Immediate fixed full-arch rehabilitation of periodontitis patients

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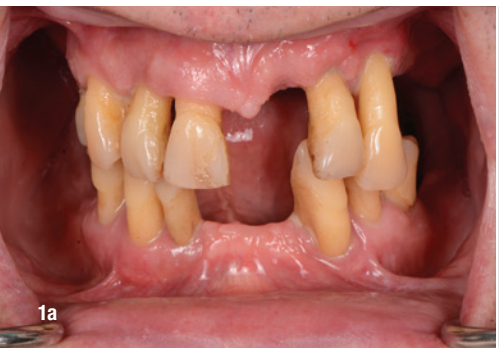
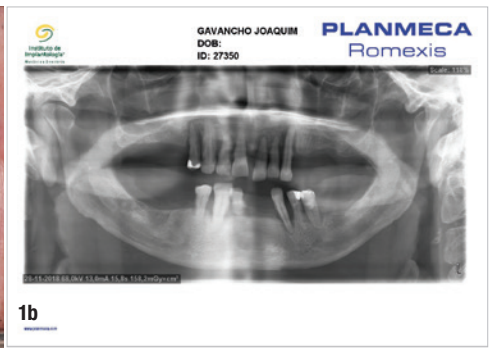
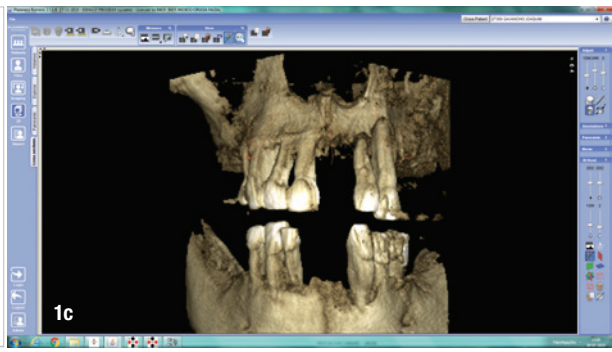






Figs. 1a–c: Initial pre-op dental and osseous conditions. Frontal view **(a)**, panoramic radiograph **(b)**, CBCT scan visualising the osseous and dental anatomical conditions **(c)**.

Background

Untreated edentulism can have a profound impact on a patient's oral health, general health and well-being by causing functional limitations, and it can lead to socio-psychological impairments, metabolic changes and even a reduced life expectancy.[1–4] Implant-supported complete dentures have established themselves as a viable treatment modality for edentulism, since they lead to an improved quality of life and patient satisfaction and are distinguished by long-term clinical success.[5,6] Among these, implant-supported fixed complete dentures (IFCDs) have demonstrated long-term implant survival rates of ≥95% and ≥97% after five years in the maxillary arch and after ten years in the mandibular arch, respectively.[7] Immediate placement and loading represent an increasingly established option for reducing the overall time required for IFCD rehabilitation for both the patient and the clinician. Optimised implant surface properties and designs result in optimised primary stability and accelerate bone integration irrespective of bone quality, supporting immediate protocols.[8–10] Immediate loading protocols might require specific placement and loading criteria in order to ensure clinical efficacy.[11] Meta-analyses of clinical data indicating equivalent five-year post-loading implant survival rates when comparing immediate and delayed loading protocols suggest that these criteria can be achieved in the case of immediately loaded IFCDs.[12–14]

IFCD rehabilitation requires the careful consideration of a variety of factors, including the available surgical protocols, prosthodontic options, patient's medical condition and patient's preferences. Specific consideration should be given to the osseous condition, potential risk factors, patient's expectations and experience of the treating clinician.[11] With the aim of standardising treatment approaches for IFCDs and in agreement with the conclusions of the sixth ITI Consensus Conference, Caramês recently reported on a clinical decision support system (CDSS) to standardise the treatment approach for IFCDs based on the osseous anatomical conditions and level of alveolar atrophy of the patient.[15,16] This system classifies five levels of treatment complexity and is applicable for straightforward cases with sufficient bone quantity to complex cases with limited bone quantity and quality. The CDSS further provides specific guidance for the choice of implant rehabilitation scheme and assists in identifying any need for bone augmentation to improve the osseous support in the context of the patient's facial aesthetics.[16]

