Anatomical and surgical aspects of implant placement in the esthetic zone

Prof. Daniel BUSER
University of Bern, Switzerland

ITI Congress South East Asia
Bangkok, Thailand
May 16 – 17
2013

Master Courses at the University of Bern School of Dental Medicine

Master Course in Regenerative and Esthetic Periodontal Therapy
Course Director: Prof. Dr. Anton Sculean

Master Course in Esthetic Implant Dentistry
Course Directors: Prof. Dr. Daniel Buser and Prof. Dr. Urs C. Belser

Master Course in GBR and Sinus Grafting Procedures
Course Director: Prof. Dr. Daniel Buser

Handout
Request to:
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The perfect Combination: CE at Top Quality & Swiss Alpine Skiing

3-day Master Course

1 week Skiing

University of Bern

Matterhorn/Zermatt
Implant Dentistry Today

• Today, we are in a phase of routine application of implant therapy
• In our department, we treat roughly 500 patients per year with about 700 implants
• More than 90% of our patients are partially edentulous
  ✓ The single tooth replacement is the no. 1 indication (> 50%)
  ✓ Average of 1.40 implants per patients
• Most patients are baby boomer patients
  ✓ The average age of our patients is roughly 50 years
  ✓ Many patients with a compromised dentition or anatomy
  ✓ Only 10% of our patients has age <30
• When providing implant therapy, it's a must to offer successful longterm outcomes
  ✓ We always aim at a longterm success of 30+ years

Patients of age >50 are often compromised and have one or several risk factors
✓ Medical risk factors
✓ Dental risk factors
✓ Anatomic risk factors
✓ Smoking is not frequent in that age group

Treatment of a baby boomer patient is always for life-time

3 Strategies for Successful Implant Therapy

• Our treatment concepts are strictly evidence-based and conservative
  ✓ Primary Objectives:
    • Successful outcomes with high predictability
    • Low risk for complications
  ✓ No cowboy techniques
• In routine application, we only use biomaterials with a good scientific documentation based on preclinical and clinical studies
  ✓ Implants, barrier membranes, and bone grafting materials
  ✓ No copy-cat biomaterials
• In the past 15 years, our treatment concepts have been carefully modified to improve the attractiveness of implant therapy
  ✓ Secondary Objectives:
    • Least number of surgical procedures
    • Reduction of healing periods and treatment time
    • Reduction of morbidity/pain for patients
Clinical Studies at the University of Bern in the past 22 Years: Excellent Longterm Results


Foth, Lussi, Schmittenberger, Buser: Early loading of titanium implants with a sandblasted and acid-etched (SLA) surface. 3-year results of a prospective study in partially edentulous patients. Int J Oral Maxillofac Implants 18:659, 2003


Clinical Studies at the University of Bern in the past 22 Years: Excellent Longterm Results

Our Benchmarks for Implant Success Rates

- Low failure rates during healing
  - Early failure rate during healing ≤ 0.5-0.8% Buser et al. JOMI 2008
- High success rates for 10 year period
  - > 98% for low risk patients (non-smoking) Buser et al. CIDRR 2012
  - Failure rates for smoking patients are higher
- These success rates are a strong confirmation for our rather conservative, evidence-based treatment concepts
  - Preference for low-risk surgical techniques
  - Strict utilization of well documented biomaterials
  - Implant surgeons with good education and clinical experience

Implant Classification

Table 10: Classification of 511 Implants

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<thead>
<tr>
<th>Classification</th>
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<tbody>
<tr>
<td>Implant failures</td>
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<tr>
<td>Surviving implants: Peri-implantitis at examination</td>
<td>2</td>
<td>0.4%</td>
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<tr>
<td>Surviving implants: History of peri-implantitis</td>
<td>7</td>
<td>1.4%</td>
</tr>
<tr>
<td>Successful implants</td>
<td>511</td>
<td>97.0%</td>
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<tr>
<td>Total</td>
<td>511</td>
<td>100.0%</td>
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<tr>
<td>10-year implant success rate</td>
<td>97.0%</td>
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**Basic Principles of Implant Surgery**

- Insert the implant in the correct prosthetic position
  - Restoration-driven implant placement
  - The implant must achieve primary stability
- The implant must be completely imbedded in healthy bone
  - Facial and oral bone walls should be at least 1 mm
  - In case of a local bone deficiency ➔ GBR
- The implant should be surrounded by healthy and keratinized mucosa

**3 Strategies for Successful Implant Therapy**

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**How can we improve secondary Objectives?**

