Peri-implant Bone Regeneration in Immediate and Immediate-Delayed Implantation

Scientific Background, Experts' Treatment Reports and Cases using Synthetic Biomaterials

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Peri-implant bone regeneration in immediate and immediate-delayed Implantation using synthetic biomaterials

Bone gaps, smaller bone dehiscence and fenestration defects are frequently encountered when placing implants in an extracted socket (Esposito et al. 2006).

Such defects can be treated before implantation or at the same time using regenerative therapies to achieve optimal results in terms of both function and aesthetics.

Although the treatment depends on the individual clinical situation, outcomes may be optimized by following general principles and guidelines.

In order to discuss such guidelines, the authors of this Guidebook met in Baden, Switzerland, in January 2015 to develop a guideline for the use of synthetic materials in the immediate or immediately delayed implant indication. The guideline was based on a review of scientific literature in addition to the authors’ clinical experience.

This Guidebook consolidates scientific evidence on regenerative procedures with the practical considerations after tooth extraction with a specific focus on application of synthetic biomaterials predominantly in a minimally invasive approach.

The successful application of these treatment guidelines in the clinical practice are further illustrated with original clinical cases by the authors which demonstrate the use of GUIDOR® easy-graft® CLASSIC and GUIDOR easy-graft CRYSTAL in cases of immediate and immediate-delayed implantation.
**Introduction**

According to Brånemark's original protocol for 2-stage implant treatment, surgical placement is carried out around 6 to 8 months after tooth extraction followed by a 3 to 6 months osseointegration period, resulting in treatment time that can easily exceed 1 year (Brånemark 1983). Further, concerns associated with such a conservative approach are missing functionality during the treatment period, the inevitable resorption of the alveolar bone, the burden of several successive surgical interventions with their associated risks, as well as the psychological impact on the patient (Koh et al. 2010).

In an attempt to shorten the overall treatment time between extraction and the final restoration of the osseointegrated implant, the number of surgical interventions, as well as to reduce the cost and the patient's discomfort, the immediate placement of implants at the time of tooth extraction was proposed. Unfortunately, the immediate placement of a dental implant following extraction brings its own potential disadvantages such as the enhanced risk of infection and the lack of soft tissue closure that may increase the rate of complications and implant failure (Chen et al. 2004; Esposito et al. 2010a; Jörino et al. 2012). Therefore, the successful implementation of this protocol demands an ideal initial bone and soft tissue situation and a low risk profile of the patient, which limits its broader application.

In order to overcome these potential problems, the immediate-delayed placement of implants was proposed. According to this concept, the clinicians will wait between 2 to 8 weeks after tooth extraction before placing the implant in which time a soft tissue healing will have occurred, thus, decreasing the risk of infections (Esposito et al. 2010a; Esposito et al. 2010b; Koh et al. 2010). Although, short-term survival rate of implant placement in an immediate, immediate-delayed approach may achieve similar levels than with the traditional two stage (late) approach (Esposito et al. 2010a; Chen et al. 2004), long-term data remains inconclusive (Chen et al. 2004; Koh et al. 2010; Esposito et al. 2010; Schropp et al. 2003). What is conclusive when reviewing recent publications and protocols is that immediate or immediate-delayed implants are typically placed in a more palatal position than the previous tooth root thus creating a gap (the jumping distance) between the implant surface and the labial buccal plate of the alveolus (Sanz et al. 2012). In more challenging situations, one or more bony walls of the post-extraction socket are partly or completely missing resulting in exposure of a larger portion of the implant surface after implant placement. Such fenestration or dehiscence type defects may reduce the potential of the implant to become fully osseointegrated, which might increase long-term complications. Filling this peri-implant gaps and defects with a grafting material is recommended in order to avoid the ingrowth of connective tissue and preserve the architecture of the ridge (Botticelli et al. 2006a; Sanz et al. 2012; Botticelli et al. 2003; Tarnow et al. 2010).

Although autogenous bone grafts are still considered the gold standard in bone regeneration procedures the donor site morbidity, unpredictable resorption, need for additional surgery together with the skill level and limited quantities retrieved remain major drawbacks. As an alternative, to overcome these limitations, a variety of bone graft substitute materials have been developed. Among these materials, porous calcium phosphates of 100% synthetic origin are widely adopted (Leventis et al. 2014a; Jensen et al. 2009). Porous beta tricalcium phosphate (β-TCP) is completely resorbed by the body and gradually replaced by newly-formed vital bone. Complementing the fully resorbable β-TCP material are biphasic materials composed of a mixture of β-TCP and hydroxyapatite (HA). Such “biphasic” materials are only partly resorbed but fully integrated into the newly formed bone. The remaining portion of the material allows to preserve the augmented volume at the grafted sites (Trias et al. 2003; Artzi et al. 2004; Ruffieux et al. 2010; Schmidlin et al. 2013; Leventis et al. 2014b). Furthermore, the stabilization and immobilization of particulate bone graft substitutes at the recipient site is shown to be of crucial importance to prevent micro-movement between bone and implanted material that promotes ingrowth of fibrous tissue and obstructs the newly bone formation at the defect site (Wang et al. 2006).

To improve initial stability of bone graft particulates in the defect site, mouldable synthetic bone graft substitutes with in situ hardening properties have been proposed that have demonstrated excellent handling properties and osseointegration (Ruffieux et al. 2010; Leventis et al. 2014a; Schmidlin et al. 2013; Troedhan et al. 2014).

### Scope and Terminology

This guidebook focuses on peri-implant bone grafting procedures in the immediate or immediate-delayed indication. The authors present their treatment concepts and surgical procedures for achieving predictable clinical results using the synthetic biomaterials: GUIDOR easy-graft CLASSIC and GUIDOR easy-graft CRYSTAL.

Other aspects of the implant therapy such as the implant insertion and prosthetic treatment will not be covered here. The reader is directed to publications and guidelines of groups and associations such as the ITI, EAO, EDI as well as other international and national dental organisations.