Consideration of the local alveolar anatomy and bone quality after tooth extraction may become even more important in the case of any compromised endodontic or periodontal conditions prior to treatment.[17,18] A growing amount of evidence suggests that successful implant osseointegration of immediately placed implants can be reliably achieved even in infected sites. Clinical workflows for such conditions need to allow for additional measures, such as disinfection and debridement of the extraction sites before implant placement.[18] Surgical manipulations such as alveoloplasty at placement to potentially reduce

the overall risk of implant failure may be considered as well.[19] A defined clinical workflow to systematically address the immediate rehabilitation of the periodontally atrophied maxillary and mandibular arches in a standardised manner is however still lacking. In this case report, the author will illustrate how the application of a CDSS may help to define and standardise the clinical workflow and rehabilitation plan for the immediate transition from a failing dentition associated with periodontally atrophied osseous conditions into a bimaxillary fixed full-arch restoration. The aim is to illustrate the complete set of steps and highlight the most important aspects of the workflow and discuss them in the context of the most recent conclusions and consensus statements from the literature using the Straumann® Pro Arch system.

Case presentation

Initial situation and medical history

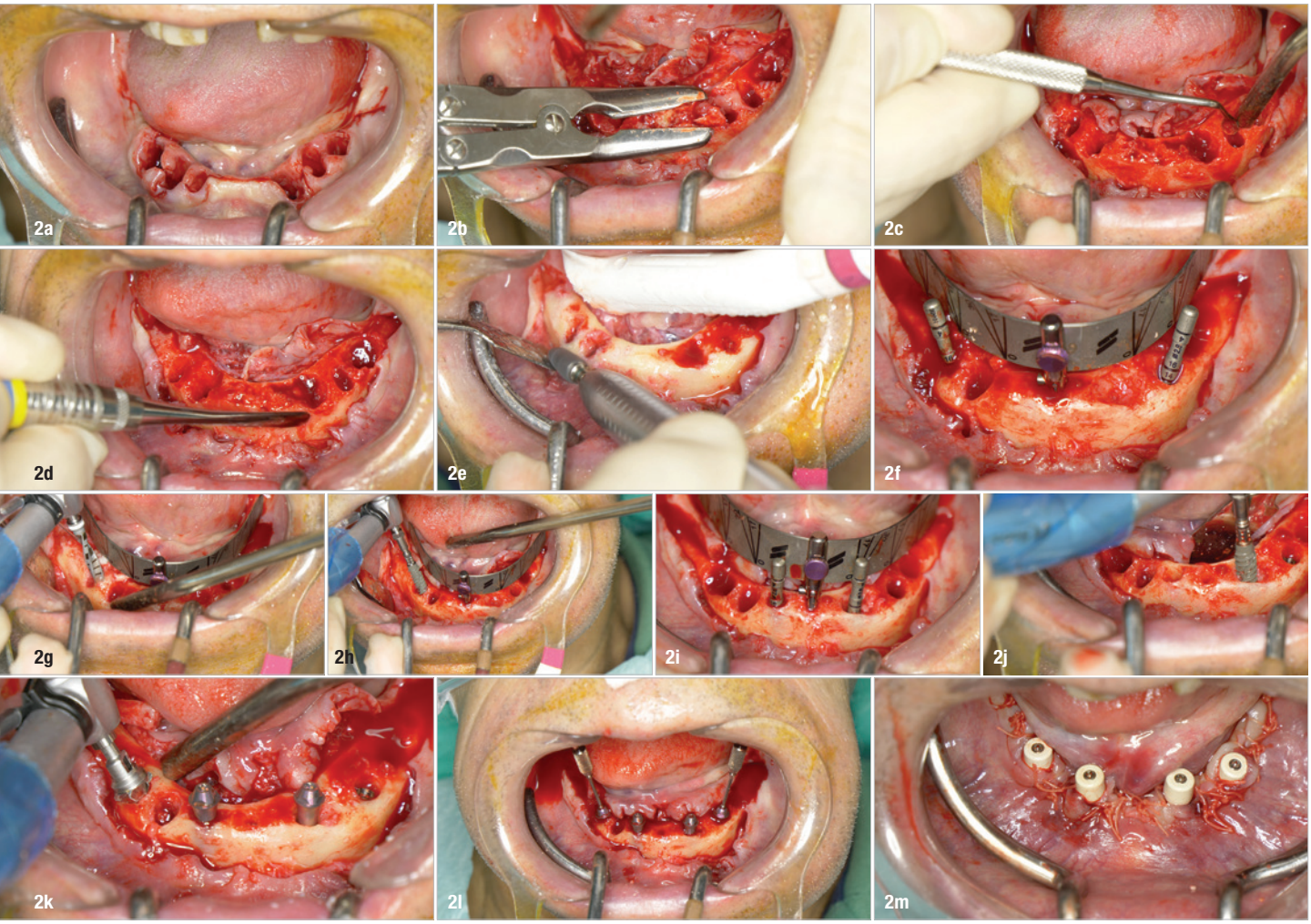
