



## Comprehensive Overview of Graftless Methods for Prosthodontic Management of Edentulous Patients: A Review

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### ABSTRACT:

Implant treatment in severely resorbed and atrophic jaws is difficult due to anatomical and mechanical challenges. Because of its complexity, the maxillary sinus floor augmentation procedure is still not a very regular practice among clinicians and requires skills and precise manoeuvrability. The conventional approaches include All-on-four, Columbus bridge protocol and Co-Axis implant while the non-conventional approaches include Zygomatic and Pterygoid implants. In this study, a combination of tilted and axial implants was used in patients with severely resorbed posterior maxilla as an alternative to sinus floor augmentation. Prosthetic rehabilitation of the edentulous maxilla includes the placement of tilted implants as a relatively recent option. The advantages of tilted implants are: (a) avoidance of the use of bone grafts and sinus lift procedures - with the resulting reduction in complexity; (b) improved primary stability by anchoring in more than one cortical layer; (c) the avoidance of cantilever extremities by placing the implants more distal and with better load distribution over the dental arch; and (d) the use of longer implants, thereby increasing the contact surface. Results indicate that the use of tilted implants is an effective and safe alternative to maxillary sinus floor augmentation procedures where grafting is done.

### Introduction

Over the past three decades, implant dentistry has advanced significantly, particularly for the treatment of patients who are completely edentulous. In the recent past, extensive bone grafting treatments were part of implant dentistry, a type of "pre-prosthetic" surgery, in order to prepare the site for the implants. In a 2-stage, delayed load technique, the implants were typically

inserted 6–12 months following the grafting surgeries. Patients were discouraged from seeking treatment because they had to wear a removable prosthesis or, occasionally, refrain from wearing any kind of dental prosthesis while the grafts healed, and because treatment took a long time and required several procedures before dental implants could be placed to support a fixed prosthesis. Many of our colleagues now handle their patients differently than they always did



because of the ability to remove the patient's deteriorating dentition, put implants, and create fixed, instant load prosthesis. Compared to the 2-stage, delayed loading procedures, the graftless technique has the same or occasionally superior long-term outcomes, according to a large body of literature. This has improved patient care and increased patient acceptance of therapy while retaining long-term success rates. It is wise to think about why there has been such a shift in treatment planning and paradigm right now by going over the key research and development results from the past several decades. Understanding bone biology and perfecting the surgical methods for preparing the osteotomy and placing the implant were the main goals of implant dentistry research and development in the 1980s. Regardless of the quantity, angulation, or distribution of the implants, we were happy if osseointegration had taken place and referred the patient for prosthetic reconstruction of the implants. The limitations of functional stresses applied to osseointegrated implants became clear in the 1990s. The management of the functional stresses placed on implants was enhanced by attention to understanding the biomechanical constraints of the hardware, leading to more predictable, long-term outcomes. Treatment planning advanced to a new level in the 2000s as a result of research on the "graftless concept" employing tilting implants and distal site anchorage using the zygoma implant. The services accessible for the treatment of our patients have undoubtedly increased with the possibility to treat a subgroup of patients deemed to be "untreatable" using the quad zygoma concept. This paper is presented to seek the possible solutions for individuals where bone grafting can be bypassed.

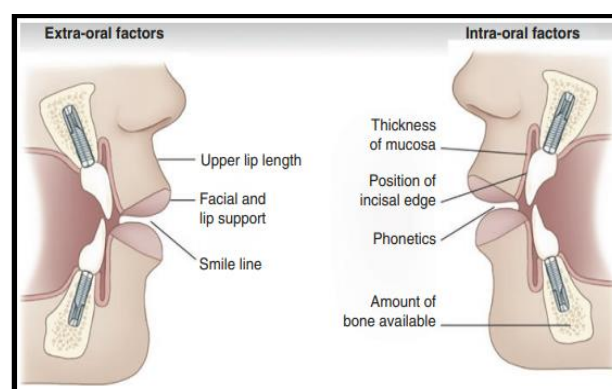
### Assessment of Bone Quality

Dental implants are the most popular and predictable modern solution for missing teeth. The early and long-term success of dental implants depends largely on the alveolar bone quantity and quality during implant placement. Poor bone quality and quantity are considered as a risk factor for biological complications of the implant, associated with lack of primary stability and impaired healing/ osseointegration that can lead to early implant loss. The external architecture of the dentate or edentulous alveolar bone and its volume are primarily evaluated during treatment planning for dental

implants. The external and internal architecture of bone controls virtually every facet of the practice of implant dentistry from implant design selection, surgical approach, healing time, type of future prosthetic reconstruction, etc.