### Indications:

This guidebook discusses treatment of bone gaps (the jumping gap), peri-implant fenestration and dehiscence type defects around implants placed immediately or in the immediately-delayed (allowing for soft tissue closure) protocol after tooth extraction.

### Terminology:

**Immediate Implantation:** Implant placement in the same surgical session as tooth extraction.

**Immediate-delayed Implantation:** Implant placement after a period of soft tissue healing (typically 2 to 8 weeks after tooth extraction).

**Delayed Implantation:** Implant placement into a healed site (at least 4 to 6 months after extractions).

### Types of extraction sockets:

Classification of extraction socket based on the presenting hard and soft tissue situation (Elahi et al. 2007).

**Type I:** Facial soft tissue and buccal bone wall are intact.

**Type II:** Facial soft tissue is intact, buccal bone wall is partially missing.

**Type III:** Facial soft tissues as well as buccal bone wall are markedly reduced.
Basic Considerations for Implant Placement

During the expert meeting, the authors agreed that the following considerations should be regarded as basic knowledge in regenerative therapy:

- The risk profile of the patient has to be evaluated before planning any implant therapy (Koh et al. 2010, Chen et al. 2014). For evaluating aesthetic risks, the risk profile proposed by the ITI may be used (Table 1, Martin et al. 2006).

- The surgeon has to consider the biological principles of bone formation and osseointegration: If bone defects exceed a critical size they will not heal spontaneously and bone grafting has to be performed (Chen et al. 2004). Bleeding in the defect is critical since the formation of a stable blood clot is a prerequisite for vascularization and bone ingrowth (Wang et al. 2006). It must be recognised that subsequent contraction of the blood clot and retraction from the bone walls may compromise bone healing and result in necrosis.

- Due to resorption of the bundle bone, tooth extraction is usually followed by loss of hard and soft tissue (Schropp et al. 2003, Araujo et al. 2005).

- This resorption takes place irrespective of immediate implant placement and especially in sites with thin buccal bone walls such as those often present in the anterior region (Botticelli et al. 2004a, Huynh Ba et al. 2010).

- A ridge preservation procedure is recommended to maintain ridge dimensions (Vignoletti et al. 2012, Hämmerle et al. 2012). According to Hämmerle et al., ridge preservation is performed to maintain the existing soft and hard tissue envelope, maintain a stable ridge volume for optimal functional and aesthetic outcomes and to simplify later treatment procedures.

- Clot stability is a prerequisite for new bone formation (Wang et al. 2006). Therefore, the graft material must be stabilized and immobilized. The synthetic bone graft material GUIDOR easy-graft hardens in situ when in contact with blood. This may present a relevant advantage over particulate graft materials in certain indications (Troedhan et al. 2014).

- The choice of resorption format (easy-graft CLASSIC or easy-graft CRYSTAL) is dependent on the individual clinical situation and the preference of the surgeon.

- Membranes and barrier materials are usually applied over the defect to prevent soft tissue ingrowth and further improve graft containment and stabilization (Wang et al. 2006, Lundgren et al. 1994b).

- In aesthetic sites, an optimal soft tissue emergence profile may need to be created using appropriate provisional restorations (Koh et al. 2010). In case of a high lip line and a thin biotype, surgeons should be aware of the consideration to place a connective tissue graft or suitable alternative material to thicken the soft tissue.

- As with any surgical procedures, surgeons should be familiar with the treatment procedures and must follow general guidelines for surgical and implant therapy.

Table 1: Aesthetic risk profile (adapted from Martin et al. 2006)

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Low risk</th>
<th>Moderate risk</th>
<th>High risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical status</td>
<td>Healthy, co-operative patient with an intact immune system</td>
<td>Reduced immune system</td>
<td></td>
</tr>
<tr>
<td>Smoking habit</td>
<td>Non-smoker</td>
<td>Light smoker (&lt;10 cigs/day)</td>
<td>Heavy smoker (&gt;10 cigs/day)</td>
</tr>
<tr>
<td>Patient’s aesthetic expectations</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Lip line</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Gingival biotype</td>
<td>Low scalloped, thick</td>
<td>Medium scalloped, medium thick</td>
<td>High scalloped, thin</td>
</tr>
<tr>
<td>Shape of tooth crowns</td>
<td>Rectangular</td>
<td>Slightly triangular</td>
<td>Triangular</td>
</tr>
<tr>
<td>Infection at implant site</td>
<td>None</td>
<td>Chronic treated</td>
<td>Acute</td>
</tr>
<tr>
<td>Bone level at adjacent teeth</td>
<td>≤5mm to contact point</td>
<td>5.5 to 6.5mm to contact point</td>
<td>≥7mm to contact point</td>
</tr>
<tr>
<td>Restorative status of adjacent teeth</td>
<td>Virgin</td>
<td>Chronic treated</td>
<td>Restored</td>
</tr>
<tr>
<td>Width of edentulous span</td>
<td>1 tooth (≥7mm)</td>
<td>1 tooth (≤7mm)</td>
<td>2 teeth or more</td>
</tr>
<tr>
<td>Soft tissue anatomy</td>
<td>Intact soft tissue</td>
<td>Soft tissue defects</td>
<td></td>
</tr>
<tr>
<td>Bone anatomy of alveolar crest</td>
<td>Alveolar crest without bone deficiency</td>
<td>Horizontal bone deficiency</td>
<td>Vertical bone deficiency</td>
</tr>
</tbody>
</table>
“Experts” Consensus for immediate or immediate-delayed Implantation

During the expert meeting the authors agreed on the following statements:

- Tooth extraction has to be performed using an atraumatic method such as that described in the Sunstar GUIDOR “Ridge Preservation Protocol” Guidebook (Schug et al. 2013).
- Risk factors have to be considered for achieving an optimal outcome. These include systemic medical conditions, smoking, alcoholism, oral hygiene and soft tissue profile (biotype).
- The presence of acute infection has to be excluded in case of immediate implant placement.
- Implants can be placed either immediately in an extraction socket, immediate-delayed (after soft tissue closure) or in a healed site.
- Cone Beam Computed Tomography (CBCT) is advised prior to implant placement.
- Implants are typically placed in an optimal 3-dimensional position (Buser et al. 2004) in accordance with the existing consensus such as that from EDI (Nickenig et al. 2014).
- In case of a bony “jumping” gap, fenestration or dehiscence defects around the implant, placement of a bone graft or substitute is advised.