A 60-year-old male patient with partial remaining dentition, teeth #15–11, 22, 23, 33–35, and 45–43, and lacking any type of prosthetic restoration presented at the Implantology Institute, the author's clinic in Lisbon in Portugal. Dental examination revealed generalised severe chronic periodontitis in the progressed stage associated with vertical loss of soft tissue, bleeding on probing, severe loss of osseous support radiographically down to the apical regions and Grade III tooth mobility. Assessment of the osseous conditions by CBCT further revealed moderate horizontal bone atrophy in both jaws. Abundant and thick keratinised soft tissue was present in the edentulous segments of the alveolar ridge. The initial dental and osseous conditions of the patient prior to treatment are illustrated in Figures 1a–c. The condition of the residual dentition did not allow for any predictable prosthetic restoration. The patient's general health was evaluated as good. Anamnesis did not reveal any systemic or local absolute contra-indications for endosteal implant therapy. After the patient had been informed of the different treatment options, he expressed a strong preference for an implant-supported fixed prosthetic restoration without palatal coverage as well as a desire to limit prolonged edentulous phases during treatment. Based on the patient's medical condition and preference, immediate fixed full-arch restoration (Straumann® Pro Arch) with immediately loaded metal-reinforced acrylic provisionalisation and definitive zirconia prostheses was proposed.

