

IMPLANT-PROSTHETIC REHABILITATION OF EDENTULOUS COMPLICATIONS IN A HOMEOSTATIC CONTEXT

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Abstract. The degree of patient damage and the severity of local and loco-regional complications influence the way reconstruction is planned and the stages of implant-prosthetic therapy. Pre-operative analysis of the dimensional parameters of the implant sites (height, width, density) can be performed by means of applications using CBCT images or based on software programs specialized in pre-implant analysis and virtual planning of dental implant positioning. Effective management of complications of partial denture requires interdisciplinary collaboration (implantology, prosthodontics, oral surgery, anesthesia-sedation) both in terms of rehabilitation of loco-regional and local complications, reconstruction of implant sites, implant stage and design of future prosthetic work. The implant-prosthetic treatment plan should focus both on reconstruction of the mucosa-bone support and on ensuring the homeostasis of the stomatognathic system in the context of restoring biomechanical and functional conditions through fixed or removable prosthetic restorations with implant support.

Keywords: edentulism, complication, rehabilitation, implantology

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Introduction

Extensive partial edentulism is frequently associated with locoregional and local complications associated with biological, functional, and biomechanical disorders that require complex treatment solutions [1]. The degree of patient impairment and the severity of local and locoregional complications influence the way reconstruction is planned and the stages of implant-prosthetic therapy. In this

context, making informed decisions that plan each stage (pro-implant, implant, prosthetic) and take into account individual risk factors allows optimizing the success rate in implant-prosthetic therapy [1].

The diagnosis of local and loco-regional complications (dysfunction of the stomatognathic system) is based on the DC/TMD (Diagnostic Criteria/Temporomandibular Disorders) diagnostic criteria and specific paraclinical techniques and instruments [2,3]:

- examination of the dento-alveolar arches (pattern study, radiographic examination, profile telerradiography);

- TMJ examination (radiographic, arthroscopy, kinetography, CT, CT scan, MRI);

- muscle group examination (tonometry, electromyography);

- occlusion examination (gnathosonic, T-SCAN III).

Dysfunctions of the stomatognathic system can be diagnosed and assessed using the following techniques:

- profile telerradiography of the skull (CADIAS);

- Grass technique (MRI);

- ultrasonography of the jaw and TMJ;

- mandibular kinematics recording (Kleinerock technique);

- electromyography.

Effective management of complications of partial denture requires interdisciplinary collaboration (implantology, prosthetics, oral surgery, anesthesia-sedation) both in terms of rehabilitation of loco-regional and local complications, reconstruction of implant sites, implant stage and design of future prosthetic work.

Therapy planning for complications of edentulous partial dentures in dental implant candidates with dysfunction of the stomatognathic system will include [4]:

- Therapy of TMJ disorders ;

- Therapy of muscle disorders ;

- Therapy of algo-dysfunctional syndrome ;

- Rehabilitation of occlusal relationships ;

- Reconstruction of implant sites.

The dimensions of the edentulous space, occlusal relationships, alveolar ridge and soft tissue contours, possibilities of creating a favorable cervical harmony, emergence profile should be taken into account in treatment planning. Treatment decisions involve consideration of the following parameters:

- type of implant - optimal dimensional parameters;

- design and surface condition - associated with osseointegration processes;

- timing of implant placement - immediate post-extraction or late;

- surgical technique - minimally invasive procedures with peri-implant soft tissue protection;

- occlusal loading - immediate or late;
- type of prosthetic restoration - fixed/movable restoration.

Interventions in the pro-prosthetic and pro-implant stage should be performed after an analysis of the biomechanical principles and potential forces exerted at the implant-perimplant tissue interface, as well as risk factors including the quality of the mucosa-bone support, loading protocol, materials from which implants and prosthetic restorations are made, macroscopic design of implants [5]

The use of grafting procedures at resorbed implant sites allows revision of aesthetic and functional concepts and modification of the traditional approach to implant-prosthetic treatment planning, allowing the patient's anatomy to dictate implant position and design of implant-supported prosthetic restorations.

Regarding the reconstruction of implant sites, the influencing factors are as follows [6]:

- type of graft material;
- local biological factors (quality of vascularization);
- local infectious factors;
- local mechanical factors (stability and biomechanical loading);
- Systemic factors (medication, systemic conditions, smoking).

Restoration of homeostasis of the stomatognathic system in edentulous patients treated with implant prosthetics can be significantly improved by using digital techniques.

The analysis of occlusal and intermaxillary (static, dynamic) pre- and post-treatment relationships is based on digital instruments such as T-SCAN (Figure 1) and CADIAX (Figure 2).

