, Maghaireh H, Worthington HV. Interventions for replacing missing teeth: different times for loading dental implants. Cochrane Database Syst Rev. 2013;3:CD003878.

Liu C-LS. Use of a modified ovate pontic in areas of ridge defects: a report of two cases. J Esthet Restor Dent. 2004;16:273–83.

Livaditis GJ, Thompson VP. The Maryland bridge technique. TIC. 1982;41:7–10.

Locante WM. The nonfunctional immediate provisional in immediate extraction sites: a technique to maximize esthetics. Implant Dent. 2001;10:254–8.

Misch CE. Nonfunctional immediate teeth. Dent Today. 1998;17:88–91.

Moskowitz EM, Sheridan JJ, Celenza F, Tovilo K, Muñoz AM. Essix appliances. Provisional anterior prosthesis for pre and post implant patients. N Y State Dent J. 1997;63:32–5.

Penarrocha-Oltra D, Monreal-Bello A, Penarrocha-Diago M, Alonso-Perez-Barquero J, Botticelli D, Canullo L. Microbial colonization of the peri-implant sulcus and implant connection of implants restored with cemented versus screw-retained superstructures: a cross-sectional study. J Periodontol. 2016;87:1002–11.

Priest G. Esthetic potential of single-implant provisional restorations: selection criteria of available alternatives. J Esthet Restor Dent. 2006;18:326–38.

Roccuzzo M, Roccuzzo A, Ramanuskaite A. Papilla height in relation to the distance between bone crest and interproximal contact point at single-tooth implants: a systematic review. Clin Oral Implants Res. 2018;29:50–61.

Santosa RE. Provisional restoration options in implant dentistry. Aust Dent J. 2007;52:234–42.

Schnitman PA, Wohrle PS, Rubenstein JE, DaSilva JD, Wang N-HH. Ten-year results for Branemark implants immediately loaded with fixed prostheses at implant placement. Int J Oral Maxillofac Implants. 1997;12:495–503.

Siadat H, Alikhasi M, Beyabanaki E. Interim prosthesis options for dental implants. J Prosthodont. 2017;26:331–8.

Steigmann M, Monje A, Chan H-L, Wang H-L. Emergence profile design based on implant position in the esthetic zone. Int J Periodontics Restorative Dent. 2014;34:559–63.

Su H, Gonzalez-Martin O, Weisgold A, Lee E. Considerations of implant abutment and crown contour: critical contour and subcritical contour. Int J Periodontics Restorative Dent. 2010;30:335–43.

Tarnow D, Elian N, Fletcher P, Froum S, Magner A, Cho S-C. Vertical distance from the crest of bone to the height of the interproximal papilla between adjacent implants. J Periodontol. 2003;74:1785–8.

Wittneben J-G, Buser D, Belser UC, Brägger U. Peri-implant soft tissue conditioning with provisional restorations in the esthetic zone: the dynamic compression technique. Int J Periodontics Restorative Dent. 2013;33:447–55.

Zitzmann NU, Marinello CP, Berglundh T. The ovate pontic design: a histologic observation in humans. J Prosthet Dent. 2002;88:375–80.