Surgical procedure

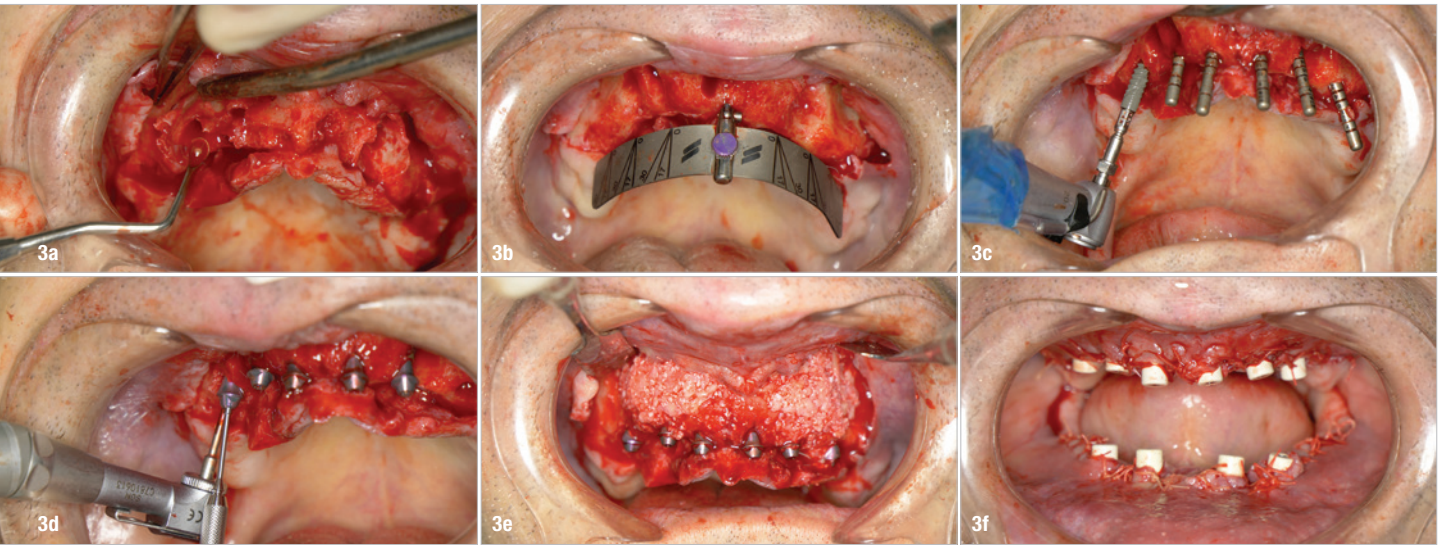
The procedure was performed as a bimaxillary full-arch restoration, involving immediate implantation and immediately loaded provisionalisation. Planning was performed based on the patient's osseous anatomy by means of CBCT scans and panoramic radiographs and considering the patient's facial aesthetics by means of face scans and digital photography. According to the detailed mesiodistal 2D cross sections of the CBCT scans, the available bone height and width in the anterior maxilla were 14.05–18.06 mm and 6.36–8.36 mm, respectively. The posterior maxilla displayed moderate bone resorption, having a bone height and width of 10.63–10.91 mm and 5.76–6.36 mm, respectively. The corresponding mandibular osseous height and width were 13.0–23.0 mm and 6.2–9.2 mm, respectively, in the anterior region and 9.6–12.0 mm and 6.4–8.4 mm, respectively, in the posterior region. According to the applied CDSS for full-arch rehabilitation, the patient's osseous conditions were classified as Class II with moderate complexity for both the mandibular and maxillary arch.[16] Accordingly, rehabilitation with six maxillary and four mandibular implants with angulation of the implants in the posterior atrophic segments of the jaws was proposed. The detailed analysis of the facial aesthetics further suggested the need for bone augmentation in the anterior apical maxilla to improve the inadequate lip support caused by the progressing bone defect. A conventional and non-guided open-flap treatment approach was chosen. Detailed planning and verification of implant types and positions were performed based on a 3D planning model (Implant Studio, 3Shape).

Mandibular procedure

The mandibular treatment procedure involved the creation of an extended



Figs. 2a–m: Surgical procedure in the mandible. Situation after tooth extraction **(a)**. Preparation of the alveolar crest, including removal of sharp edges after elevation of a mucoperiosteal flap, thorough debridement of extraction alveoli, removal of periosteum and alveoloplasty **(b–d)**. Placement of four implants involving placement of a surgical guide, verification of the correct depth and angulation of the osteotomies using alignment pins, placement of bone-level implants and preparation of the emergence profile using a bone profiler **(e–k)**. Placement of the screw-retained abutments **(l)**. Primary wound closure after placement of protective caps **(m)**.



Figs. 3a–f: Surgical procedure in the maxilla involving tooth extraction **(a)**, placement of a surgical guide **(b)**, implant placement **(c)**, placement of screw-retained abutments **(d)**, guided bone regeneration **(e)**, placement of protective caps and primary wound closure **(f)**.

