The use of narrow implants

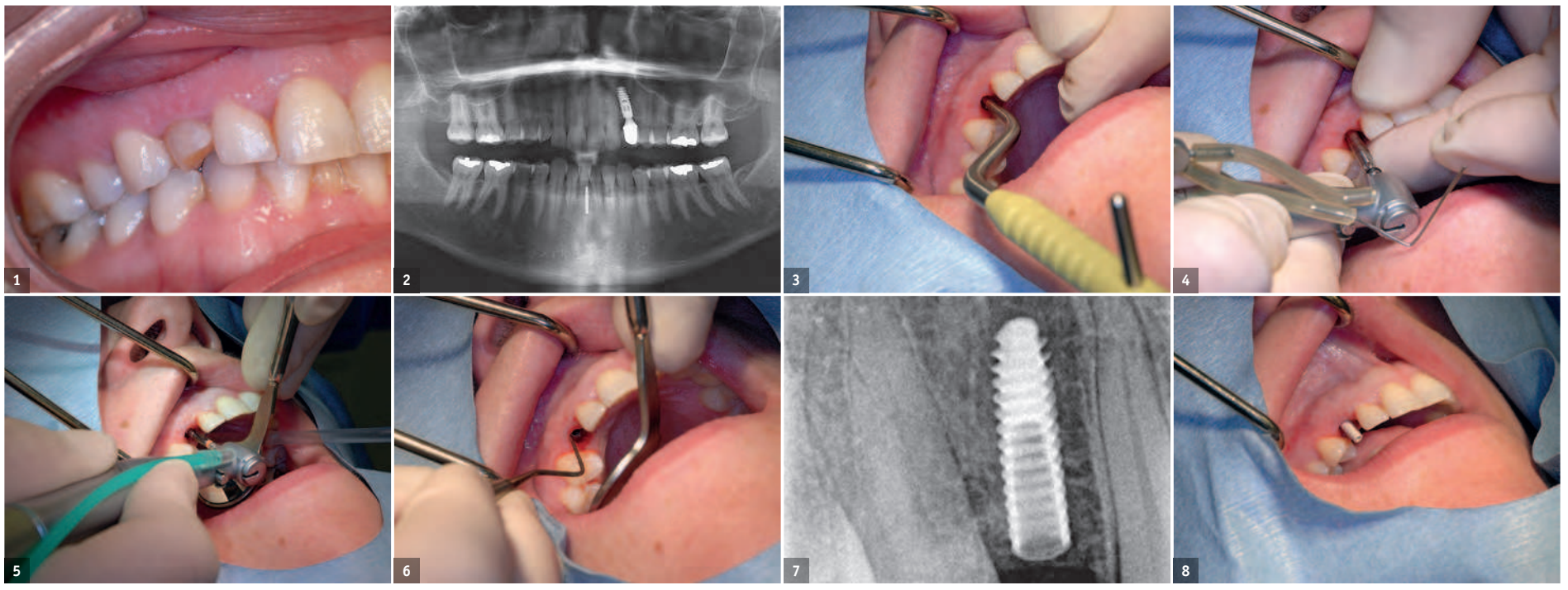

*Fig. 1: Initial situation with the strongly resorbed tooth #53 in situ.—**Fig. 2:** Dental panoramic tomogram showing the initial situation.—**Fig. 3:** The preparation was performed precisely using a Nentwig osteotome.—**Fig. 4:** The autologous bone was ground and harvested using the K-system.—**Fig. 5:** The preparation was performed to the correct depth using a 2.6 drill.—**Fig. 6:** Insertion of the implant 1 mm below the bone crest level.—**Fig. 7:** Radiograph after implantation.—**Fig. 8:** The PEEK abutment in situ.*

By Dr Huub van't Veld, Netherlands

The development of very narrow implants can provide a solution for interdental spaces in the aesthetic zone that are smaller than 5–6 mm and in which implant placement is indicated to fill the diastema with an implant-supported crown. Increasingly, in the choice of implant, not only the quantity (> 1 mm) and quality of the surrounding bone are important, but the supporting function of the bone to obtain a good mucosal seal is too. The major implant brands have developed small-diameter implants for these narrow spaces. Nobel Biocare has the 3 mm NobelActive implant, concerning which many publications have already appeared. Dentsply Sirona has the OsseoSpeed 3 mm implant (part of the Astra Tech Implant System) and the Xive 3.0 implant.

