FROM VIRTUAL PLANNING TO CLINICAL REALITY: A CASE REPORT OF GUIDED IMPLANT SURGERY

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ABSTRACT

This case report describes the successful implementation of a fully guided surgical approach for dental implant placement in the mandibular right posterior region of a 38-year-old male patient with a missing second molar (37). Following comprehensive preoperative planning utilizing cone-beam computed tomography (CBCT) and computer-aided design/computer-aided manufacturing (CAD/CAM) technology, a surgical guide was fabricated to ensure precise implant positioning.

The surgical procedure involved a flapless approach with the placement of a 4.0 mm × 10 mm titanium implant using the fully guided protocol. The guide allowed for sequential osteotomy preparation and implant placement with controlled depth, angulation, and positioning relative to critical anatomical structures such as the inferior alveolar nerve. Post-operative CBCT evaluation proved optimal implant placement with a 2.1 mm safety margin from the mandibular canal and ideal positioning for future prosthetic rehabilitation. After 8-week osseointegration period, the implant demonstrated successful integration with good primary stability (35 Ncm insertion torque) and was restored with a screw-retained porcelain-fused-to-metal crown.

This case highlights the benefits of fully guided implant surgery in the posterior mandible, including enhanced precision, reduced surgical time, minimal postoperative discomfort, and predictable prosthetic outcomes. The digital workflow facilitated accurate implant placement in an anatomically challenging region while minimizing risk to vital structures.

Keywords: dental implant, fully guided surgery, mandibular posterior, computer-guided implantology, digital workflow, flapless technique

INTRODUCTION

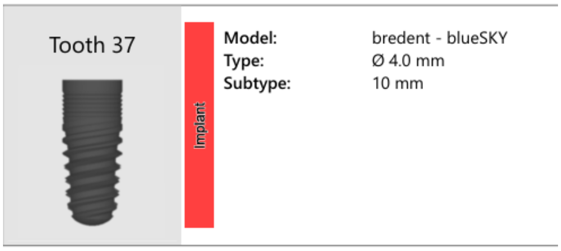
Dental implantology has undergone a remarkable evolution, transitioning from conventional methods to sophisticated guided implant surgery approaches. Practitioners commonly face significant challenges in treatment planning for dental implant therapy, regardless of whether they employ traditional techniques or guided surgical protocols[1,2].

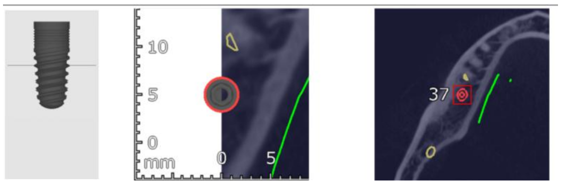
Guided implant surgery offers a streamlined and highly predictable alternative to conventional methods. Central to this approach is the surgical guide , a customized medical device created through three-dimensional printing based on Cone Beam Computed Tomography (CBCT) imaging[3]. These patient-specific guides enable clinicians to place implants with optimal precision, directing both surgical instruments and implants according to predetermined positions with remarkable accuracy[1,4].

Advancements in dental procedures have significantly improved predictability, accuracy, and patient comfort in clinical treatments. The advent of osseointegration has introduced numerous surgical options with high long-term success rates, with preoperative planning being essential for successful rehabilitation. Dental surgeons now utilize computed tomography (CT) for detailed visualization of facial anatomic structures, and specialized software can convert these images into physical prototypes and surgical guides for precise implant placement[5,6]. For partially edentulous patients, metal-free removable dentures can be included in scans to align tooth positions with bone morphology. Virtual planning results in faster, more predictable, and less traumatic surgeries while simplifying prosthetic restorations. The surgical guide transfers the virtually planned positions to the oral cavity through metal cylinders that indicate drilling locations and guide implant alignment, enhancing safety and predictability while reducing complications, morbidity, and discomfort. This approach enables evaluation of discrepancies between virtual plans and actual clinical outcomes after titanium implant placement[7].

Case Report

A 38-year-old male presented with a complaint of missing teeth and sought oral rehabilitation at our department of oral implantology. After comprehensive examination including clinical assessment, supplementary tests, CT scan analysis, and evaluation of intermaxillary relationships, guided surgery was planned. The methodology involved intraoral scanning of the patient's upper and lower arches followed by CBCT scanning to procure data in STL format. These two sets of images were superimposed digitally on a planning software. After a thorough evaluation of the positioning of the nerve, inter-implant distance evaluation, and available width and height of bone, appropriate implants were planned. Once the positions of the planned implants had been defined in the virtual model, a teeth-supported surgical guide was designed for 3D printing, using the same software. The remaining natural teeth were used to support the guide, eliminating the need for stabilization screws. After merging the intraoral scan with the CBCT image on planning software (Exocad), the files were sent to a 3D printer (Asiga ultra max , Australian diamond company). The guide was printed in 3D printing resin, and metal sleeves were fitted into the slot to allow for digital drilling protocol (Bredent sky pro guide). The fabricated guide was then autoclaved at 121 degrees Celsius.