### Treatment Planning: a Restorative Perspective

Considering all the factors that can affect the prosthesis' aesthetics and functionality, implant rehabilitation for edentulous patients continues to rank among the most challenging restorative tasks. Complete dentures have historically been the standard treatment for edentulism. According to epidemiological data, the number of adults who needed one or two dentures will rise from 35.4 million in 2000 to 37.0 million in 2020.<sup>1</sup> However, the researchers caution that their projections may be "significantly conservative."<sup>2</sup> According to clinical studies, people with dentures have only slightly improved quality of life compared to that receiving implant therapy. Pain, poor retention, stiffness, and other issues with dentures are major causes of patient unhappiness.<sup>3</sup> Before choosing the type of prosthesis that is most appropriate for the patient, numerous diagnostic parameters must be assessed. (Fig.1) Planning for restorative treatment should take into account the following factors:



**Fig.1** Factors that need consideration before deciding upon a fixed vs. removable implant rehabilitation

### Treatment Planning: Guided Surgery

Those who wear dentures have only slightly improved their quality of life, whereas those who have had implant therapy have significantly improved their functionality. Patients who have full dentures frequently express complaints of discomfort, sore spots, unstable dentures, and trouble swallowing. When resorption is



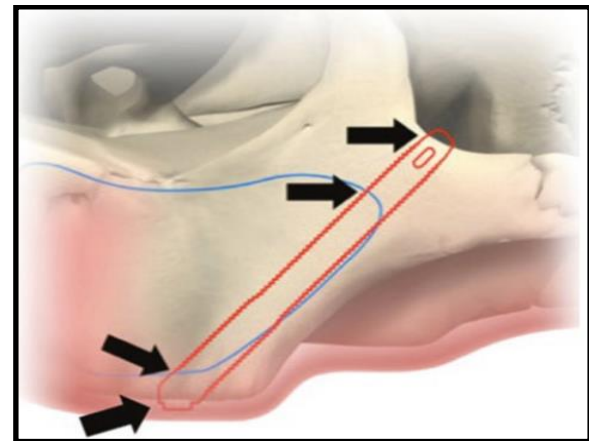
extensive, there is also a lack of retention.<sup>4</sup> Patients who have terminal dentitions seek full-implant-supported fixed restorations as a treatment option. A presentation of spread, supraerupted teeth is frequently the outcome of this diagnosis. These two occurrences could be pathogenic or physiological, and they both involve dentoalveolar compensation. A lack of restorative space is frequently the result of these changes. According to the type of prosthesis being designed, requirements for enough restorative space must be followed in the treatment.<sup>5</sup>

### Biomechanics of Graftless Solutions

A unique anatomical presentation of the edentulous maxillae restricts the number and distribution of implants that can be inserted within the maxillary arch length. The vertical movement is restricted on both sides by the presence of pneumatized maxillary axial endosteal implants can be placed in the posterior maxilla to support a fixed prosthesis if there is enough alveolar bone available for that purpose. The use of the zygoma implant is advised for this group of patients with anterior extension of their maxillary sinuses into the bicuspid region, establishing posterior support for an implant-supported fixed prosthesis.<sup>6</sup>

### Review of Surgical Principles

The zygomatic bone's quantity and quality were reported by Nkenke et al. in 2003.<sup>7</sup> Histomorphometry and quantitative computer tomography were used to evaluate the morphology and microstructure of the os zygomaticus. The density of minerals, in 30 human zygomatic bone specimens, bone volume and trabecular bone pattern were examined and correlated. According to the conclusion, the trabecular bone of the os zygomaticus was not a good location for implant placement. Nkenke goes on to say, however, that the engagement of four cortices during the placement of the implant (Fig. 2) is what accounts for the success seen with the zygomatic implant. Bicortical stabilisation at the platform is provided by the lingual cortex of the maxillary alveolus and the cortical floor of the maxillary sinus. The lateral cortex of the os zygomaticus and the roof of the maxillary sinus create the bicortical stabilisation at the apex of the zygomatic implant.