In 1976 already, the US Food and Drug Administration defined implants with a diameter of 3 mm and greater as conventional dental implants. In 1997, this agency defined implants with a diameter smaller than 3 mm as small-diameter implants. This mainly concerns one-piece implants used in very narrow jaws for a removable device or as an anchor for orthodontic appliances. These implants often consist of one piece owing to the fragility of the connection between the implant and abutment in such a narrow diameter. Unfortunately, they offer too few options for a crown because it is not possible to choose abutments with different angles for a perfect prosthetic solution. Therefore, the practitioner has to choose an implant with a separate abutment. Most narrow implants have a conical connection between the implant and abutment. This connection is attached via a screw. Stress tests have shown that the screw is the most limiting factor with stress. A solid abutment and a conical connection with a Morse taper of sufficient length and a cone of between 1.5 and 4° result in a nearly leakproof and rigid connection between abutment and implant. This is referred to as a "cold weld". This makes such an implant almost as strong as a one-piece implant.

In this article, I discuss the treatment procedure of two patients I treated with 2.8 mm Axiom implants (Anthogyr) and present the final results.

Case 1

The first patient was referred to me by her dentist owing to a persistent tooth #53 **(Fig. 1)**, which occasionally caused pain and had begun to exhibit mobility. Tooth #13 was congenitally absent, as was tooth #23, which I had already replaced with an implant with a crown in 2011 **(Fig. 2)**. At the time, the left side of the upper jaw still had sufficient space for a 3.4 mm implant (Ankylos, Dentsply Sirona). In the top right at tooth #53, I only measured an interdental space of 4.8 mm. I decided to use a 12.0 × 2.8 mm implant with a 4.0 mm and 1.5° Morse taper. I chose this implant on the one hand because the manufacturer promised that considerable primary stability could be achieved owing to the aggressive threading in the lower third of the implant and on the other hand because the residual root of tooth #53 was very short. The latter allowed a small extraction alveolus and thus sufficient bone for good primary stability and consequently the possibility of seating a temporary crown immediately after implantation.

I removed tooth #53 atraumatically; the mesial and distal papillae remained intact. By using a very sharp osteotome (Nentwig) as a guide, I determined the location (more palatal) and direction of the preparation **(Fig. 3)**. I gently tapped the osteotome to approximately 8 mm (according to calibration) into the jaw bone, and by rotating it slightly, I achieved a good guide preparation. After this, I used the K-system (DentaK) for further preparation **(Fig. 4)**. This set consists of a hollow drill shaft containing a grinder in which, during further preparation, the bone is collected and then used to fill the space around the preparation and the residual alveolar bone. I drilled to no more than two-thirds of the desired preparation length. The narrowest K-drill has a 3.2 mm diameter so that the preparation at the top is slightly wider than the 2.8 mm implant to be used. This allows one to adjust the implant somewhat in the axial direction if necessary. I used a 2.6 drill of the Anthogyr implant system **(Fig. 5)** to prepare to the correct length. The total length of the preparation was 13 mm, allowing placement of the implant 1 mm below the bone crest **(Fig. 6)**. In this manner, very good primary stability is achieved (> 35 Ncm; **Fig. 7**).

