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## Short implants: an alternative treatment option

Matteo Sartori\*, Riccardo Monguzzi\*, Salvatore Longoni\*\*, Kwang Bum Park\*\*\*, Massimo Mingardi\*\*\*\*, Marco Baldoni\*\*\*\*\*

The increased use of short dental implants is an emerging trend in the literature today. The aim of this study is to assess a number of articles to be able to draw conclusions for our own day to day clinical use. Twenty patients were selected and 32 implants were placed in both maxillary and mandibular bone. Single crowns or part bridges were the planned prostheses. The implant survival rate was about 97%. A single implant, placed in the maxillary tuberosity area, failed during the second stage surgery.

**Key words:** Short implants, alternative to regeneration, crown-root ratio.

### INTRODUCTION

Beginning with the pioneer work of Bråne-mark, one of the fundamental dogmas of implantology has been the placement of the longest possible dental implants possible in relation to the amount of available bone. This was the beginning of the phase of implantology

(surgically driven implantology) based on osseo-integration and the use of smooth-surface “machined” implants. Since then technological development supported by research and clinical activity have brought about continuous changes in indications and have extended the boundaries of implant-prosthetic therapy.

In particular, surface treatments, modifications to the implant design and surgical techniques have allowed a progressive use of implants of decreasing length<sup>1</sup>. Back in 1998, ten Bruggenkate published the results of a multi-centre study on the use of 6mm implants. Later, Deporter reported on the results of short implants with modified porous surface implants in both the maxillary bone and in mandibular bone<sup>2-5</sup>. In the recent literature, the use of “short implants” with a minimum length of 5mm and with wide diameters (wide diameter implants) is now emerging<sup>6-25</sup>. The minimum requirement of 10 mm of length for an implant to be successful has now been surpassed<sup>6</sup>. In the case of short implants, the reduction in length is

compensated for by a concomitant increase in diameter, in many cases reaching a surface available for osseo-integration that is comparable to standard implants. A standard implant of 10 mm in length and 4 mm in diameter provides a surface area of about 152 mm<sup>2</sup> whilst an implant 6 mm in length and 5 mm in diameter provides a surface of about 150 mm<sup>2</sup>. From a biomechanical point of view, the increase in the implant diameter also determines a parallel increase in the size and rigidity of the entire system's components. The size of the abutment, the connection and abutment screw all increase thereby reducing the incidence of unscrewing and/or fractures at this level. Considering the fact that these implants are essentially used in the posterior regions, the notable stress from cyclical fatigue to which the mechanical components are subjected can be addressed.

Finally, the increased diameter of the implant platform allows crowns to be created with an adequate emergence profile that is closer to the normal size of a multi-rooted tooth.

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When a standard diameter implant is used to replace the wide mesio-distal space left by the loss of a molar, the emergence profile of the crown must be modelled following unnatural profiles, mediating between two opposing clinical situations: either a linear profile that directly joins the narrow implant platform to the marginal crest, leaving a wide, triangular interproximal space that is uncomfortable for the patient, or a profile that tries to fill in the interproximal space as well as possible, progressing first horizontally and then vertically. Another option is to use two standard implants that are restored with a single crown. Often however the space available is too much for a single implant and too small for two implants. In both the case of an excess cervical prosthetic profile and in the positioning of two implants, professional and home hygiene maintenance will be difficult and probably compromised.

In the past, the wide fixture was essentially designed and used as a "rescue implant", as an emergency solution if it was necessary to make the implant site oval in poor quality bone (type IV) or if failed standard implants had to be replaced immediately<sup>7</sup>. Nowadays the indications for the use of short implants have increased:

1. Patient's general health linked to age, presence of systemic pathologies, use of pharmaceuticals, presence of local oral conditions preventing advanced surgical techniques for the vertical regeneration of mandibular bone tissue or the lifting of the maxillary sinus.
2. To avoid complex regenerative surgery with a possible increase in early or delayed complications.

3. Clinical situations in which a partial failure of tissue regeneration has occurred.

In all cases it is necessary to remember and therefore warn the patient that prosthetic rehabilitation on short implants often creates longer crowns, which will therefore appear longer than the natural adjacent teeth.

## INDICATIONS FOR THE USE OF SHORT IMPLANTS

The use of short implants has allowed rapid rehabilitation of partial edentulism in patients with healing times that are comparable with those of standard implants with modified surfaces i.e. two months in the mandible and three months in the maxilla.

Of course, to obtain success in using short implants, some rules should be observed.