**Fig. 2** Quad-cortical stabilization; the four points of BIC when placing the zygoma implant

### Graftless Surgical Protocol

The All-on-4 treatment concept was created in the 1990s as a surgical protocol to restore immediate function to the completely edentulous, with implant placement, abutment installation, and prosthesis connection all taking place on the same day as surgery. The idea was created to prevent the need for graft procedures or any additional surgery (such as inferior alveolar nerve lateralization), which would reduce recovery time and surgical complications.<sup>8</sup> A more distal implant position could be achieved by inserting four implants acting as "cornerstones," two anterior implants in an axial position and two posterior implants tilted distally between 30° and 45°. <sup>8-11</sup> This reduced cantilever and improved implant anchorage by placing the implants in better bone quality regions. The surgical All-on-4 protocol can be carried out in both arches either through freehand flap surgery or guided surgery.

### Comprehensive integrated digital and guided surgery

Dentists encounter difficulties when restoring the appearance and functionality of patients with terminal dentition as a result of advanced periodontal disease<sup>12</sup> or when rehabilitating patients who are completely edentulous because it is challenging to match soft tissue facial features to the definitive casts used to determine the needs of the intended restoration.<sup>12</sup> There are limitations to describing the three-dimensional (3D) structures of a patient's face using conventional two-dimensional diagnostic tools. The challenge of transferring the facial soft-tissue anatomic landmarks to

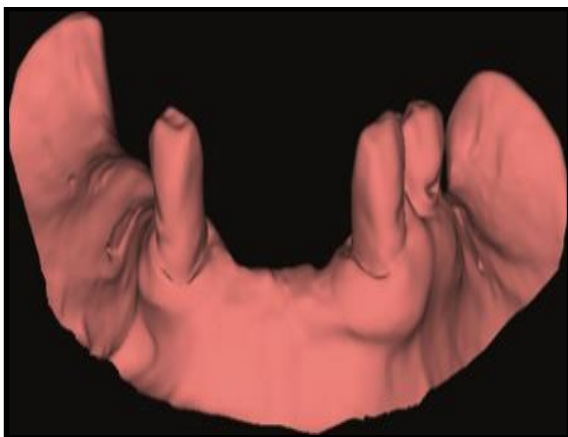


the virtual cast produced by the planning software program still exists in a digitized workflow. The ability to create simulated patient models based on 3D skeletal, facial, and dental imaging has been made possible by technological advancements.

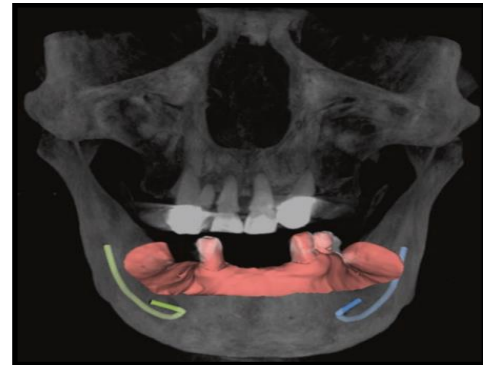
A virtual dental patient can be created thanks to three-dimensional imaging and the ability to combine different data sets (DICOM and STL files). Under static conditions, a virtual patient can be created by superimposing data on the facial skeleton, soft tissue, and/or dentition. In order to provide a systematic method of evaluating dentofacial aesthetics in a logical, interdisciplinary manner and to meet patient demand for more attractive teeth, dentists must become more familiar with the formerly independent disciplines of orthodontics, periodontics, restorative dentistry, and maxillofacial surgery.<sup>13</sup>

#### Integrated Digital Workflow

Encouragement should be given to new technologies that combine CT/CBCT data (DICOM) with details on the soft tissues and crown morphology obtained from digital high-resolution optical scanners. To ensure proper matching between the two data sets during the superimposition of the DICOM and optical surface scanning (STL) files, it is necessary to identify at least three dental units or points in the jaw (Figs. 3 and 4). The main obstacle to using an integrated digital workflow in patients with complete dentition is the requirement for mutual landmarks on both data files.



