Orthodontic appliances on temporary anchorage devices: Single-stage procedure

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DDS-Pro enables precise planning, guided implantation and appliance design in orthodontics by integrating CBCT data and intra-oral scans into a streamlined digital workflow.

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Orthodontic appliances are used to reposition teeth by leveraging the natural process of bone remodelling. When force is applied to teeth, it triggers bone resorption by osteoclasts and bone formation by osteoblasts. The direction of the applied force dictates the direction of remodelling. Proper force planning is essential in the design of orthodontic appliances but so too is ensuring appropriate anchorage.

Rodrigo Viecilli (J. Dental Res 2013) studied the periodontal ligament (PDL) necrosis threshold, which is typically 8–10 KPa. Attention to the PDL is essential for the biomechanics of tooth movement. The PDL enables and restricts tooth movement. Both excessive and insufficient force acting on a tooth (specifically its root) are detrimental to the biomechanics of movement.

In traditional orthodontic appliances, such as fixed braces, the anchorage point is located on teeth (orthodontic brackets). The applied forces also act on adjacent teeth, creating undesirable side effects that may cause unintended tooth movement.

When an appliance is anchored on a larger group of teeth with comparable (large) bone retention force to move one or a small group of teeth, unwanted effects may be minimal. However, in cases where changes involve teeth that are strongly embedded in the bone, the efficiency of the applied forces using standard appliances becomes limited.

From a biomechanical perspective, to avoid unwanted reactions or movements, it is necessary to anchor forces in structures resistant to movement. These structures are the bones of the maxilla or mandible. Using these structures as anchors, force can be precisely applied to individual teeth without affecting others. For this purpose, orthodontic mini-implants are used as temporary elements to anchor the appliance to the bone (TAD). After treatment, mini-implants are removed easily and safely without complications.

The way orthodontic implants connect to the appliance depends on the chosen system and appliance design. A typical procedure for TAD is two-stage.

Two-Stage Procedure:

1. Implant placement – using a "freehand" or guided method. Navigation preceded by digital design is definitely safer and more clinically effective. It also allows for optimal use of the conditions in the patient's mouth

Fig. 1 Digital design of the final and optimal implant placement in DDS-Pro (All images: Artur Kriger)

2. Registration of implant positions via scanning with a scanbody system (previously with impressions) to plan the appliance's assembly.

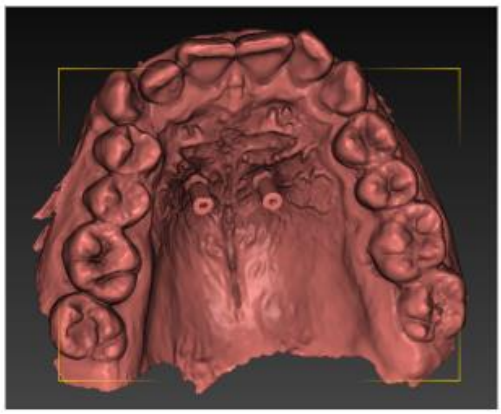

Fig. 2 Registration of implant positions using a scan with the scanbody system (All images: Artur Kriger)

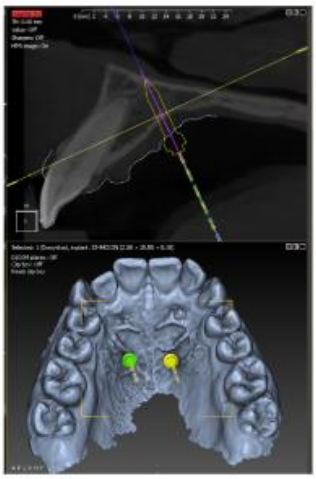

Fig. 3 Design of orthodontic implant placement, followed by the process of determining the appliance's purpose, adapted to the patient's oral conditions (All images: Artur Kriger)

The stage of inserting orthodontic implants is separated from the later design of the appliance. Most often, at this stage, the construction of the appliance is not analyzed, only the purpose is. The design of the appliance must be adapted to the existing conditions in the patient's mouth.

3. The design of the device is performed on digitally or analogue recreated implant positions, and the installation takes place during a separate visit.