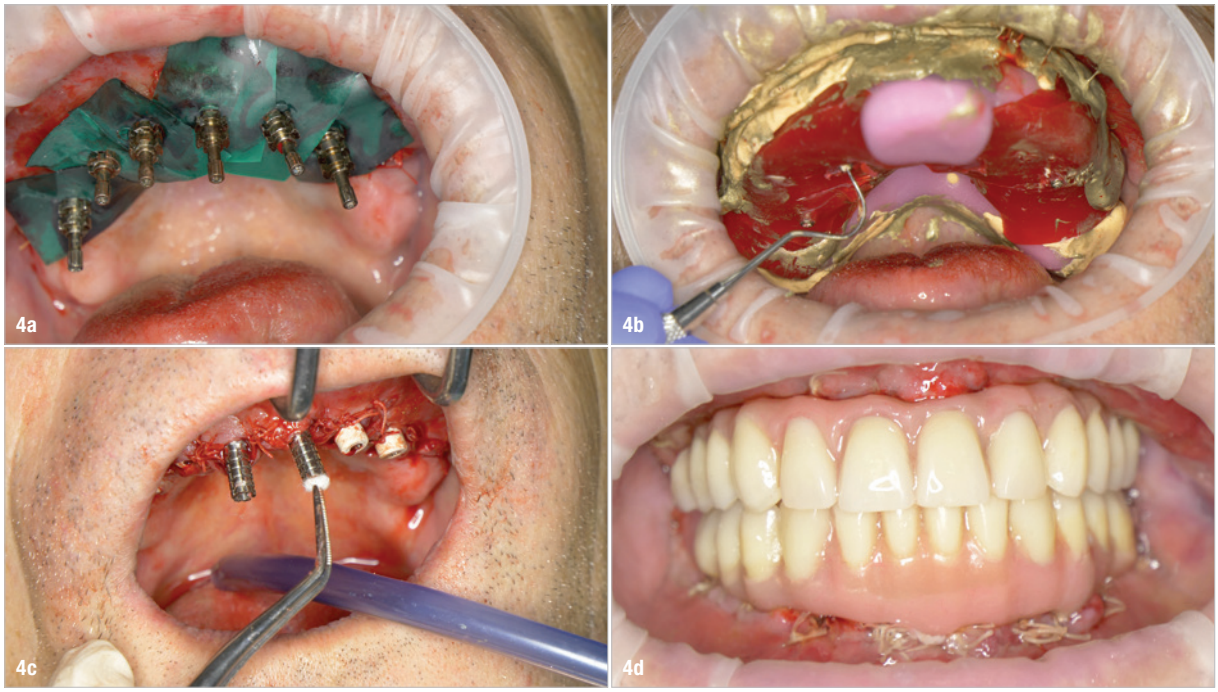
mucoperiosteal flap and exposure of the complete alveolar crest after extraction of the residual dentition (Fig. 2a). Next, the alveolar crest was flattened by manual removal of any sharp bone edges with a Rongeur (Fig. 2b). The extraction alveoli were thoroughly debrided using sequences of manual curettage and irrigation with saline in order to remove any infected tooth root remnants and granulation tissue (Fig. 2c). Any possible remnants of inflammatory tissue were removed from the alveolar crest using a sharp periosteal elevator (Fig. 2d). Alveoloplasty of the buccal and occlusal aspects of the alveolar crest was performed with a round bur in order to prepare the alveolar crest for the implantation procedure (Fig. 2e). The implant treatment plan included placement of two straight implants in positions #42 and 32 and two angulated posterior implants in positions #44 and 34 (Straumann BLX; diameter: 4.5 mm; length: 14.0 mm; RB; SLActive; Roxolid). The position and angulation of the osteotomies were determined by use of a surgical guide (Straumann® Pro Arch Guide; Fig. 2f) and performed according to the manufacturer's instructions. The position, depth and angulation of the osteotomies were verified prior to implant placement using verification pins (Fig. 2g). Next, the implants were placed at subcrestal level to a torque of 35 Ncm (Figs. 2h–k). Coronal emergence profiles of the posterior implants were adapted with a bone profiler (Straumann; Fig. 2l). Implants were subsequently restored with screw-retained abutments (RB/WB; straight: 0°; angulated: 17°; diameter: 4.6 mm; gingival height: 3.5 mm; Straumann) and protective caps (diameter: 4.6 mm; Straumann), followed by primary wound closure (4/0 VICRYL RAPIDE, Ethicon; Fig. 2m).

Maxillary procedure

Maxillary treatment was performed directly after the mandibular procedure and was carried out analogous to the mandibular procedure. The treatment sequence involved removal of remaining teeth, mucoperiosteal flap elevation, and thorough debridement and degranulation of the resulting extraction alveoli (Fig. 3a). Next, any sharp edges of the alveolar crest were manually removed and the osteotomies were prepared in accordance with the positions and angulations indicated by the surgical guide (Fig. 3b). Osteotomy preparation and verification were followed by placement of six Straumann BLX implants (diameter: 3.75 mm; length: 12.00 mm; RB; SLActive; Roxolid) in positions #16, 14, 12, 22, 24 and 26 to a torque of 35 Ncm. The posterior implants were placed at an angle (Fig. 3c). All implants were restored with screw-retained abutments, and bone augmentation of the anterior alveolar process was carried out using a xenograft (Straumann XenoGraft, 0.5 mm granules) and a collagen membrane (Straumann Membrane Flex; Figs. 3d & e), followed by placement of protective caps and primary wound closure (Fig. 3f).

