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Synthesis

The six ultrasonic tips that comprise the “Extraction” Kit are mainly intended for tooth extractions, hemisections and root amputations. Connected to the Piezotome handpiece, these tips provide:

Precision
- Preservation of the alveolar plate due to the slimness, selective action and regular movement at constant amplitude of the tips.

Rapid usage and learning acquisition
- The ultrasonic micro-oscillations transmitted through the tips immediately detach the periodontal ligament by a simple sweeping movement around the tooth to be extracted.
- The tips are adapted to the anatomical situation of the anterior and posterior areas.
- High cutting efficiency of the saw-tooth tip (Ninja™) on hard tissues such as bone and dentin.

Safety
- Thanks to their cutting selectivity, these tips are inactive on soft tissues and delicate anatomical components (nerves, arteries and mucous membranes).

Comfort
- Atraumatic act
- Effortless
- Less post-operative pain
- The ultrasonic generator being silent and the ultrasonic vibrations being gentle and constant, the patient’s stress is thus limited.

Acknowledgements
This booklet was written with the kind support of Drs. Francis Louise (specialist in periodontology-implantology, Vice Dean of the Faculty of Dentistry, University of the Mediterranean, Marseilles), Gilles Gagnot (periodontology, Vitré and University Hospital Assistant, Rennes University), Yves Macia (private practitioner, University Hospital Assistant in the Department of Oral Surgery, Marseilles) and Eric Normand (periodontology - implantology, Bordeaux, University Hospital Assistant in Victor Segalen, Bordeaux II). For more than 35 years, our experience has been enriched through our contacts with skilled dentists on all continents. Their opinions and advice have oriented and helped us in developing and improving our products. Our main objective is to present effective, reliable and safe products. Each tip is thus tested and then validated by experienced dentists in order to correspond the best to your expectations. Our operating protocols and complementary information are based on university theses and international publications quoted in the bibliography at the end of this booklet. Finally, special thanks go to each of our users who have put their trust in us by choosing a SATELEC product.
Introduction

Tooth extraction is a surgical invasive act of last resort for the practitioner and feared by the patient. Nevertheless it remains a fast, efficient and economical solution. Two types of instrumentation are currently available on the market:

• manual instrumentation: periotome, elevators and forceps;
• motorized instrumentation:
  - rotary (micro-motors) and
  - ultrasonic (piezoelectric generator).

This booklet will cover the different techniques for total and partial extraction available with the use of the Extraction Kit as well as the advantages of this new technology.

Causes for total or partial extractions
Causes for total or partial extractions

The causes for total or partial (root) extractions are numerous and can result from:

- Anatomical crowding and/or bad occlusion
- Wisdom teeth (impacted or not) and/or ankylosed teeth
- Periodontal diseases
- Insufficient bone and/or gingival support
- Bacterial involvement
- Advanced caries on exposed roots or furcations
- Shock
- Crown or root fracture/crack
- Infections
- Abscess (eg. situated at the root apex)
- Orthodontic, prosthetic or maxillo-facial treatment (eg. shortening of the dental arch)

Semi-conservative surgery: root amputations and hemisections
Semi-conservative surgery

Nowadays, practitioners favor prosthetic or surgical treatment with a view to conservation. Hemisections and root amputations or resections are surgical techniques that allow the surgeon to preserve the dental function. Although necessary, these procedures are sometimes difficult to perform due to delicate anatomical situations such as proximity to nerves, arteries or roots of the adjacent teeth. Root resection techniques are often complex because periodontal, endodontic and/or prosthetic constraints must be taken into account.

1. Causes

Advanced periodontal diseases provoke deleterious losses of bone and gingival supporting tissue of the tooth. Periodontal probing is performed to evaluate the attachment loss. A gingival sulcus measured up to 3 mm deep is considered as healthy. Beyond this value, the presence of a periodontal pocket is diagnosed (5). According to Papanou and Tonetti 2000, two types of periodontal pockets can be distinguished (9):

• supra-alveolar pocket inducing horizontal bone loss,
• infra-alveolar pocket with vertical bone loss.