After fitting a temporary abutment made of PEEK **(Fig. 8)**, I fabricated a temporary composite crown. A PEEK temporary abutment is easy to construct using composite or temporary resin. This

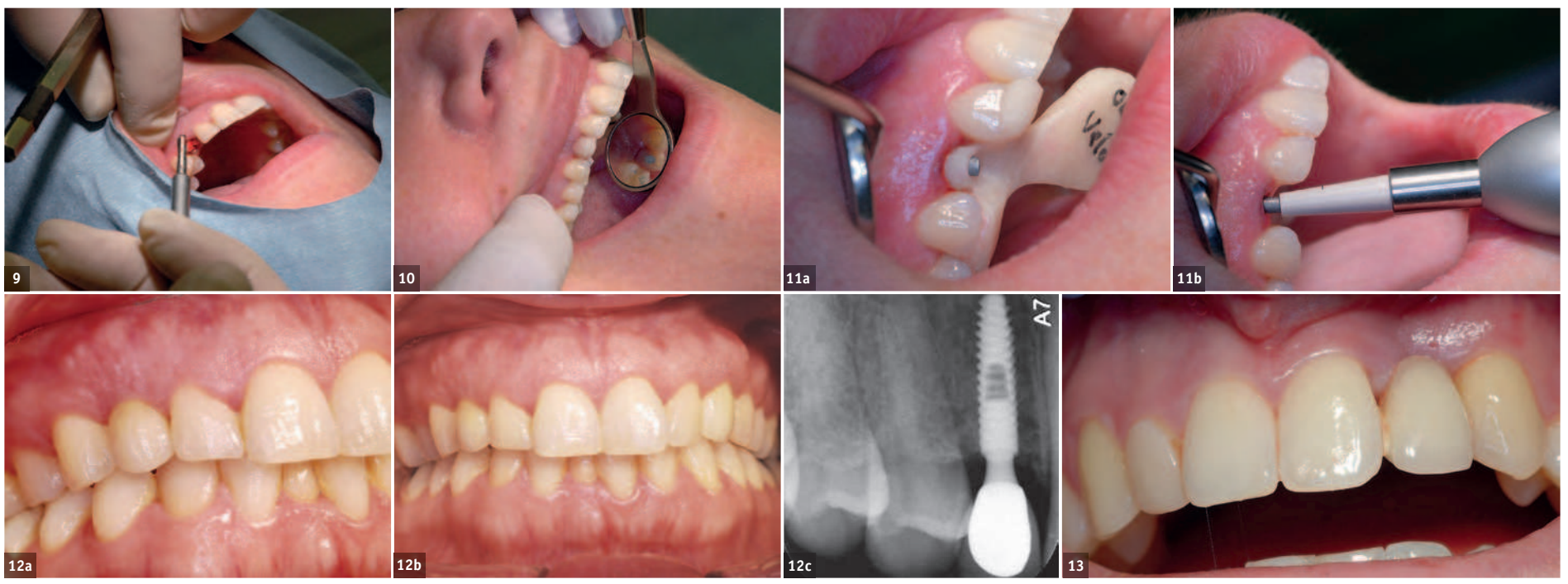

*Fig. 9: The harvested bone was placed around the implant with the K-system.—**Fig. 10:** The temporary crown in situ.—**Figs. 11a & b:** (a) Transfer of the abutment with a transfer key. (b) Structure impaction using the Safe Lock instrument.—**Figs. 12a–c:** (a) Result six months after starting treatment. (b) Result 20 months after starting treatment. (c) Radiograph 20 months after starting treatment.—**Fig. 13:** Clinical image of the initial situation with bonded bridge in situ.*

temporary abutment also has a 1.5° Morse taper, which provides good friction retention and does not damage the cone in the implant. Before placing the temporary crown, I applied the bone obtained in the hollow drill shaft on the labial side and condensed it so that the alveolus was filled properly **(Fig. 9)**. The temporary crown was shaped in such a way in the cervical area that the alveolus was completely covered. I checked that there was no functional stress **(Fig. 10)**. At the follow-up a week later, good adaptation of the mucosa was already visible and the patient reported no problems.