Implants

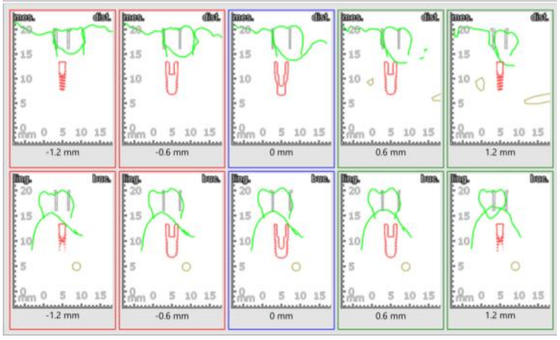
Lower jaw: Only one implant set!

Minimum safety distance between implants and anat. structures (e.g. mandibular canals):	1.5 mm
Minimum safety distance between two implants:	3 mm
Minimum safety distance between two anchor pins:	3 mm
Minimum safety distance between anchor pins and implants:	3 mm
Minimum safety distance between anchor pins and anat. structures (e.g. mandibular canals):	1.5 mm
Result of alignment (Acceptable/Not Acceptable):	Acceptable
CT alignment object for lower jaw was modified during planning:	No
CT alignment object for lower jaw was modified after alignment step:	No
Left mandibular canal was skipped by the user:	No

X-ray panoramic radiograph image with all set implants and sleeves.

Implant

Model:	bredent - blueSKY
Type/Subtype:	Ø 4.0 mm/10 mm
Diameter Body:	4 mm
Diameter Platform:	4 mm
Implant Length:	10 mm
Manufacturer:	bredent medical GmbH & Co.KG
Part/No.:	blueSKY, Ø 4.0 mm, RP, 10 mm/bSKY4010
Web address:	http://www.bredent.com/
General information:	N/A
Legal information:	N/A

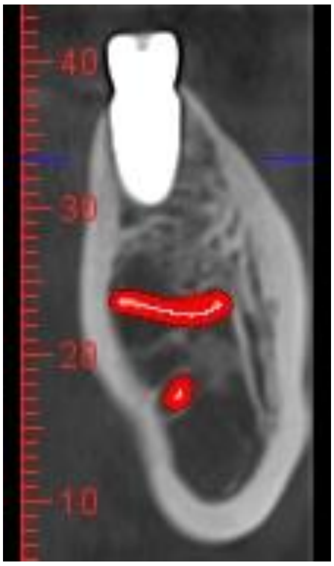


DISCUSSION

Digital planning and guided implant surgery have revolutionized modern implantology, as demonstrated in this case utilizing the Bredent Sky pro guide (bredent medical) implant system. The treatment protocol began with comprehensive diagnostic imaging using cone-beam computed tomography (CBCT)[4], which provided detailed three-dimensional visualization of the patient's bone architecture, density, and proximity to vital anatomical structures. The digital workflow continued with virtual implant planning software, where the prosthetically-driven approach determined optimal implant positioning, angulation, and depth based on both functional requirements. The stereolithographic surgical guide was fabricated with high precision tolerances to ensure accurate transfer of the virtual plan to the clinical scenario[8,9].

Following local anaesthesia administration, the tooth-supported surgical guide was verified for stability and to prevent micro-movements during osteotomy preparation. The Bredent kit's sequential drilling protocol with dedicated sleeve inserts maintained precise control over both the drilling axis and depth, with each drill's length calibrated to account for the guide's height, sleeve dimensions, and planned implant depth. The flapless approach was made possible by the high predictability of the guided system, preserving periosteal blood supply and maintaining soft tissue architecture. The Bredent Sky pro guide implant(4.0/10mm) was then placed through the guide at precisely 35 Ncm insertion torque, achieving primary stability ideal for the planned loading protocol.

Postoperatively, the patient reported minimal discomfort with minimal inflammation and no need for analgesics beyond the first day. The precision achieved through guided surgery significantly enhanced both functional outcomes and minimal invasive surgery, with postoperative radiographic evaluation confirming the implant's placement in exact accordance with the preoperative plan. The digital workflow reduced chair time by approximately 40% compared to conventional protocols, benefiting both patient comfort and clinical efficiency. This case illustrates how guided implant surgery with the Bredent Sky pro guide (bredent medical) system effectively addresses challenges of spatial positioning while minimizing surgical trauma and maximizing predictability. The technique's combination of digital precision and biological respect resulted in optimal osseointegration conditions and excellent emergence profile development for the final restoration, underscoring the value of guided approaches in contemporary implant dentistry, particularly in cases requiring exceptional precision or where anatomical limitations present significant challenges[10,].



CONCLUSION

The fully guided implant placement protocol demonstrated in this case report of the mandibular right posterior region illustrates the significant advantages of digital workflow integration in modern implantology. Through meticulous preoperative planning utilizing CBCT imaging, intraoral scanning, and implant planning software, we achieved precise positioning that respects critical anatomical landmarks while optimizing prosthetic outcomes.

The surgical guide fabricated from this digital workflow facilitated a minimally invasive approach with reduced chair time and patient discomfort. The accuracy between the planned virtual position and the actual implant placement validated the reliability of this technique in the posterior mandible, where anatomical considerations such as the inferior alveolar nerve and lingual concavities traditionally present challenges.

Follow-up evaluations demonstrated excellent osseointegration, with optimal soft tissue healing and ideal emergence profile development. The final prosthesis achieved proper occlusal loading and harmonious integration with the existing dentition.

This case demonstrates that fully guided implant surgery represents not merely a technological advancement but a paradigm shift in treatment predictability, precision, and patient experience in the management of posterior mandibular edentulism. The seamless integration of digital and clinical workflows showcased in this report supports the broader implementation of guided implantology as a standard of care for complex implant cases.

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