

TOPICS – Day 1

- Factors influencing the long-term stability of dental implants
- **Surgical procedures in posterior sites: Standard implant placement with or without flap elevation**
- Surgical procedures in posterior sites: Implant placement with GBR
- Implant placement and sinus floor elevation: Lateral window vs. Osteotome technique, when simultaneous, when staged?
- Prosthetic planning and restorative principles in posterior sites
- Fundamental esthetic principles involved in the context of anterior maxillary implant restorations - a critical appraisal
- Esthetic risk assessment and basic surgical principles in esthetic sites
- Prosthetic handling of esthetic challenges: case reports

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3 Surgical Strategies for Long-term Success with Implants

- **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 morbidity/pain for patients
 - * Reduction of healing periods and treatment time

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Secondary Objectives of Implant Therapy

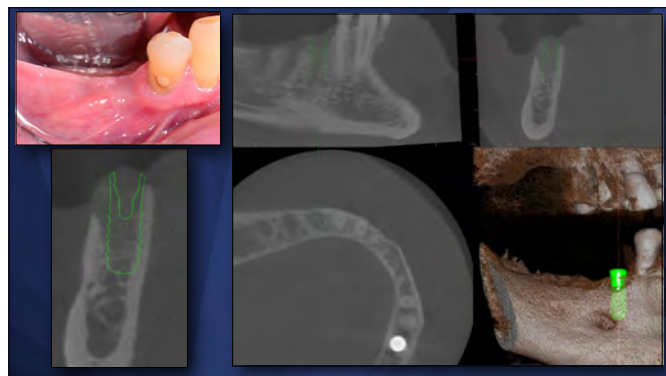
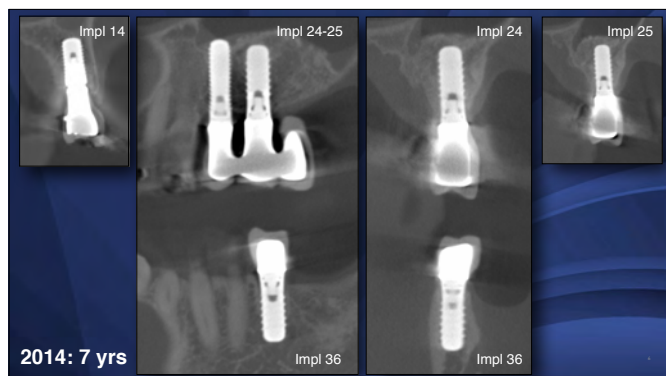
- **Reduce the number of surgical procedures**
 - ✓ Whenever possible, we use implant placement with simultaneous bone grafting procedures
- **Reduce morbidity for the patient**
 - ✓ Avoid bone harvesting from the chin or from the retromolar area as much as necessary
 - ✓ Avoid harvesting of connective tissue grafts from the palate as much as necessary
 - ✓ Use flap-less implant placement, whenever the anatomy allows for it
- **Reduce healing periods and overall treatment time**
 - ✓ Utilize micro-rough implant surfaces with a high osteophilic potential
 - ✓ Utilize autogenous bone chips with a high osteogenic potential to accelerate bone healing

2006



2014: 7 yrs





Preoperative Analysis in the posterior Mandible

- Which anatomic structures are of interest?
 - ✓ If present, anatomy of questionable teeth
 - Root anatomy
 - Periapical structure
 - Facial and lingual bone wall
 - ✓ Crest width at potential implant sites
 - ✓ Localisation of the mental foramen
 - ✓ Anatomic course of mandibular canal
 - ✓ Bone height above mandibular canal
 - ✓ Anatomy and shape of the mandibular body
 - Shape of the mandible
 - Extended lingual undercut

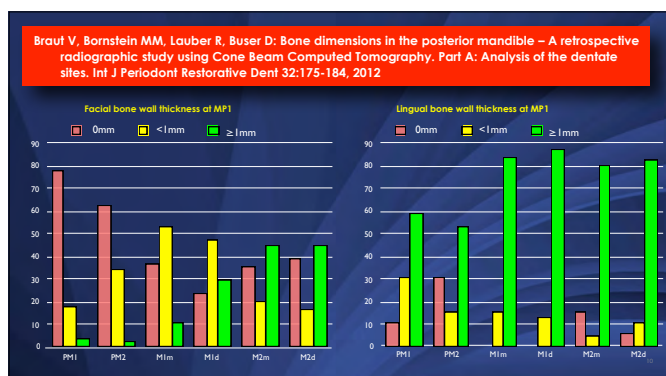
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Braut V, Bornstein MM, Lauber R, Buser D: Bone dimensions in the posterior mandible – A retrospective radiographic study using Cone Beam Computed Tomography. Part A: Analysis of the dentate sites. Int J Periodont Restorative Dent 32:175-184, 2012

