

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. We aim to discuss the techniques of blade implants to improve the understanding of the technique.

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 years (min–max: 24–80 years). The implants were inserted in deep and atrophic narrow crests.

Results

The 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 10 years. These data show very good results at 5 years, but slightly more failures at 8 and 10 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 demonstrated long-term survival. Nonetheless, to prevent failure, practitioners should

be aware that blade implants are not indicated in wide alveolar crests or in areas where bone density is insufficient and that the implant cannot be positioned in the deep cortical layer.

Introduction

The idea of endosseous blade implants was 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 it around 1968, thereby making it possible to treat partial or total edentulism^{1,2}.

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, tricolor

anchorage is the most suitable technique, according to Manenti³, that is the implant is stabilised by press-fit in both the internal and external bone cortex, as well as the deep cortex (Figures 1 and 2). This condition represents the *optimum* to allow immediate functional loading of provisional prosthesis.

The original surgical protocol of Linkow 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

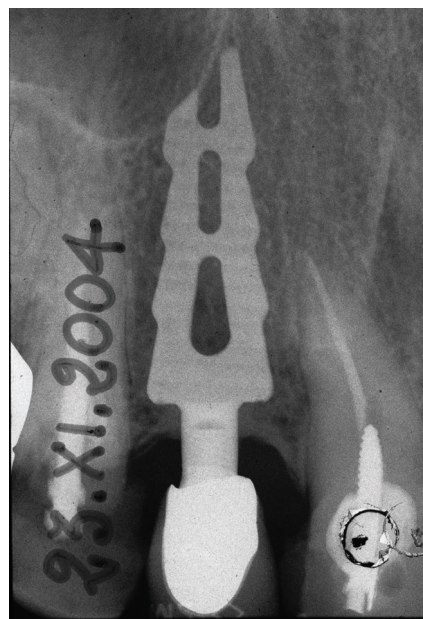


Figure 1: Radiograph at 11 years of submerged blade implant positioned in zone 1.2 in 1993.



Figure 2: Photograph 7 years after fitting the prosthesis on the implant in Figure 1.

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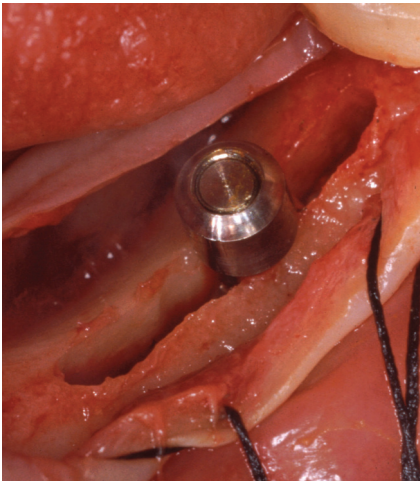


Figure 3: The guide holes are joined, tracing the site for insertion of a Pasqualini screw-abutment blade implant.

- 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 surgical protocol is not correctly followed^{4,5}, implant form was not suitable in a patient, movements of the tongue were not taken into consideration⁶⁻⁸, and 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 developed numerous improvements to the shape and surface of

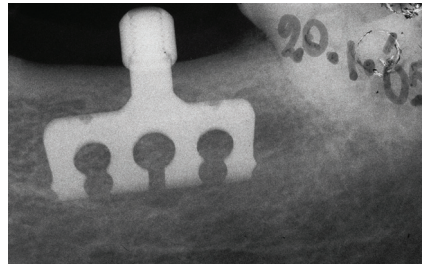


Figure 4: Intra-oral radiograph performed immediately after positioning the Pasqualini blade implant in Figure 4.

his device. At the beginning of the 1970s, Pasqualini proposed a 'polymorphous' blade implant, which could be modelled 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 post-surgical failures)⁹. A provisional abutment with a short temporary screw-on cap should be replaced with a longer one, 3–4 months after surgery (Figures 3 and 4).

Many other authors have developed changes to the shape and prosthetic component: emergent, semi-emergent and submerged forms¹⁰⁻¹⁶.

