DIGITAL TECHNOLOGIES

Minimally invasive implantology – Implant treatment in the digital age
Minimally invasive implantology

Implant treatment in the digital age

Dr Detlef Hildebrand

While most dental technicians have now “made themselves at home” in the digital workflow, many dentists still feel somewhat disoriented when it comes to digital dentistry. This article introduces the computer-generated, digitally produced dental root replicas in oral implantology and presents a vision of where oral implantology may be headed.

Key words: Oral implantology, immediate placement, 3D planning, digital manufacturing, root-shaped implants, Replicate

About the patient case

For what indications does immediate implant placement make sense?

Dr Detlef Hildebrand: Immediate placement makes sense when an inflammation-free socket is present and the bone compartment is intact. In addition, there should be no periodontal and apical inflammation; extraction should have been gentle, preserving the architecture of the bone; and sufficient primary stability should be achievable.

Clinical examination and indication; non-salvageable tooth; 2D/3D diagnostics; model fabrication or intraoral scan of the intraoral situation, including the opposing jaw; digital inspection of the radiological and clinical dental records and creation of a Replicate design proposal; review of this design with possible suggestions for improvement by the clinician; creation of a revised design proposal; review and approval by the clinician.
The digital transformation has had a massive impact on oral implantology over the past 20 years. Examples include digital X-ray using dental film and panoramic radiographs — now an established technology — but also radiological 3D diagnostics such as computed tomography (CT) and cone-beam computed tomography (CBCT) in dentistry (Fig. 1). The resulting diagnostic findings can be processed and evaluated to obtain the requisite information for safe implant positioning, linking interactive interfaces using modern digital planning programs. Thus, the CBCT technology has revolutionized the entire field of oral implantology, from diagnostics and treatment planning to 3D implementation application using guided surgery (Figs. 2a to 2e). A substantial majority of established digital procedures in the field of oral implantology today were developed to improve the surgical performance and the predictability of the implantological outcome. Especially in the field of implant-supported prosthetic restorations, the digital workflow has practically become indispensable. In modern dental technology, CAD/CAM is almost old hat: Using scanned models (or intraoral scans...
Planning and digital imaging

In preparing for a Replicate tooth, the clinician needs a 3D image — ideally a high-resolution cone-beam computed tomography (CBCT) of the affected jaw and the root of the tooth to be extracted. In addition, a digital scan of the models produced or an intraoral scan of the jaw is required. Using an online planning process, the clinician will then receive a design proposal for the future Replicate tooth based on the natural template. This design will then be reviewed on-screen by the clinician — dentist or implantologist — and if necessary corrected, then approved for production (Figs. 5a to c). A high-precision manufacturing process then results in the individual patient-specific Replicate tooth.

Replicate — the new custom implant

Procedure

A very interesting development in the field of oral implantology is the newly developed Replicate procedure (Natural Dental Implants, Berlin, Germany/Dallas, Texas, USA). Here, each implant is designed and fabricated individually for a specific patient. The Replicate process has blazed the trail for an innovative digital implantological workflow. Each Replicate tooth is the precise replica of the natural model — a tooth, including its root (Fig. 4). This complex procedure must currently be the most advanced one in the field of oral implantology, creating an all-digitally produced implant or “duplicate” of a natural tooth. The planning of each individual Replicate tooth takes place before the planned extraction of a natural tooth with preserved tooth root. The method is applicable to both single-root and multi-root teeth.

Planning and digital imaging

In preparing for a Replicate tooth, the clinician needs a 3D image — ideally a high-resolution cone-beam computed tomography (CBCT) of the affected jaw and the root of the tooth to be extracted. In addition, a digital scan of the models produced or an intraoral scan of the jaw is required. Using an online planning process, the clinician will then receive a design proposal for the future Replicate tooth based on the natural template. This design will then be reviewed on-screen by the clinician — dentist or implantologist — and if necessary corrected, then approved for production (Figs. 5a to c). A high-precision manufacturing process then results in the individual patient-specific Replicate tooth.
4 A Replicate of an anterior tooth in the planning software.

5a and b Online planning of the Replicate and the cover shield to be produced.

5c Cover shield for load-free healing, palatal view.

Implantology is about to radically change.

Find out why!

www.replicatetooth.com

Natural Dental Implants AG • info@replicatetooth.com • +49 30 526 84 93 30
Digital procedure, step by step
A clinical examination and subsequent imaging are followed by 3D evaluation and treatment planning. The treatment plan and tooth design are based on high-resolution 3D imaging (CBCT) and documentation of all pertinent bony, dental, and soft-tissue findings related to the patient using a precision impression or a digital scan. The next step is the digitally controlled production of the Replicate tooth (Figs. 6a to k).
Clinical procedure
The treatment begins with an extremely gentle extraction of the natural tooth, preferably with a Benex extractor (Zepf Medizintechnik, Seitingen, Germany) and careful curettage of the extraction socket, and ends with the placement of the Replicate tooth by careful taping into the congruent extraction socket (Figs. 7a to i).
Specifically, the rapid reactive resorption of the bundle bone areas is inhibited, and the area achieves immediate initial stability. This procedure offers improved aesthetic and natural-looking results for patients requiring tooth extractions (Fig. 11). Thus, the entire digital workflow can be realized in the implant area. The novel scientific and clinical approaches and applications thus pose a stimulating challenge to conventional implantology (Figs. 12a to f and 13).