Prosthetic restoration

Immediate provisional prosthetic restoration with full-arch metal-reinforced acrylic prostheses was performed directly after primary wound closure and involved open-tray impression taking followed by immediately loaded provisional restoration. Specifically, impression posts were mounted and the wound margins were protected with dental dams (Fig. 4a). Next impression posts were splinted using cold acrylic (Kiero Form, Kuss Dental) to maintain the alignment of the impression posts, followed by filling of the detailed contours of the implants by syringe application of elastomeric impression material and standard silicone impression material (AFFINIS putty super soft and regular body, COLTENE; Fig. 4b). After the pickup impression, the acrylic provisional prostheses fabricated by an in-house laboratory (Labimplant) were adapted and screw-retained on to two titanium copings (Fig. 4c) in closed bite position using cold acrylic. Next, the remaining copings were adapted and a metal reinforcement was fabricated in the subsequent hour by the in-house laboratory as support for the provisional prostheses. The installed provisional restoration is shown in Figure 4d. Definitive restoration with screw-retained monolithic zirconia prostheses with buccal porcelain veneering was performed at the six-month follow-up.



Figs. 4a–d: Open-tray impression taking and immediate provisionalisation involving placement of impression posts and coverage of wound margins with dental dams **(a)**, impression taking after splinting of impression posts using cold acrylic **(b)**, placement of titanium copings and mounting of acrylic provisional prostheses **(c & d)**.

Visual and radiographic assessment indicated that all implants had successfully osseointegrated with no signs of inflammation. Definitive restoration started with open-tray impression taking of the fully healed maxillary and mandibular arches with screw-retained copings in place (Figs. 5a & b). Abutment-level impressions of the detailed soft-tissue contours with splinted impression posts in place were taken with standard silicone impression material (AFFINIS putty super soft and regular body; Fig. 5c). The prosthetic procedures followed the standardised protocol recently reported by Caramês et al.[20] The definitive restoration was designed and milled by CAD/CAM with a zirconia structure (Prettau, Zirkonzahn) with feldspathic veneering porcelain (ICE Zirkon Ceramics, Zirkonzahn) on the non-functional buccal areas. The prosthetic restoration fitted with the implant base optimally (Figs. 5d & e), and the final aesthetic outcome was considered satisfactory (Fig. 5f).