Currently, implantologists can use expert software to analyze the clinical case for virtual planning of the pro-implant phase (Figures 3, 4), fabrication of surgical guides (Figure 5) and design of the future prosthetic work [7,8]. The use of digital techniques allows practitioners to create virtual restorations with optimized design and placement [9].

Digital expert systems can be used to analyze multiple factors involved in implant failure or success: required bone volume; dental implant-adjacent tooth, inter-implant distances; location of risk areas (maxillary sinus, mandibular canal); positioning of dental implants.

Preoperative analysis of dimensional parameters of implant sites (height, width, density) can be performed by means of applications using CBCT images (PlanmecaRomexis, OnDemand3D, coDiagnosticX) or based on software programs (NobleGuide, Implant3D, DDS) specialized in pre-implant analysis and virtual planning of dental implant positioning [10,11]. 3D navigation systems (Robodent, X-Guide) assist the implantologist in the optimal positioning of dental implants.

Optical impression methods and future implant-supported prosthetic design applications complete the arsenal of modern techniques that have revolutionized the implant prosthetic management of edentulous patients.



Figure 1. T-SCAN Novus System
(www.tekscan.com/products-solutions/systems/t-scan-novus)

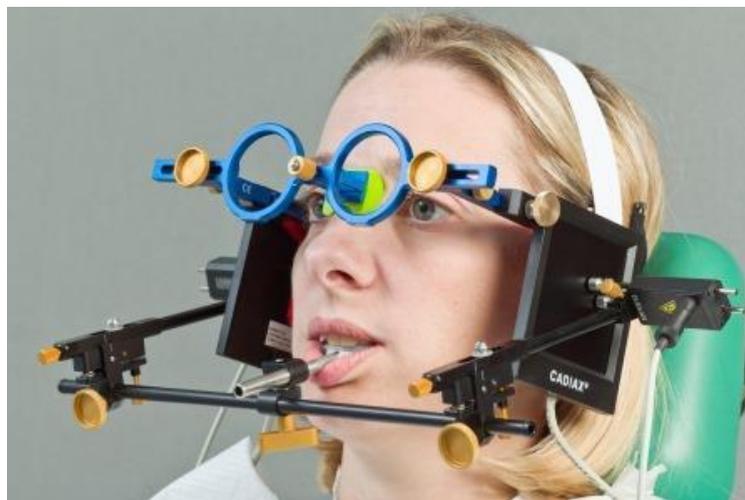


Figure 2. CADIAX System
(www.gammadental.com/en/jawtracking.html)

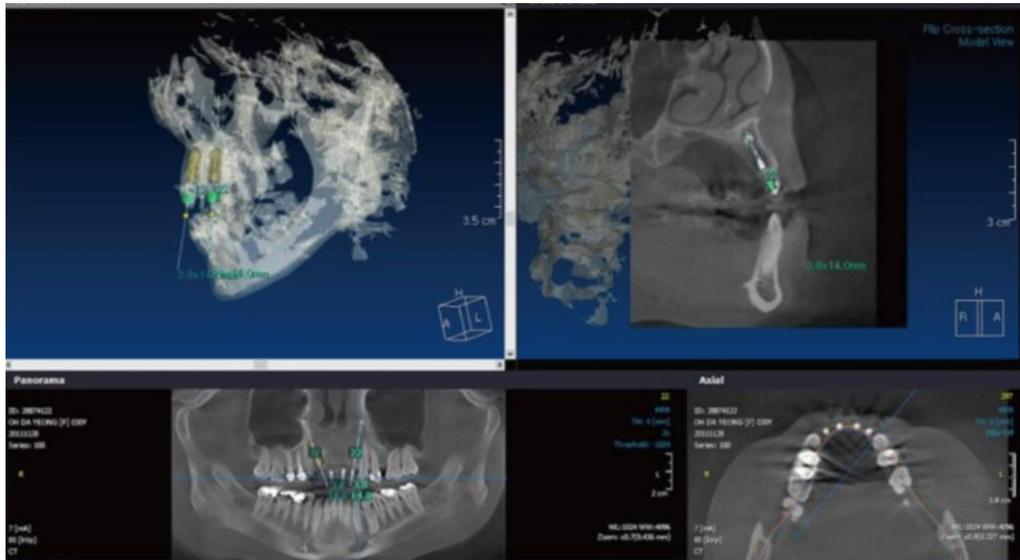


Figure 3. Implant site analysis and virtual planning of dental implant location and angulation with OnDemand software application [11].

