Implant positioning

Precision and biological considerations

Minimally invasive procedures and esthetics
Introduction

It is undeniable that dental implantology has moved on in 20 years from research for osseointegration and function to research for tissue integration and esthetics.

This paradigm shift has switched the notion of implant survival to biological success, a mandatory condition for tissue stability. This is the result of multiple factors and cannot be summed up in the simple design of an implant or the choice of a prosthetic device.

It is not solely a question of an implant design, which is the intelligent form for a given function, concentrated in a few millimeters-subtleties that have a decisive impact on the primary and secondary implant stability. It is decisively based on bio-esthetic integration with the present peri-implant soft tissues, the reliability of the prosthetic connection, the simplicity of the surgical procedure and the prosthetic components installation, just to give these examples.

The anterior region represents the most critical area from an esthetic standpoint and the most complex with regard to the osseous and gingival architecture, and especially when the tooth loss occurs a deficiency of the hard tissues and/or soft tissues irreparably complete the clinical status.

Traumas, fractures, cracks and injections generate bone and soft tissue defects, slow or sudden. It is essential to diagnose for establishing the sequences in a surgical-prosthetic treatment plan, the methods of tissue regeneration, the possibilities for immediate implantation in a fresh extraction site, or more simply (but more rarely) how to preserve tissues.

The clinical examination, which should be completed by a radiographic and/or tomographic examination, should take account of the periodontal biotype and guide the clinician’s decision-making.

At present, prior to the first surgical act, the treatment rationale is based on the following questions:

- Orthodontic pre-treatment
- Bone volume augmentation
- Gingival and mucosal tissue enhancement
- Timing of these procedures before, during or after implant placement
- Provisionalization modalities
- Type of implant(s)

The choice of this last element depends from a large extent on the clinician experience, the surgical instrumentation at his/her disposal and his/her confidence, which is related somewhat from the use of a "family" of implants.

Bio-esthetic considerations
There is thus a kind of "routine" that only can be counteracted by understanding the features of each implant. It is therefore essential for the improvement of tissue integration to study these characteristics and their biological outcomes (this being one of the objectives of this special issue), and not to hesitate to use a new generation of implants in appropriate clinical situations, as there is no "universal" implant that would be suitable in all sites and for all indications.

But in the anterior region, partial edentulism, immediate implantation following extraction and implant in a healed site with a thin biotype generally represent the greatest clinical challenges. Some of the popular implants consist in titanium screws called "one piece" if they are transmucosal, and "two piece" if it is the role of the prosthetic abutment to provide an adherence surface for the three-dimensional biological space composed by the junctional epithelium and the connective attachment.
A contemporary implant presents the key-features as the apex, the body ("core"), the threads, the collar, the external or internal connection system, and a osseoconductive surface.

Modern development has had a tendency to modify all of these characteristics in the light of studies and experience acquired during the last 20 or 25 years. This tendency could be set out as follows:

- **The apex** is quite narrow, and the threads makes it self-cutting, or self-tapping, which enables it to operate in a narrower osteotomy and thus to gain in primary stability.
  The design of the threads also makes it "backward-cutting", enabling reorientation during placement of the implant in a bone with a compatible density.

- **The body**, neither cylindrical nor tapered, has a spiral form with an osteotome effect, compressing the bone and making it denser during the implant placement.

- **The threads** are more aggressive and their design develops along the height of the implant a variable cutting effect and that of compression. A double thread spire allows for faster placement, the spacing between the thread spires and a groove facilitating the escape of bone chips and reducing overheating.

- **The collar** is of a slightly smaller size compared to the body of the implant, back tapered, and has mini-threads or grooves on it, not smooth but textured. Its design allows for a certain "rebound" of the cortex after the implant has been through it, and its macro- and micro-surfaces lead to osseointegration of the implant neck in order to stabilize the crestal bone at this level.

- **The connection system** combines a Morse taper with internal interlocking, hexagonal or otherwise, for improved hermeticity with regard to bacteria, better retention of prosthetic components (and therefore less screw loosening), and a greater ease for seating these without necessarily need for positioning index and retro-alveolar radiography. The connection system, narrower than the diameter of the implant, allows a real platform-switching effect.

- **Finally, the surface** of the titanium implants is rough, and has an oxidized layer that accelerates bone formation and thus leads for faster secondary stability.

Not all of these features are found within all modern implant systems (and other variants sometimes provide the same results), but overall this development seems to have influenced the last generation of implants designs recently, which also copy one another, "research and development" not being possible for all manufacturers...

The use of an implant with modern characteristics is not the only guarantee of harmonious integration. Three-dimensional seating is essential, and the literature that abounds on the subject demonstrates this well.

