Beyond Limits: Customized Implant Rehabilitation of Severely Resorbed Ridges Using Integrated Digital and Analog Protocols

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Abstract

Digital dentistry has transformed modern clinical practice by offering enhanced diagnostic capabilities, streamlined workflows, and highly predictable outcomes. However, in complex rehabilitative cases, such as those involving severe jaw resorption due to congenital anomalies, a purely digital approach may not suffice. This case report demonstrates the successful integration of digital precision and analog adaptability to address both functional and esthetic demands. Through the combination of virtual planning, 3D-printed subperiosteal implants, and hands-on prosthetic refinements, a patient-centered and predictable outcome was achieved. The report underscores the importance of a balanced workflow, where digital innovation and traditional techniques work together to enhance treatment success and patient satisfaction.

Introduction

The dental industry has experienced substantial changes due to the rise of digital technology. Innovations like computer-aided design and manufacturing (CAD-CAM), 3D printing, and digital imaging have improved the accuracy and efficiency of treatments. Nonetheless, while digital workflows present benefits in both planning and execution, traditional methods offer necessary flexibility in cases tailored to individual patients. A thoughtful combination of both approaches can help achieve the best functional and aesthetic results. This article discusses a case where both digital and analog methods were integrated to ensure precise and patient-focused rehabilitation in a situation involving a congenital anomaly with significant jaw resorption. [1,2,6]

Case Presentation

A patient with a congenital anomaly and severe resorbed jaw presented for dental rehabilitation. Beyond the functional aspect, the patient's emotional and psychological well-being was also a major concern. To instil confidence in the proposed treatment, an initial manual simulation of teeth using a removable denture was conducted. This step helped the patient visualize the outcome and ensured their acceptance before proceeding with definitive treatment.

Following patient approval, digital techniques were incorporated. CBCT scans and profile pictures were obtained for comprehensive case assessment and documentation. Data acquisition and thorough analysis led to the decision to fabricate a customized 3D-printed subperiosteal implant. [3,4]

The implant was designed virtually using CAD-CAM technology and manufactured with advanced milling and 3D printing by BONEEASY. The surgical phase proceeded seamlessly, with the implants placed precisely as planned, without complications.

Seven days postoperatively, the prosthetic phase commenced. The transition from planned denture to fixed prosthesis was smooth due to prior analog records. The same wax-up used before surgery was transferred into the definitive prosthesis, maintaining the exact vertical dimension, occlusion, and esthetic parameters as initially promised. The tactile bite registration and functional assessment were performed with minimal adjustments, demonstrating the effectiveness of the hybrid workflow. [5,6,8]

Figure 1(a, b) : Preoperative intraoral photographs of the edentulous arches.

Figure 2: Manual simulation of the prosthesis using a removable denture to enhance patient understanding and gain acceptance prior to definitive treatment planning.

Figure 3: Digital diagnosis and planning using CBCT scan data and extraoral facial profile photographs for comprehensive assessment with prefabricated denture.

Digital Diagnosis and Planning

1. **Comprehensive Imaging & Virtual Simulation:** CBCT scans and intraoral digital impressions were utilized to assess bone morphology and soft tissue contours, ensuring precise case evaluation. [1,3,6]

2. **3D Patient-Specific Implant Framework:** A virtual model of the jaw was developed using CAD software, allowing for a tailored subperiosteal implant framework design. Digital planning prioritized optimal load distribution and biomechanical stability. [3,4,6]

3. **Precision Manufacturing:** The framework was fabricated using titanium alloy via additive manufacturing (3D printing), ensuring an exact anatomical fit. [2,4,7]

Analog Prosthetic Integration

1. **Tactile Bite Registration & Functional Assessment:** Despite digital advancements, vertical dimension and occlusion were manually recorded using wax rims and silicone materials. This hands-on refinement ensured functional and aesthetic harmony. [6,8]

2. **Patient-Centric Adjustments:** A trial denture was fabricated analogously, allowing real-time occlusal and lip support refinements based on patient feedback during speech and mastication. [6,9]

Figure 4: CAD-designed customized subperiosteal implant framework with patient-specific anatomical adaptation.

Figure 5: Fabricated titanium subperiosteal framework post-manufacturing, ensuring a precise anatomical fit.

3. **Hybrid Prosthetic Finalization:** The definitive prosthesis (acrylic teeth on a milled metal base) was manually adjusted at the chairside to optimize fit, comfort, and occlusal balance—addressing discrepancies undetectable in static digital models.

