# Full-laser implant bed preparation: case studies using different implant systems

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The ability to treat a wide range of tissues with a laser has been a fact of life for a long time. What is new are the potential applications (new indications) and the refinement of techniques. The favorable absorption in water and hydroxyl apatite, and the interaction of water and laser light that substantially enhance the laser's effectiveness make the Er,Cr:YSGG laser (wavelength 2,780 nm, frequency 20 Hz, pulse length 140 µ, average output 6 W) an ideal tool for the gentle treatment of soft tissue and bone.

## _Case 1

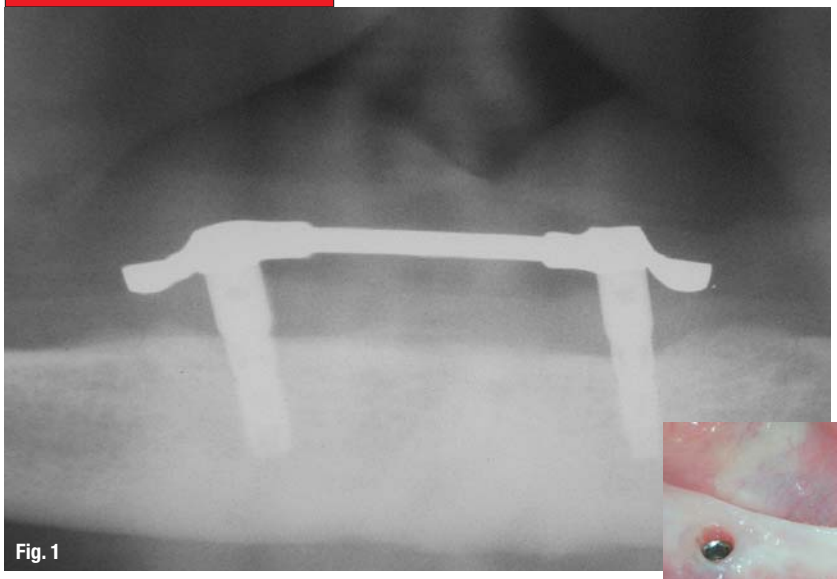
Fig. 1

### _Case 1: Improving prosthesis stabilization with two additional implants

**Findings**

A 72-year-old male patient complained of the increasing instability of his mandibular prosthesis that was stabilized 10 years ago with a bar construction and two implants (Screw Vent) at 43 and 33 (Fig. 1).

We resolved to exchange the abutments with shorter ones possessing a pushbutton, and two additional implants with a pushbutton (Bauer screws) at teeth 42 and 32 to counteract the tipping of the prosthesis.

**Clinical procedure**

First, the old bar construction was removed (Fig. 2) and the new, shorter abutments were inserted for orientation. After infiltration anesthesia, the opening incision (Fig. 3) was made using the Er,Cr:YSGG laser with 2 W, 100 mJ, 40 % water, 40 % air*, tip S4, to the bone. A small zone was left to the mesial side of 43 and 33. After exposing the bone, an insignificantly bleeding surgical area was revealed (Fig. 4)

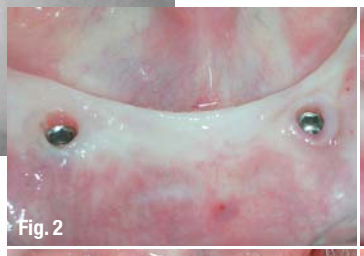
Fig. 2


Fig. 3


Fig. 4


Fig. 5

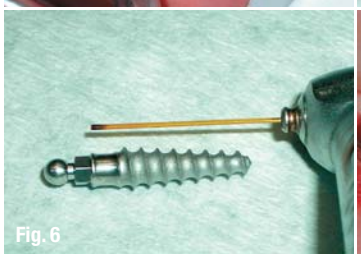
Fig. 6


Fig. 7

where the locations for implantation could be lightly marked using the same laser setting.

In order to work with cortical bone, more energy and less water and air are required because bone contains less water. We therefore used 3.5 W, 175 mJ and a sapphire tip (S6/10) to create a circumscribed opening the size of the implant neck using 65 % water and 50 % air*. We subsequently prepared the spongiosa with a 14 mm tip (Z4/14) and 3 W, 150 mJ with 55 % water and 50 % air* (Fig.5) with an angled and a straight handpiece. Due to the large amount of available space, the 12.5 mm implant length was easily achieved with the 14 mm tip (Fig. 6).