- Examination of 56 Cone Beam Computed Tomographies (CBCT) in the posterior mandible
- 122 teeth were measured at two points:
 - ✓ At the crest area (4 mm apical to the CEJ)
 - ✓ In the middle of the root

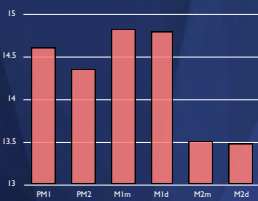
Results

- A steady increase in facial bone thickness from PM1 to M2
- The majority of the examined teeth exhibited either a missing (53.5%) or a thin facial bone wall (29%), except for the second molars
- Alveolar bone height was constant for all the examined teeth
- Presence of a lingual undercut was observed in 38.93% of the examined teeth



Braut V, Bornstein MM, Lauber R, Buser D: Bone dimensions in the posterior mandible – A retrospective radiographic study using Cone Beam Computed Tomography. Part A: Analysis of the dentate sites. Int J Periodont Restorative Dent 32:175-184, 2012

Alveolar bone height in the posterior mandible

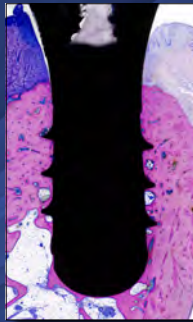


Conclusions

- A thin facial bone (<1mm) is found in more than half of the premolars as opposed to molars that predominantly exhibit a thick facial bone wall
- A thick lingual bone wall (≥1 mm) is present in most teeth (96.1%)
- Alveolar bone height is relatively constant for all the posterior teeth.
- For the specific selection of an appropriate treatment approach following extraction, CBCT analysis of alveolar bone dimensions prior to extraction is an important prognostic factor of the extent of crestal bone resorption post extraction

Basic Principles of Implant Surgery

- **Select an appropriate implant type**
 - ✓ Implant diameter and length
 - ✓ Implant shape and implant surface
- **Insert the implant in a correct 3D 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**



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Selection of Biomaterials in Implant Dentistry

Evidence-based Strategy

- **In routine application, only biomaterials with a good scientific documentation are utilized**
 - ✓ Implant systems at S.M. University of Bern (2015: 797 Implantate)
 - ➔ Straumann as main implant system (736 Implantate)
 - ➔ Thommen Medical, Nobel Biocare, and Zeramex in addition
 - ✓ Bone substitutes: DBBM (since 1994), BCP (since 2005)
 - ✓ Barrier membranes: e-PTEF membranes (since 1988) and non-crosslinked collagen membranes (since 1995)
- **New biomaterials are first carefully tested**
 - ✓ Pre-clinical examination (cell cultures and/or animal studies)
 - ✓ This is followed by clinical studies in patients
 - ✓ In case of positive results, a routine application in the post-doc clinic is feasible

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Clinical Long-term Studies

Take Home Message

Authors & Year	Implant type & surface	Surgical techniques	Pat	Impl	Follow-up	Survival rates	Success rates
In posterior implant sites, we have a clear preference for Tissue Level implants They are based on the principle of a hybrid design with a machined implant surface in the neck area							
Buser et al. 2013	Bone level implants/ SLActive	GBR simultaneous	20	20	4 Y	100.0%	95.0%
Chappuis et al. 2017	Tissue level implants/ SLA	GBR staged	38	52	10 Y	98.1%	98.1%

CLINICAL INVESTIGATIONS

Effectiveness of Implant Therapy Analyzed in a Swedish Population: Early and Late Implant Loss

J. Derks¹, J. Håkansson¹, J.L. Wennström¹, C. Tomasi¹, M. Larsson¹, and T. Berglund¹

Research Reports: Clinical

Effectiveness of Implant Therapy Analyzed in a Swedish Population: Prevalence of Peri-implantitis

