A retrospective study on needle implants positioned in the posterior inferior sector: surgical procedure and recommendations

L Dal Carlo, ME Pasqualini, F Carinci, PM Mondani, S Fanali, F Vannini, M Nardone

Abstract

Introduction
The titanium needle implants received great enthusiasm at the time of presentation, but have recently received negative publicity due to unusual technique and because it requires a specific instrument to be used, such as the intra-oral welding instrument. This study discusses surgical procedures and recommendations in needle implants positioned in the posterior inferior sector.

Materials and methods
A total of 351 implants were placed during a 17-year period (1996–2012) in the posterior inferior sector and welded to a titanium bar using the intra-oral welder. The implants were inserted in atrophic ridges of the D3–D4 bone and were all loaded immediately with a temporary prosthesis.

Results
Overall success of the implants investigated during the years 1996–2012 was 97.1% (341/351); five-year success rate was 99% (266/299) and 10-year success rate was 95.8% (138/144). Progressive thickening of the bone around the implants was observed.

Conclusion
Titanium needle implants can be used with immediate loading in the posterior atrophic sector, especially in the elderly people, in the zone below the maxillary sinus, in the upper front area. They also give stability to other implants. In all cases, intra-oral welding is necessary and requires specific clinical training. Needle implants are not suitable for deep and wide ridges containing dense spongy bone.

Introduction
The needle implants were designed and presented in the early 1960s by the French dentist Scialom. He understood that, using biomechanical properties related to implant divergence, thin cylinders of metal could ensure implant-prosthetic structure reliability. The needle implant was greeted with much enthusiasm. Several authors provided the press with several publications to describe the technique and the implementation of the prosthesis.

Initially, needle implants were made of tantalium. In 1972, Paololesi, an Italian dentist, published his experiences with the needle titanium implants. Due to its success, titanium then became the material of choice for needle implants.

These implants must be joined together in a stable manner and several authors described the tests on using resin or gold meso-structures. It was discovered that the seal of the resin was unreliable and caused failures due to detachment, while the use of meso-structures was complex and involved the need to leave the patient with implants emerging in the mouth while waiting for metal castings to be constructed. It is important to note that needle implants require a reliable means which allow them to join them together stably.

In the 1970s, Mondani invented the intra-oral welding machine that allows an immediate connection of titanium implants, emerging and submerged, reducing a lot of possible failures. The connection can be made either by welding a bar to the implants or welding the implants directly to each other.

The needle implants are cylinders of titanium provided with a tip that ends with an obtuse angle, as to gently enter the bone tissue (Figure 1). They are mainly used in diameters between 1.2 and 1.5 mm and lengths from 25 to 40 mm. At the coronal end, there are two fins used for mounting on the mandrel that must be mounted on the surgical hand piece. The mandrel is provided with two grooves through which the fins of the needle enter. The mandrel is available in different sizes and lengths.

Figure 1: Needle implant with its mandrel.

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Sometimes, in order to have a good visibility in the mouth of the patient, it is necessary to use a long mandrel; in other cases a lack of mouth opening requires a short mandrel.

Usually, needle implants go inside the bone tissue with a slow, swirling motion, using a surgical hand piece at low speed (double green ring, 25–30 rpm). The descent into the bone tissue is completed with a concave surgical chisel and hammer, stopping as soon as one hears the typical sound of the cortical bone reached in depth. The aim of this study was to discuss surgical procedures and recommendations in needle implants positioned in the posterior inferior sector.

**Current indications to the technique**

Welded titanium needle implants have some specific indications in cases of bone deficit, where the residual bone is sparse and therefore the stability of the implant system is entrusted to the cortical anchorage. The stability provided by anchoring to the cortical bone allows immediate loading. In particular, welded needle implants give very good results in the following situations of bone defect:

- upper anterior aesthetic zone, as immediate post-extraction implants (Figures 2 and 3),
- posterior inferior district characterised by rarefied bone (D3–D4) (Figures 4–9),
- area below the maxillary sinus (Figures 10 and 11),
- as a support to other implants (Figure 12).

In the treatment of the lower arch, the welding of a series of deep bi-cortical needle implants guarantees implant prosthesis immobility when the bone is rarefied.
Biomechanical aspects

For the correct application of this technique, it is necessary that every needle implant reaches the bicorticalism, according to Garbaccio’s principles. The needle enters in search of the impact with the cortex opposite to the point of insertion, then anchoring itself to the more resistant bone. The impact with the deep cortex is an event that can be verified, as it will be described in the section dedicated to the surgical technique.

Like other implant systems, the ideal condition is achieved when an axial load is applied on the needle implants. The divergence with which these implants are inserted, however, allows to have biomechanical conditions favourable even in the case where the applied forces are not axial, providing their application falls within the area enclosed within the apexes of the implants. Bicorticalism allows ridges with different densities to be treated, because the forces are transferred to the compact bone tissue.

Materials and methods

This study 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.

Between 10 January 1996 and 31 December 2012, we used 351 bicortical needle implants (ø 1.3 mm) in the posterior (behind the fourth) atrophic lower sector, during 77 surgical interventions, with immediate welding and loading. The implants were inserted in atrophic ridges of the D3-D4 bone.

In this study, 85.7% of the patients were female, while male patients represented just 14.3% of the group. The average age of patients was 61.4 years, in a range from 26 to 83 years (Table 1).

Three interventions were conducted on patients affected by...
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hepatitis C, two on patients affected by depression, one affected by bronchial asthma, one patient affected by breast cancer and one by polio. In any case, none of the present or past pathologies here described seem to have any relationship with the outcome of the surgery performed.

Overall success of the implants studied during the 1996–2012 time period was 97.1% (341/351). Five-year success rate was 99% (266/299) and 10-year success rate was 95.8% (138/144).