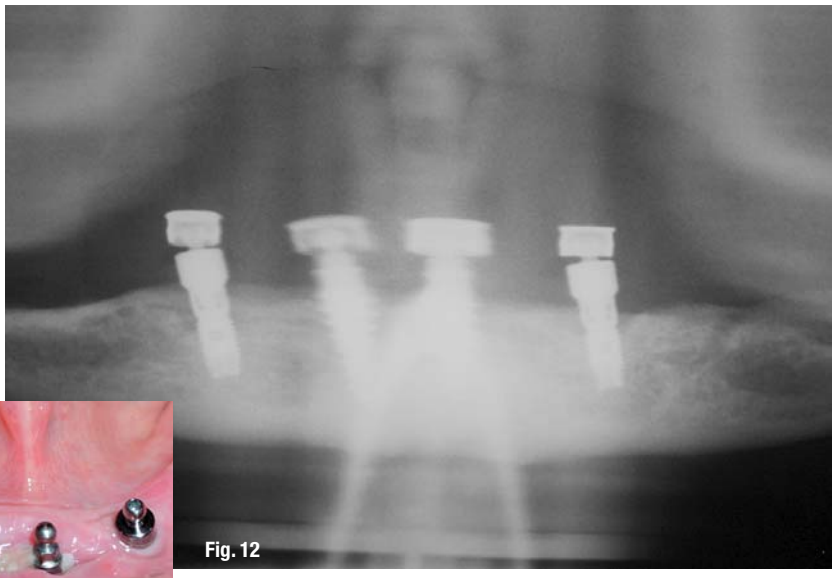
Fig. 12


Fig. 8


Fig. 9


Fig. 10


Fig. 11

Both implants were inserted with maximum primary stability (the patient was almost pulled out of the chair) (Fig. 7), and the wound was closed with 4.0 sutures (Fig. 8). Three weeks after surgery (Fig. 9), the matrices in the prosthesis were fixed and subjected to a load (Figs. 10, 11).

### Results

The wound healed without irritation or pain. The favorable primary stability enabled early loading. The envisioned goal was achieved (Fig. 12) since the patient was very satisfied with the new seat of the prosthesis.

### Discussion

In preparing implant beds, there are certain matters that need to be addressed. First, the laser tip needs to be longer than the implants. In this case, 12.5 mm implants were used, and the tip length was 14 mm (Fig. 7).

Second, there must be congruence between the bone preparation and the shape of the implant. This, however, is less critical with the utilized conical, self-tapping implants then with cylindrical implants. A more precise fit is required in the mandible in contrast to the maxilla because of the denser bone. (When screwing in the implant, broken off bone parts can be moved to other locations to balance the shape of the cavity.) Third, the bone must be sufficiently cooled during the entire operation, which is achieved by the ingenious water spray system of the Er,Cr:YSGG laser. Carbonized sites can arise when a tip comes too close to the bone, but these can be removed by additional irradiation from a greater distance. In addition to its many advantages, laser treatment has one disadvantage—it takes more time, up to 20 minutes with very dense bone.

### The advantages are:

1. Slight bleeding, clean and hence visible preparation.
2. No smear layer that accelerates osseointegration.
3. The laser works on the surface and is thus not associated with the harmful penetration of heat.
4. Biostimulation accelerates wound healing.
5. Sterilization of the surface obviates the necessity for antibiotics.
6. Fewer instruments are required (no scalpel, drill or physiodispenser), which simplifies logistics.
7. Working without contact substantially increases patient comfort.
8. There is almost no pain, tumors, heat or inflammation after surgery.

## _Case 2: Minimally invasive, delayed immediate implantation of a single tooth with direct loading

### Findings

A 32-year-old female patient lost tooth 24 from a root fracture (Fig. 1) and wore a removable interim

## _Case 2


Fig. 1

prosthesis for six weeks (Fig. 2). Since she had a new boyfriend and her interim prosthesis was annoying while kissing and made her embarrassed, she immediately wanted a permanent tooth. A bridge was not considered because tooth 23 had not been brightened, and tooth 25 had an unclear root filling with apical brightening and revealed a crown and pin and hence could not reliably serve as a bridge abutment. The patient rejected extracting tooth 25 and extending the bridge to tooth 26. The amount of bone for implantation was sufficient in a palato-vestibular and mesiodistal direction, and the extraction wound was primarily closed.

### Clinical procedure

The measurement using the implant template on the OPG revealed a safe depth of 12 mm (Fig. 3). After infiltration anesthesia, the straight handpiece and tip Z4/14 were used to penetrate the middle of the still relatively fresh extraction wound with 3 W, 150 mJ, 50 % water, 50 % air* (Fig. 4). The direction was determined by the neighboring teeth and the path of the bone in the alveole.

After achieving the desired length (Figs. 5, 6) and extending in a horizontal direction, the implant (Reuter One Day 4.2/12) was first inserted manually (Figs. 7, 8) and then using a torque wrench (Fig. 9) with the maximum torque advised by the manufacturer for a direct load (50 Ncm) and with primary stability (Fig. 10).

