Dual zone therapeutic concept

Digital workflow in guided immediate implant placement

Dr Kalin Marinov, Bulgaria

The field of dental implantology has observed a paradigm shift in immediate implants becoming the preferred modality of treatment for replacing hopeless teeth. In the basic form, immediate implant placement means the insertion of the implants into fresh alveolar sockets at the time of tooth extraction.

Guided immediate implant placement utilises three-dimensional imaging and printing technology for fabrication of surgical guides used for precise positioning and placement of implants. A Randomised Controlled Clinical Trial (RCT) aimed to compare the accuracy of immediate implant placement with freehand and static guided surgery and concluded that immediate implant placement with static guided surgery demonstrated better accuracy than freehand surgery.[1] When immediate implant placements are performed with this digital planning and executed with computer guided surgical stents, it makes the surgery less traumatic with reduced surgical time, precise implant position and better aesthetic outcomes. Hence, leading to improved patient overall satisfaction. A systematic review and meta-analysis were done to evaluate implant failure rates and their association with guided and free hand implant placement technique. The study concluded that both guided and free-hand implant placement techniques resulted in a high implant survival rate. However, implant failure rates were almost three times higher in the free-hand implant placement category. A guided implant placement approach is recommended for a successful outcome.[2] A common challenge clinicians encounter in implant dentistry are anatomical features such as the maxillary sinus in the upper arch and the inferior alveolar nerve in the lower arch. Additionally, complex scenarios such as limited bone availability, infections in hopeless teeth, or periodontally compromised teeth requiring extraction further complicate the process. Achieving primary stability with an optimal prosthetic profile is a critical factor in case selection under such circumstances.

Hence, guided surgery is a major boon as it helps plan safe positioning of the implant prior to the surgery, boosting clinician's comfort and confidence for ensuring stable results in immediate implants.

The use of immediate guided implant placement along with grafting the jumping gap followed by immediate digital temporisation guarantees a better aesthetic outcome while reducing time, cost, and the number of clinical visits.[3] The dual


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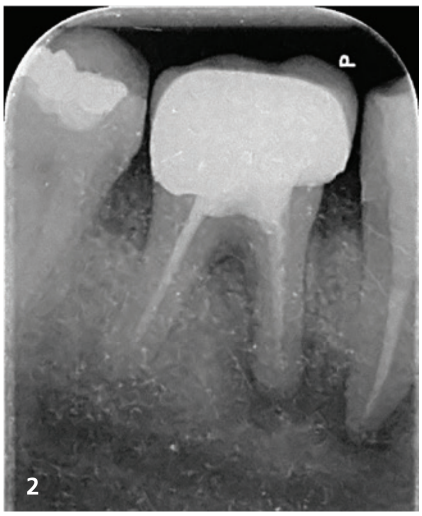
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Fig. 1: Periapical abscess associated with the left mandibular first molar. – **Fig. 2:** Diagnostic periapical X-ray showing infected mesial root with furcation involvement.

zone refers to the tissue zone apical and coronal to the immediately placed implant shoulder, which could recede or collapse after tooth extraction. Dual zone technique consists of packing the bone graft material in the bone gap between the implant and the buccal plate until the free gingival margin. This is followed by prosthetic socket sealing using either a custom healing abutment or a provisional restoration to enhance aesthetics in the anterior region and preserve the peri-implant tissue after extraction and implant placement 4A customised healing abutment is designed by modifying the size and transmucosal shape of the healing abutment to guarantee the creation of a soft-tissue profile similar to a natural tooth. Thereafter, it is connected to the implant on the day of surgery and left undisturbed until osseointegration and tissue maturation are achieved.[5]