- Reduce the number of surgical procedures
  - Implant placement with simultaneous bone grafting is better than staged approach procedures
- Reduce morbidity by reducing harvesting procedures
  - Avoid extra-oral bone harvesting as much as necessary
  - Avoid bone harvesting from the chin or from the retromolar area as much as necessary
  - Avoid harvesting of connective tissue grafts from the palate as much as necessary
- Reduce healing periods and overall treatment time
  - Use implant surfaces with a high osteophilic potential
    - Hydrophilic implant surfaces (SLActive, Innicell)
  - Utilize bone fillers with a high osteogenic potential to accelerate bone healing
    - Autogenous bone chips harvested with an appropriate technique

**Implant Placement in Esthetic Sites**

- This is a frequent clinical situation today
  - Today, we see predominantly implant placement post extraction
- Implant sites in the esthetic zone are demanding
  - Cat. A or Cat. C
- The timing of the treatment is crucial:
  - When to place and when to restore the implant(s)
Factors influencing Treatment Outcomes

Surgical Recipe for successful Esthetic Outcomes

- Good understanding of tissue biology
  - Concept of biologic width
  - Ridge alterations following extraction
    Schropp et al. 2003, Araujo et al. 2005a,b, Araujo et al. 2006a,b, Fickl et al. 2008

- Detailed esthetic risk assessment is mandatory
  Martin et al. 2006

- Correct 3-D implant position must be achieved
  Buser et al. 2004

- Facial contour augmentation with GBR is most often needed
  Buser et al. 2008

- Primary wound closure to protect applied biomaterials

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- Primary wound closure to protect applied biomaterials
The concept of the **biologic width** around dental implants


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The **tissue** is the **issue**, but the **bone** sets the **tone**

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**Surgical Recipe for successful Esthetic Outcomes**

- Good understanding of tissue biology
  - Concept of biologic width
    - Berglundh, Lindhe 1996
  - Ridge alterations following extraction
    - Schropp et al. 2003
  - Ridge alterations following extraction
    - Araujo et al. 2005a, b, 2006a, b
  - Fickl et al. 2008
- Detailed **esthetic risk assessment** is mandatory
  - Martin et al. 2006
- Correct 3-D implant position must be achieved
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- **Facial contour augmentation** with GBR is most often needed
  - Buser et al. 2008
- **Primary wound closure** to protect applied biomaterials
### Esthetic Risk Assessment in Implant Patients

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<tr>
<th>Risk Factor</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
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<tbody>
<tr>
<td><strong>Medical status</strong></td>
<td>healthy patient</td>
<td>intact immune s.</td>
<td>reduced immune system</td>
</tr>
<tr>
<td>Smoking habit</td>
<td>non-smoker</td>
<td>light smoker</td>
<td>heavy smoker</td>
</tr>
<tr>
<td>Patient’s aesthetic demand</td>
<td>low</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>Age</td>
<td>low</td>
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<td>thin</td>
<td>medium thick, medium scalloped</td>
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<td>Shape of soft tissues</td>
<td>rectangular</td>
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<td>≤ 5.5 mm to 1 tooth</td>
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<tr>
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<td>none</td>
<td>chronic</td>
<td>acute</td>
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<td>no bone deficiency</td>
<td>horizontal bone deficiency</td>
<td>vertical bone deficiency</td>
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### Medical Risk Factors in Implant Dentistry

- High risk factors for implant therapy
  - Severe bone diseases
  - Immunocompromized patients
  - Intra-venous medication with bisphosphonates
- Risk factors for implant therapy
  - Local radiotherapy
  - Uncontrolled or juvenile diabetes
  - Bleeding disorders such as hemorhagic diathesis
  - Drug abuse & psychological/mental disorders

**References**

- Buser, von Arx, ten Bruggenkate, Weinmann: Basic surgical principles with ITI implants.
- Scully, Maclachlan: Osteointegrated implants in patients on bisphosphonate therapy.

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Smoking as a Risk Factor in Implant Dentistry

- Smoking has been identified already 15 years ago to be high risk factors
- Differentiation into several levels of smoking
  ✓ Non-smokers
  ✓ Light smokers (<10 cigarettes/day)
  ✓ Heavy smokers (≥10 cigarettes/day)
- Negative synergy with genetic factor (Interleukin/PST)
  ✓ Heavy smoking and PST positive are really at risk
- Controversial discussion


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### Vertical crest height at adjacent teeth

- **Choquet, Hornens, Addesens, Daelemans, Tarnow, Malevez**: Clinical and radiographic evaluation of the papilla level adjacent to single-tooth dental implants. A retrospective study in the maxillary anterior region. *J Periodontol* 72:1364, 2001
- **Ryser, Block, Mercante**: Correlation of papilla to crestal bone levels around single tooth implants in immediate or delayed crown protocols. *J Oral Maxillofac Surg* 63:1184, 2005
A generalized periodontal infection needs to be addressed prior to implant therapy.