At the palatal side, a small gingivectomy was created with 2 W, 100 mJ, 20 % water, 20 % air* (Fig. 11), which was necessary to correctly place the special impression post (Fig. 12). The area surrounding the implant was slightly de-epitelized with 1 W, 50 mJ, 10 % water, 10 % air*.

The master dental technician worked with a gingiva mask (Fig. 13) on the model to support the healing and shaping of the gingiva around the crown. On the next day, the finished crown was inserted (Fig. 14). The patient commented, that from the beginning the new tooth felt like one of her own. At the check-up after 14 months the gingiva was nicely adapted (Fig. 15).

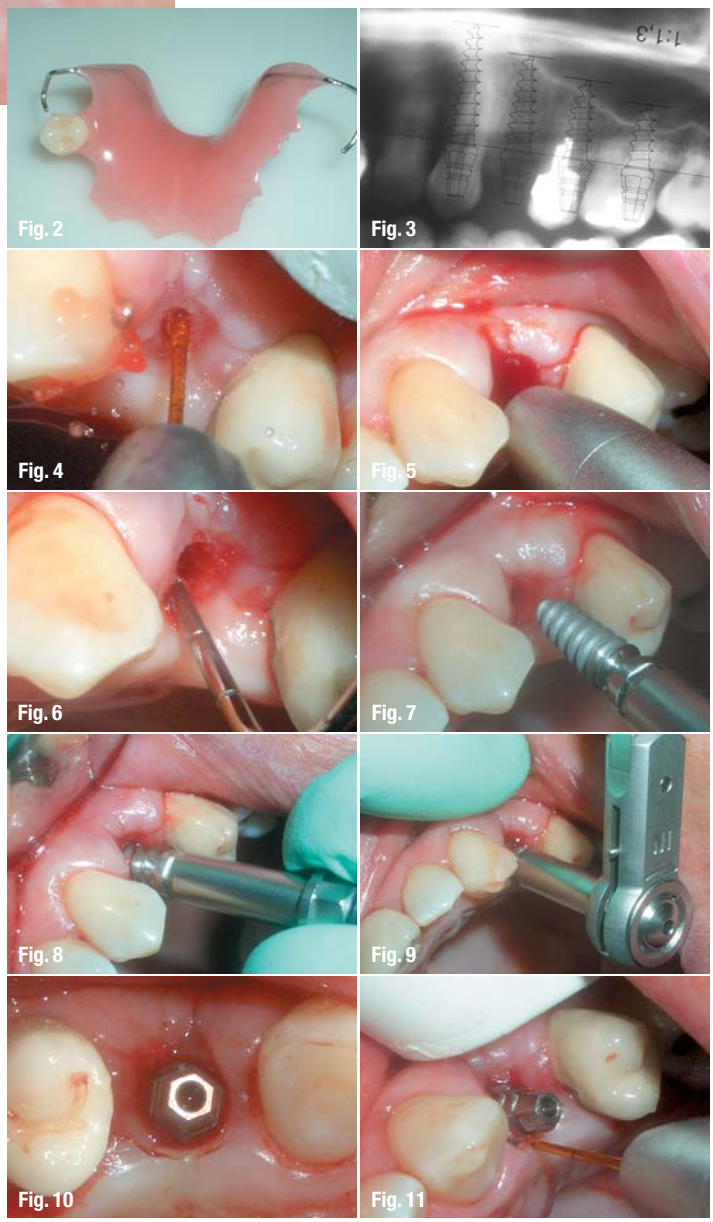
Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6


Fig. 7


Fig. 8


Fig. 9


Fig. 10


Fig. 11

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Fig. 12


Fig. 13


Fig. 14


Fig. 15

**Results**

The preparation of the implant bed and the impression took no longer than 15 minutes. The implant had maximum primary stability (a requirement for immediate loading), and the definitive restoration was finished on the next day. As a precaution, it was kept free of occlusion. The patient was extremely satisfied (as was her boyfriend).

**Discussion**

In (delayed) immediate implantation, the not-yet ossified alveole serves as a reference and yardstick. Lasers cannot slide or slip off as is the case with drills. Flap surgery is not required, which would create an unnecessary wound. Preparation beyond the apical margin of alveole requires careful prior measurement and sensitivity. When the sinus floor wall is reached, it is more difficult to proceed through hard cortical bone, hence indicating where to stop (a minor internal sinus lift can be created with an osteotome if necessary).

The horizontal extension of the bone cavity in the apical area is made easier by continuously probing with the inactive laser tip, proceeding cautiously so as not to break the tip. The indications for such an operation are limited by the available handpieces and tips (manufacturers should respond to this need).