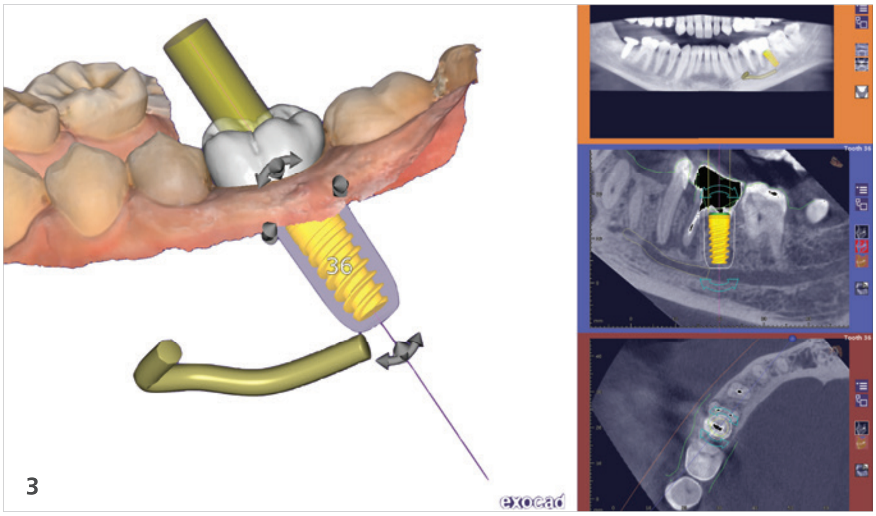
The following case report showcases utilisation of digital technology for precise planning in a challenging case of an immediate implant with dual zone augmentation and a custom healing abutment for streamlining treatment protocols to achieve predictable outcomes.

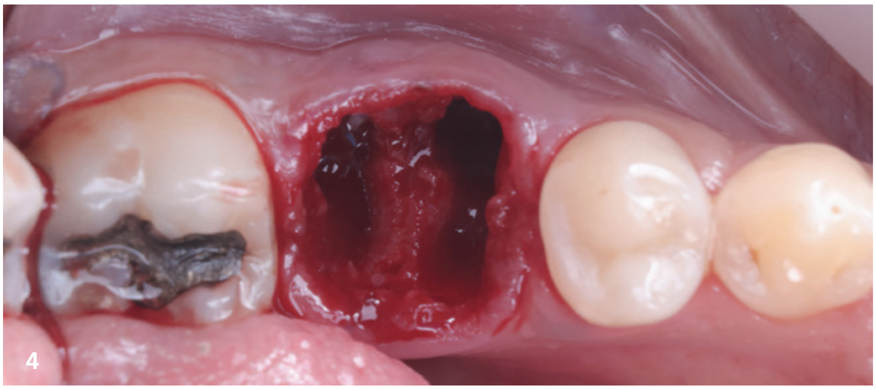
Initial situation

A 42-year-old, non-smoker, male patient reported in our clinic with mild pain and discomfort when chewing from left side. Clinical and radiological examination revealed furcation involvement and periapical granuloma in the mesial root of lower left first mandibular molar. (Figs. 1+2) The tooth had a hopeless prognosis and was planned for extraction and immediate placement of implant after patient was informed about all the treatment options.

Preoperative digital planning

A cone beam computed tomography (CBCT) for the area was done along with an intra-oral scan (Medit i500) and exoplan software (exocad) was used for digitally planning the implant position and surgical guide fabrication. The furcal septum was very thin and the mesial socket infected, hence the implant position was restricted to the distal socket. The copaSKY 4.5 x 10 mm (bredent medical) was selected as the fixture of choice for the case due to its unique morphological and surface characteristics for achieving high primary stability in immediate implants (Fig. 3).