**Fig. 3** Images obtained through scan on Intra-oral scanning



**Fig. 4** Superimposition of intra-oral 3D CBCT

#### Material considerations for full-arch implant supported restorations

Full-arch fixed implant-supported restorations can now be created using a variety of materials. Unfortunately, there isn't much in the way of solid evidence in the literature when it comes to the best kind of material to use. There is no proof that one design is better than another or that one set of materials is better than another. The majority of articles are case reports that track a small group of patients over a brief period of time.<sup>14</sup> These reports do give us useful information, but they cannot be taken as actual proof. Design considerations in fabrication of the prosthesis include but are not limited to factors such as screw access trajectory, restorative space, nature of opposing dentition, aesthetic demands, framework cross-sectional area for cantilevers and around screw channels, ease of fabrication and passivity.

#### Clinical steps for fabrication of full-arch implant supported restoration

In 1<sup>st</sup> appointment, Impressions are made, followed by impression verification and interocclusal record in the 2<sup>nd</sup> appointment. Whereas in the 3<sup>rd</sup> appointment, teeth arrangement trial is done, framework trial and second interocclusal record is done in the 4<sup>th</sup> appointment. Appointment 5 includes bisque trial and occlusal adjustments. Delivery of prosthesis is done in appointment 6. Appointment 7 includes maintenance and follows up.

#### Laboratory fabrication of full-arch implant supported restorations

For the best results, precise impressions, cast verification, and records of jaw relationships are



essential. These fabrication techniques apply to any material. The fabrication of rigid bases is required for repeatable jaw relation records. The primary portion of the occlusal rim, which is screw-retained to the implants/abutments, and the secondary portion, which is removable and modifiable, are the types of occlusal rims that the authors prefer.

### Complications with immediate loading, full-arch, fixed implant supported prosthesis

It is crucial to first point out the common misconceptions about the use of immediate placement and immediate loading of dental implants with full-arch fixed implant-supported prostheses (Fig.5) before talking about prosthetic complications. The first is that there is only one procedure involved in this treatment. This is an oversimplification, despite the fact that it is marketed as an effective way to handle several dental issues at once. It is a process rather than a single procedure, like the majority of prosthetic treatments. Each of the five distinct phases of treatment has its own complexities and difficulties. The diagnostic stage, surgical procedure, interim prosthodontic stage, final prosthodontic stage, and maintenance stage are some of these. Additionally, in order to achieve overall success, practitioners need to be able to recognize, avoid, and deal with potential complications in each phase.



**Fig. 5 (a)** Preoperative condition. **(b)** Post-operative condition—maxillary and mandibular full-arch fixed implant-supported prostheses

### Management of Failure in Graftless Implant Reconstruction

A graftless implant solution may have several benefits for patients with advanced atrophy. However, since this might involve using angled or short implants, there might be insufficient anchorage and mechanical advantage. These circumstances add a level of complexity that may make complications or failure

harder to handle in an environment that is already anatomically constrained. Attention to detail in prosthetic planning as well as in the provisional and definitive phases of prosthetic reconstruction is also of the utmost importance given the anatomical restrictions and surgical challenges. In addition to aesthetic and prosthetic complications, poor prosthetic planning may also result in insufficient surgical planning, inadequate jaw preparation during surgery, inappropriate implant positioning, and inappropriate loading and ultimate implant failure.

### Maintenance of full arch implant-supported restorations

When compared to the periodontal attachment, the peri-implant attachment is different. The gingival fibres surround the implant in a circumferential fashion; they do not insert onto the implant's surface or the abutment. However, the gingiva around a tooth is hemidesmosomally attached to the cementum layer of the root. There is no doubt that the periodontium surrounding the tooth provides a seal that keeps bacteria from invading at the bone level when compared to the peri-implant and the periodontal attachment. Since the peri-implant attachment does not provide as much protection for the surrounding bone, it is crucial to practise excellent home care and to treat peri-implantitis in a preventive manner as opposed to a disease-treating manner.

### Conclusion

The modern technologies do have some drawbacks and some unanswered questions that call for more research. In terms of precise implant placement and the delivery of a prefabricated provisional prosthesis, a CBCT combined with interactive planning software and the creation of a bone reduction and implant placement guide offers significant advantages. It is crucial to stress that there is a steep learning curve involved and that before beginning guided surgery protocols, practitioners should be familiar with traditional surgical and loading techniques. Technology advancements give us the tools to deliver care more effectively, but they should not be seen as a replacement for accurate diagnosis and treatment planning. Patient selection is important and meticulous attention must be paid to a myriad of details to enhance treatment outcomes.



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