### Increase in diameter

Short implants are characterised by wide diameters to compensate for the reduction in length and to present an extensive overall surface for osseo-integration. The recommendation is to choose an implant with the widest possible diameter in relation to the tooth to be rehabilitated and the residual bone available. The presence of at least 1 mm of bone around the implant is needed to ensure adequate blood supply of the residual bone that supports the implant, thus avoiding the undesired phenomena of resorption<sup>26</sup>.

### Surface treatment

Modern modified implant surfaces allow the correct stability of the coagulum on the implant

body. A short implant can only guarantee performances that are comparable to standard length and diameter implants if they have a modified, larger surface than a "machined" surface implant<sup>1</sup>.

### Internal connection

In most case internal connection short implants are preferred to the use of external connection implants. Internal connection means the surface treatment can be extended to include the platform, up to the external perimeter of the connection area. This results in osseo-integration on the upper surface of the implant body and once healing is completed, the implant will be locked inside a closed bone structure (apical part, lateral walls and upper portion) that effectively combats lateral stress.

### Platform switching

The use of abutments with a reduced diameter base compared to the diameter of the implant platform allows horizontal space to be gained, in order to manage biological width, reducing the loss of vertical bone in the ridge area<sup>27</sup>.

### Increase in number of implants

If short implants are used, it is preferable to increase the number of implants, inserting one for each tooth to be restored, thereby avoiding bridges with intermediate elements<sup>6</sup>.

### Splinting of implants

Splinting of implants is also recommended i.e. by planning crowns that are joined together to reduce the effect of lateral stress<sup>6</sup>.



## MATERIALS AND METHODS

32 short implants with an internal connection (Rescue® Internal, Megagen Co, Ltd, South Korea) were inserted in the latero-posterior sectors of the maxillary bone and in the mandible of 20 patients: 8 males and 12 females aged between 45 and 70 years of age, with an average age of 60.2 years were treated. The length of the implants ranged between 5 and 7.5 mm with a diameter of between 6 and 8 mm. The implants were restored with single crowns or with partial bridges (figures 1-7).

The reasons that brought about the choice of a short implant differed depending on the clinical case. In 13 patients, it was impossible to carry out advanced surgery for the vertical regeneration of bone tissue, due to general health problems (figures 8-11). Four patients, although they had no general medical problems, refused the complexity and duration of the treatment plan that required regeneration and the associated risks connected with it. In 2 cases, a previous implant failure was resolved (Figures 12-15). Finally, in 1 case, the patient was rehabilitated after the partial success of a mandibular regeneration.

The follow-up lasted from 6 to 14 months from the loading of the final prosthesis. Implant survival was about 97%, as 1 implant inserted into quality IV bone in the maxillary tuberosity area failed during the second stage procedure, with clinical evidence that no osseo-integration had taken place in this single case.



Fig. 1 Surgical phase: evaluation of bone ridge.

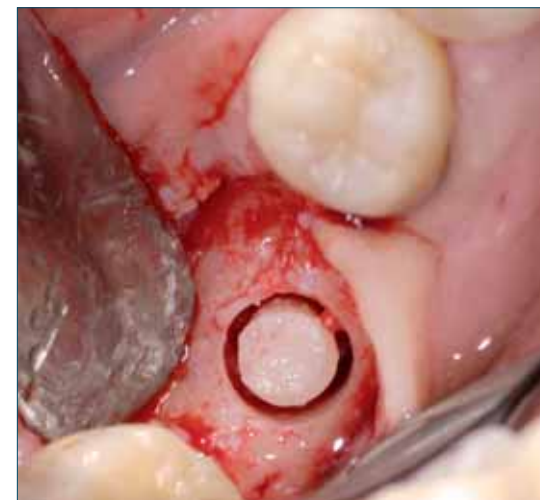


Fig. 2 Preparation of implant bed using a trephine cutter/bur.

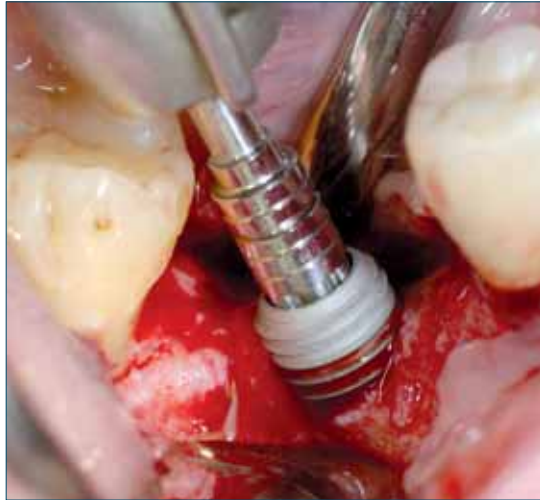


Fig. 3 Removal of bone core.