J. Derks¹, D. Schaller¹, J. Håkansson¹, J.L. Wennström¹, C. Tomasi¹, and T. Berglund¹

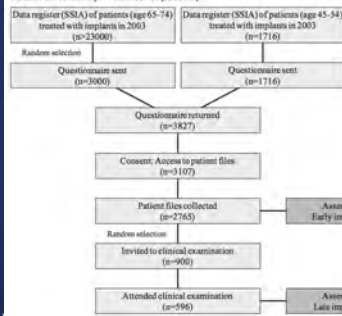
Journal of Dental Research
2015, Vol. 94(14) 43-48
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DOI: 10.1177/0022034514268821
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Figure.

Patient enrollment (n = number of patients)



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Table 3.
Implant Loss

	Early Loss (2,765 Patients, 11,311 Implants)	Late Loss (596 Patients, 2,367 Implants, Mean Function Time: 8.9 y)	Total Loss (596 Patients, 2,367 Implants, Mean Function Time: 8.9 y)
Patients affected	121 (4.4%)	25 (4.2%)	46 (7.6%) ^a
Implants lost	10 patients unaccounted for 154 (1.4%) 50 implants unaccounted for	46 (2.0%) ^a 2 implants unaccounted for	72 (3.0%) 2 implants unaccounted for

Late Loss after 8.9 y (2,367 Implants, 596 Subjects)	Late Loss (% of Implants)	Odds Ratio	95% Confidence Interval	P Value
Implant brand				
A Straumann	0.5	1		
B Nobel Biocare	2.4	6.13	0.47-80.51	0.139
C Astra Tech	2.5	5.23	0.28-99.38	0.244
D Others	3.8	58.15	2.35-1435.92	0.012

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Derks et al. JDR 2015

Risk Factors for the Development of Peri-implantitis

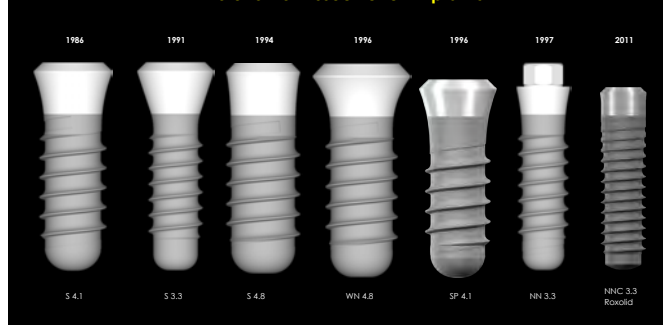
Table 4. Factors Associated with Moderate/Severe Peri-implantitis^a at the 9-y Examination: Patient-level Regression Analysis (n = 427).

	Odds Ratio	95% Confidence Interval	P Value
Periodontal status (at 9-y examination)			
Healthy	1		
Periodontitis	4.08	1.88 to 8.86	<0.001
Edentulous	1.64	0.75 to 3.59	0.219
No. of implants placed			
<4	1		
≥4	15.09	6.17 to 36.88	<0.001
Prosthetic therapy			
Specialist	1		
General practitioner	4.27	1.76 to 10.41	0.001
Implant brand ^b			
S Straumann = Tissue Level Implant	1		
NB Nobel Biocare = Bone Level Implant	3.77	1.60 to 8.87	0.002
AT Astra Tech = Bone Level Implant	3.55	1.29 to 9.77	0.014
R Others	5.56	1.70 to 18.24	0.005

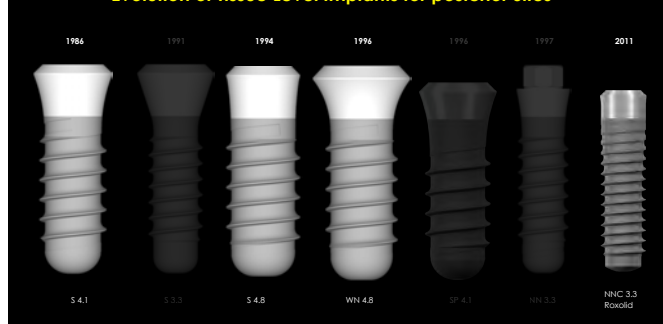
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Derks et al. JDR 2016