The advantages of blade implants are as follows:

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 with endosseous distal extension (EDE) technique)



Figure 5: Blade implant during implantation in zone 3.5.

8. Adequate management of attached gingiva during implant surgery
9. Simple surgical technique performed with standard instruments

The disadvantages of blade implants are as follows:

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 modelling the blade implant requires the operator to possess skills to evaluate the biomechanical suitability of the implant. Blade implant should have a root/crown depth ratio of 1:1¹⁷.

This study is focused on the techniques attributed to blade implants and their long-term reliability.

Materials and methods

This work conforms to the values laid down in the Declaration of Helsinki (1964). The protocol of this study has been approved by the relevant ethical committee related to our institution in which it was performed. All subjects gave full informed consent to participate in this study.

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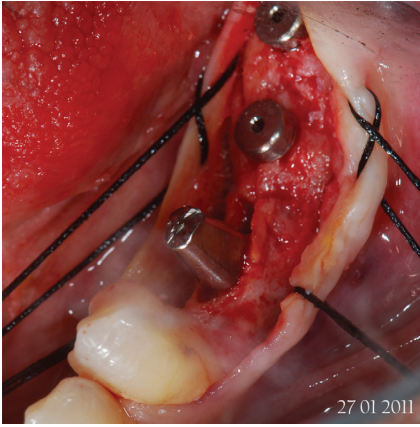


Figure 6: The blade implant in its definitive position. The abutment reaches the bone crest.

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 advantages and disadvantages.

The incision must be performed to ensure adequate adherent gum around the prosthesis. To decide about the precise position of the abutment, an intra-operative surgical mask is required.

After incision, the flap is detached using a periosteal elevator. In case of very thin alveolar crest, flap lifting should be performed cautiously trying not to compromise blood supply to the underlying bone.

A line of small guide holes 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 lines will serve as a guide for the implant insertion (Figure 3). Instead of the drill, a piezo-electric 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.

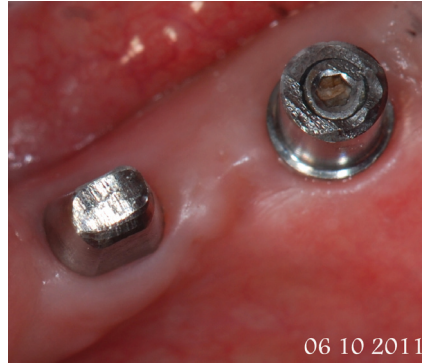


Figure 7: On the left, note the excellent response of the soft tissues around the blade implant in Figures 5 and 6.

If the bone is not particularly dense, 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 (Figure 5).

The abutment neck should be surrounded by patient's gum of correct biological width (Figures 6 and 7).

The blade implant can be modified to perfectly suit the crestal bone anatomy (Figure 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 positioned¹⁸, 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 stabilise the implant.

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

Oral rehabilitation

Numerous articles have demonstrated the long-term stability of these types of implants^{19–25} and documented their histological osteointegration, without connective tissue in the bone/implant interface^{26–29}.

Strictly following the surgical and prosthetic protocols is the first step towards success. A comparative study published online in 2011³⁰ has shown that 'blade implants have yielded the best success rates at 5 years. The success rate decreases between the 5th and 8th year.'

Over the years, several authors have proposed changes to the original technique^{3,31}. For instance, the technique known as EDE is particularly useful for treatment of lower posterior sectors with scarce bone density.

First used in 1993, the EDE was published in 2001^{31,32}. The best type of blade implant to use is ramus blade, which was designed during the 1970s 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.

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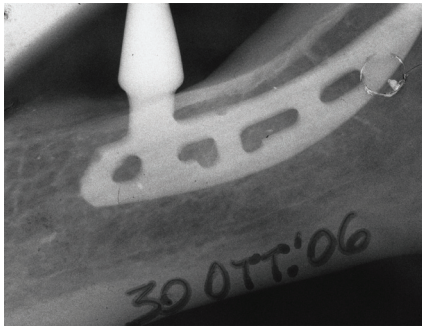


Figure 8: The blade has reached its final destination with the abutment against the distal border of the bone site. Implant body has been inserted between the superficial cortical bone and the superior side of the alveolar canal. The cortical bone posterior to the abutment remains intact.

