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A brief history and guidelines of blade implant technique: a retrospective study on 522 implants.

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Abstract

Introduction

Despite initial enthusiasm, blade implants have received bad press over the years due to fairly high failure rates reported in some publications of non-users.

Materials and methods

A total of 522 blades were inserted in 20 years (1989-2009). 309 in females and 213 in males. The median age was 59 ± 11 (min--max 24--80 years). The implants were inserted in deep and atrophic narrow crests.

Results

Success rate was 93.4 % (488/522) globally, 98.9 % (369/373) at 5 years, 89 % (261/293) at 8 years and 86.2 % (200/232) at ten years. These data show very good results at five years, but slightly more failures at eight and ten years.

Conclusion

The blade implant is a valid therapeutic device useful for treating cases such as narrow bone crest and scarce spongy bone in the lower distal sector. They have been demonstrated long-term survival. Nonetheless, to prevent failure, practitioners should know that blade implants are not indicated in wide alveolar crests, or in areas where bone density is insufficient and the implant cannot be positioned in the deep cortical layer.
**Introduction**

The idea of endosseous blade implants has been developed by L.I. Linkow and R. Roberts, but its spread all over the scientific community must be attributed to Prof. Leonard Linkow, who published about it in 1968, thereby making it possible to treat partial or total edentulism.

Blade implants can be used in any alveolar crest, but are particularly useful in the thinnest, where the use of root-form implants is difficult and needs bone regeneration procedures. When the ridge is thin, tricortical anchorage is the most suitable technique, according to Manenti, i.e. the implant is stabilized by press-fit in both the internal and external bone cortex, as well as the deep cortex (Fig. 1-2). This condition represents the *optimum* to allow immediate loading with a functional provisional prosthesis.

The original Linkow surgical protocol is based on the following simple steps:

- Select the patient correctly
- Consider general health conditions
- Value crestal size;
- Open a flap to have a correct ridge overview;
- Perform a line of little holes in the superficial cortical bone;
- Connect holes and insert blade implant as deep as possible;
- Gently bend implant abutment to reach correct position in relation with the antagonist teeth;
- Gently bend implant body if necessary;
- Press the blade inside its implant site till it reaches the correct position.
- Control occlusal functions;
Osseointegration of titanium blade implants has been confirmed by numerous histological studies. Figure 1 allows you to appreciate bone thickening around the neck and body of a blade implant 11 years after surgery.

If patients are suitably selected, blade implants are successful. In fact, clinical experience shows that the majority of failures occur when:

- the surgical protocol is not correctly followed \(^4,5\);
- the implant form was not suitable in that patient;
- the movements of the tongue was not taken into consideration \(^6-8\);
- the implant was used in too much atrophic crestal bone.

*Types of blade implants*

Linkow’s original blade implant was performed in different shapes according to the anatomical site of insertion. Subsequently Linkow has been developed numerous improvements to the shape and surface of his device. At the beginning of the 1970s Pasqualini proposed a “polymorphous” blade implant, which could be modeled to suit the most common anatomical conformations and which, with its screw abutment, offered for the first time a solution to the problem of tongue-thrust during swallowing (causing the majority of postsurgical failures) \(^9\). A provisional abutment with a short temporary screw-on cap should be replaced with a longer one, 3- 4 months after surgery. (Fig.3-4)

Many other authors have developed changes to the shape and prosthetic component: emergent, semi-emergent and submerged forms \(^10-16\).

Blade implants advantages are:

1. possibility to insert blades in the narrowest alveolar crests;
2. adaptability to the majority of anatomical conformations;
3. avoiding bone regeneration surgery;
4. mechanical correction of parallelism during implant surgery;
5. easy adaptation to the deep anatomical structures by modifying the implant;
6. presence of numerous contacts with deep cortical layer;
7. possibility of inserting a part of the implant below the intact cortex (as compared to EDE technique);
8. adequate management of attached gingiva during implant surgery;
9. simple surgical technique performed with standard instruments.