Discussion and conclusion

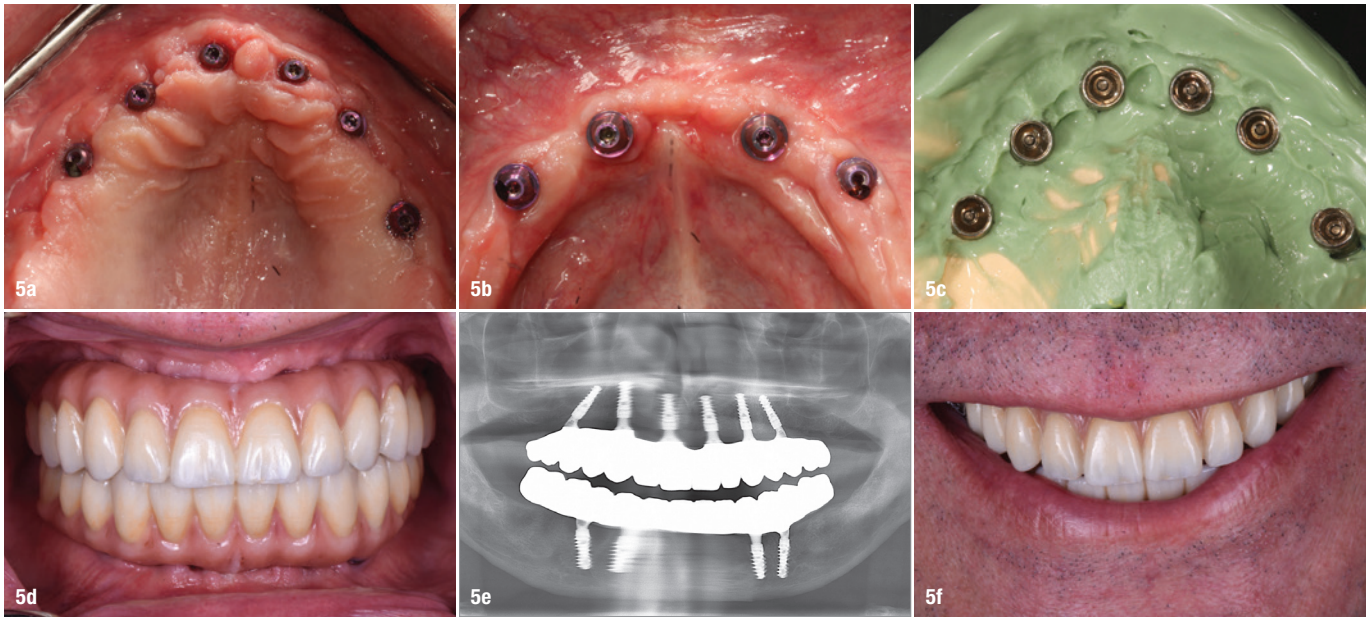
With this case report, the author has aimed to illustrate a possible workflow for a bimaxillary fixed full-arch restoration using immediate placement and immediate loading in a partially edentulous periodontitis patient with atrophied bone. The most important aspects of the workflow are as follows: 1) The decision for the treatment plan was guided by a CDSS based on the anatomical osseous dimensions of the alveolar arches (Caramês classification).[16] 2) The concept involved immediate placement and loading in extraction sites of teeth affected by chronic periodontitis. 3) Horizontal contour augmentation of the apical aspects of the anterior maxilla was performed based on an analysis of the patient's facial aesthetics in order to provide lip support. 4) Screw-retained zirconia restorations were chosen after immediate provisionalisation with metal-reinforced acrylic prostheses.

The choice for the specific type of implant rehabilitation was guided by an osseous anatomy-based CDSS for full-arch restoration.[16] Compared with the *SAC Classification in Implant Dentistry*, which helps clinicians to identify the degree of complexity and potential risk involved in individual cases, this type of system gives additional recommendations for the specific type of rehabilitation within the group of full-arch restorations. The system is supported by the current state of knowledge on mandibular and maxillary full-arch restorations and consensus statements of the recent sixth ITI Consensus Conference.[15,16] According to the CDSS, the patient was classified as treatment option IIb, defining the placement of four and six implants in the mandible and maxilla, respectively. Posterior implants in the individual arches were tilted by 30°. The tilted placement of implants as part of full-arch rehabilitation in order to reduce prosthetic cantilevers and prevent additional surgical interventions can be considered well established. A recent consensus report concluded that for IFCD rehabilitation axial or tilted implants can be considered equivalent with regard to implant and prosthetic survival and complication rates, peri-implant marginal bone loss, and the risk of soft- and hard-tissue complications.[21]

Systematic reviews on immediately loaded full-arch rehabilitation furthermore indicate that in the maxilla tilted implants have a favourable short-term prognosis, including maintenance of the crestal bone level, in comparison with conventional axially placed implants after one year of function.[22,23]