After ten weeks, I removed the temporary crown and abutment. This is easy using crown removal pliers vertically. Using a pop-in impression coping, I took an impression in a closed tray. The laboratory then made the permanent crown. The temporary crown with PEEK abutment was easily repositioned. In this case, I arranged for the crown to be returned from the laboratory separately from the abutment. The construction then had to be fitted from the model of the mouth with a transfer key **(Fig. 11a)** because the structure is not indexed (therefore, it can be cemented in several ways because there is no internal indexing, such as a trilobe or internal hex). After fitting the crown, which was ideal in both colour and shape, the structure was secured using the Safe Lock instrument (Anthogyr; **Fig. 11b**). This device is connected to the micromotor and produces short micro-strokes after activation using the foot pedal. Five strokes is sufficient to lock the abutment in place in the implant. The cold weld is then complete. I then cemented the crown accurately in the mouth with luting cement. At the six-month **(Fig. 12a)** and 20-month **(Figs. 12b & c)** follow-ups, good adaptation of the mucosa was seen, and the results were considered to be good too.

Case 2

The second patient approached me at the suggestion of a dental student who had read an interview about my first experiences with narrow implants. The patient was no longer satisfied with the bonded bridge that replaced her tooth #22 owing to agenesis. She also found that the tissue increasingly appeared indented at that location **(Fig. 13)**. The radiograph taken at the initial consultation showed significant convergence of the radices of teeth #21 and #23. The interdental space was 7.4 mm, but only 5.2 mm apically **(Fig. 14)**.

I approached this challenge with a 2.8 mm implant. I immediately took an impression to make a temporary crown later. After I had removed the bonded bridge, I made a crestal sulcular incision, after which I tried to remove as little mucosa as possible. Again, I started by creating a guide with the osteotome (Nentwig), which allowed me to determine the position and direction. By using a slightly larger condenser, I very carefully pressed the labial wall down. As there was no large alveolus (no extraction had been done), applying autologous bone using the K-system was not necessary, and I only needed to use the condensation technique. Again, the preparation was done to the correct length using the 2.6 drill. I made a direct temporary crown on a PEEK abutment and paid much attention in the cervical area to creating the shape and a proper emergence profile. In this case, an additional complication was that I had to convince the patient of the robustness and reliability of the temporary crown because of her six-month stay in Africa immediately after seating of the temporary crown on the implant. Based on my experience using this method for seven implants, I was able to reassure her.

After six months, the patient returned to the practice and reported that she had not experienced any problems. I observed good adaptation of the mucosa **(Fig. 15)**. After removing the temporary crown, which revealed an excellent emergence profile with healthy mucosa, I made a pop-in impression coping **(Fig. 16)**. The laboratory again provided the structure with the separate crown. However, in this case, I decided to seat the crown as a whole after having fitted it satisfactorily and bonded it outside the mouth. This allowed me to avoid any embedding of cement residue **(Fig. 17)**. However, I had to exercise greater care because I now had to tap the Safe Lock instrument directly on the zirconium dioxide porcelain crown to secure the abutment. A special attachment is available for this, which allowed fixture without any difficulties **(Fig. 18)**. For this patient, I paid much attention to the cervical gingival line. Tooth #12 was a cone tooth constructed with composite, and it was too small. I corrected the patient's cervical gingival line satisfactorily with an electrotome and reconstructed tooth #12 with composite. This achieved a good result **(Figs. 19–20b)**.