Discussion

The rapid evolution of digital dentistry has encouraged practitioners to embrace fully digital workflows. While digital approaches offer unparalleled accuracy and efficiency, combining digital and analog techniques can yield more predictable, precise, and promising results. [1,6,7]

One of the challenges observed in this case was the difficulty of obtaining an intraoral scan immediately post-surgery. Due to extensive soft tissue manipulation, suture threads, and flat ridges, digital impression-taking lacked reliable reference points. This limitation

reinforced the importance of preoperative analog records in guiding the final prosthetic outcome. [8,10]

Fully digital workflows, though advantageous, have inherent limitations, particularly in complex cases where functional adaptation is crucial. Digital scans provide excellent static records, but real-time occlusal assessments, soft tissue behavior, and patient-specific functional adjustments often require a tactile, hands-on approach. Analog methods allow the clinician to make incremental modifications based on intraoral observations and patient feedback, ensuring a final prosthesis that is not only precise but also functionally optimal.

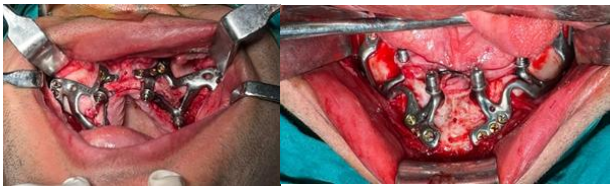

Figure 6: Intraoperative photograph showing the successful placement of the customized subperiosteal implant with no complications.

Figure 7: Transferring preoperative denture into the final prosthesis, preserving aesthetics, vertical dimension, and occlusion.

In this case, the analog steps, including manual bite registration and functional try-ins, played a significant role in ensuring an accurate vertical dimension, occlusion, and esthetic harmony. Preoperative wax-ups served as a reliable reference point for the final prosthetic design, ensuring that the patient received exactly what was planned. [6,8,9,10]

Figure 8 (a, b): Functional try-in with analog techniques for patient evaluation of speech, lip support, and occlusal balance. Postoperative result showing the fixed prosthesis in function, demonstrating excellent aesthetics and stability. (a preoperative with denture, B final Fixed prosthesis simulating the same)

Moreover, patient-centric dentistry demands a balance between technology and personalized care. A fully digital approach may sometimes alienate the patient from the process, whereas incorporating analog methods fosters better communication, understanding, and trust. The ability to physically handle and experience trial prosthetics before committing to the final restoration reassures the patient and enhances satisfaction.

The collaboration between digital planning and analog flexibility illustrates the idea of "ANAGITAL" (we suggest this term) dentistry, in which the combination of ANALOG and DIGITAL processes results in enhanced clinical results. By embracing this method, practitioners can take advantage of the benefits offered by both techniques, guaranteeing:

- **Enhanced precision through digital planning**
- **Improved adaptability and real-time adjustments with analog techniques**
- **Better patient communication and acceptance**
- **Predictable and promising results in complex rehabilitations**

Through this discussion, I would like to introduce the term “ANAGITAL” to the field of dentistry—a concept that embodies the seamless integration of analogue and digital methods in clinical practice. This term, a blend of "Analogue" and "Digital," represents an approach where traditional hands-on techniques and modern technological advancements come together to create more precise, predictable, and patient-centered treatment outcomes. [1,6,9].

The beauty of ANAGITAL dentistry lies in its ability to bridge the best of both worlds—preserving the tactile precision and adaptability of traditional methods while embracing the efficiency and accuracy of digital workflows. While digital tools help us plan, simulate, and execute with remarkable precision, the analogue touch is still essential for fine-tuning occlusion, assessing soft tissue dynamics, and making real-time intraoperative adjustments that a digital scan alone cannot capture. [1,3,4] This is particularly crucial in complex rehabilitative cases, such as customized subperiosteal implants for patients with severe jaw resorption, where the combination of both approaches ensures superior clinical outcomes and enhanced patient satisfaction.

After an extensive review of prosthodontic glossaries and peer-reviewed literature, it is evident that no

existing term fully captures this hybridized workflow. [10] By formally introducing ANAGITAL dentistry, we create a standardized reference point for professionals who embrace both analogue and digital methodologies in their practice. This term is not just a linguistic convenience—it is a framework for clinical communication, academic writing, and research discussions, allowing us to better articulate treatment approaches that leverage the strengths of both techniques. [6,9].

By defining ANAGITAL dentistry as a distinct paradigm, this article aims to inspire further research, interdisciplinary collaboration, and a shift in how we approach digital-analogue synergy. The future of dentistry is not about choosing between traditional craftsmanship and digital innovation—it's about combining them in a way that enhances precision, efficiency, and, most importantly, patient care. [1,6,9,10]. In doing so, ANAGITAL dentistry sets a new standard—one that is both scientifically grounded and deeply human-centered.

Conclusion

This case highlights the significance of integrating digital and analog workflows in complex dental rehabilitations. While digital tools provide precision and efficiency, analog techniques contribute to adaptability and patient-specific refinements. The **ANAGITAL** approach serves as a promising model for future clinical applications, bridging the gap between technology and traditional expertise to achieve optimal patient-centered care.

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