Blades disadvantages are:

1. invasion of adjacent bone sites with mesio-distally positioned blades;
2. poor adaptability to post-extraction alveolar sites.

Biomechanical aspects

The possibility offered by the surgical technique of modeling the blade implant, requires that the operator has the skill to evaluate the biomechanical suitability of the implant. Blade implant should have a root/crown depth ratio of 1:1. 17

Materials and Methods

Surgery standard protocol

Patient’s anamnesis is mandatory. The preliminary phases of surgery are based on clinical and radiographic examinations. Written informed consent is mandatory. The patient must be thoroughly informed about treatment options to know relative vantages and disadvantages.

The incision must be performed to ensure adequate adherent gum around the prosthesis. In order to decide about the precise position of the abutment, an intraoperative surgical mask is required.

After incision, the flap is detached using a periosteal elevator. In cases of very thin alveolar crest, flap lifting should be cautious not to compromise blood supply to the underlying bone.
A line of small guide hole on the surface of the crest should be designed using a 0.9–1.0-mm gauge multi-blade metal drill mounted on a turbine, or high-speed contra-angle (red band) handpiece. These ideal line will serve as a guide for the implant insertion (Fig.3). In alternative to the drill, a piezoelectric scalpel can be used.

The mesio-distal dimensions of the implant site must be calculated in relation to blade shape, selected on the basis of radiographic images and the anatomy of the implant site. If the bone is not particularly dense, it is normally to drill a slightly shallower channel, so that the implant will have greater primary stability upon press-fitting. The implant site should be traced with a slow movement of the wrist, following the longitudinal direction of the crest; its depth should be sufficient to maintain a safe distance from the underlying anatomical structures.

Once the mesio-distal implant site has been bored and its depth checked using a gauged probe, the implant can be inserted, ensuring that its shoulder has been positioned at least 2 mm below the superficial cortex. The implant is fitted in its site using pliers, and the mounting device should be tapped gently and safely (Fig. 5).

The abutment neck should be surrounded by patient’s gum with the correct biological width (Fig. 6-7).

The blade implant can be modified to perfectly suit the crestal bone anatomy (Fig. 1) and the body can be curved to follow the anatomical profile. If the abutment needs to be angled, this can be achieved mechanically, up to maximum of 20°, before the implant is positioned using two pair of steel pliers, thereby resolving beforehand any problems that could arise due to incongruous abutment positioning.

The sutures should surround the protruding abutment and not compromise the anatomy of papillae.

*Post-surgical protocol*
After surgery, patients are likely to experience slight swelling and normal post-surgical symptoms. Five days of antibiotics is a precautionary measure to suggest.

**Immediate loading**

The blade implant can be immediately loaded if adequate stability has been achieved. Anchoring the implant through two cortical layers and in contact with the deeper cortex should stabilize the implant.

Static and dynamic occlusion should be meticulously checked when temporary or permanent crowns have been positioned.

**Oral rehabilitation**

Numerous articles have been demonstrated the long-term stability of this type of implants and documented their histological osteointegration, without connective tissue in the bone/implant interface.

Strictly following the surgical and prosthetic protocols is the first step for success. A comparative study published on-line in 2011, have been showed that “blade implants have yielded the best success rates at 5 years. The success rate decreses between the 5th and 8th year.”

Over the years, several authors have proposed changes on the original technique. For instance, the technique known as Endosseous Distal Extension is particularly useful for treatment of lower posterior sectors with scarce bone density.

First used in 1993, the endosseous distal extension (EDE) was published in 2001. The best type of blade implant to use is ramus blade, which was designed during the seventies by Roberts and Linkow.
The technique consists in performing the implant site mesially, so that the blade is gradually rotated distally until it reaches the distal border of implant site.

In this way almost all of the implants is placed beneath the intact bone and soft tissues. The presence of intact superficial bone tissue posterior to the abutment can be controlled with an X-ray (Fig.8).