This seating is a determining factor for bio-esthetic integration: it is responsible for the morphology of the prosthetic restoration, its emergence and angulation, and the architecture of the peri-implant soft tissue at the level of the scalloped gingival margins and inter-dental papillae.

During the 1980s, implantology was guided by anatomical imperatives. Since then, prosthetic requirements (such as the ideal position for a prosthetic restoration) and biological imperatives (such as tissue stability) rule all implant treatment.

At present, with the advances made possible by 3-D imaging (Scanners and Cone Beams) and software for implantology, guidance of implant positioning may be entirely computer-assisted with great precision and great safety with regard to the various anatomical landmarks.

The seating of an implant should not negatively affect bone volume; if this is insufficient in terms of height or thickness it should be regenerated to support the soft tissues ("The tissue is the issue but the bone sets the tone" Garber/Salama).

Horizontally the diameter of the implant should promote inter-dental bone peak (where there are natural teeth), the minimum thickness of which should not be less than 1.5mm (Esposito, 1993). This bone portion determines a predictable factor of the gingival papillae (Salama 1998).

Implant stability is required in an extraction socket, but not at the price of choosing the widest implant diameter: it is here where the implant design plays an important role.

In the case of adjacent implants the space should be increased to 3 or 4 millimeters, the biological conditions being different in the absence of Sharpey's fibers, periodontal blood supply and a smaller and less firm fascicle of collagen fibers: the peri-implant...
soft tissue is a scar tissue, and does not have the same potentialities for repair as healthy gingiva, firmly-attached to the bone and highly-vascularized.

Vertically the implant should promote the volume of the soft tissue barrier that ensures a tight joint with regard to bacteria, toxins and all aggressive elements within the buccal environment, thanks to the adherence of the junctional epithelium (which contains glycoproteins and hemi-desmosomes) and the connective tissue fibroblasts. This 3-D biological space should have a height of around 3 mm to ensure its stability, which is why the gingival biotype is important. When insufficient space recreates the necessary volume at the expense of the crestal bone, recession occurs. The thickness of the soft tissue should be sufficient around the implant collar and can be achieved naturally (thick biotype), surgically (subepithelial connective tissue graft) or prosthetically (transmucosal-Curvy® abutment, Nobel Biocare® or platform-switching concave implant abutment).

The reference point for this distance of 3 mm should be the predetermined level of the marginal soft tissue in the case of a gingival graft: implant placement in the anterior region combined with soft tissues regeneration implies prudence and skills.
BIO-ESTHETIC CONSIDERATIONS FOR OPTIMAL IMPLANT POSITIONING

Sagitally the implant should not reduce the thickness of the buccal bone wall, which should be a minimum of 1.5 mm, even 2 mm (Spray 2000).

Nowadays the use of a countersink is not recommended. The crestal bone needs to be protected and the horizontal component of the biological space is a key-issue to maintain it.

In an extraction socket, the implant should be anchored in the palatal bone wall and not in the center of the alveolus (unless the buccal bone table is thick), allowing the emptied buccal space being filled with a bone substitute.

This procedure is held to provide the longest-term implant/bone contact and to recreate a thicker buccal bone wall (Abushahba 2008, Kan 2009).

In natural teeth a thin buccal cortical plate with reduced or no spongy bone is viable, and may be stable, as the bone is stimulated by the Sharpey's fibers and take advantage of the rich blood supply provided by the periodontal ligament.

In the case of an implant, only a thick bone wall can guarantee stability and play a counteract to various remodeling patterns, as tissue stability depends on a number of factors...

Nowadays implant success is not reduced by the implant design or position (although these parameters are important) and cannot be covered in a few lines.

Contemporary dental implantology also has other requirements, like minimizing surgical trauma by applying minimally invasive procedures, protecting the blood supply, reducing the handling steps of prosthetic components, using materials that are biocompatible with the transmucosal area, providing immediate support to the soft tissues by means of a temporary esthetic restoration, preferably fixed, and sub-contouring all trans-mucosal prosthetic components.

All of these paradigm shifts lead our clinical and laboratory prosthetic concepts to do the same. Except in situations where a zirconium oxide abutment has been prepared beforehand, as for a temporary restoration, prior to surgery using an advanced planning technique, in all other cases our preference is for a screw-retained one-piece crown on a zirconia base. It has the advantage of eliminating the abutment/crown joint and luting cement removal sub-mucosally.

Today we have at our disposal an advanced planning strategy, whether supported by digital technology or not. A surgical-prosthetic co-ordination should facilitate some prosthetic phases such as the production of implant abutments and temporary restorations. For example, these steps can be anticipated before the first surgery, giving a timing and a planning for the surgical sequences over time.

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