In multi-rooted teeth, this bone loss can lead to exposure of furcations which constitutes a bacterial niche favoring caries and abscesses in particular.

Interradicular defects are classified according to the following parameters (9):

<table>
<thead>
<tr>
<th>Degree</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Bone loss (≤ 3 mm) without exposure of furcations</td>
</tr>
<tr>
<td>II</td>
<td>Bone loss (≥3 mm) with exposure of furcations but interradicular bone is still present</td>
</tr>
<tr>
<td>III</td>
<td>Exposure of furcations with interradicular bone loss on all sides</td>
</tr>
</tbody>
</table>

To preserve a multi-rooted tooth subject to degrees II or III defects that is to support a fixed prosthesis, generally hemisection or root amputation surgery is used. Treatments by GTR (guided tissue regeneration) as well as tunneling procedures (osteotomy of the interradicular bone septum associated to an apically repositioned flap) for degree II cases will not be addressed in this booklet.

Certain fractures of multi-rooted teeth can be treated by crown lengthening but this is not always possible, for example when a bone resection respecting the biological width (3 mm situated between the summit of the free gingiva and the bone crest) may lead to:

• an unfavorable root/crown ratio;
• exposure of furcations;
• esthetic damage,

in which case a root amputation or an extraction will be recommended.

2. Definition and treatments

Root amputations and hemisections are semi-conservative techniques to maintain fractured or carious multi-rooted teeth by modifying the interradicular space, eliminating periodontal pockets and facilitating prophylaxis.

Root amputation or root resection is the removal of a root from a multi-rooted tooth.
Tooth hemisection, performed mainly on lower molars (3-4), consists of splitting a bi-rooted tooth into two halves. The affected root can then be removed without having to extract the whole tooth. However, both halves can also be preserved if they are stable, have long roots and a short root trunk (3). A molar will thus be transformed into two premolars. Finally, a hemisection can also be performed on a molar or a wisdom tooth in order to facilitate its extraction. Each half will be removed individually.

To determine the appropriate treatment of lesions, an open curettage is recommended to gain direct visual control.

Root amputations or hemisections must be planned only if:
- the residual root(s) is/are stable;
- the remaining bone level is sufficient to maintain the treated tooth by a core or radicular post;
- the periodontal status is improving after disappearance of the furcation;
- the occlusal context is favorable;
- the patient maintains acceptable oral hygiene.

According to Sato (7), the bone height is considered as insufficient to preserve the roots if a distance of more than 4 mm can be measured from the roof of the interradicular space.

Clinical examination
Prior to root removal, it is essential to evaluate:
- periodontal condition by means of a round-ended probe;
- the patient’s endodontic status;
- the number, shape (height of the root trunk) and location of the relevant tooth’s roots and those of adjacent teeth, by means of X-ray;
- quantity and quality of radicular and interradicular bone;
- location of any anatomical elements potentially at risk, ie. nerves, arteries, membrane, cysts, impacted teeth, etc.

Endodontic treatment
It is strongly recommended to treat the canal of the root to be preserved prior to root amputation. Potential bacterial contamination between the different canals of the tooth can thus be avoided.

During a root resection or amputation, the coronal structure should be preserved as much as possible. However, it may be necessary to remove part or even all of the crown in the case of bacterial infection such as advanced caries.
3. Case with fixed prostheses preserved
With an aim to preserving fixed prostheses on the affected teeth due to their high cost, the practitioner is often obliged to perform more and more complex treatments. A root amputation without removal of prosthesis thus allows the patient to limit the costs and the number of interventions. Without having recourse to alveolectomy, ultrasonic instruments allow complete preservation of the cortical plate.

Mono-radicular tooth amputation and extraction:
Case performed by Pr. F. Louise
Extraction

1. Decision-making criteria
According to Bercy and Tenenbaum (2), deciding when to extract must take into account the following elements:
- function and strategic significance of the tooth (a wisdom tooth will not be retained for example);
- extent of the periodontal lesion (bone loss) or the fracture (the tooth cannot be preserved if the lesion is situated at the apical third);
- class III furcation involvement (if all the roots are involved, otherwise it is recommended to perform, as explained earlier, a root amputation);
- endodontic-periodontal lesions;
- mobility of the tooth due to advanced bone loss;
- esthetic aspect.