Materials

GUIDOR easy-graft synthetic bone graft substitute

GUIDOR easy-graft is a synthetic bone augmentation material that is applied directly from the syringe into the defect. The mouldable adhesive granules can be shaped in the defect. When in contact with blood, the material hardens within minutes to form a porous defect analogue. GUIDOR easy-graft products are 100% synthetic and do not contain substances of animal or human origin.

GUIDOR easy-graft is available in two formats easy-graft CLASSIC and easy-graft CRYSTAL:

- easy-graft CLASSIC consists of coated, phase pure β-tricalcium phosphate (β-TCP). During healing easy-graft CLASSIC is completely resorbed and replaced by newly formed bone within a time period of 5–15 months. No material remains.
- easy-graft CRYSTAL consists of coated biphase calcium phosphate (compound of 60% hydroxyapatite and 40% β-TCP). The β-TCP component is completely resorbed and replaced by newly formed bone whilst the hydroxyapatite portion remains integrated in the newly formed bone providing long-term volume stability.
Treatment pathways

Based on the scientific literature and their clinical experience, the authors agreed on the following treatment pathways for using synthetic biomaterials in immediate and immediate-delayed implant placement.

**Objective: Immediate Implant Placement**

Risk factors to be considered for an optimal outcome:
- Systemic medical conditions, smoking, alcoholism, oral hygiene and soft tissue profile (biotype).

Atraumatic extraction

Determine integrity of buccal wall

- Intact
- Defect with apical or mid-root fenestration
- Dehiscence or missing buccal wall

- Per-implant gap (jumping distance <1.5mm)
- Per-implant gap (jumping distance >1.5mm)

- Implanted placement if sufficient stability can be achieved
- Fill the gap with e-g (small granules)
- Fill the gap with e-g (large granules)
- Fill the gap w or w/o a membrane

**Objective: Immediate-delayed Implant Placement**

Risk factors to be considered for an optimal outcome:
- Systemic medical conditions, smoking, alcoholism, oral hygiene and soft tissue profile (biotype).

Determine integrity of buccal wall

- Intact
- Defect with apical or mid-root fenestration
- Dehiscence or missing buccal wall

- Per-implant gap (jumping distance <1.5mm)
- Per-implant gap (jumping distance >1.5mm)

- Implant placement if sufficient stability can be achieved
- Fill the gap with e-g (large granules) w or w/o a membrane

- Case specific implant placement if sufficient stability can be achieved
- Fill the gap with e-g (large granules) w or w/o a membrane
- GBR with e-g (large granules) and/or membrane

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*Figure 1: Decision tree for Immediate Implant placement
  *e.g.: GUIDOR easy-graff

*Figure 2: Decision tree for Immediate-delayed Implant placement*
Case Reports

Immediate Implantation

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**Immediate Implantation**

Dr. Leventis

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Socket with intact buccal wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>1</td>
</tr>
<tr>
<td>Follow-up</td>
<td>14 months</td>
</tr>
</tbody>
</table>

**Clinician:**
Dr. Minas Leventis

**Patient:**
Female, 45 years old

**Initial situation:**
Root fracture of maxillary right incisor thus the root could not be restored. The tooth had a restoration with post and crown for many years.

**Material used:**
GUIDOR easy-graft CRYSTAL, Paltop 3.25 x 11.5 mm dental implant.

**Socket filling:**
The 3mm buccal gap was filled with GUIDOR easy-graft CRYSTAL (1 x 0.25ml). Graft was placed buccally and condensed with bone grafting instrument (bone condenser from STOMA) in order to fill the jumping distance up to the level of the buccal bone.

**Wound closure:**
The biomechanical properties of GUIDOR easy-graft resulted in a stable site which did not require a flap. The grafted site was covered with a haemostatic sponge and cross-mattress suture to stabilize the wound without obtaining primary closure. Soft tissue healing occurred by secondary intention.

**Mechanical protection of the surgical site:**
A provision acrylic bridge was immediately cemented to the left maxillary incisor with a pontic protecting the site without applying any pressure.

**Medication & post-surgical care:**
Amoxicillin 500 mg every 8 hours for 1 week and Nimesulide 100 mg every 12 hours for 2 days post-op. The patient was advised to rinse with Chlorhexidine 3 times/day for 1 week and to use a soft brush.

**Treatment:**
Immediate Implantation following flapless atraumatic (periotome) extraction with close attention given to preserving buccal hard and soft tissues. Intense socket debridement and rinsing with sterile saline. Preceded placement of the 3.25 x 11.5mm implant at the correct 3D position.

Immediate implant placement shortened the treatment time with less surgical intervention and reduced morbidity.

**X-ray - Initial situation, failing maxillary right incisor.**

**Immediate implant placement and grafting buccally with GUIDOR easy-graft CRYSTAL.**

**X-ray - at placement.**

**Immediate placement of provisional restoration.**

**2 weeks post-op.**

**5 weeks post-op. Excellent preservation of site architecture utilizing minimally invasive techniques and GUIDOR easy-graft CRYSTAL.**

**2 weeks post-op, after removing the provisional restoration.**

**4 months post-op.**

**4 months post-op, after removing the provisional restoration.**

**4 months post-op.**

**5 months post-op, excellent preservation of the architecture of the ridge.**

**Final restoration: 14 months after extraction and immediate implant placement.**

**X-ray at placement.**

**2 weeks post-op.**

**4 months post-op. Excellent preservation.**
Immediate Implantation
Dr. Flichy

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Intact buccal wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>24</td>
</tr>
<tr>
<td>Follow-up</td>
<td>24 months</td>
</tr>
</tbody>
</table>

**Clinician:**
Dr. Antonio Flichy  
**Patient:**
Female, 48 years old  
**Initial situation:**
Extraction of tooth 24 with broken crown due to caries.  
**Material used:**
GUIDOR easy-graft CRYSTAL, Mozo-Grau Inhex 3.75 x 11.5 mm dental implant and 3-0 silk suture.  
**Treatment:**
The tooth extraction was performed atraumatically to maintain the buccal plate. After extraction the socket was degranulated and the implant placed according to the ideal anatomical aspects. An insertion torque value of 35 N was recorded.