Fig. 4 Correction of implant bed.

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**Fig. 5** Insertion of implant: diameter 6 mm and length 7 mm.



**Fig. 6** View of soft tissues before prosthesis.



**Fig. 7** Check-up endoral radiography: follow-up at 13 months.



**Fig. 8** Preparation of implant bed using a trephine cutter.



**Fig. 9** Insertion of implant: diameter 6 mm and length 7 mm.

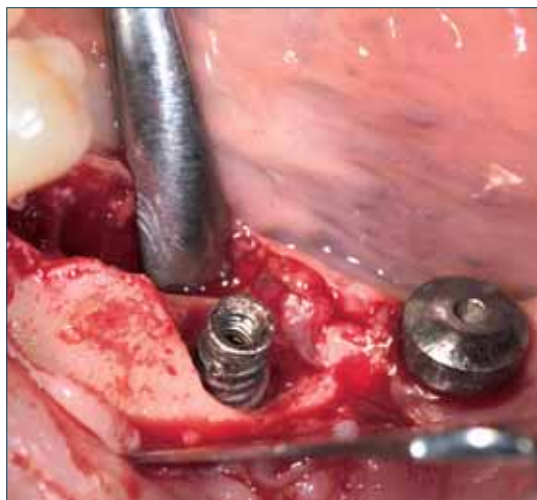


**Fig. 10** Final prosthesis: follow-up at 8 months.

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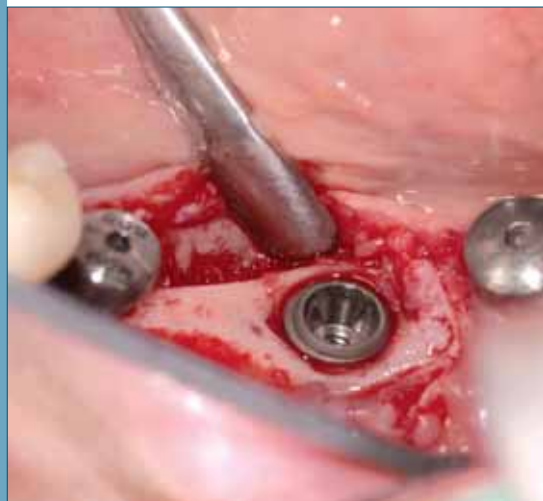
**Fig. 11** Check-up endo-oral radiography: follow-up at 8 months.



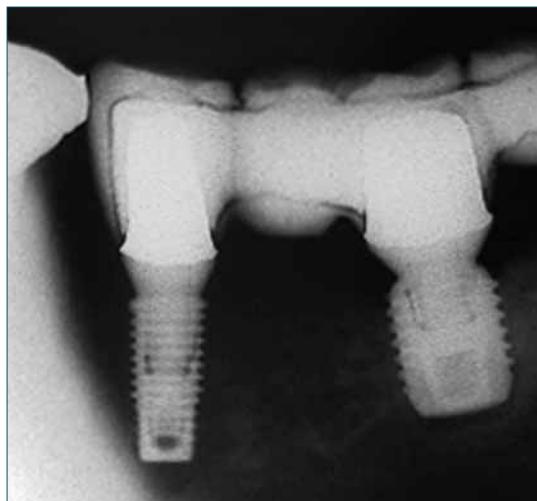
**Fig. 12** Surgical phase: removal of a fractured standard implant in the mandible.



**Fig. 13** Revision of implant bed using a correction bur.



**Fig. 14** Suitability between implant bed and positioned implant.



**Fig. 15** Check-up endo-oral radiography: follow-up at 10 months.



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## CONCLUSIONS

Short implants are a valid treatment modality and option if one wishes to avoid more sophisticated, invasive regenerative surgery due to clinical reasons or if the patient does not wish to undergo such surgery. These implants allow us to provide implant-retained restorations in areas characterised anatomically by the presence of structures such as the mandibular canal and the maxillary sinus.

The limited current follow-up has only allowed us to carry out only a preliminary evaluation, and does not take into account the possible failure of these implants.