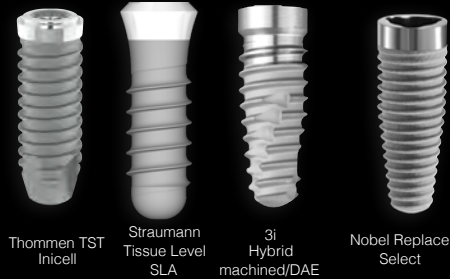
Evolution of Tissue Level Implants



Evolution of Tissue Level Implants for posterior Sites



There are more and more arguments to strictly use Hybrid Design Implants



Criteria for Implant Selection

- **Implant diameter**
 - ✓ 3.3 mm, 4.1 mm and 4.8 mm
- **Implant length**
 - ✓ Standard lengths: 8, 10 and 12 mm
 - ✓ Special lengths: extra-short: 4 & 6 mm; extra long: 14 mm
- **Implant type and shape**
 - ✓ Tissue level vs. bone level implants
 - ✓ Narrow neck vs. regular neck vs. wide neck implant
- **Most important criteria: Anatomic aspects**
 - ✓ Implant length: Nerve localisation, sinus floor, floor of nose
 - ✓ Implant diameter: crest width and gap size
 - ✓ Implant type: Indication and location of implant site

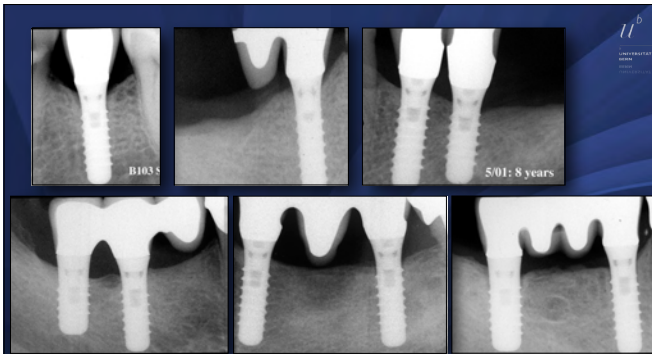
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Indications for Tissue Level Implants

- **We still use roughly 80% Tissue Level implants in daily practice**
 - ✓ Clearly preferred in posterior sites
 - ✓ Posterior mandible: S 4.1, S 4.8, WN 4.8 or NNC 3.3
 - ✓ Posterior maxilla: S 4.1, S 4.8, WN 4.8
 - ✓ 14/24: NNC 3.3 or BL 4.1
 - ✓ In ext. edentulous sites in the ant. maxilla: Preference for S 4.1 and NNC 3.3
- **Implant diameters utilized in 2014-16 (Straumann implants, n=2'168)**

✓ Ø 2.9	2	(0.1%)
✓ Ø 3.3	561	(25.8%)
✓ Ø 4.1	1'034	(47.7%)
✓ Ø 4.8	571	(26.3%)
✓ Total	2'168	(100%)

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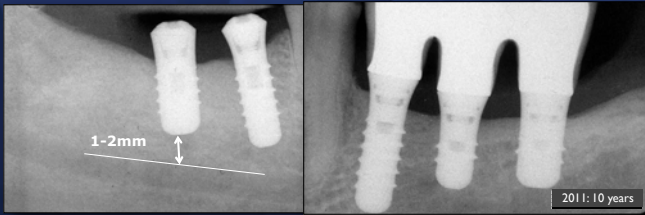
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Implant Diameter and Length

- **Important rule: Don't give up implant diameter and length, if it is not needed**
- **Need for shorter implants is mainly dictated by anatomy**
 - ✓ Mandibular canal
 - ✓ Floor of the sinus
- **When 6 mm or even 4 mm implants are used, they are always splinted to other implants**
 - ✓ Be careful with short, single standing implants in bruxers
 - ✓ Exceptions are made in elderly patients with reduced bite force
- **Need for a smaller diameter is dictated by anatomy as well**
 - ✓ Crest width due to bone resorption
 - ✓ Reduced gap size

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In the mandible, keep a safety distance to the mandibular canal



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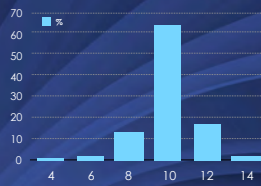
Principles of Implant Surgery