Local infection as well:
- Endodontic problems
- Root resorption or fracture
- Infected root remnants

We don't recommend to place implants into infected extraction sockets.

---

**Risk Factors in Implant Dentistry**

**Local Infection**

- A generalized periodontal infection needs to be addressed prior to implant therapy
- Local infection as well
  - Endodontic problems
  - Root resorption or fracture
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- We don't recommend to place implants into infected extraction sockets

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**Risk Factor Low Medium High**

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<td>≤ 5 mm to contact point</td>
<td>5.5 to 6.5 mm to contact point</td>
<td>≥ 7 mm to contact point</td>
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<tr>
<td>Local infection at implant site</td>
<td>none</td>
<td>chronic</td>
<td>acute</td>
</tr>
<tr>
<td>Restorative status of neighb. teeth</td>
<td>virgin</td>
<td>restored</td>
<td></td>
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<tr>
<td>Width of edentulous space</td>
<td>1 tooth ≤ 7 mm*</td>
<td>1 tooth 7.1 to 8.0 mm</td>
<td>≥ 2 teeth and more</td>
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<tr>
<td>Soft tissue anatomy</td>
<td>intact soft tissues</td>
<td>soft tissue defect</td>
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<tr>
<td>Bone defect at implant site</td>
<td>no bone loss</td>
<td>hard bone</td>
<td>vertebre</td>
</tr>
<tr>
<td>Bone loss of adjacent tooth</td>
<td>none</td>
<td>hard bone</td>
<td>vertebre</td>
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**References**

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<th>Risk Factor</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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<td>Medical status</td>
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<td>reduced immune system</td>
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<td>Smoking habit</td>
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<td>Patient’s esthetic demand</td>
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<td>medium</td>
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<td>Lip line</td>
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<td>Gingival biotype</td>
<td>thick, low-scalloped</td>
<td>medium thick, medium scalloped</td>
<td>high scalloped</td>
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<td>Shape of tooth crown</td>
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<td>triangle</td>
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<td>Bone level at adjacent teeth</td>
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<td>6.5 mm to 6.5 mm to contact point</td>
<td>≥ 7 mm to contact point</td>
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<tr>
<td>Local infection at implant site</td>
<td>none</td>
<td>chronic</td>
<td>acute</td>
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<td>Restorative status of adjacent teeth</td>
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<td>chronic</td>
<td>acute</td>
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<tr>
<th>Critical dimensions: H &gt; 5 mm D &lt; 3 mm</th>
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<td>Tarnow, Magnor, Retchie: The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. J Periodontol 63: 995, 1992</td>
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<th>Low</th>
<th>Medium</th>
<th>High</th>
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<tbody>
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<td>1 tooth ≤ 7 mm*</td>
<td>1 tooth ≥ 5 mm</td>
<td>2 teeth and more</td>
</tr>
<tr>
<td>Soft tissue anatomy</td>
<td>intact soft tissues</td>
<td>horizontal bone defect</td>
<td>vertical bone defect</td>
</tr>
</tbody>
</table>

| Bone defect at implant site | no bone defect | horizontal bone defect | vertical bone defect |

| Bone defect at implant site | no bone defect | horizontal bone defect | vertical bone defect |
Cone Beam Computed Tomography (CBCT)
A revolution of 3-d radiologic examination

- New Tom
  Quantitative Radiology, Italy
- I-CAT
  Henry Schein, USA
- 3D Accuitomo
  Morita, Japan

Good understanding of tissue biology
Concept of biologic width
Ridge alterations following extraction
Schropp et al. 2003, Araujo et al. 2005a,b, Araujo et al. 2006a,b, Fickl et al. 2008
Detailed esthetic risk assessment is mandatory
Martin et al. 2006
Correct 3-D implant position must be achieved
Buser et al. 2004
Facial contour augmentation with GBR is most often needed
Buser et al. 2008
Primary wound closure to protect applied biomaterials

Surgical Recipe for successful Esthetic Outcomes

- Good understanding of tissue biology
- Concept of biologic width
- Ridge alterations following extraction
- Detailed esthetic risk assessment is mandatory
- Correct 3-D implant position must be achieved
- Facial contour augmentation with GBR is most often needed
- Primary wound closure to protect applied biomaterials

Chapter 8
Esthetic complications due to implant malpositions: etiology, prevention, and treatment
Stephen Chen BDS, MDSc, PhD and Daniel Buser DDS, Prof.Dr.Med.Dent.