**Socket filling:**
The 4 mm peri-implant/buccal gap was filled with GUIDOR easy-graft CRYSTAL. The biomaterial was placed and condensed with an amalgam packer and periosteum to fill the site to the level between buccal bone and gingiva.

**Wound closure:**
The biomechanical properties of GUIDOR easy-graft resulted in a stable site which did not require a flap or membrane for containment. The gingiva was sutured to approximate the wound edges.

**Mechanical protection of the surgical site:**
No prosthesis or other mechanical protection was necessary after the surgery.

**Medication & post-surgical care:**
Prescription of Amoxicillin 750 mg 1/8h 7 days; ibuprofen 600 mg 1/8h 5-7 days; Paroex 0.12% 3 times/day 10 days; hyaluronic acid 0.6% 5-6 times/day (for soft tissue healing).

**Final restoration:**
A CAD-CAM screwed prosthesis was made by BioCam Company. The design and fabrication of the prosthesis and the ceramic coverage was made by Dinnbier Dental laboratory. Clinical and radiological follow-up was made at 6 months.
### Immediate Implantation

**Clinician:**
Dr. Antonio Flichy

**Patient:**
Female, 44 years old

**Initial situation:**
Apical lesion without option to save mandibular molar; tooth 46.

**Material used:**
GUIDOR easy-graft CRYSTAL Mozo-Grau Index 3.75 x 11.5mm dental implant.

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#### Status of buccal wall

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Intact buccal wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>46</td>
</tr>
<tr>
<td>Follow-up</td>
<td>18 months</td>
</tr>
</tbody>
</table>

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#### Treatment:

The tooth extraction was performed atraumatically to maintain the buccal plate. After extraction the socket was degranulated and the implant placed according to the ideal anatomical aspects. An insertion torque value of 35 N was recorded.

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#### Socket filling:

The buccal gap was filled with GUIDOR easy-graft CRYSTAL and condensed with an amalgam packer and periotope to the level between the buccal bone and gingiva.

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#### Wound closure:

The biomechanical properties of GUIDOR easy-graft resulted in a stable site which did not require a flap or membrane for containment. A suture was used to gently approximate the wound edges with healing by secondary intention.

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#### Medication & post-surgical care:

Prescription of Amoxicillin 750 mg 1/8h 7 days; ibuprofen 600 mg 1/8h 5-7 days; Panex 0.12% 3 times/day 10 days; hyaluronic acid 0.6% 5-6 times/day (for soft tissue healing).

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#### Final restoration:

A CAD-CAM screw retained prosthesis was made by BioCam Company. The design and fabrication of the prosthesis was made by Sr. Javier Ortolà at Dinnbier Dental laboratory and placed by Dr. Isabel Rodriguez.
Immediate Implantation  
Dr. Kakar

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Intact buccal wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5 mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>13</td>
</tr>
<tr>
<td>Follow-up</td>
<td>4 months</td>
</tr>
</tbody>
</table>

**Socket filling:**
The buccal gap was filled with GUIDOR easy-graft CRYSTAL. The easy-graft was placed and condensed to fill the site to the level of the neck of the implant. The graft was overfilled over the implant neck.

**Wound closure:**
The biomechanical properties of GUIDOR easy-graft resulted in a stable site which did not require a flap or membrane for containment. Tissue approximation was done using one interrupted and one cross mattress suture.

**Medication & post-surgical care:**
Post-operative antibiotics were prescribed for a period of 5 days (Amoxicillin and Clavulinate). One gram BID (Ibuprofen 600) was also prescribed to be taken as required.

**Clinician:**
Dr. Ashish Kakar

**Patient:**
Female, 72 years old

**Initial situation:**
The tooth 13 was fractured after an endodontic treatment. The fracture was at the gingival margin and it was decided to extract the tooth and to replace it with a single tooth implant in the area.

**Material used:**
GUIDOR easy-graft CRYSTAL, Xive dental implant (Dentsply - Germany).

**Treatment:**
The fractured tooth was extracted using minimal invasive atraumatic techniques. Periotomes and luxators were used to gently luxate the tooth out of the socket. Care was taken to preserve the integrity of the marginal gingival tissues. No flaps were reflected to preserve the periosteal blood supply in the area. A single implant Xive (Dentsply - Germany, 3.4 x 13mm) was placed in the prepared osteotomy site. The osteotomy was performed using a palatal approach for the implant placement thus preserving the thin buccal plate. The implant was placed about 1mm sub-crestally.

**Socket filling:**
The buccal gap was filled with GUIDOR easy-graft CRYSTAL. The easy-graft was placed and condensed to fill the site to the level of the neck of the implant. The graft was overfilled over the implant neck.

**Wound closure:**
The biomechanical properties of GUIDOR easy-graft resulted in a stable site which did not require a flap or membrane for containment. Tissue approximation was done using one interrupted and one cross mattress suture.