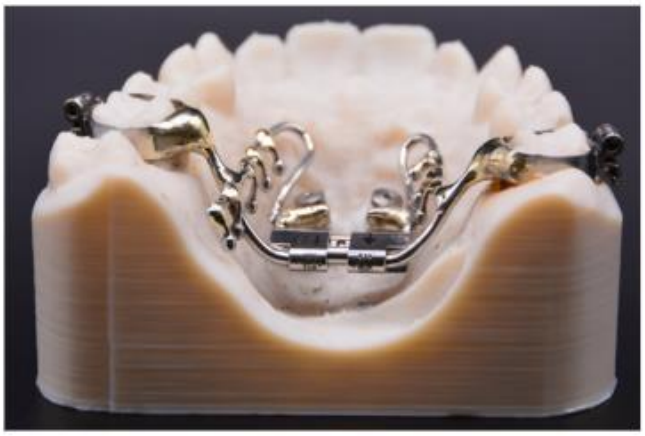

Fig. 4 The finished appliance, designed based on digitally or analogously reproduced implant positions. Its installation takes place during a separate visit. (All images: Artur Kriger)

This procedure (given current digital capabilities for appliance design) is no longer optimal. The support of digital techniques in such a variant includes planning the implant positions, optionally creating navigation templates (if a CBCT scan is available), and digitally recreating implant positions using the scanbody system.

In practice, however, the single-stage procedure has become the preferred method due to significant advantages in convenience, speed, and precision. This approach requires an intraoral scan and CBCT imaging.

Single-Stage Procedure Using DDS-Pro Software:

1. CBCT analysis combined with the scan to select optimal mini-implant positions for good anchorage and the planned appliance design.

2. Creation of templates for guided implantation.

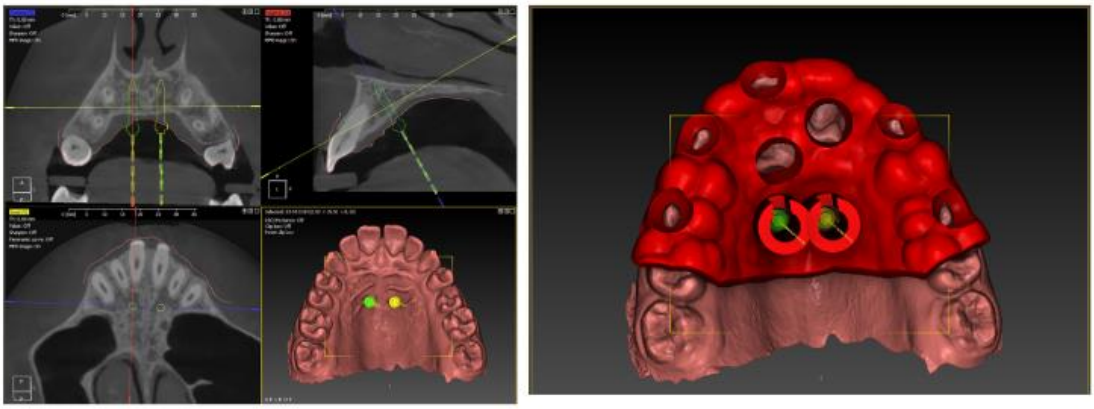

Fig. 5 Design in DDS-Pro and fabrication (3D printing) of templates for guided implantation
(All images: Artur Kriger)

3. Fabrication of a ready-to-install appliance based on the intraoral scan and implantation plan.

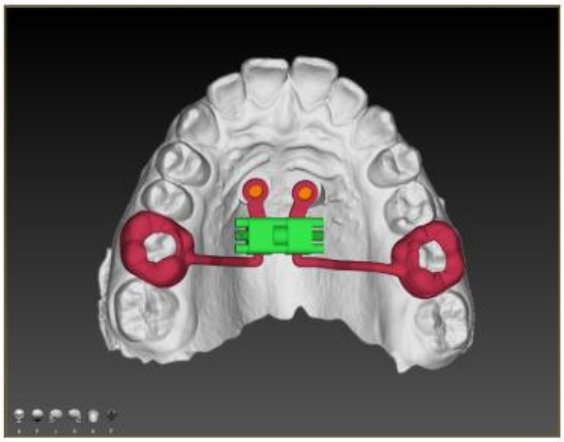

Fig. 6 Fabrication of the appliance ready for installation based on an intraoral scan and implantation plan. Guided implant placement (3D prints) and appliance installation take place during a single visit.
(All images: Artur Kriger)