In this way, almost all of the implants are 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 (Figure 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 be loaded with a fixed prosthesis.

Indeed, this kind of procedure is characterised 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 inserted immediate- and deferred-load monoblock blade implants in narrow alveolar crests since 1989³⁰. 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

10 years. These data show very good results at 5 years, but slightly more failures at 8 and 10 years. This is due to some implants being inserted into particularly atrophic posterior sectors and unfavourable crown/root ratio.

The efficacy of blade implants has also been documented by an independent multi-centre randomised 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 experiment this method, however, without having a clear idea of indications. Therefore, the improper use of the blade implant was unsurprisingly 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 criticised. 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^{32,34-36}. We believe that it is not scientifically correct to assume that this technique is useless on the basis of some case reports. Indeed, a report of blade implants used instead of a failed root-form implant³⁴ has also been published; however, 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 provided long-term reliability^{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 article and Covani et al.³⁷. The idea that blade implants are poorly osteointegrated with respect to other types of implant has been effectively denied by histological examination, which has demonstrated total absence of connective tissue interlayer^{26,28}. With regard to this, there are numerous clinical reports that attest the reliability of blade implants.

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. 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.

Abbreviations list

EDE, endosseous distal extension.

Acknowledgements

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References

1. Linkow LI. The blade vent - a new dimension in endosseous implantology. *Dent Concepts*. 1968 Spring;11(2):3-12.
2. Linkow L. Endosseous bladevent implant - insertion guidelines. *Dent Today*. 1984;3.
3. Manenti PA. La riabilitazione di creste mandibolari atrofiche distali con l'ausilio