Selection of Implant Length

• Implant length utilized in 2014-16

• 4 mm	13	(0.6%)
• 6 mm	49	(2.3%)
• 8 mm	304	(14.0%)
• 10 mm	1'378	(63.6%)
• 12 mm	386	(17.8%)
• 14 mm	38	(1.8%)

Total = 2'168



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Basic Principles of Implant Surgery

- **Select an appropriate implant type**
 - ✓ Implant diameter and length
 - ✓ Implant shape and surface
- **Insert the implant in a correct 3D prosthetic position**
 - ✓ Restoration-driven implant placement
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 - ✓ Facial and oral bone walls should be at least 1 mm
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- **The implant should be surrounded by healthy and keratinized mucosa**



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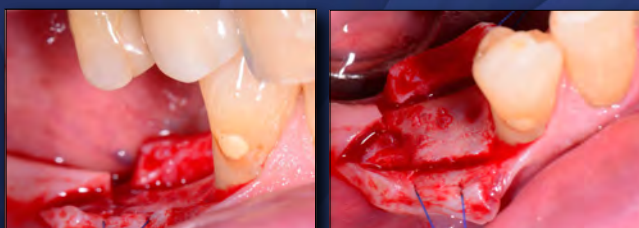


Implant Site Preparation

- Smoothing of crest
- Selection of appropriate implant diameter
- Achieve intact oral and buccal bone walls (> 1 mm)
- In case of a defect → bone augmentation

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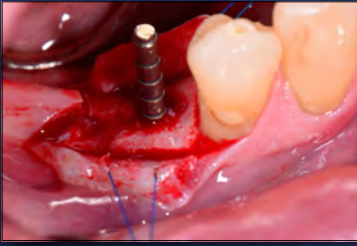
Midcrestal incision, small flaps



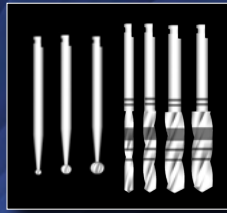
Check the interocclusal distance (> 6mm!)

Flattening of the ridge to gain crest width

Low-trauma, precise implant bed preparation



Goal: Achieve a thick lingual and buccal bone wall (>1mm)



Use drills of increasing diameters

Low-Trauma Surgical Technique

Bone Preparation

- Drilling speed of 500 rpm
- Cooling with chilled saline
- Sharp drills with light hand pressure

Soft Tissue Handling

- Application of a combination Oral Surgery and Perio Surgery

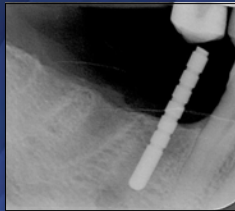


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Check axis and interocclusal relationship



At this stage, minor changes can be made to correct the axis



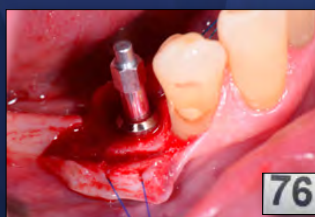
An intra-op. radiograph is often taken to check the distance to the mand. canal

Finalize implant bed preparation



The planned sink depth is always implant length plus 1-2 mm

Measurement of implant stability with ISQ value



3rd Generation Osstell Device

Standard diameter Implants:
Crest width > 6 mm

The border of smooth to micro-rough surface (SLA) is always located subcrestally (≥ 1 mm)

In h... a non-submerged healing is used!

The wound margins are adapted and secured with interrupted sutures

Take Home Messages

Don't compromise on the thickness of the buccal and lingual bone wall
They must be more than 1.5 mm in thickness!
Position the micro-rough implant surface always ≥ 1 mm below the crest!

Reduction in Crest Height to improve Crest Width

Wide diameter Implants:
Crest width > 7 mm

Standard diameter Implants:
Crest width > 6 mm

NNC Implants:
Crest width > 5 mm

Important: Position the SLA surface always below the crest (≥ 1 mm)
→ Consequence: The crown-to-implant ratio is altered

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Clinical Studies on short Implants and Crown to Implant Ratio