If preservation of the tooth is not possible, the practitioner can consider extraction. As explained previously, the most common extractions are performed on ankylosed teeth and wisdom teeth (impacted or not). These third molars are particularly difficult to access. The SATELEC extraction tips were developed to respond to this precise type of anatomical constraint.

The extraction becomes much more delicate when it concerns a permanent tooth located in the anterior esthetic area, hence, the choice of prosthetic solution must be agreed beforehand with the patient. The practitioner will recommend that, subsequent to extraction, an implant or bridge for example be placed, depending on the patient’s informed consent and the feasibility of the case.

2. Consequences
The extraction of a tooth leads to an inevitable loss of hard tissue (in height and thickness) and soft tissues. Any delay in treatment presents a risk of engendering such bone loss that an implant placement can only be performed after pre-implant surgery to restore the necessary bone volume. Two approaches are presently practiced: conventional or delayed post-extraction implant placement and immediate post-extraction implant placement.

3. Immediate or delayed implant placement
An extraction causes anatomical disorganization. Conventional delayed post-extraction implant placement favors osseointegration. The implant is then placed approximately two months after the extraction and the prosthetic phase will be performed three to six months after the implant placement.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliable technique advised in areas where esthetics are a priority.</td>
<td>Multiplication of surgical interventions: 1 - Extraction 2 - 3 Implant placement and/or prosthetic phase</td>
</tr>
<tr>
<td>Risk of post extraction bone loss.</td>
<td></td>
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</tbody>
</table>

Immediate post-extraction implant placement considerably reduces the time and the cost of treatment

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment time and cost reduction.</td>
<td>Non global technique.</td>
</tr>
<tr>
<td>Fewer interventions.</td>
<td>Minimum primary stability necessary &gt; 5 mm.</td>
</tr>
<tr>
<td>Limited bone resorption.</td>
<td>Post implant bone resorption must be evaluated beforehand.</td>
</tr>
<tr>
<td>Less drilling stages.</td>
<td>Only possible for type I and II density.</td>
</tr>
</tbody>
</table>

After the immediate placement of 1925 implants between 1988 and 2004, Wagenberg (8) obtains an overall success rate of 96 %. This technique of extraction and immediate implant placement can thus be recognized as reliable.

1 Classification by Lekholm and Zarb
Extraction

Manual instruments
According to Antoun and Guillot (1), it is essential when performing an extraction to preserve bone and gingival tissue, gingival papilla and festoon. The use of manual instruments, associated with rocking movements during extraction, tends to damage the bone crests thereby altering the original environment.

Ultrasonic instruments
The use of ultrasonic instruments is much less traumatizing for the patients and preserves the bone tissue essential for osseointegration. Inserted between the cementum and the periodontal ligament of the tooth, the tips will widen the ligamental space. Thus separated from its attachment system, the tooth can be removed rapidly and with a less traumatic luxation. The alveolar bone edge can be kept intact since the tip essentially acts on the tooth and not on the bone. An alveolectomy is therefore avoided.

Advantages of ultrasonic instrumentation
Advantages of ultrasonic instrumentation

Piezoelectric devices are widely used today for bone surgery, osteoplasty or even sinus elevation. Their benefits are well known. Ultrasonic technology also presents numerous advantages for tooth extractions compared with conventional instrumentation.

Precision
Thanks to the tips’ slimness and their regular to-and-fro movement, the bone’s integrity is preserved. Indeed, no alveolectomy is necessary to perform an extraction. The practitioner simply slips the tip between the root and the alveolar bone, the tooth is then detached and can be removed “gently”.

Rapid usage and learning acquisition
The use of forceps with a “rocking” movement to dislocate a tooth from its alveolus, often by destroying the cortical plate, is thus no longer inevitable in most cases.