4. Guided implantation (3D-printed templates) and appliance installation in a single visit.

Both procedures can be executed using DDS-Pro software. The single-stage approach eliminates the problem of implant position mismatches, which is a common challenge with the classical two-stage method. This approach also significantly improves the precision of appliance installation, leading to better reproducibility without additional appointments or chairside work.

Once 3D design and treatment planning are complete, mini-implants are inserted with great precision, independently of the operator, and the appliance anchored to these implants operates effectively in precisely the locations planned during diagnostics and planning.

In my practice, I frequently use this innovative approach in treating orthodontic patients, particularly in cases requiring precise tooth alignment or where traditional anchorage methods are insufficient. The single-stage method enhances treatment consistency with the planned course of action.

Recently, I treated a 29-year-old female patient with severe crossbite who was unresponsive to standard orthodontic treatment. After diagnosis, I decided to use orthodontic micro-implants, allowing controlled movement of molars and eliminating the need for surgical intervention. The micro-implants provided full control over tooth movement, shortening treatment time. After completing treatment, the implants were removed seamlessly, and the patient experienced no health complications. This solution is also beneficial for borderline cases that previously required surgical interventions, such as crossbite correction (MARPE procedure) or treatment of open bites via posterior tooth intrusion. Orthodontic micro-implants are non-invasive and serve as an effective alternative for complex malocclusions.

The single-stage method with orthodontic mini-implants, executed with DDS-Pro software, is one of the most effective tools in my practice, providing patients with faster, more precise, and comfortable treatment outcomes.

PLANNING A NAVIGATED IMPLANTATION PROCEDURE FOR TEMPORARY ANCHORAGE DEVICES WITH SIMULTANEOUS ORTHODONTIC APPLIANCE INSTALLATION

CASE DATA PREPARATION FOR SURGICAL PLANNING (MERGING TOMOGRAPHY AND INTRAORAL SCAN DATA)

INPUT DATA	WORKING TIME/SOFTWARE	LICENSE FEE	WHO CAN PERFORM THE TASK
• Scanner (stl, obj, ply) • Tomography (DICOM)	15 min "DDS-Pro"	included in the software license	Technician/Assistant/Clinician

📍 This stage requires final approval by the clinician.

💰 Outsourcing may incur additional costs

IMPLANT PLANNING

INPUT DATA	WORKING TIME/SOFTWARE	LICENSE FEE	WHO CAN PERFORM THE TASK
DDS-Pro study 📍 This stage requires final approval by the clinician.	10 min "DDS-Pro"	0 EUR	Clinician alone or with support from a technician or assistant

NAVIGATION TEMPLATE DESIGN

INPUT DATA	WORKING TIME/SOFTWARE	LICENSE FEE	WHO CAN PERFORM THE TASK
DDS-Pro study with implantation project 📍 This stage requires final approval by the clinician.	5min "DDS-Pro"	0 EUR	Technician/Assistant/Clinician

TEMPLATE CONVERSION (EXPORT) TO STL FOR 3D PRINTING

INPUT DATA	WORKING TIME/SOFTWARE	LICENSE FEE	WHO CAN PERFORM THE TASK
DDS-Pro study with the templates 💰 For projects requiring more than one template, the license fee may increase.	5min "DDS-Pro"	23,5 EUR	Technician/Assistant/Clinician

SUMMARY OF TIME AND COSTS FOR SURGICAL PLANNING AND NAVIGATION TEMPLATE SET

OUTPUT DATA	WORKING TIME/SOFTWARE	LICENSE FEE	WHO CAN PERFORM THE TASK
DICOM and .stl	35 min of design work	Total cost 23,5 EUR	Technician/Assistant/Clinician

💰 Local printing costs will depend on labor and resources required for template production

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Table: Planning navigates implantation procedure for temporary anchorage devices with simultaneous orthodontic appliance instalation