Since the implant must be surrounded by healthy tissue (superficial cortex, upper cortex of alveolar canal, labial and lingual cortical layers), this type of implant is extremely stable even if it should immediately loaded with a fixed prosthesis.

Indeed, this kind of procedure is characterized by excellent soft tissue response. The same results could be reached for ramus blade implants inserted using this technique.

Results

Statistical data

Dr. L. Dal Carlo have been inserted immediate- and deferred-load monoblock blade implants in narrow alveolar crests since 1989 30. The implants were used in both deep and atrophic narrow crests, and their success rate was 93.4 % (488/522) globally, 98.9 % (369/373) at 5 years, 89 % (261/293) at 8 years and 86.2 % (200/232) at ten years. These data show very good results at five years, but slightly more failures at eight and ten years. Probably this was due to some implants inserted into particularly atrophic posterior sectors and unfavourable crown/root ratio.

The efficacy of blade implants has also been documented by an independent multicentre randomized trial (Veterans Administration Cooperative Dental Implant Study) conducted over a 5-year period. This study revealed 91.5 % success in cases of partial edentulism treated using fixed prostheses on blade implants33.
Discussion
The introduction of blade implants by Linkow in the 1960s was a great innovation, inducing numerous implantology neophytes to expertize this method, without however having a clear idea of indications. The improper use of the blade implant was unsurprisingly therefore the main cause of failure of this device. As with any new technique, especially when practiced by non-experts, there have been failures that have been particularly exalted in some published reports over the years. In these reports implant insertion technique, implant shape and quality of osseointegration have been particularly criticized. At the same time, however, scientific works have been published about the benefits arising from the use of blade implants after failure of root-form implants\textsuperscript{32, 34-36}. We believe that it is not scientifically correct to assume that this technique is useless on the basis of the case some reports. Indeed, a report of blade implants used instead of a failed root-form implant\textsuperscript{34} has also been published, but this does not necessarily mean that one technique is superior to the other. Moreover, when compared with other implants inserted in the same period of time, some studies have shown that the blade implant provide long-term reliability\textsuperscript{35,36}. Furthermore, the possibility of replacing a failed blade implant with a new blade implant has been experienced by both the authors of this paper and Covani et al.\textsuperscript{37}. The idea that blade implants are poorly osteointegrated with respect to other types of implant, has been effectively denied by histological examination, which have demonstrated total absence of connective tissue interlayer\textsuperscript{26,28}. With regard there are numerous clinical reports that attest blade implants reliability.

Conclusions
The blade implant is a valid therapeutic device useful for treating cases such as narrow bone crest and scarce spongy bone in the lower distal sector. It can be used, in its mesio-distally extended form, not only in the upper and lower posterior sectors, but also to provide deep anchorage in posterior and anterior (aesthetic) sectors. Furthermore, this method offers
excellent response of the surrounding soft tissues. Nonetheless, to prevent failure, practitioners should know that blade implants are not indicated in wide alveolar crests, or in areas where bone density is insufficient and the implant cannot be positioned in the deep cortical layer.

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Figure legends

Fig. 1: Radiograph at 11 years of submerged blade implant positioned in zone 1.2 in 1993

Fig. 2: Photograph 7 years after fitting of the prosthesis on the implant in figure 1

Fig. 3: The guide holes are joined, tracing the site for insertion of a Pasqualini screw-abutment blade implant

Fig. 4: Intraoral radiograph performed immediately after positioning of the Pasqualini blade implant in figure 4

Fig. 5: Blade implant during implantation in zone 3.5

Fig. 6: The blade implant in its definitive position. The abutment reaches the bone crest

Fig. 7: On the left note the excellent response of the soft tissues around the blade implant in figures 5-6

Fig. 8: The blade has reached its final destination with the abutment against the distal border of the bone site. Implant body has been inserted between the superficial cortical bone and the superior side of the alveolar canal. The cortical bone posterior to the abutment remains intact.