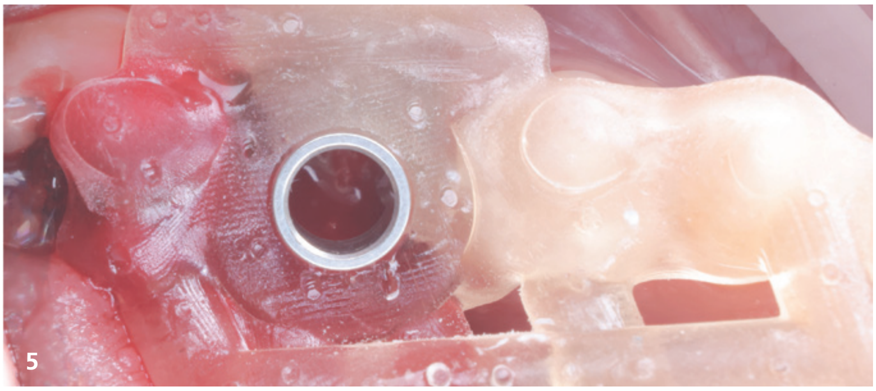
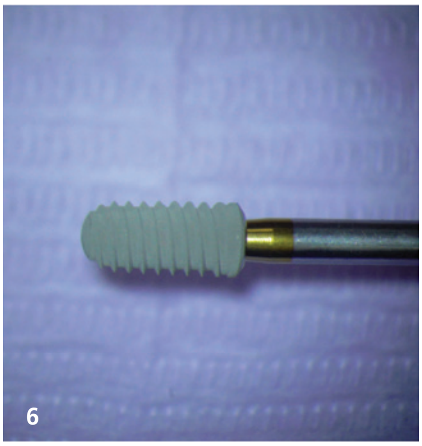
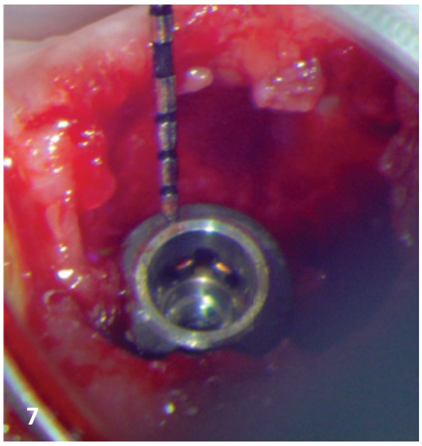


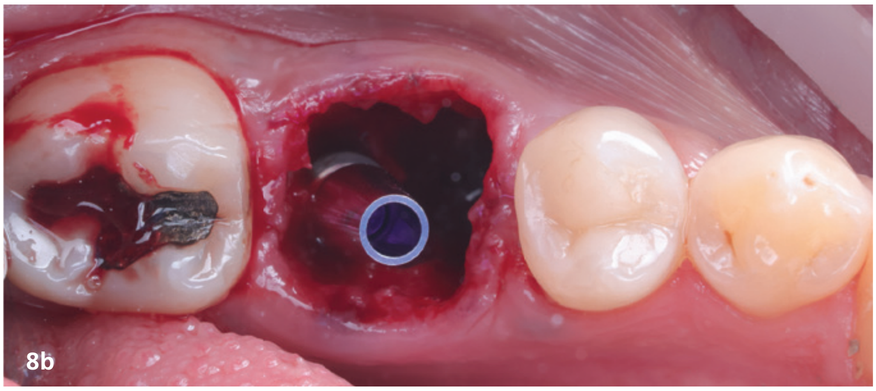
Fig. 3: Digital planning of implant size and position, with subsequent fabrication of the surgical guide. – **Fig. 4:** Atraumatic extraction of the tooth. – **Fig. 5:** CAD/CAM milled surgical guide positioned for osteotomy preparation.

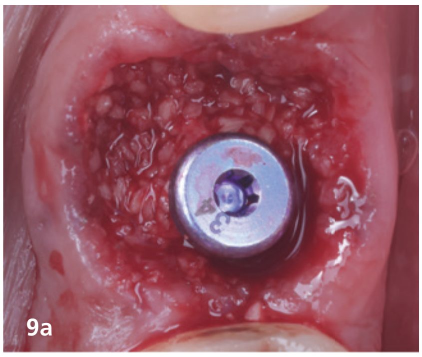
Surgical procedure

The procedure was performed under local anaesthesia with 1:100,000 lidocaine. The mandibular molar was atraumatically extracted (Fig. 4). The surgical guide was placed in position (Fig. 5) and the osteotomy was performed completely flapless as per the plan, during which the bone









