# Interproximal root spreading for narrow implant placement

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## Introduction

Congenitally missing lateral incisors are quite common. In some communities, we observe an incidence of up to 3% in the young population. Today, these teeth can be successfully replaced with dental implants.[1] Very often, these patients must undergo orthodontic treatment to obtain the adequate mesiodistal and buccooral dimensions. In many of these cases, the distances between the two neighbouring teeth remain critical because the orthodontist has moved the coronal part, but the roots still remain critically close to one another.[2] Narrow implants are becoming the ideal treatment option in case of reduced bone volume.[3–6] An accurate literature review on the correct protocol to follow during treatment planning for narrow spaces in the maxillary anterior region leads us to the conclusion that the minimum width for narrow implant placement (3.0–3.3 mm diameter) to replace a maxillary anterior tooth should respect a 5 mm distance between the neighbouring roots and a 5 mm buccopalatal measurement for a minimum width which would assure a good prosthetic outcome and avoid the phenomenon of pressure necrosis. Areas involving dense bone seem to be at increased risk of compression necrosis.[7,8]

According to Salama et al., Tarnow et al. and Cardaropoli et al., it is important for the correct insertion of threaded implants, both in simple and complex cases, to maintain a minimum distance between implants (3 mm) and between the implant and an adjacent tooth (1.5–2.0 mm) in order to maintain an adequate interproximal bone crest and therefore the possibility of having a natural papilla as well as having a correct prosthetic design.[9–11] Sometimes, these cases present a Cawood and Howell Class IVa bone anatomy, and ridge expansion procedures can be performed to widen the crest. In cases with a Cawood and Howell Class IVb, where the crest has a bicortical fusion and no expansion procedures are possible, only bone grafting procedures such as guided bone regeneration or Khoury's box technique can resolve the situation.[12,13] The following case report demonstrates that, with the spreading technique, natural roots can be displaced, and demonstrates how important the implant design can be. Plateau-form press-fit implants do not compress the adjacent bone structures because of the presence in their design of healing chambers throughout most of the implant body. Only the edges of each plateau are in direct contact with the osteotomy walls, avoiding pressure necrosis. Also,

**Fig. 1:** Panoramic radiograph. Note the narrow space at position #22. **Fig. 2:** Periapical radiograph of congenitally missing maxillary left lateral incisor. The interproximal space between tooth #21 and tooth #23 remained critical after orthodontic treatment.

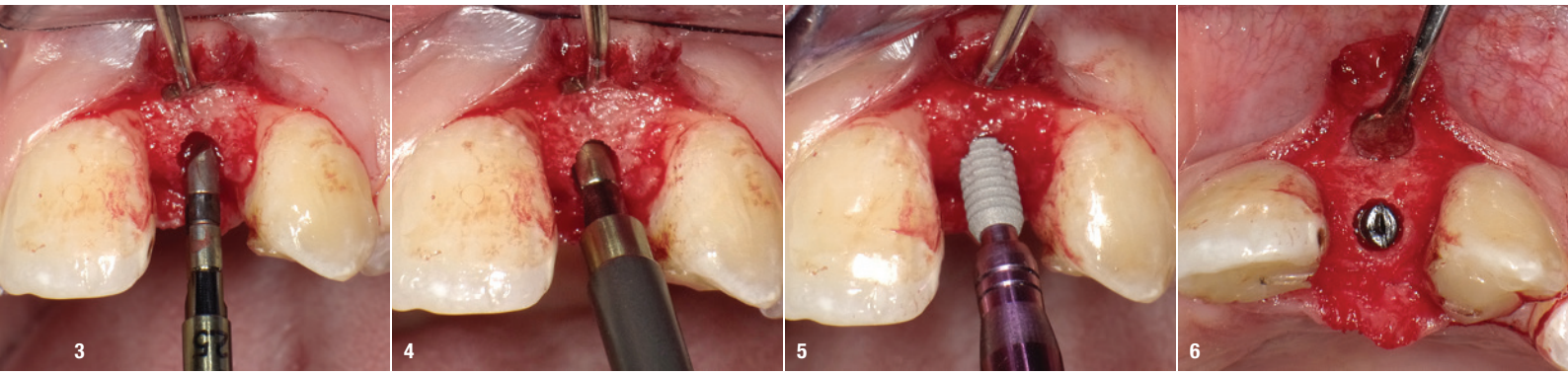

**Fig. 3:** A 2.5 mm diameter hand reamer is used to expand the initial osteotomy previously prepared with the high-speed pilot drill. **Fig. 4:** The final 3 mm diameter hand reamer is carefully pressed by hand in between the two roots. The cutting edge is directed towards the palatal plate, and the rotation is a maximum of 45°. **Fig. 5:** The 3 mm diameter implant is inserted into the expanded osteotomy. Note the plateau design and the sloping shoulder at the neck. **Fig. 6:** The implants (Bicon Dental Implants) are inserted 2–3 mm under the crest. A 2 mm thin black PTFE healing post protected the implant during the healing period.