**Medication & post-surgical care:**
Post-operative antibiotics were prescribed for a period of 5 days (Amoxicillin and Clavulinate). One gram BID (Ibuprofen 600) was also prescribed to be taken as required.
Immediate Implantation

Dr. Leventis

Status of buccal wall
Peri-implant gap
Tooth
Follow-up

Thin buccal wall with fenestration defect
> 1.5mm
11
4 months

Implant placement and GBR:

Immediately after extraction an implant was placed in without raising a flap. The correct positioning of the implant not only ensures an aesthetic and functional final restoration but also allows for adequate space between the implant surface and the thin buccal bone wall to perform guided bone regeneration. A resorbable polymer matrix (GUIDOR matrix barrier) was contoured into a V-shape and placed in the internal aspect of the socket to support the thin bone and to cover a small fenestration. The thickness of GUIDOR matrix barrier allowed for easy insertion into the socket and its space maintaining aspect allowed placement labially without folding or collapsing. The gap between GUIDOR matrix barrier and implant was filled and condensed with GUIDOR easy-graft CLASSIC.

Wound closure:

A haemostatic sponge was placed over the site and a tension-free cross mattress suture was made to stabilize the site. Primary wound closure was not required. Soft tissue healing occurred by secondary intention.

Mechanical protection of the surgical site:

An ovate pontic provisional Maryland restoration was bonded to the adjacent teeth immediately post-op. The pontic of the acrylic tooth was shaped in order to seal the site without applying pressure and guide the soft tissue healing in terms of contour. This permitted the gradual proliferation of newly-formed epithelium over the grafted site and under the pontic of the provisional tooth.

Medication & post-surgical care:

Amoxicillin 500 mg every 8 hours for 1 week and Nimesulide 100 mg every 12 hours for 2 days post-op. Rinsing with Chlorhexidine 3 x day for 1 week and use of a soft brush advised.

Clinician:
Dr. Minas Leventis

Patient:
Female, 23 years old, smoker

Initial situation:
The maxillary right central incisor was diagnosed as hopeless due to external resorption of the root and chronic periapical infection. History of trauma-extraction and re-implantation of the tooth 11 years ago.

Material used:
GUIDOR easy-graft CLASSIC, GUIDOR matrix barrier, connective tissue graft, Nobel Active 4.3 x 15mm dental implant.

Treatment:
Non-surgical “atraumatic” extraction of tooth 11 without raising a flap. Extraction performed by periotome to mobilize the tooth and forceps with gentle elliptical movements. Care was given not to damage the interproximal papillae and the buccal soft and hard tissues. The socket was thoroughly debrided with bone curettes and special round diamond-coated burrs and rinsed with sterile saline.

Immediately after extraction an implant was placed in without raising a flap. The correct positioning of the implant not only ensures an aesthetic and functional final restoration but also allows for adequate space between the implant surface and the thin buccal bone wall to perform guided bone regeneration. A resorbable polymer matrix (GUIDOR matrix barrier) was contoured into a V-shape and placed in the internal aspect of the socket to support the thin bone and to cover a small fenestration. The thickness of GUIDOR matrix barrier allowed for easy insertion into the socket and its space maintaining aspect allowed placement labially without folding or collapsing. The gap between GUIDOR matrix barrier and implant was filled and condensed with GUIDOR easy-graft CLASSIC.

Wound closure:

A haemostatic sponge was placed over the site and a tension-free cross mattress suture was made to stabilize the site. Primary wound closure was not required. Soft tissue healing occurred by secondary intention.

Mechanical protection of the surgical site:

An ovate pontic provisional Maryland restoration was bonded to the adjacent teeth immediately post-op. The pontic of the acrylic tooth was shaped in order to seal the site without applying pressure and guide the soft tissue healing in terms of contour. This permitted the gradual proliferation of newly-formed epithelium over the grafted site and under the pontic of the provisional tooth.

Medication & post-surgical care:

Amoxicillin 500 mg every 8 hours for 1 week and Nimesulide 100 mg every 12 hours for 2 days post-op. Rinsing with Chlorhexidine 3 x day for 1 week and use of a soft brush advised.

A haemostatic sponge was placed over the site and stabilised with a tension-free cross mattress suture.

One week post-op: Non-invasive techniques allowed the fast healing of the tissues with minimal morbidity for the patient.

10 days post-op: The pontic of the acrylic tooth was shaped accordingly in order to seal the site without applying pressure and guide the soft tissue healing in terms of contour.

Two weeks after a screw-retained provisional acrylic crown was placed. The connective tissue graft is successfully integrating.

A haemostatic sponge was placed over the site and stabilised with a tension-free cross mattress suture.

An ovate pontic provisional Maryland restoration was bonded to the adjacent teeth immediately post-op.

At 10 days gradual proliferation of newly-formed epithelium over the grafted site and under the pontic of the provisional tooth.
### Immediate Implantation

**Dr. Flichy**

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Mid apical buccal wall defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>25</td>
</tr>
<tr>
<td>Follow-up</td>
<td>8 months (33 weeks)</td>
</tr>
</tbody>
</table>

#### Treatment:

Tooth extraction was made carefully to maintain the buccal plate. After the extraction, the socket was well cleaned. The dental implant was placed according to the anatomical aspects considerations. A torque of 35N was obtained.

#### Socket filling:
Correct 3 dimensional placement of the implant resulted in a 5mm buccal gap. GUIDOR easy-graft CRYSTAL was introduced and condensed with an amalgam packer and periodontal up to the level of buccal bone and gingiva.

#### Wound closure:
The wound edges were approximated using a suture. Healing occurred by secondary intention.

#### Mechanical protection of the surgical site:
No prosthesis or other mechanical protection was necessary after surgery.

#### Medication & post-surgical care:
Prescription of Amoxicillin 750mg 1/8h 7 days; Ibuprofen 600mg 1/8h 5-7 days; Paracetamol 0.125% 3 times/day 10 days; hyaluronic acid 0.6% 5-6 times/day (for soft tissue healing).

