Implantation in a case of severely reduced interproximal width of the alveolar ridge in the anterior upper jaw

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Introduction

As dentists, we often are faced with the challenge of restoring tooth loss situations in the upper jaw that offer only very little room between related neighbouring structures. Especially the vertical reduction of the alveolar ridge forces us to plan the implant position more cranially, and owing to the tapering oval form of the upper jaw, the space becomes reduced.

In most cases, the correct correlation and distance cannot be measured using 2D radiography. 3D radiographic diagnostics like CBCT offer us the possibility of measuring the exact parameters and precisely planning a restoration. The following case report describes a highly precise implant positioning procedure to replace teeth #21 and 22.

Anamnesis

The 79-year-old patient was referred to our clinic by his general dentist with the request for a fixed restoration
of regions #21, 22 and 25. The patient’s health was appropriate to his age. He was a non-smoker and reported suffering from minor heart problem, which had been treated about five years before and for which he took ASS 100 daily. His pre-existing periodontal disease had been continually treated for several decades, but had led to loss of the second molars on both sides of the lower jaw and the first molar in the left lower jaw in 2013. Implantation in region #36 was done in our clinic.

In October 2019, his treating dentist extracted teeth #21, 22, 25 and 26 owing to massive loosening, owing to periodontal lesions. The healing process was uneventful. After a healing period of around three months for the extraction sites, we started planning the restoration. For that purpose, we took a CBCT scan (X-Mind trium, ACTEON; position: seated; 80 × 80 mm; 90 kV; 8 mA; 1,128.38 mGy cm²).

The evaluation of the situation with the ACTEON Imaging Suite software (Version 5.0; Figs. 1–4) showed significant vertical bone loss at all examined remaining teeth and the implant in region #11 directly next to one of the implantation sites. The distance measured between the neighbouring structures, tooth #23 and implant #11, was 15 mm. As the implant-to-implant distance should...
not be less than 3.0 mm and the implant-to-tooth distance must not be less than 1.5 mm, according to all known guidelines, the working space could be described as limited. The vertical length of the alveolar ridge towards the nasal floor was measured as 10 mm.

Owing to the limited residual bone, which narrowed the choice of usable implant lengths, and the expectable negative implant-to-crown relation, we decided not to use diameter-reduced implants and chose a size of 3.5 × 9.0 mm. These implant diameters added to the mandatory safety distances between the structures exactly suited the situation. To ensure the correct positioning of the axes of both implants, we created virtual teeth to simulate the future prosthetic crowns (Fig. 5).

Even with a great deal of experience in dental surgery and a good eye for the situation, the precise insertion of implants regarding axes and horizontal dimensions is a challenge that can easily lead to failure. To avoid this risk, we decided to insert the implants guided with a surgical template.

Planning

The surgical template was not designed for a fully guided workflow, but for transferring the defined position.

After the precise planning of the implant locations, drill sleeves (StecoGuide, steco-system-technik) with an inner diameter of 2 mm were set and an intra-oral scan (Primescan, Dentsply Sirona) of the soft tissue was matched with the DICOM bone formation (Figs. 6–10). To clear the view on the distances between the planned implants and the neighbouring structures, tooth #23 and implant #11 were segmented as stand-alone images (Fig. 11).

The construction of the surgical template was done with ACTEON Imaging Suite as well and resulted in an exportable STL data file of the surgical template (Figs. 12–15). The template was printed using a stereolithographic procedure (Form 2, Formlabs) and an autoclavable plastic material (Dental SG, Formlabs). After the rinsing and hardening procedures, the sleeves were worked in manually (Fig. 16). The complete surgical template was sterile-packaged at 121 °C and a pressure of 2 bar.

Surgical procedure

A professional dental cleaning was done a few days before the procedure. For further bacterial reduction, we used chlorhexidine digluconate directly before the procedure. We first administered local anaesthesia (Ultracain D-S forte, Sanofi-Aventis; two vestibular appli-
cations and one palatal application). Thereafter, we raised a flap at the implantation site, avoiding vestibular periosteal elevation (Fig. 17). The open bone surface was cleaned with diamond-coated rotating burs (degranulation kit designed by Dr Efraim Klir; Strauss & Co.; Fig. 18).

With the surgical splint, we started the transfer of the planned implant positions, using the depth preforming drill with a diameter of 2 mm (Astra Tech OsseoSpeed TX implantation kit, Dentsply Sirona) and a penetration depth of around 5 mm (Figs. 19–21). The final depth, as well as the widening of the implant bed, was achieved without the splint (Fig. 22). Two implants (Astra Tech OsseoSpeed TX) were inserted (Fig. 23), and the small bone defect palatal of the collar of the implant in region #22 was restored with self-hardening beta-tricalcium phosphate (GUIDOR easy-graft CLASSIC 400, Sunstar Suisse; Fig. 24) and sutured with a PTFE suture (GORE-TEX Suture, P5K17; Gore Medical; Fig. 25). We tried to take the postoperative radiograph as parallel as possible (Fig. 26).

Conclusion

The outcome of this special case was able to be improved by the use of 3D planning and 3D guided surgery procedures. The re-entry was planned for June 2020. Since we were able to minimise the risk of damaging the neighbouring structures to a large extent, the healing process had been uneventful by the time of writing and the greatest part of the implant surface was covered with native bone, we expected a positive end result.

To improve the already very reliable procedure, it would be great to widen the possibilities of the STL file transfer system. Once it is possible to transfer an image of templates of implants in STL format, positioned in a DICOM data set and matched with the anatomy taken with an intra-oral scan, back to a restorative construction software programme like exocad, CEREC or inLab, we would have the possibility of backward planning completely digitally to determine the perfect implant position.

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