the horizontal bone formation inside the healing chambers guarantees blood supply to the adjacent periodontal ligament.[14, 15]

The sloping shoulder design combined with the sub-crestal placement of the plateau implant makes it possible for the restorative portion to respect all necessary parameters for a healthy crestal bone and its long-term preservation.[16–18] The implant neck in sub-crestal position (between 2 and 3 mm in the aesthetic area) respects the physical law that two objects cannot occupy the same space, which occurs with supra-crestal or transmucosal implant designs. In a reduced mesiodistal and buccooral space of approximately 4 mm, a 3.3 mm diameter implant would occupy almost all the crestal space, taking away the soft tissue's bony support.[19] However, the prosthetic shaft connection of a narrow sub-crestal implant is only 2 mm, allowing the crestal bone to regrow over the implant after its placement.[20] In our case, as in various other cases of congenitally missing maxillary anterior teeth, an interradicular space could not be achieved, and the space between the two adjacent roots was less than 4 mm (Fig. 1). Too close a drilling and the following insertion procedure of a conventional implant would have harmed the periodontal ligament.

## Case report

A 21-year-old healthy female patient presented complaining about a congenitally missing maxillary left incisor. She had undergone three years of orthodontic treatment, through which the orthodontist could only achieve a 4 mm mesiodistal space between the mesial contact point of the maxillary left canine and the distal contact point of the maxillary left central incisor. The periapical digital radiographic analysis showed that the distance between the roots after the first 6 mm from the crestal bone was only 2.7 mm, and after 8 mm, the interradicular space was only 2.1 mm (Fig. 2). We advised the patient to undergo a second orthodontic treatment, but she refused, and we thus discussed inserting a narrow implant placed with the interproximal root spreading technique. The implant was 3 mm in diameter and 8 mm in length (Bicon Dental Implants) and had the following characteristics: press-fit implant tapped into the osteotomy; plateau root-form design without threads; sloping shoulder with reduced diameter at the neck (platform switching); sub-crestal placement 1–3 mm under the crestal bone. The patient was anaesthetised with articaine and epinephrine (Septocaine, Septodont), and a small crestal incision with a 15c blade was performed. The pilot drill was used at a speed of 1,100 rpm to perforate the cortical bone and to achieve a depth of approximately 4 mm. A 2.5 mm hand reamer and then a 3 mm diameter hand reamer were used for the root spreading.[3, 4]

The interproximal spreading technique entails gently pressing away the adjacent roots in a narrow interradicular space using a special instrument. The hand reamers (Bicon Dental Implants) have one vertical cutting edge ending in a sharp tip, and 270° of the reamer is a round non-cutting surface which acts as an expander. The hand reamers are pressed by hand into an initial osteotomy with the help of a threaded straight handle. This osteotomy is made with a regular 2 mm diameter pilot drill (1,100 rpm) and is only 3–4 mm deep. High-speed burs are traumatic in these cases because they could overheat the periodontal ligament and accidentally damage one of the roots. The initial 2 mm wide and 3–4 mm deep osteotomy is enough to allow the 2.5 mm diameter hand reamer to slide between the roots, keeping in mind that, firstly, the reamer tip is tapered 3 mm apically and therefore thinner than the diameter of the reamer body and, secondly, the cutting edge is used only to make its way along the thicker palatal plate. The round non-cutting surface of the reamer is pressed across the smooth cancellous bone and between the two roots without damaging them. This is possible because no torque or cutting is