With the ultrasonic extraction tips, the practitioner will perform a simple sweeping movement around the tooth to be extracted. Ultrasonic micro-oscillations transmitted through the tip will lead to the widening of the periodontal space. The tips draw very fine “trenches” that eventually facilitate an avulsion of the tooth from its alveolus.

The tip geometry was specially studied to adapt to the anatomical situation with reduced space and visibility in the anterior and posterior areas. Less aggressive than cutting burs mounted on rotary instruments, the risk of involuntarily damaging the bone septum, which could harm the gingival papilla, is avoided. Without inertia, these extraction tips limit the risk of lesions to adjacent teeth and roots.

Safety (selectivity of cutting)
The ultrasonic tips, active on hard tissue and non-active on soft tissues, offer the practitioner greater safety in the presence of such anatomical elements as the inferior mandibular nerve, lingual nerve, antral artery, sinus membranes, etc. Indeed, the frequency modulation renders the tips harmless to surrounding soft tissues (mucosa).

Comfort
An extraction becomes a less traumatic treatment performed with less effort. Irrigation associated to the phenomenon of cavitation (the appearance of micro-bubbles) provides optimal visibility of the operative field. This sterile spray is carefully controlled which avoids any temperature rise leading to tissue damage and reduces post operative pain. Extraction can therefore be performed with minimum trauma.
Ultrasonic instrumentation

Principal uses recommended by Dr. J-F Michel and Dr. M-G. Michel (6):

- Extraction of wisdom teeth
- Extraction of ankylosed teeth
- Extraction of impacted teeth
- Radicular extrusions
- Extraction followed by immediate implant placement
- Avulsion of a residual root apex
- Avulsion of subgingival roots

Usage guidelines
According to Dr Gagnot’s recommendations (6):

- The tip must be activated before its insertion in the periodontal space.
- The tip must be placed parallel to the root.
- Perform a to-and-fro movement towards the apex.
- It is important not to exert a lever effect with the tips.

Schematic presentation courtesy of Dr Gilles Gagnot
Ultrasonic instrumentation

**LC1**

Ultrasonic periotome intended for syndesmotomy and periradicular osteotomy.

**Height**: 26.4 mm  ●  **Active part**: Length: 9 mm - Thickness: 0.5 mm

This tip can be inserted deeply and with great care, along the periodontal ligament, between the root and the alveolar bone.

**LC1 90°**

Oriented at 90°, the active part of the tip can easily reach the difficult to access areas.

**Height**: 25.9 mm  ●  **Active part**: Length: 9 mm - Thickness: 0.5 mm

This ultrasonic periotome facilitates widening of the periodontal space in the interproximal, lingual and distal areas of molars.

<table>
<thead>
<tr>
<th>Irrigation ml/min</th>
<th>Recommended setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-80</td>
<td>2</td>
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</table>

Pr. F. Louise
Ultrasonic instrumentation

**LC2**

The particularly slim LC2 allows access to the tight spaces between the root and the alveolar bone without risk of damaging cortical bone.

Height: 26.6 mm • Active part: Length: 10 mm - Thickness: 0.5 mm

**LC2L**

Oriented at 45°, the LC2L facilitates access to the posterior areas. The tip’s slimness respects the morphology of cortical bone and offers working comfort in the sectors with reduced visibility.

Height: 26.4 mm • Active part: Length: 10 mm - Thickness: 0.5 mm
Ultrasonic instrumentation

**LC2R**

Oriented at 45°, the LC2R facilitates access to the posterior areas. The tip’s slimness respects the morphology of the cortical plate and offers working comfort in the sectors with reduced visibility.

Height: 26.4 mm • Active part: Length: 10 mm · Thickness: 0.5 mm

**Ninja™**

This saw-tooth tip with double cutting surfaces is endowed with a laser marker every 3 mm, to control depth or cutting thickness. It is particularly efficient for hemisections and root amputations. It is also indicated to split certain impacted molars during extraction.

Height: 26.4 mm • Active part: Length: 9 mm · Thickness: 0.5 mm