Introduction
In the past 10 years, surgical expansion of implant therapy has taken place in the field of implant dentistry. Several factors have contributed to this expansion: the development of improved implant designs, increased knowledge of surgical techniques, improved understanding of the biology of soft and hard tissues, and improved surgical technology. These developments have led to an increase in the number of implant procedures performed. However, despite these advances, implant complications remain a significant challenge for clinicians. In order to prevent and manage these complications, a comprehensive understanding of the etiology and prevention of esthetic complications is crucial. This chapter will discuss the various factors that contribute to esthetic complications, including the role of implant design, surgical technique, and patient factors. The importance of a multidisciplinary approach to the management of esthetic complications will also be emphasized.
Evolution of Soft Tissue Level Implants

Development towards Bone Level Implants

Characteristics of Bone Level Implants

- Implant shape is a TE implant with a cut-off neck portion
- «Platform Switching» Concept
- New abutment connection with Crossfit®
- SLA or SLAactive implant surface
- Broad range of prosthetic components
- Clinical procedures in most steps similar to tissue level implants
- No change with basic principles of treatment planning

Correct 3-d implant position: Concept of «Comfort & Danger Zones»

Implant Platform in Mesio-distal Direction

Peri-implant saucer:
- Following restoration, bone resorption up to 2 mm takes place as physiologic bone remodeling process
- It is at least 1 mm wide

Soft Tissue Level vs. Bone Level Implants

Mesio-distal Positioning: Bone Level Implants

Mesio-distal Position:
- Respect a minimal distance to the root surfaces of adjacent teeth
- A distance of 1 mm is recommended for Bone Level Implants

How to avoid Mucosal Problems mesio-distally

Recommendations

• Measure the mesio-distal gap size
• Select an appropriate diameter of the platform
✓ Avoid wide-platform implants in the aesthetic zone
• Respect a minimal distance on both implant side
✓ Perform a precise implant surgery

Corono-apical Direction

Problems with corono-apical malpositions

• Too superficial location: Coronal malposition
✓ Metal margin becomes visible
✓ Emergence profile becomes problematic
• Too deep location: Apical malposition
✓ Too much countersinking
✓ Malposition often results in facial recession of mucosa
✓ Difficult prosthetic handling

Coronal malposition of an implant is rather rare!

Apical malposition of an implant is much more frequent!

Corono-apical Direction

Corono-apical Positioning

How to avoid Mucosal Problems corono-apically

Recommendations

- Use surgical stents if needed
  ✓ There is no need in single tooth gaps, if you have good landmarks at adjacent roots
  ✓ In sites with multiple missing teeth, it is imperative to use a stent
- Avoid too much countersinking
  ✓ Develop a gut feeling for a correct vertical positioning
  ✓ Just as much as necessary

Implant Platform in Oro-facial Direction

Problems with oro-facial malpositions

- Common are facial malpositions
  ✓ Increased risk for mucosal recession
  ✓ Associated with immediate implant placement
  ✓ Facial malposition can be caused by oversized implants (wide-platform)
- Rare are palatal malpositions
  ✓ This requires restorations with a ridge-lap design
Oro-facial Positioning

Recommendations

- Don’t use wide-platform implants in the anterior maxilla
- Make sure to position the implant into the alveolar process
- Implant platform should be ≈ 1.0 to 1.5 mm palatal to the point of emergence of the future implant crown

✓ Use periodontal probe for orientation
Protocol for Healing Period (since 1998)

- Implant Surgery
- Provisional Restoration
- Initial Bone Healing Period
- Restorative Phase
- Reopening
- Soft Tissue Conditioning

0 6 8 weeks

1997: 1 year
Implant Surgery in Esthetic Sites

Conclusions

• The primary goal is an esthetic treatment outcome
• These situations are demanding for involved clinicians
  ✓ Advanced to complex level
• A correct 3-dimensional implant position is essential
  ✓ Restoration-driven implant placement within the comfort zones
  ✓ Don’t use wide-neck or wide-platform implants in the esthetic zone
• Contour augmentation is a key factor for esthetic outcomes
  ✓ The surgeon must master the GBR technique
• A submerged healing is preferred

Recipe for successful Outcomes in Implant Esthetics

• Good understanding of tissue biology
  ‣ Concept of biologic width
  ‣ Ridge alterations following extraction
    Schropp et al. 2003, Araujo et al. 2005a,b, Araujo et al. 2006a,b, Fickl et al. 2008
• Detailed esthetic risk assessment is mandatory
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• Correct 3-D implant position must be achieved
  Buser et al. 2004
• Facial contour augmentation with GBR is most often needed
  Buser et al. 2008
• Primary wound closure to protect applied biomaterials

Apical Fenestration Defects

• Often in sites with congenitally missing teeth
• Cat. A level

Crestal Dehiscence Defects

• Most often in post-extraction sites
• With or without an intact facial bone wall
• Cat. A, rarely Cat. C level

Large Flattened Bone Defects

• Often in trauma patients, years following trauma
• 1-wall defect situations
• Crest width < 4 mm
• Cat. C level