The first evaluation of the patients was done using first-level X-ray examinations (intra-oral and panoramic). For safety, we also used CT scan to decide the direction of insertion of the implants along the side of the inferior alveolar canal.

We used a small amount of local anaesthetic in the posterior inferior sector because, as a rule, it is better to not have a complete nerve block.

Because the technique requires that the needle implant must be fit with differing orientations, the incision is important, because it allows you to reposition the gingiva around all the implants, ensuring a proper protection against infection. When there is a band of attached gingiva so wide as to accommodate divergent needles, the incision can be avoided, according to the criteria of minimally invasive surgery16.

After the incision, we discovered the bone crest by the periosteal elevator to have a clear vision of the anatomic district. The dissection was minimal when the ridge was thin, so it did not take periostral bleeding supply off the bone.

After making a small hole, we used a thin gauge cutter, smaller than the calibre of the implant, so as not to lose the sealing of the cortical surface, this being one of the requirements for the stability of these implants. In rarefied bone, we proceed to the placement of the needle implant immediately after making the hole in the cortical surface; in dense bone, we used a thin cutter mounted on a surgical hand piece at low speed, keeping away from the sensitive anatomical structures.

After piercing the bone crest surface, the needle implant was mounted on the mandrel and by a slow rotary motion we arrived at the deep cortical bone. If you are treating the lower back area and need to go along the inferior alveolar nerve side, it is advisable to be careful using a slow rotation, reversing the direction of rotation several times, which makes the descent of the implant17 much smoother and more accurate. When we arrived at the deep cortical bone, a gentle percussion allows for affirmation of the typical ‘cortex sound’, which gives the diagnostic confirmation that the implant has been placed accurately.

The correct implant placement was verified by intra-operative X-ray examinations, before oral welding.

The surgical sutures, with separate stitches, were made anteriorly and posteriorly in respect to each needle implant. In the event that many needle implants need to be inserted, more time is required. An accurate suture allows you to create the ideal situation to maintain a proper seal of attached gingiva around the implants. In the case where the needles are welded together to create a stump, the suture must be done around it.

The needle implants were put immediately in retention after insertion by intra-oral welding of a titanium wire or a titanium bar.

In the case of implants adjacent to each other, they can be welded together without adding wires or titanium bars. Where it was not possible to join them directly, we used one bar of titanium to join them together. You can use single or multiple bars, dependent of the need to give strength to the implant structure. Beneath these bars, no bacterial infiltrations different from those, which are found with implants not joined by the welded bar18 were found.

Intra-oral welding can also be made between needle implants together with other types of implants, in order to give the necessary stability for the immediate loading.

The stump obtained by welding together the needle implants is built at the end of the surgical procedure. In the presence of the bar that joined numerous needles between them, our efforts were to put the bar in a correct lingual–buccal position and minimise the undercuts. After preparing the abutment or the bar, we adjusted the provisional prosthesis, immediately putting it in place.

As a preventive measure, the prescription of an appropriate antibiotic was done against the risk of infection.

After we had properly milled the abutment or the titanium bar in the mouth, we took definitive impressions. The final prosthetic restoration was cemented following the same principles of teeth restorations19.

**Results**

The statistical results obtained using this technique with immediate loading was the following: overall success of all the implants investigated during the years 1996–2012 was 97.1% (341/351); five-year success rate was 99% (266/299) and 10-year success rate was 95.8% (138/144). Progressive thickening of the bone around the implants was observed. Some implants were lost because of inflammation, while three were fractured. There has never been a report of problems of permanent anaesthesia of the lip due to a lesion of the inferior alveolar nerve.

**Discussion**

The introduction of the needle implants by Scialom1,2 arose with great enthusiasm in 1962, prompting many newcomers to experiment with this method, attracted by the fact that it is possible to obtain

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high stability with an atraumatic surgery. Some operators used this technique in all anatomical situations, even those for which the needle technique was not suitable. The means of restraint with which needle implants were joined together in origin was insufficient. These facts, combined with the fact that the knowledge of implant dentistry were fragmentary at the time, led to numerous failures that caused bad publicity for the technique. The invention of the intra-oral welder and the identification of precise indications for the technique have radically changed the prospects of success. If the needle technique is used in an appropriate manner, it allows one to obtain significant duration results, as documented in numerous studies.20,22,23,24,25

In our experience, we have identified, as additional important indicator of success, the fact that the patient, many years later, returns to the same office to require the same implant solution on the opposite side of his mouth.

Histological examinations demonstrate the perfect osseointegration of these cylinder titanium implants.2,22,23,24

This surgical procedure has many advantages such as:

- Fast surgical execution,
- Minimally invasive technique and is well-accepted in elderly patients,
- Shortening of treatment time,
- Suitability for immediate loading,
- Absorption of forces not in axis with the prosthetic crown,
- Stability due to implant length,
- Treatability of ridges with deficits of density and thickness.

Also, there are some disadvantages such as:

- Invasion, especially in monolithic, of the adjacent anatomical spaces,
- Need of a specific training for the technique.

**Conclusion**

Titanium needle implant is a valid therapeutic device, useful for dealing with immediate loading cases of atrophy in the aesthetic zone, in the lower back area, in the seat below the maxillary sinus and as a support to other implants.

Mandatory requirement is that all the implants are bi-cortical and connected to each other by intra-oral welding. They are not the first choice when the bone crest is thick and deep.

This technique is suitable for cases in which bone is not particularly dense. We have noticed a prevalence of female patients who provided adequate conditions for this rehabilitative solution; in fact, situations in which bone is less dense are more frequent in female patients.

**Authors’ contribution**

We would like to thank Dr. Luca Dal Carlo from Venice and Dr. Franco Vannini from Rome, Italy for the images.

**References**