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## Immediate loading of fixed partial bridges: clinical experience in the anterior mandible

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The option of immediately loading our implant fixtures significantly simplifies the aesthetic and functional solution for patients, in particular when the anterior region is compromised. This article presents five cases of immediate loading for the replacement of four periodontally compromised mandibular incisors, carried out using Intermezzo® (Megagen Co, Ltd, South Korea) one-piece implants.

**Key words:** Immediate loading, partial bridges, one-piece implants.

### INTRODUCTION

The successful resolution of aesthetic and functional problems, caused by the loss of mandibular incisors due to periodontal disease, by successful combined prosthodontic and immediate loaded implant treatment modalities,

allows a rapid return to normal social life and interactions for our patients. For this reason immediate loading protocols in the aesthetic area are becoming an increasing part of daily dental practice, reducing the number of surgical operations, treatment time and biological costs in appropriate cases<sup>1-9</sup>.

Five cases of immediate loading and restoration of implants for patients, who presented with periodontal disease, are presented here. These patients all had periodontal pockets with depths ranging from 7 to 11 mm as well as type II-III mobility of their inferior incisors. "One piece" Intermezzo® (Megagen Co, Ltd, South Korea) implants with transmucosal healing abutments were used. This type of implant was chosen as they have a narrow abutment and an emergence profile which aid aesthetics for the inferior incisor group. In addition, the possibility of changing the inclination of the abutment during the surgical phase aided the correct placing of the prosthesis and its subsequent restoration.

### MATERIALS AND METHODS

The patients, three females and two males, with an average age of 52.3 years, non-smokers, without parafunctional activity and with a stable occlusion, presented with a previous history of periodontal disease. In two cases they presented with a fractured splint (Fig. 1) used to try and solve the aesthetic and functional problem and in three cases presented with severe mobility of the four incisors (Fig. 2). Once the patients' clinical history and informed consent had been gathered, a clinical examination and orthopantomograph (Figures 3 and 4) were carried out and impressions, bite registration and facial arch were recorded for preparation of articulator models with average values. The insertion of 2 Intermezzo® (Megagen Co, Ltd, South Korea) implants, diameter 3.10 mm and 13 mm in length were then planned. In particular, they were positioned in the area of teeth 32 and 42, with planning for two intermediate units. Prior to surgery, a dental laboratory was asked

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**Fig. 1** Patient (I01) with fractured anterior inferior splinting.



**Fig. 2** Patient (I03) with severe mobility of inferior incisors.



**Fig. 3** Initial Orthopantomography (Items I01).



**Fig. 4** Initial Orthopantomography (Items I03).



**Fig. 5** Use of countersink to determine the correct placement of the implant neck.



**Fig. 6** Insertion of Intermezzo® (Megagen Co, Ltd, South Korea) one-piece implant, diameter 3.10 mm and 13 mm in length.

to create a surgical stent and a shelled temporary bridge prosthesis that was to be relined and cemented during the procedure.

Following the administration of local anaesthesia with Articaine containing adrenaline 4% 1:100,000 (Ubistesin 3M ESPE, Seefeld, Germany), flaps were created using an intrasulcular incision; the teeth were removed in the least traumatic way possible, limiting the separation

of the soft tissues. The implant sites at the lateral incisor site were then prepared according to the protocol with a lance bur, followed by a calibrated bur with a diameter of 1.8 mm, a countersink bur suited to the diameter and the shoulder of the implant (Fig. 5) and then a calibrated cutter bur with a diameter of 2.6 mm. The implants were inserted (figures 6 and 7) and, if necessary, the axis was corrected by

working on the abutment, not using a bur, but by bending the abutment with a purpose-made hand-drive instrument, exploiting the design of the implant neck. Plastic "comfort caps" were then placed on the abutments and the temporary prostheses were relined in the patients' mouth with cold resin (Sintodent s.r.l., Rome) (Figures 8 and 9). The space between the plastic cap and the resin temporary prosthesis was

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**Fig. 7** Inserted implants: the axis of the abutments was changed to obtain easy insertion of the prosthesis.



**Fig. 8** Positioning of plastic caps on abutment.



**Fig. 9** Relining of temporary prosthesis with cold resin on plastic caps.



**Fig. 10** Removal of temporary prosthesis after relining.



**Fig. 11** The marginal gap is filled with fluid composite and the ovate pontics are created.



**Fig. 12** Intraoral view of bridge just cemented (Items. I01).

filled with a fluid composite (Axia Fluid, Dentalica Spa, Milan), while ovate pontics were created on the intermediate elements (Figures 10 and 11) penetrating 2 mm inside the post-extraction sockets of the two central incisors. The temporary prosthesis was then finished and polished in the laboratory and then cemented with a non-eugenol temporary cement (Temp Bond NE, Kerr Italia SpA, Scafati SA) leaving

open flaps, in order to check and remove excess cement. The papillae were then sutured using simple sutures with Vicryl Rapid 4-0 (Ethicon, Johnson & Johnson, Brussels, Belgium) (Figure 12).