Based on the pre-extraction Replicate planning, the tooth is extracted and the accuracy of the Replicate tooth checked using a special try-in copy, which is an exact copy of the Replicate tooth (Fig. 8). After successful verification, the sterile Replicate package is opened and the Replicate tooth is inserted directly into the socket (Figs. 9a to c and 10a to c). This manufacturing process permits a perfect anatomical reconstruction of the extracted teeth in every respect. Since we are dealing with a one-piece implant, we do not have to worry about abutment movements or leaks. The implant also provides ideal support for the management of the surrounding hard and soft tissues, which has a positive effect on the gingival margin, especially with regard to the anatomically shaped emergence profile. This will initiate certain resorption and remodeling processes within the surrounding bone and soft tissue as a result of immediate “recoding” by the Replicate tooth.

Specifically, the rapid reactive resorption of the bundle bone areas is inhibited, and the area achieves immediate initial stability. This procedure offers improved aesthetic and natural-looking results for patients requiring tooth extractions (Fig. 11). Thus, the entire digital workflow can be realized in the implant area. The novel scientific and clinical approaches and applications thus pose a stimulating challenge to conventional implantology (Figs. 12a to f and 13).
11 All-ceramic Replicate tooth 21 after six months of loading.

12a to f Planning data for a Replicate tooth 11 obtained before extracting the natural tooth 11.

13 Clinical situation following atraumatic extraction and immediate replacement with the Replicate tooth.
the buzzwords of this innovative technology do not merely tease us with their vision of a bright future. Rather, they provide an alternative, realistic clinical option for treating extraction sockets that works better than any of the existing options.

**Conclusion**
Digital technology provides oral implantologists with new options to improve their procedures and to optimize clinical outcomes in every sense. All-digital, high-precision, efficient, and economical – the buzzwords of this innovative technology do not merely tease us with their vision of a bright future. Rather, they provide an alternative, realistic clinical option for treating extraction sockets that works better than any of the existing options.

**What about multi-root teeth?**
Of course, posterior teeth, multi-root premolars and molars are also suitable for extraction and immediate replacement with Replicate teeth (Figs. 14a and b, 15a and b).

**About the author**

Dr Detlef Hildebrand completed his vocational training as a dental technician in Dortmund in 1986. From 1987 to 1992 he completed a degree in dentistry at Albert Ludwig University in Freiburg, Germany. In 1993, he was Assistant Dentist at the Department of Prosthodontics in Freiburg. He received his doctoral degree (Dr. med. dent) in 1995. From 1995 to 1997 he was Senior Physician at the Department of Prosthodontics in Freiburg. From 1997 to 2005 he was involved in the development and expansion of the Department of Implantology at the Clinic for Maxillofacial Surgery and Plastic Surgery of the Charité University Hospital in Berlin. Since 1998 he has been running a private dental clinic in Berlin, to which a dental laboratory was added in 1999.

Dr Hildebrand’s research centers on oral implantology and prosthodontics as well as navigated surgery and robotics. He is a highly appreciated speaker at national and international conferences and congresses. Since 2005, he has been a member of the Executive Board, and since 2007, Secretary General of the European Association of Dental Implantologists (BDIZ EDI).

**Kontakt**
Dr Detlef Hildebrand
DentalForum Berlin
Westhafenstr. 1
13353 Berlin-Tiergarten
Germany
+49 30 39898813
hildebrand@dentalforum-berlin.de

**Product list**

<table>
<thead>
<tr>
<th>PRODUCT TYPE</th>
<th>PRODUCT NAME</th>
<th>MANUFACTURER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant</td>
<td>Replicate</td>
<td>Natural Dental Implants</td>
</tr>
<tr>
<td>CBCT</td>
<td>Picasso Trio</td>
<td>E-Woo (Korea), sold by orangedental</td>
</tr>
<tr>
<td>Tooth extraction</td>
<td>Benex Extractor</td>
<td>Zepf Medizintechnik</td>
</tr>
</tbody>
</table>
Anatomy of the REPLICATE system

Each REPLICATE tooth is produced individually for each patient based on a 3D radiograph (CBCT scan) and the dentist’s prescription and is an exact replica of the non-salvageable tooth to be replaced. The new REPLICATE tooth is implanted in the same treatment session, directly following the extraction of the tooth.

All components of a REPLICATE tooth are custom-made to meet each patient’s individual needs. This includes, among other things: defining the shape of the zirconia ceramic structure that will replace the tooth; adjusting the insertion depth to optimize esthetics in the buccal region; reducing the root surface, if bone augmentation is to be performed concurrently; and correcting divergent roots.

Synthesizing Nature and Technology

The REPLICATE System combines nature’s form with proven materials to create a unique alternative to traditional implants and three-unit bridges. The anatomical shape of the tooth to be replaced guides the design of each REPLICATE System component.

Customizing the titanium endosseous portion, the transgingival zirconia preparation of the REPLICATE Tooth and the translucent zirconia REPLICATE Temporary Protective Crown ensures proper fit, proportion and aesthetics.

Because the REPLICATE Tooth conforms to the shape of the existing bone socket, both specialists and general dentists can place a REPLICATE Tooth without drilling, thus reducing the risk of damaging surrounding bone, tissue and nerves. The entire cross-section of the socket is utilized, preserving hard and soft tissue, and additional procedures like sinus lifts may not be necessary.
Time for a Change

Introducing the REPLICATE® System
Technology Guided by Nature

ORIGINAL TOOTH

REPLICATE® TOOTH