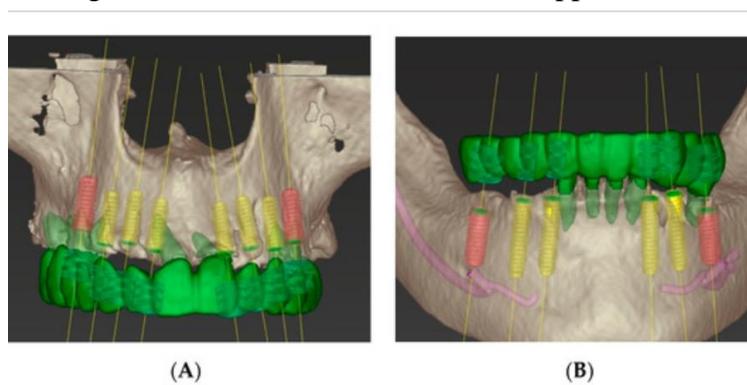


Figure 4. Virtual implant position planning using coDiagnostiX (Straumann USA, LLC, Andover, MA, USA) [11].

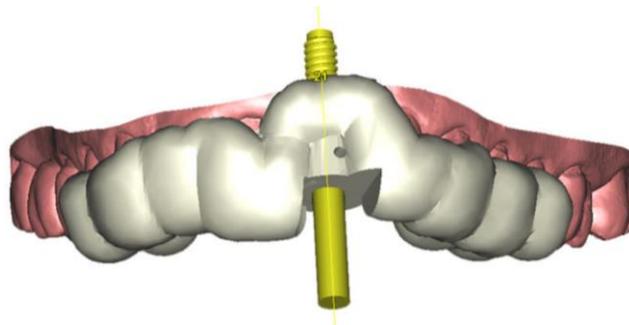


Figure 5. Surgical guide design planning with SMOP software application [10]

Conclusions

- Patients with complications of partial edentulism (masticatory and physiognomic disorders, tooth migration, periodontal disorders, occlusal imbalances) are a challenge for prosthodontists, implantologists, and oral surgeons.

- The implant-prosthetic treatment plan should focus both on the reconstruction of the mucosa-bone support and on ensuring the homeostasis of the stomatognathic system in the context of restoring biomechanical and functional conditions through fixed or removable prosthetic restorations with implant support.

- Optimization of the treatment plan in the pro-implant and implant phase requires paraclinical imaging investigations (CBCT, MRI) to measure alveolar parameters, devices to test the parameters and functions of the stomatognathic system (T-SCAN, CADIAX) and digital applications that allow accurate assessment of the need for bone support reconstruction and the fabrication of the surgical guide.

- The production of a practical guide including the management of loco-regional and local complications and the balancing of the stomatognathic system may be useful to practitioners in order to optimize long-term implant-prosthetic therapy in patients with edentulous teeth.

REFERENCES

1. Forna N. *Tratat de Protetica Dentară*. Editura Enciclopedică, 2011.
2. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. *J Oral Facial Pain Headache*. 2014;28(1):6-27. doi:10.11607/jop.1151
3. Srivastava, K.C., Shrivastava, D., Khan, Z.A. *et al.* Evaluation of temporomandibular disorders among dental students of Saudi Arabia using Diagnostic Criteria for Temporomandibular Disorders (DC/TMD): a cross-sectional study. *BMC Oral Health* 2021; 21, 211. <https://doi.org/10.1186/s12903-021-01578-0>
4. Forna NC, Checheriță LE. *Muscular rehabilitation for the patients with algodysfunctional syndrome vol I, II*, publisher Grigore T. Popa, UMF Iași, 2018.
5. Dundar S, Topkaya T, Murat Yavuz S, Ferhan Y, Atalay Y, Saybak A, Asutay F, Cakmak O. Finite element analysis of the stress distributions in peri-

- implant bone in modified and standard-threaded dental implants. *Biotechnol Biotechnol Equip* 2016; 30(1):127-133.
6. Plonka AB, Urban IA, Wang HL. Decision Tree for Vertical Ridge Augmentation. *Int J Periodontics Restorative Dent*. 2018;38(2):269-275.
 7. Davarpanah M, Szmukler-Moncler S, Davarpanah K, Rajzbaum P. Implantologie assistée par ordinateur. Éditions CdP., 2011.
 8. David O.T., Szuhaneck C., Tuce R.A., David A.P., Leretter M. Polylactic Acid 3D Printed Drill Guide for Dental Implants Using CBCT. *Rev.Chimie (Bucharest)* 2017; 68(2): 341-342.
 9. Scherer MD. Presurgical implant-site assessment and restoratively driven digital planning. *Dent Clin North Am* 2014; 58: 561–595.
 10. Kernen, F., Kramer, J., Wanner, L. *et al.* A review of virtual planning software for guided implant surgery data import and visualization, drill guide design and manufacturing. *BMC Oral Health* 2020; 20, 251.
 11. Lee JH, Park JM, Kim SM, Kim MJ. An assessment of template-guided implant surgery in terms of accuracy and related factors. *J Adv Prosthodont* 2013; 5(4): 4407.