The occlusion was then adjusted, leaving the temporary prostheses completely free in protrusion and lateral movements. Radiographs were taken post-surgery to check results (Figure 13)

and the patients were given appropriate post-operative instructions. The patients followed a liquid diet for the first week, then a semi-solid one and hard foods were avoided until after the fourth week. Use of the anterior teeth had to be limited for the same period.

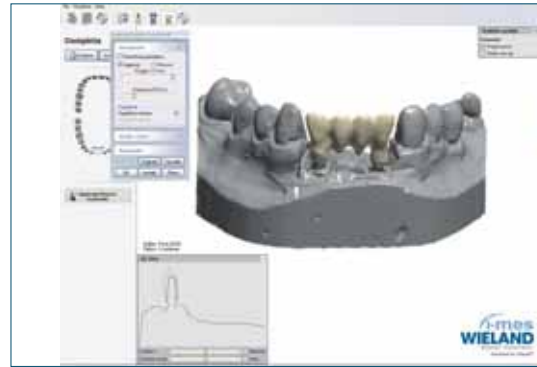
The sutures were removed at 10 days and follow-ups were carried out at 20, 30 and 60 days from loading. The permanent prosthesis



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**Fig. 13** Check-up Ortopantomography (Items I01).



**Fig. 14** CAD design phase of zirconium structure.



**Fig. 15** View of prosthesis already positioned (Items I01).



**Fig. 16** Check-up endoral radiography: follow-up at 10 months (Items I01).



**Fig. 17** View of prosthesis already positioned (Items I03). The excellent emergence profile can be seen.



**Fig. 18** Check-up ortopantomography: follow-up at 8 months (Items I03).

was then completed at a later date. In all cases there was no need to file down the abutments in the mouth and the impression procedure was therefore simplified. The final impression was taken using a polyether material (Impregum, 3M Espe, Seefeld, Germany) and plastic impression caps joined with resin (Pikuplast, Bredent, Senden, Germany). The master model obtained in this way included the duplica-

tion of soft tissues (Gingifast, Zhermack, Badia Polesine). A scan was carried out with similar models and the structure was modelled with the use of a specific software (Zeno® Tec System, Wieland Dental & Technik, Germany) (Fig. 14). The final crowns were made with structure in zirconium oxide and ceramic and were cemented with a glass ionomer cement (Ketac Cem radiopaque, 3M Espe, Seefeld, Germany).

## RESULTS

During the short observation period of about eight months on average, no changes in the quality or quantity of the peri-implant tissues were observed (Figures 16 and 18). The method proved to be simple and predictable with great satisfaction for the patients, as their aesthetic and functional problems were solved immedi-

ately from the first session. In particular, the reduced size of the implant neck allowed a prosthetic emergence that is comparable with the natural teeth that have been replaced (Figures 15 and 17).

## DISCUSSION AND CONCLUSIONS

The decision to proceed with immediate loading was taken for the following reasons:

- the bone height and bone quality available allowed the 13 mm implants to be positioned with an insertion torque of 30-35 Ncm;
- the patients had normal occlusion and no parafunctional activity, therefore the dental units at 32 and 42 received limited occlusal loads, which were mainly vertical in direction;
- as a result they did not have to bear the large chewing forces which were borne by the posterior teeth. Micro-movements could therefore be avoided, which are harmful for the formation and maintenance of a stable bone-implant interface<sup>10</sup>.

From a prosthetic point of view, the shape of the abutment, with a neck diameter that is less than the underlying implant platform, allowed a possible modification of the axis to aid insertion of the prosthesis. This advantage prevented the need for modifying and/or shaping the abutment in the patient's mouth which is what normally occurs in one-piece implants, thus aiding insertion of both the temporary and the permanent prosthesis. In addition, the availability of plastic caps helps to obtain an excellent

marginal seal of the temporary prostheses and transfer of the implant position quickly.

To conclude, this type of implant can help to obtain a quick & simple functional and aesthetic result, but it must be remembered that the abutment shaped in this way must respect specific indications of use in the mandibular anterior region or in the superior lateral incisors, in order to avoid possible risks of fractures caused by functional overload.

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