- di lame bicorticali. In: 4° Congresso Internazionale A.I.S.I. Verona: Edizioni ETS 2002;2002.
4. Linkow L. The endosseous blade: a new dimension in oral implantology. *Rev Trim Implant.* 1968;5:13–24.
 5. Pasqualini U, Pasqualini M. *Treatise of implant dentistry.* Ariesdue srl Carimate, Como; 2009.
 6. Pasqualini U. *Le patologie oclusali:* Masson; 1993.
 7. Dal Carlo L. Tongue's influence on the integration of endosseous implants. *Doctor OS.* 2003;14:479–84.
 8. Dal Carlo L, Brinon EN. Influencia de la lengua en la integración de los implantes intra-òseos. *Rev Espanola Odontoes-tomatol Implante.* 2004 Apr–Jun;XII(2): 102–11.
 9. Pasqualini U. *Impianti Endoossei: La protezione dell'osteogenesi riparativa con la metodica del "moncone avvitato".* Tecnica personale Dental Cadmos, No. 8; 1972.
 10. Viscido AJ. Submerged functional predictive endosteal blade implants. *Oral Implantol.* 1974 Autumn;5(2):195–209.
 11. Babbush CA. Endosteal blade-vent implants. *Quintessence Int Dent Dig.* 1976 Jun;7(6):9–15.
 12. Roberts RA. Types, uses, and evaluation of the plate-form implant. *J Oral Implantol.* 1996;22(2):111–8.
 13. Grafelmann HL. The latest developments in blade implant clinical applications. *Dent Implantol Update.* 1993 Mar;4(3):22–5.
 14. Muratori G. [Blade implants simplified]. *Attual Dent.* 1986 Apr;2(13):44–5, 47, 49–51.
 15. Misch CE. Osteointegration and the submerged blade-vent implant. *J Houston Dist Dent Soc.* 1988 Jan:12–6.
 16. Misch C. Blade vent implant: still viable. *Dent Today.* 1989;8:34–42.
 17. Fallschussel GKH. *Implantologia Odontoiatrica – Scienza e Tecnica Milano:* Edizioni internazionali; 1986.
 18. Strietzel FP, Krueger H, Semmler R, Hopp M. Morphological study of Osteo-plate 2000 – extension implants after bending. *Implant Dent.* 2000;9(3):261–7.
 19. Koch WL. Statistical evaluation of success and reasons for failure in 700 endosseous blade implants done in the office. *Oral Implantol.* 1974 Apr;1(1):108–35.
 20. Cranin AN, Rabkin MF, Garfinkel L. [Statistical evaluation of 952 endosseous implants]. *Riv Ital Stomatol.* 1978 Jan;47(1):53–61.
 21. Ricciardi A. Nine years with Pasqualini implants – a full mandibular arch. *J Oral Implantol.* 1980;9(1):83–94.
 22. Ferrer F, Castillo J, Rodriguez H, Guzman J, Korchin L, Cabanas R. Mandibular posterior blade implants. A twelve year clinical and statistical evaluation. *Rev Odontol P R.* 1986 Jan–Jul;23(1):9–17.
 23. Smithloff M, Fritz M. The use of bladevent implants in a selected population of partially edentulous adults: a three year report. *Oral Implantol.* 1973 Autumn;4(2):145–73.
 24. Proussaefs P, Lozada J. Evaluation of two vitallium blade-form implants retrieved after 13 to 21 years of function: a clinical report. *J Prosthet Dent.* 2002 Apr; 87(4):412–5.
 25. Pasqualini ME. *Implantopotesi in un caso di monoedentulismo. Analisi retrospettiva a 38 anni.* Dental Cadmos. 2010 Dec;10:65–70.
 26. Linkow LI, Donath K, Lemons JE. Retrieval analyses of a blade implant after 231 months of clinical function. *Implant Dent.* 1992 Spring;1(1):37–43.
 27. Bianchi A, Sanfilippo F, Zaffe D. *Implantologia e Implantopotesi.* Torino: UTET; 1999.
 28. Di Stefano D, Iezzi G, Scarano A, Perrotti V, Piattelli A. Immediately loaded blade implant retrieved from a man after a 20-year loading period: a histologic and histomorphometric case report. *J Oral Implantol.* 2006 Aug;32:171–6.
 29. Trisi P, Quaranta M, Emanuelli M, Piattelli A. A light microscopy, scanning electron microscopy, and laser scanning microscopy analysis of retrieved blade implants after 7 to 20 years of clinical function. A report of 3 cases. *J Periodontol.* 1993 May;64(5):374–8.
 30. Dal Carlo L. *Studio Statistico su 6200 impianti inseriti in 20 anni in 2800 interventi* 2011.
 31. Dal Carlo L. Nuova tecnica per l'inserzione di impianti a lama: Estensione Distale Endoossea. *Dental Cadmos.* 2001;16:41–9.
 32. Dal Carlo L. Endosseous distal extension: a new technique that is useful to solve clinical cases characterized by scarceness of cancellous bone tissue in the lower distal sector. *Stomatologhieski J.* 2002;3.
 33. Krishan KK. Veterans administration cooperative dental implant study – comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. Part IV: comparisons of patient satisfaction between two treatment modalities. *J Prosthet Dent.* 1991 Oct;66(4):517–29.
 34. Linkow LI, Wagner JR. Management of implant-related problems and infections. *J Oral Implantol.* 1993;19(4):321–35.
 35. Knöfler W, Knöfler A, Graf H-L. Survival analysis of implants in a dental office over a period of 10 years. *Z Zahn Implantol.* 2004;20(4).
 36. Strecha J, Jurkovic R, Siebert T, Prachar P, Bartakova S. Fixed bicortical screw and blade implants as a non-standard solution to an edentulous (toothless) mandible. *Int J Oral Sci.* 2010 Jun;2(2):105–10.
 37. Covani U, Marconcini S, Crespi R, Barone A. Immediate implant placement after removal of a failed implant: a clinical and histological case report. *J Oral Implantol.* 2009;35(4):189–95.