#### Final restoration:
A CAD-CAM screw retained prosthesis was made by BioCam Company. The design and fabrication of the prosthesis was completed by Sr. Javier Ortollà at Dinnbier Dental laboratory and placed by Dr. Isabel Rodriguez.
Immediate Implantation
Dr. Kakar

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Buccal wall defect</th>
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<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5 mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>23</td>
</tr>
<tr>
<td>Follow-up</td>
<td>4 years</td>
</tr>
</tbody>
</table>

**Clinician:**
Dr. Ashish Kakar

**Patients:**
Male, 37 years old

**Initial situation:**
Fractured tooth 23 at the sub-crestal level following secondary decay under the old crown.

**Material used:**
GUIDOR easy-graft CRYSTAL.
Nobel 5.0 x 13mm implant.

**Treatment:**
Atraumatic minimally invasive, flapless extraction was performed using luxators. An implant was placed with an ITV of 40 Ncms. Primary stability was achieved. The peri-implant defect was filled with GUIDOR easy-graft CRYSTAL. Re-entry was performed after 3 months of healing when the final restoration was made.

**Medication & post-surgical care:**
Post-operative antibiotics were prescribed for a period of 5 days (Amoxicillin and Clavunate) 1 gram BID.

**Socket filling:**
The buccal gap was filled with GUIDOR easy-graft CRYSTAL (1 x 0.4ml). The GUIDOR easy-graft was placed and condensed to fill the site to the level of crestal bone.

**Wound closure:**
Soft tissue closure was accomplished by tissue approximation for the site.

**Status of buccal wall**
- Peri-implant gap: > 1.5 mm
- Tooth: 23
- Follow-up: 4 years

**Buccal wall defect**
- > 1.5 mm
- Tooth: 23
- Follow-up: 4 years

**Material used**
- GUIDOR easy-graft CRYSTAL
- Nobel 5.0 x 13mm implant

**Medication & post-surgical care**
- Post-operative antibiotics prescribed for 5 days (Amoxicillin and Clavunate) 1 gram BID

**Clinician**
Dr. Ashish Kakar

**Patients**
Male, 37 years old

**Initial situation**
Fractured tooth 23 at the sub-crestal level following secondary decay under the old crown.

**Material used**
GUIDOR easy-graft CRYSTAL.
Nobel 5.0 x 13mm implant.

**Treatment**
Atraumatic minimally invasive, flapless extraction was performed using luxators. An implant was placed with an ITV of 40 Ncms. Primary stability was achieved. The peri-implant defect was filled with GUIDOR easy-graft CRYSTAL. Re-entry was performed after 3 months of healing when the final restoration was made.

**Medication & post-surgical care**
Post-operative antibiotics prescribed for 5 days (Amoxicillin and Clavunate) 1 gram BID.

**Socket filling**
The buccal gap was filled with GUIDOR easy-graft CRYSTAL (1 x 0.4ml). The GUIDOR easy-graft was placed and condensed to fill the site to the level of crestal bone.

**Wound closure**
Soft tissue closure was accomplished by tissue approximation for the site.
Immediate Implantation
Dr. Flichy

Status of buccal wall
Intact buccal wall

Peri-implant gap
> 1.5mm

Tooth
11, 12, 21, 22

Follow-up
24 months

Socket filling:
The peri-implant gap of 3mm was filled with GUIDOR easy-graft CRYSTAL compacting the biomaterial to the apex of the sockets. An interproximal suture was placed to approximate the sides.

Wound closure:
The biomechanical properties of GUIDOR easy-graft resulted in a stable site which did not require a flap or membrane for containment. The sockets were overfilled and GUIDOR easy-graft compressed. At flap reopening excess biomaterial was removed which was partially infiltrated by soft tissue.

Mechanical protection of the surgical site:
A removable prosthesis was made for the aesthetics and functional conditions of the patient during the 6 months of healing.

Medication & post-surgical care:
Prescription of Amoxicillin 750 mg 1/8h 7 days; Ibuprofen 600 mg 1/8h 5-7 days; Paracetamol 0.5% 3 times/day 10 days; hyaluronic acid 0.5% 5-6 times/day (for soft tissue healing).

Final restoration:
A CAD-CAM screw retained prosthesis was made by BioCam Company. The design and fabrication of the prosthesis was completed by Sr. Javier Ortola at Dinnbier Dental laboratory and placed by Dr. Isabel Rodriguez.

Treatment:
The patient had movement of her teeth prompting extraction with immediate implantation and simultaneous bone grafting.

Extraction was performed atraumatically to maintain the buccal wall. After extractions, the sockets were extensively degranulated prior to placement of the Mozo-Grau Inhex 3.75 x 11.5mm dental implant. An insertion torque value of 35 N was obtained.

Situation 8 months post surgery: excellent soft tissue healing and placement of the final prosthesis.

Panoramic x-ray situation after 24 months. Frontal view of clinical situation prior to extraction. Situation with maxillary incisors (teeth 12, 11, 21, 22). Extraction due to non active periodontal pathology.
Immediate-delayed Implantation
Dr. Leventis

Status of buccal wall | Defect with intact buccal wall
---|---
Peri-implant gap | > 1.5mm
Tooth | 46
Follow-up | 3 months

Treatment & discussion:
Atraumatic (non-surgical/ flapless) extraction of tooth 46 followed by debridement of the socket and rinsing with sterile saline. The socket was left open to heal spontaneously by secondary intention. Implant and simultaneous bone graft placement at 6 weeks post extraction. At 3 months the implant was uncovered with a linear incision crestally and a healing abutment was placed. This technique shortened the overall treatment time, while minimizing the risk of implant failure due to the chronic infection of the site.

Clinician:
Dr. Minas Leventis

Patients:
Male, 45 years old, non-smoker

Initial situation:
Caries and endo-treatment failure at the mandibular right first molar thus the tooth could not be restored. The tooth had a restoration with a crown for many years.

Material used:
GUIDOR easy-graft CLASSIC, Nobel Replace 5.00 x 10mm dental implant Osstell ISQ device.

Implant placement and grafting:
A 6 week post extraction period was observed to allow for soft tissue healing after which a site specific full-thickness flap was raised and an implant placed according to ideal 3D positioning. The resulting 3mm (mesial and distal) gaps were simultaneously filled to crestal bone level with a well condensed application of GUIDOR easy-graft CLASSIC.