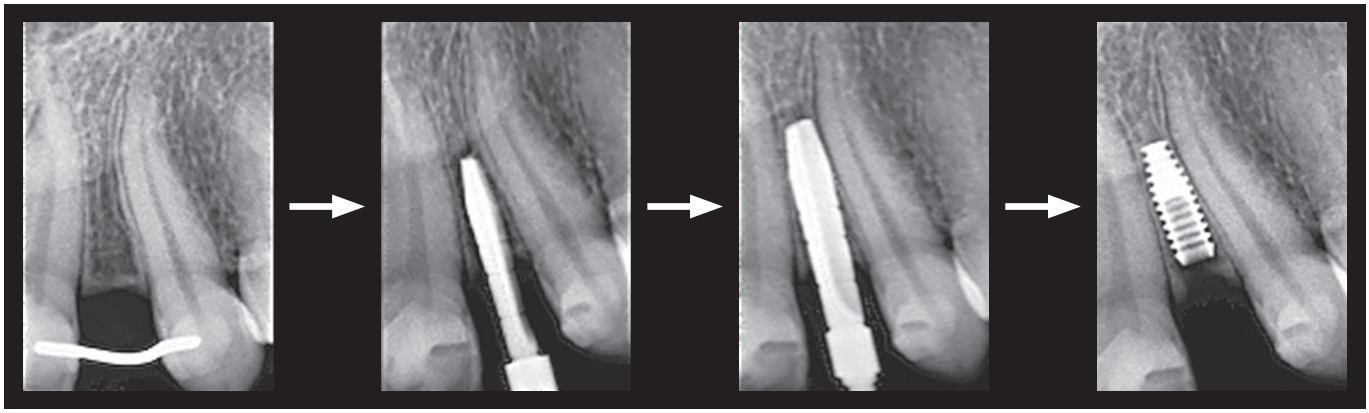

**Fig. 7:** Radiographic follow-up of the interproximal root spreading technique. Note the 2.5 mm and 3.0 mm hand reamers sliding between the roots and making space for the 3.0 mm diameter implant, which was placed 3.0 mm under the crestal bone level.

involved during this procedure. The final 3 mm diameter hand reamer was equally pressed into the osteotomy and directed between the roots. Continuous and slow pressure was applied on the straight handle. Sometimes the help of a mallet is needed to move the reamer 10–11 mm down to the crest (Figs. 3 & 4).

The implant was inserted with a special instrument (implant inserter), allowing the operator to push the implant with firm and precise pressure into the previously prepared osteotomy (Fig. 5). The last step was the final tapping with the mallet using the seating tip mounted on to the straight handle. The narrow implant was therefore compressed between the two roots (Fig. 6). The 3 mm diameter and 8 mm long implant was inserted with pressure into the finished osteotomy and tapped with the seating tip and the mallet 3 mm down to the crestal bone (Fig. 7). After six months of healing, the second-stage procedure was performed and the implant well was exposed. An abutment with a 2 mm diameter shaft and a 4 mm diameter hemispherical base was selected to support the temporary crowns. It is paramount to let the soft tissue heal around the appropriate crown profile, and this aspect can be achieved by modifying the emergence profile of the temporary crown until the papillae are formed. Once the soft tissue had completely healed, the final impression was taken and the definitive crown cemented on to the titanium abutments (Figs. 8 & 9).

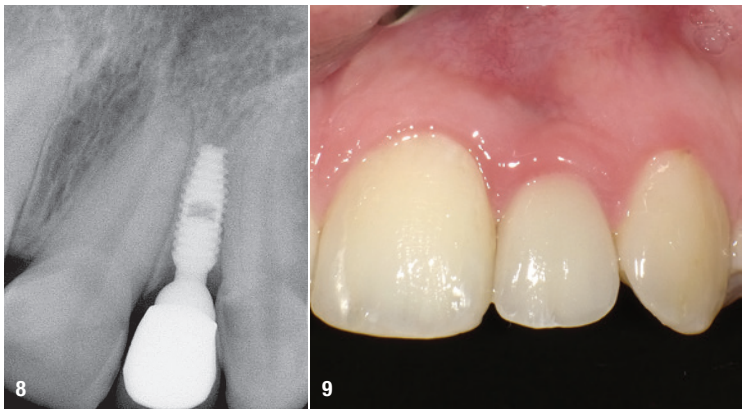


**Fig. 8:** Final radiographic control after three years of function. Note the platform switching between the neck of the implant and the hemispherical base of the abutment. **Fig. 9:** Intra-oral control of the crown and surrounding soft tissue at three years. Note the stability of the papillae, being supported by bone formed over the sloping shoulder.