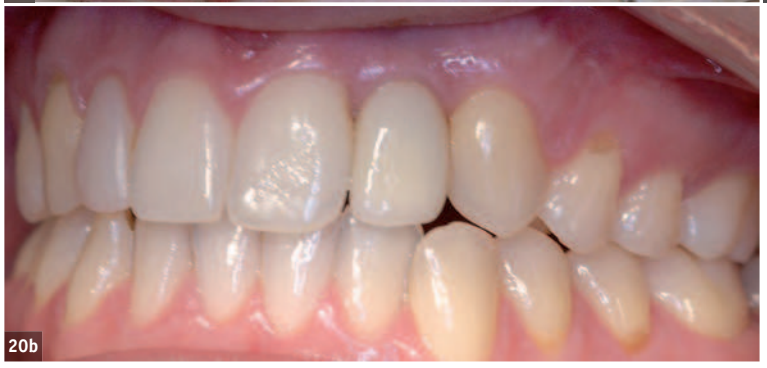

*Fig. 14: Radiograph of the initial situation.—**Fig. 15:** Clinical image after six months with a temporary solution.—**Fig. 16:** Insertion of a pop-in impression coping after removal of the temporary crown.—**Fig. 17:** Bonding of the permanent crown.—**Fig. 18:** The Safe Lock instrument with tips.—**Fig. 19:** Clinical image immediately after insertion of the permanent crown and adjustment of the gingival line.—**Fig. 20a & b:** (a) Radiograph and (b) clinical image three months after inserting the crown.*

Discussion and conclusion

I inserted my first 2.8 implant in 2013. Initially, I had some doubts about implants of such small diameter and had questions such as: Is the construction strong enough? Will it not break? Will the abutment–implant connection remain intact? However, although the use of such narrow implants remains a challenge, it has so far only yielded positive results. Nevertheless, I would like to make some remarks based on my experiences:

1. All of the major brand implant systems marketing narrow implants have paid much attention to the root shape of the implant with threads that have a condensing effect. This significantly increases the primary stability, which enhances osseointegration.
2. This primary stability also results in greater usability in immediate placement and provides the option of seating a temporary crown immediately.
3. The PEEK abutment used in this system has been proven to allow trouble-free retention over a longer time. Because in these cases, the implant was placed subcrestally and despite the small space, there was still enough surrounding bone, I observed good support of the mucosa and the presence of a good mucosal seal. In these cases, a 2.8 mm platform was used as a superstructure with a platform switch. As a result, a proper emergence profile was achieved with the temporary crown.
4. Particularly with regard to reduced mesiodistal spaces, the use of an implant with a small diameter is a solution, but only in the aesthetic zone, where no extreme transverse stress will be placed on the implant.
5. I believe that with excessive stress and great forces, because the implant is so narrow, the abutment–implant connection could be a limiting factor.
6. The facio-lingual bone thickness is less restrictive in the application of a small-diameter implant because with several techniques, such as bone splitting and harvested autologous bone with the K-system or possibly with a bone graft, more volume can be created in a less invasive way.
7. In order to achieve a good result, it is necessary for the practitioner to have the choice of various abutments. Therefore, one of the two-piece implant systems should be chosen. A narrow one-piece implant is less suitable for the aesthetic zone.
8. The solid connection between abutment and implant with the Morse taper connection is indeed strong and poses no risk of screw fracture, but there is no return. The implant becomes a one-piece implant with the solid abutment. By using Grade 5 titanium, strength is assured: extensive stress tests have been carried out up to 200 N. The positioning and permanent fixing of the restoration do require more attention than with a screwed abutment. For instance, a break in the crown may only be repaired by using the abutment for a new impression of the crown stump. It is unfortunate that only titanium abutments are available (owing to the strength). However, these are so narrow that there is enough body for the crown to make the restoration aesthetically pleasing.

The use of a narrow implant in a very limited space requires a well thought-out diagnosis, great precision of work, and good use of and experience with different implant techniques. These cases were not treated using any guided surgery, but this could be recommended for precise implant positioning.

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***Dr Huub van't Veld** has over 40 years of experience as a dentist and is certified as an implantologist by the Dutch Association of Oral Implantology. He can be contacted at tandartsvtveld@planet.nl.*