Wound closure:
Tension-free closure using PGA 4-0 resorbable sutures.

Mechanical protection of the surgical site:
No provisional restoration was used.

Medication & post-surgical care:
Amoxicillin 500 mg, 8 hourly for 1 week. Nimesulide 100 mg, every 12 hours for 2 days. Rinsing with Chlorhexidine 3 times/day for 1 week and use of a soft brush. Suture removal at 2 weeks.

Discussion
The newly-formed keratinized gingiva over the post-extraction socket allowed for tension-free primary closure post implant and graft placement without the need for advanced flap. This approach coronally displaced the buccal keratinized soft tissues and mucogingival junction.

The biomechanical in situ hardening properties of the grafting material resulted in stability of the grafted site, thus allowing for excellent bone regeneration around the implant and preservation of the volume and architecture of the ridge.

Preservation of the bone septum. The buccal wall was kept intact.

Soft tissue healing with new keratinized soft tissue after 6 weeks.

Surgical re-entry for implant placement.

A 5mm x 10mm implant was placed at the ideal 3D position with the corresponding space filled with GUIDOR easy-graft CLASSIC.

3 months post-op. Excellent preservation of site architecture utilizing minimally invasive techniques and GUIDOR easy-graft CLASSIC.

Excellent implant stability (implant stability quotient of 78) using resonance frequency analysis.

Screw retained metal-ceramic crown.

Final situation after extraction and immediate-delayed implant placement.

Periapical x-ray 3 months after implant placement and 1 week after final restoration. Excellent bone integration and preservation of ridge architecture.
Immediate-delayed Implantation
Dr. Hollay

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Apical bone cyst</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>46</td>
</tr>
<tr>
<td>Follow-up</td>
<td>5 years</td>
</tr>
</tbody>
</table>

Clinician: Dr. Henrik Christian Hollay
Patients: Male, 57 years old

Initial situation:
Tooth 46, apical bone cyst with present infection.

Material used:
GUIDOR easy-graft CLASSIC, Astra Tech implant.

Treatment:
Extraction of right mandibular molar (tooth 46) due to present infection and apical bone cyst.
The atraumatic extraction was performed with a piezotome (LC2-tip).

Wound closure:
The site was closed with sutures (Gore Tex PSK 1/7A) obtaining a primary closure of the site.

Mechanical protection of the surgical site:
None required due to the excellent biomechanical properties of the in situ hardening bone graft.

Medication & post-surgical care:
Analgesics after surgery: Ibuprofen.

Panoramic radiograph of initial situation. Infected mandibular molar 46 with apical bone cyst.
Bone defect 5 weeks after the extraction with piezotome surgery and situation before placement of the implant.
Situation after simultaneous implant and graft with GUIDOR easy-graft CLASSIC. Optimal 3-D positioning of the fixture. Graft condensed to the level of the crestal bone.
Definitive restoration 8 months after the implantation. Good aesthetic outcome was achieved.
Clinical picture of situation 5 years post-op.
Excellent implant stability and bone preservation 5 years after placement.
# Immediate-delayed Implantation

**Dr. Flichy**

<table>
<thead>
<tr>
<th>Status of buccal wall</th>
<th>Apical fenestration defect and thin buccal plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-implant gap</td>
<td>&gt; 1.5mm</td>
</tr>
<tr>
<td>Tooth</td>
<td>12</td>
</tr>
<tr>
<td>Follow-up</td>
<td>24 months</td>
</tr>
</tbody>
</table>

## Socket filling:

After tooth extraction only a thin buccal plate remained. Implant was placed and the peri-implant gap was filled with GUIDOR easy-graft CRYSTAL. The biomaterial was placed and condensed with a periote to compact the bone to the buccal plate.

## Treatment:

The patient came to the dental office because of missing tooth 12 due to an accident 8 weeks before the visit. An immediate-delayed implant placement was planned.

A flap was opened and a fenestration in the apical buccal plate and the socket was observed. The socket was cleaned and the area was prepared for the implant placement. The implant was set with a torque of 35 N.

## Mechanical protection of the surgical site:

A removable prosthesis was made for the aesthetics and functional conditions of the patient during the 6 months healing period.

## Medication & post-surgical care:

Prescription of Amoxicillin 750mg 1/8h 7 days, Ibuprofen 600mg 1/8h 5-7 days; Paroex 0.12 % 3 times/day 10 days.

## Final restoration:

A CAD-CAM screw retained prosthesis was made by BioCam Company. The design and fabrication of the prosthesis was made completed by Sr. Javier Ortolà at Dinnbier Dental laboratory and placed by Dr. Isabel Rodriguez.

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**Clinician:**
Dr. Antonio Flichy  
**Patient:**
Male, 37 years old  
**Initial situation:**
Absence of lateral incisor (tooth 12) due to trauma.  
**Material used:**
GUIDOR easy-graft CRYSTAL, Mozo-Grau Inhex 3.75 x 11.5mm dental implant.
Immediate-delayed Implantation
Dr. Leventis

Status of buccal wall | Buccal bone fenestration
--- | ---
Peri-implant gap | > 1.5mm
Tooth | 24
Follow-up | 3 months

Implant placement and grafting:
A 7 week post extraction period was observed to allow for soft tissue healing after which a site specific full-thickness flap was raised and an implant placed according to ideal 3D positioning.

Wound closure:
Tension free closure with PGA 4.0 resorbable suture.

Medication and post surgical care:
Amoxicillin 500 mg, 8 hourly for 1 week. Nimesulide 100 mg, every 12 hours for 2 days. Rinsing with Chlorhexidine 3 times/day for 1 week and use of a soft brush.

Clinician:
Dr. Minas Leventis

Patients:
Male, 56 years old

Initial situation:
Failing first left maxillary premolar (tooth 24). Fractured root that cannot be restored.

Material used:
GUIDOR easy-graft CLASSIC, Nobel Replace 3.5 x 11.5mm dental implant.