## Discussion

In the case of congenitally missing lateral incisors in the maxilla, planning of implant treatment depends on the following factors: condition of the neighbouring teeth, occlusion, space requirements and anterior relationships. There are several possible problems that need to be taken into consideration, such as close proximity of the apices of adjacent teeth to the proposed implant site, space limitations for implant placement and prosthodontic restoration, insufficient ridge thickness that requires augmentation and insufficient bone support for the gingival papillae.[21] Close proximity of the apices of neighbouring teeth often makes orthodontic treatment for angulation correction necessary. The adjacent roots should ideally be slightly divergent or parallel. A minimum of 1 mm between the implant and the adjacent roots is recommended.[10] In our case, the spreading procedure had to be performed with both reamers (2.5 and 3.0 mm) with a very slow motion. The pressing involves placing the palm of the hand on the straight handle wrench and at the same time rotating the handle less than 45° in order to engage the cutting tip in the cancellous bone. Once the reamer has been inserted into the bone to the desired depth, the reamer should be left inside the osteotomy for some minutes. That allows the bone and the ligament of the adjacent roots to adapt to the new positioning.[23,24]

No excessive pressure is exerted by the implant because no torque is used for the insertion. The special design of the implant (Bicon Dental Implants) with its

plateaus and the interposed healing chambers, which are empty spaces between each plateau, result in minimally invasive compression against the surrounding areas.[25] In the 1980s, Ewers and Dueker published a study on beagles in which they inserted self-tapping osteosynthesis screws close to mandibular roots. The aim of the research was to observe with histology whether a tight compression of the periodontal ligament would lead to its damage or whether a repair reaction of the periodontal cell structure would lead to a positive result (Fig. 10). The histological results showed that compression on the periodontal ligament does not necessarily damage it, but instead produces a reaction by the connective cells.[26,27] The histology at root tip level showed the deviation of the periodontal ligament towards a new position (Fig. 11).

## Conclusion

The interproximal root spreading technique is a valid alternative to many bone grafting procedures if orthodontic treatment has not been able to move the interproximal roots of a congenitally missing maxillary anterior tooth. It is paramount to select the appropriate implant design and surgical technique in order to obtain a satisfactory surgical and aesthetic result.

Literature

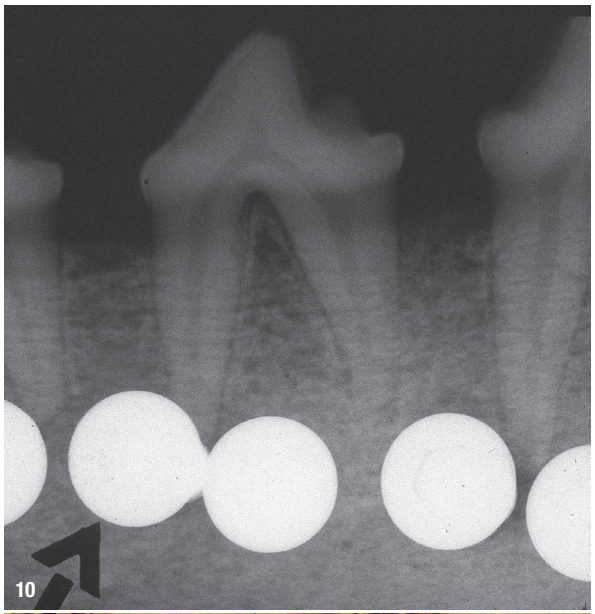



**Fig. 10:** Radiographic control of the teeth of an adult beagle dog after inserting several 2.5 mm thick Synthes screws into the mandible, trying to compress the roots as much as possible. **Fig. 11:** Undecalcified hard-tissue histological specimen. The area between the screw and the root tip was completely filled with connective tissue and had the appearance of new periodontal ligament.

## about the author

A specialist in implant dentistry, **Dr Mauro Marincola** obtained his doctoral degree in dentistry in Rome in 1988. In 1990, he obtained the licence to practise dentistry in Germany. Dr Marincola completed a master's programme in stomatology with a focus on implantology in Rome in 1996. Since 1998, he has taught, as a Professor, oral implantology at the University of Cartagena in Colombia and he has been clinical co-director of the Implant Dentistry Centre in Boston in the US. In the same year, the Dental Association of Rhineland-Palatinate authorised him to be a Specialist for Implantology in Germany.

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