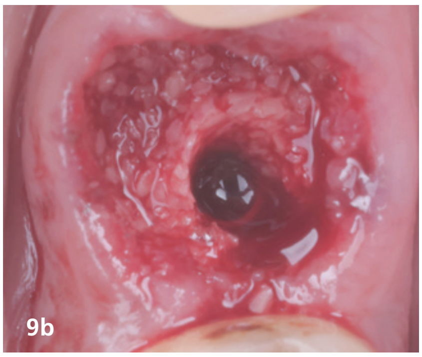


Fig. 6: copaSKY 4.5 x 10 mm fixture ready for insertion. – **Fig. 7:** Subcrestal implant placement according to the digital plan, with torque > 45 Ncm. – **Figs. 8a+b:** Buccal view confirming implant angulation with copaSKY abutment (a). Occlusal view showing implant placement in the distal socket as planned (b). – **Figs. 9a+b:** Healing abutment placed and area around implant grafted (a). Dual-zone grafting completed up to the gingival margin (b).

chips collected in the drill (autograft) were preserved. A copaSKY 4.5 x 10 mm implant (Fig. 6) was placed subcrestally with a torque > 45 Ncm (Fig. 7). The three-dimensional implant position was verified with a titanium abutment (copaSKY; Figs. 8a+b). A healing abutment was placed on the implant prior to grafting to prevent the graft from entering the fixture. Dual zone grafting was done with 1:1 autograft and allograft (Puros Mix allograft, Zimmer Biomet) in the jumping gap up to the gingival margin (Figs. 9a+b). A custom healing abutment was fabricated chairside by sandblasting the titanium abutment (copaSKY; used previously for the axial verification) and relining it with flowable composite (Nexcomp Flow, META BIOMED). This assembly was polished, abutment plugged with Teflon and finally screwed onto the implant (Figs. 10a+b). This custom healing abutment would aid in protecting the biomaterials in the socket as well as developing a favourable emergence profile for the definitive prosthesis. An immediate postoperative periapical radiograph was taken to confirm the complete seating of the custom healing abutment (Fig. 11).

Definitive restoration

A digital scan was taken using an intraoral scanner (IOS; Medit i500) after six months, and a screw-retained zirconia monolithic crown was fabricated on a Ti-base (Figs. 12a+b). An immediate postoperative X-ray was then taken to confirm the complete seating of the prosthesis (Fig. 13). Two-year postoperative follow-up radio-visuograph (RVG) showed stable crestal bone levels (Fig. 14).

Discussion

In selected scenarios, immediate implant placement in molar extraction socket might be considered a predictable technique as demonstrated by high survival and success rates, with minimal marginal bone loss.[6] However, it is challenging to control the axial angulation during implant bed preparation in immediate implants for multi-rooted teeth. In posterior areas


10a


10b

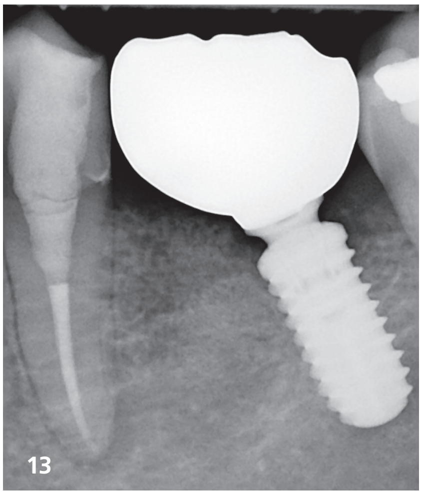

11

Figs. 10a+b: Titanium abutment adjusted, plugged with Teflon, relined with flowable composite, and screwed onto the implant (a). Buccal view of customised healing abutment (b). – **Fig. 11:** Immediate postoperative X-ray.