In addition, this case illustrates the concept of immediate placement in extraction sockets of teeth affected by chronic periodontitis. Such condition is considered challenging, since periodontitis has been classified as a risk factor for peri-implant disease.[24] Moreover, implant placement in extraction sites of periodontally or endodontically compromised teeth has been discussed as a risk factor for microbial interference with implant osseointegration.[25] In order to prevent bone resorption caused by delayed placement protocols, clinicians have recently started to adopt immediate implantation in infected sites.[18,26] Chrcanovic et al. recently reviewed the existing evidence on immediate placement in infected sites.[18] They concluded that such implants might not display a higher risk of implant failure compared with implants placed in non-pathological extraction sites as long as meticulous cleaning and debridement of the extraction sites, along with the application of local antiseptics and systemic antibiotics, are implemented in the treatment protocols.[18] Another study on immediate placement in subjects with untreated periodontal disease investigating single, bridged and full-arch rehabilitation with a follow-up period of five years concluded similarly that immediate placement under such conditions might be clinically feasible.[27] Concerning immediate IFCD treatments, Li et al. performed an implant survival study in relatively young adults with generalised aggressive periodontitis and reported a five-year clinical survival rate of 98.7%.[28] Furthermore, Malo et al. reported average two-year clinical survival rates of 97.7% for maxillary and 94.8% for mandibular implants placed in sites that were compromised by dehiscences, fenestrations and periodontitis and reported lower clinical survival rates in the periodontally compromised sites.[29] Pałka and Lazarov performed a study on IFCDs immediately loaded on to bicortically stabilised implants and reported 35-month clinical survival rates of 97% irrespective of the presence of periodontitis.[30] Although these results support the use of immediately loaded IFCDs in periodontitis patients from a clinical research perspective, detailed reports on a standardised treatment approach remain scarce and treatment workflows seem to display high degrees of variability.[31,32] To the best of the author's knowledge, this case report is the first example of immediate restoration with IFCDs that applied a standardised CDSS.

Although the success rates of immediately loaded single and bridged implants in comparison with conventionally loaded implants remains controversial, immediately loaded full-arch restoration can today be regarded as a well-established treatment option.[13,33,34] Papaspyridakos et al., for example, recently concluded from a systematic review that implant survival, failure and complication rates of immediately loaded IFCDs in edentulous patients are comparable to those of conventionally loaded ones.[14] Furthermore, estimated one-year implant survival rates of IFCDs were found to be > 99% with all three loading protocols. The authors also recommended an insertion torque of >30 Ncm, which was adopted within the protocol presented in the current article. Another important aspect with regard to IFCD rehabilitation of patients with progressing bone atrophy is facial aesthetics, which is also considered part of the Caramês classification.[16] Araújo et al. have, for instance, demonstrated in a preclinical model that immediate placement alone might be insufficient to prevent post-extraction vertical loss of the buccal wall.[35] Likewise, other studies indicate that the extent of dimensional change during bone loss may be influenced by the thickness of the labial buccal bone.[35] Thicker buccal bone may help to reduce the extent of dimensional ridge alterations. In order to avoid loss of lip support and improve facial aesthetics, horizontal bone defects in the anterior buccal maxilla might therefore significantly benefit from horizontal



Figs. 5a–f: Occlusal view of healed maxillary and mandibular ridges six months post-op **(a & b)**. Occlusal view of the gingival impression with impression posts **(c)**. Definitive prostheses after installation **(d)**. Post-op panoramic radiograph six months after definitive restoration **(e)**. Frontal view of facial aesthetics after definitive restoration **(f)**.

contour augmentation.[36] Insufficient crestal bone height however might be compensated for by adapting the maxillary cervical edge of the transition line between the prosthetic gingiva and teeth of the IFCDs. These aspects were specifically considered in the case described.

For the definitive restoration, screw-retained zirconia prostheses were chosen to replace the metal framework-supported acrylic provisional restorations. Ceramic prostheses have the advantage of fabrication via a CAD/CAM workflow. Recent consensus reports indicate comparable survival and biological complication rates to those of metal–ceramic prostheses and a lower risk of complications in the aesthetic area.[33] Specifically, in the case described, fixed monolithic zirconia prostheses veneered with porcelain only in non-functional areas were chosen. This recently introduced type of prosthesis has been researched by the author of this article and colleagues with regard to the risk of prosthetic complications as part of IFCDs. This new type of restoration specifically showed a lower incidence of complications, for example ceramic chipping, when compared with conventional full-arch ceramic-veneered zirconia prostheses.[20,37] In summary, this case report has described the bimaxillary full-arch restoration of a partially edentulous periodontitis patient based on a CDSS that may help to standardise the rehabilitation plan based on the local alveolar osseous anatomy and level of atrophy. The case report has illustrated and discussed the most essential clinical and anatomical aspects that might be relevant for the design of the treatment plan and individual clinical workflow specifically with regard to the treatment of patients with active periodontitis. In conclusion, the application of this CDSS may help to standardise the workflow and rehabilitation plan of immediate IFCD rehabilitation in daily clinical practice and future clinical research.

Author details | Video | Literature

about the author

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