Treatment:
An immediate placement protocol was not followed due to the chronic infection. Therefore, an immediate-delayed protocol was chosen in order to reduce the infection risk and also to gain soft tissue regeneration prior to the implant placement and the buccal augmentation in order to achieve tension-free primary closure, without the need of flap advancement that would lead to coronal displacement of the mucogingival junction.

Site specific flap with papilla preservation. Debridement of the socket. Precise 3D implant placement, ISQ measurement (60).

Grafting with GUIDOR easy-graft CLASSIC (50).

Tension-free suture closure. Periapical x-ray immediately post-op. 1 month post-op.

Initial CBCT. Atraumatic flapless extraction. 7 weeks post extraction - soft tissue closure. Situation 3 months after implant placement and 4 weeks after placement of the healing abutment. Excellent preservation of the architecture of the ridge. Final screw-retained restoration (3 months after implant placement). Final x-ray 3 months after implant placement.
Immediate-delayed Implantation

Dr. Leventis

Clinician:
Dr. Minas Leventis

Patients:
Female, 63 years old

Initial situation:
Failing of first right maxillary premolar 14. The root could not be restored. Bone resorption buccally. An immediate placement protocol was not followed due to the chronic infection that resulted to the loss of the buccal bone plate, as seen in the initial CBCT. An immediate delayed protocol was chosen in order to reduce the infection risk and also to gain soft tissue regeneration prior to the implant placement and the buccal augmentation in order to achieve tension-free primary closure, without the need of flap advancement that would lead to coronal displacement of the mucogingival junction.

Material used:
GUIDOR easy-graft CLASSIC, GUIDOR matrix barrier, Paltop 3.75 x 11.5mm dental implant.

Wound closure:
Tension free closure with 4.0 resorbable Vicryl suture.

Medication and post surgical care:
Amoxicillin 500 mg, 8 hourly for 1 week. Nimesulide 100 mg, every 12 hours for 2 days. Rinsing with Chlorhexidine 3 times/day for 1 week and use of a soft brush.

Implant placement and grafting:
An 8 week post extraction period was observed to allow for soft tissue healing after which a site specific full-thickness flap was raised. Implant placement in the optimal 3D position reveals a large dehiscence defect necessitating simultaneous GBR with GUIDOR easy-graft CLASSIC and GUIDOR matrix barrier.

Status of buccal wall | Buccal wall dehiscence defect
---|---
Peri-implant gap | > 1.5mm
Tooth | 14
Follow-up | 5 months

Treatment:
Atraumatic (flapless) extraction of tooth 14. After soft tissue healing an immediate-delayed implant placement and simultaneous graft to the dehiscence defect was undertaken. A GUIDOR matrix barrier was trimmed and placed over the grafted site.

Periapical x-ray immediately after surgery.

3 weeks post-op.

Re-entry to uncover the implant. Note the bone regeneration buccally.

GUIDOR matrix barrier. Tension-free closure of the site with resorbable 4-0 Vicryl sutures.

After precise 3D placement of the implant the buccal threads were exposed.

Grafting with GUIDOR easy-graft CLASSIC.

Initial CBCT of failing first right maxillary premolar 14.

8 weeks after atraumatic flapless extraction.

The socket is not filled with bone. Granulation tissue (provisional matrix that will gradually become bone) is found. After thorough removal of the granulation tissue the buccal dehiscence was exposed.

Penetration x-ray 5 months after implant placement.

Penetration x-ray 3 months post-op. Placement of the healing abutment.

3 months post-op. Placement of the healing abutment.

Final situation: 5 months after implant placement. Excellent soft tissue healing and successful preservation of the architecture of the ridge.

8 weeks after atraumatic flapless extraction.

Periapical x-ray immediately after surgery.
Disclaimer

Medical science is dynamic and constantly advancing. The presented information is accurate to the best of the author’s knowledge and reflects current knowledge at the time of publication (2015), but we cannot guarantee its correctness and completeness.

The document has been written for a professional audience that is able to place the information in the proper context and to assess the risks and advantages of the procedures and methods presented by the authors where they deviate from the traditional schools of thought.

It must be taken into account that indications differ for each patient. Treatment success significantly depends on multiple biological and medical factors as well as on adequate preliminary and follow-up treatment. The authors and the company Sundast Suisse SA can therefore not guarantee the success of treatment with the suggested treatments.

Any liability for material or immaterial damage arising from the use (or disuse) of this information is excluded. The GUIDOR easy-graft CLASSIC and GUIDOR easy-graft CRYSTAL instructions for use leaflets, which are authoritative regarding therapeutic information, must be observed. Each user is asked to study the instructions for use in detail.

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The Combined Use of Allograft and a Polylactic Acid Barrier for GTR and GBR Efforts: 2 Case Reports

Links

ITI, International Team for Implantology
http://www.itli.org/

EAO, European Association for Osseointegration
http://www.eao.org/

EDI, European Association of Dental Implantologists
http://www.bdizedev.org/
Surgical protocols for early implant placement in post extraction sockets: a systematic review

Evaluation of moldable, in situ hardening calcium phosphate bone graft substitutes

Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study

Post Extraction Alveolar Ridge Preservation; Scientific Background, Minimally Invasive Treatment Protocols and Experts Reports using Alloplastic Biomaterials.

Human histologic verification of osseointegration of an immediate implant placed into a fresh extraction socket with excessive gap distance without primary flap closure, graft, or membrane: a case report

Histologic effect of pure-phase beta-tricalcium phosphate on bone regeneration in human artificial jawbone defects

Primary implant stability in augmented sinus-lift sites after completed bone regeneration: a randomized controlled clinical study comparing four subantrally inserted biomaterials

“PASS” principles for predictable bone regeneration
GUIDOR easy-graft
GUIDOR calc-i-oss

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Switzerland

Distributor:
Sunstar Europe SA
Route de Pallatex 11
1163 Etoy
Switzerland

0297 Medical Device Class III

Before use, carefully read the instructions for use

For more information, please visit
www.guidor.com or contact our local affiliate.

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