with a limited field of view, non-flap implant bed preparation can be challenging when considering the three-dimensional position of the implant preparation and the avoidance of damage to essential structures. Notably, the drill continually slips in the interradicular septum, resulting in inaccurate site preparation and, consequently, an unfavourable implant insertion. Such deficiencies may cause biomechanical and occlusal related complications.[7] The current case had a very thin inter-radicular septum with the inferior alveolar nerve in close proximity to the planned implant position. Hence a guided implant placement with a surgical stent was done for precise positioning of the implant. Static guided surgery has a high level of accuracy and control, in which osteotomy is pre-planned and executed through a surgery guide; depending on the complexity of the case and the patient's anatomy, it has a higher level of value than free hand surgery.[8] Computer-guided template-based implant placement showed high implant survival rates ranging from 91 to 100%.[9] A crucial factor is the correct selection of the macrostructure of the fixture. A self-tapping conical-cylindrical implant was selected in this case. In Ciabattoni's study, it was observed that these types of implants with aggressive macro-design with self-tapping threads are advantageous where the density and effective residual bone volume are low, such as in extraction sites.[10]

A flapless approach was employed due to its benefit of uninterrupted blood supply to the implant site as the interdental papilla and periosteum remain intact. The flapless approach in implantology could also result in lesser marginal bone loss.[11] Divakar et al. concluded that flapless implant surgery results in lesser loss of marginal bone in addition to better patient comfort.[12] Pozzi and his colleagues observed that due to the frequent flap elevation associated with free hand surgeries, patients reported more postoperative pain and clinically observed swelling compared to flapless guided implant placements.[13]

Following implant insertion, dual-zone grafting was performed between the implant and the socket walls. Ridge preservation techniques reduce the morphological horizontal bone changes that occur, mostly in the coronal portion of the buccal bone plate following tooth extraction, when compared to spontaneous healing.[14] A recent study concluded that, the Dual Zone Therapeutic (DZT) technique implemented with immediate implants in posterior extraction sockets showed promising peri-implant marginal tissue health results with no observed complications or implant loss over three years. This technique is easy to apply and depends on grafting the jumping gap to the free gingival margin using a customised healing abutment as a prosthetic sealing device.[15] This customised healing abutment bridges the gap between the anatomy present at the time of tooth removal and the anatomic characteristics of the site after osseointegration. An analysis demonstrated an overall survival rate of 98.26% of dental implants placed into fresh molar extraction sites using chairside fabricated immediate custom healing abutments. This outcome, which is equivalent to or better than other studies on immediate molar implant placement, verifies this technique as a viable approach with additional benefits of flapless socket sealing and immediate capture of the anatomic emergence profile.[16]



Figs. 12a+b: Final screw-retained monolithic zirconia crown on tooth #36 (a). Buccal view showing final crown in occlusion (b). – **Fig. 13:** Immediate periapical X-ray post-definitive restoration. – **Fig. 14:** Two-year postoperative follow-up X-ray showing stable bone levels.

A digital workflow was used for the definitive restorative phase and a custom restoration over a Ti-base was fabricated as a screw-retained crown. Nowadays, implant definitive restoration with digital workflows are achieved with CBCT segmentation, IOS, facial scans, CAD and 3D fabrication. Digital implant impressions offer advantages over conventional impressions including reduced risks of distortion during the laboratory phases; improved patient comfort and acceptance; and improved efficiency.[17] The digital technique emerges as the most preferred one according to patient-centered outcomes and was more time-effective compared to conventional impressions.[18]

Conclusion

Guided immediate implants have transformed restorative dentistry into a patient centric treatment approach with it being less invasive with reduced number of surgical intervention and chairside treatment time thereby improving overall patient satisfaction. Simultaneous socket preservation using grafts and custom healing abutments in guided immediate implants not only expedites the treatment process by avoiding second stage surgery but also sculpts the emergence profile and maintains tissue volume during the osseointegration period. Thus, facilitating a solid peri-implant hard and soft tissue foundation for long term stable results. Digital workflows have evolved as the optimum standard of treatment for ensuring accuracy and predictability of procedures by evading complex anatomic situations in immediate implant dentistry and simplifying the planning, surgical and restorative stages. Advances in modern equipment and software promise even more streamlined predictable protocols for the benefit of patients and dental practitioners. If you have not started using digital workflows in your clinic, do give it a try!

Acknowledgements

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Author details

References

Contact address

Dr Kalin Marinov
SKY Dental Clinic
Sofia, Bulgaria
skyklinik@gmail.com
www.skydental.bg