Due to their large, flat thread, conical implants are specially designed for direct loading, which is essential for primary stability to compress the bone when screwed in. The congruence of the bone cavity with the shape of the implant is not as critical in the spongy maxillary bone.

With minimally invasive laser surgery, wound healing is fast, free of complications, and with no postoperative complaints. To avoid undesired lateral loads in the osseointegration phase from articulation, it is recommended to be particularly careful with the occlusal fit of the crown.

## _Case 3: Prosthesis fixation on two implants in the mandible and exposure with the laser

**Findings**

A 78-year-old patient presented with a very loose mandibular prosthesis that caused him daily problems with speaking and eating. He was no longer able to bear adhesives. In the past, he underwent an invasive bone resection of the sharp bony edges on the alveolar process of the entire mandible by a maxillofacial surgeon. He suffered postoperative symptoms for many months, and consequently developed a phobia of oral surgery. He was accordingly afraid of implant surgery, but agreed to it after an extensive explanation of the laser procedure.

**Clinical procedure**

Under infiltration anesthesia, the transgingival areas at teeth 43 and 33 were marked with the laser with a flat tip, 2.5 W, 125 mJ, 50 % water and 50 % air* (Fig. 1). The mucosa was sectioned to expose the surgical area using the same setting (Fig. 2). At the marked locations on the cortical bone, 3.5 W, 175 mJ, 65 % water and 60 % air* were used to make circular recesses the diameter of the implant neck (Fig. 3). Then the spongiosa was prepared with 3 W, 150 mJ and various tips. A standard drill was used during surgery to measure if the desired diameter and the length had been reached. Then 13 mm tapered Screw Vent implants were used with a diameter of 3.7 mm (Figs. 4–6).

The wound was primarily closed with 4.0 sutures (Fig. 7). After three months of closed healing (Fig. 8), the implants were exposed with tip Z4/14, 2 W, 100 mJ, 50 % water and 50 % air* under slight anesthesia (Fig. 9). The connection with the prosthesis was created (Figs. 10–12) and loaded.

**Results**

The implants were inserted with maximum primary stability in a slightly long operation. There were absolutely no complications or pain post OP, the patient's trust in oral surgery was restored, and he was very thankful.

**Discussion**

In an edentulous jaw, the desired implant position is preferably defined before flap surgery. The laser can be used for transgingival marking at those locations after exposing the tooth and bone, which is very helpful when determining the correct position. The preparation of bone cavities for (nearly) cylindrical implants requires a calm

patient, a confident hand, and a good ability to estimate. Given a maximum laser tip depth of 14 mm, a maximum of 13 mm implants can be inserted assuming that the laser handpiece can contact the bone. Mobility must remain unrestricted, which is generally only the case in edentulous areas.

The success of laser surgery can be easily monitored with a standard drill (a 3.2 mm drill for 3.7 mm implants) where the drill is manually inserted into the preparation without force. Wherever it stops, additional bone has to be removed.

## _Case 3


Fig. 12


Fig. 1

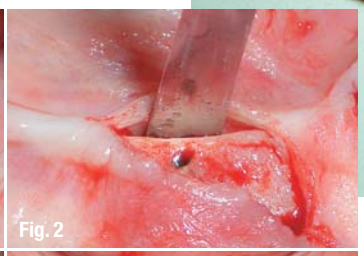
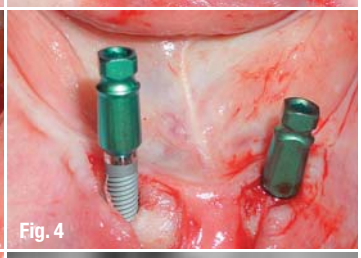


Fig. 2


Fig. 3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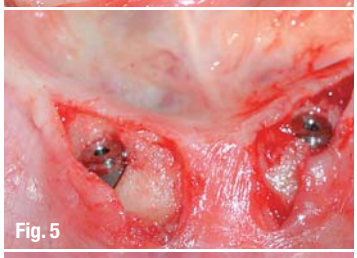
Fig. 5


Fig. 6


Fig. 7


Fig. 8

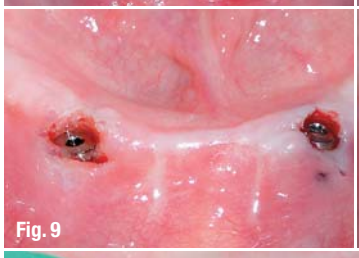
Fig. 9


Fig. 10


Fig. 11

Only the opening in the cortical bone must have the exact diameter of the implant neck to prevent fracturing during insertion. This can be achieved relatively quickly with a bit of practice. The extra time is justified by the patient's comfort (no vibration and easy, fast and painless wound healing)._

** The cited settings are guideline values and depend on the tissue, sensitivity, utilized tip and care provider.*

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laser

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