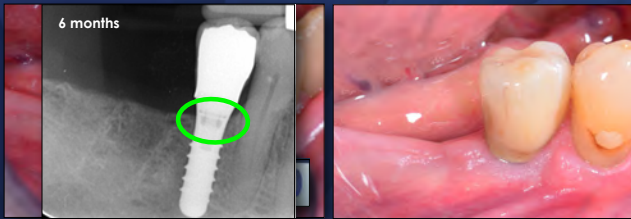
Take Home Messages

The crown-to-implant ratio is no risk factor for the long-term stability of implants
If you have to use shorter implants (<10 mm), splint them to other implants

Schneider et al.: "Influence of the crown-to-implant length ratio on the clinical performance of implants supporting single crown restorations: a cross-sectional retrospective 5-year investigation", Clin. Oral Impl. Res. 23, 169-174, 2012

Anilua et al.: "Retrospective study of short and extra-short implants placed in posterior regions: Influence of crown-to-implant ratio on marginal bone loss", Clin. Imp. Dent. Rel. Res. 17:102-10, 2015

A 4-week healing is anticipated in standard cases

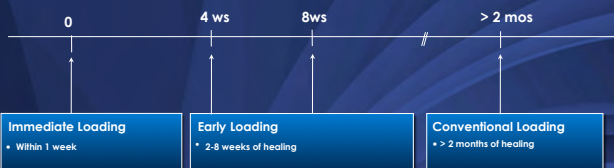


At 4 weeks, the ISQ value is 80. The patient is sent back to the dentist and restored

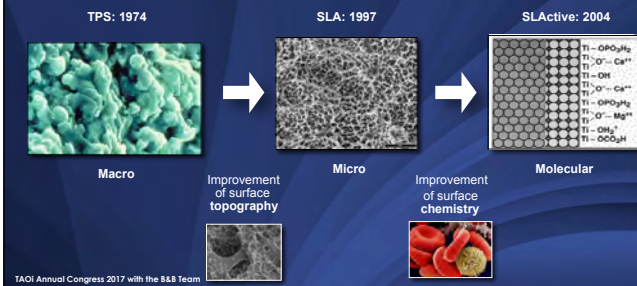
Final treatment outcome with a screw-retained implant crown

Healing Periods in Implant Dentistry Today

ITI Consensus Conference 2008



Evolution: from Topography to Chemistry



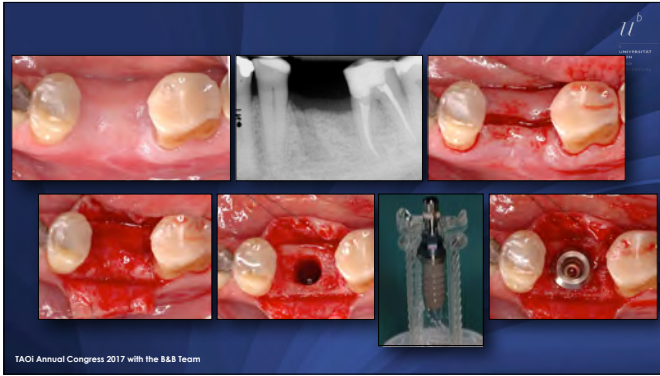
Early 2000: Systematic Examination of the modSLA surface

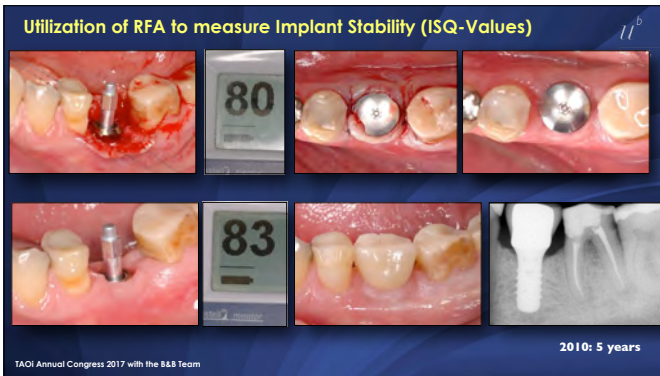
In-vitro and in-vivo preclinical studies

- Buser, Broggini, Wieland, Schenk, Denzer, Cochran, Hoffmann, Lussi, Steinemann: Enhanced bone apposition to a chemically modified SLA titanium surface. *J Dent Res* 83:529-533, 2004
- Ferguson, Broggini, Wieland, de Wild, Rupp, Geis-Gerstorfer, Cochran, Buser: Biomechanical evaluation of the interfacial strength of a chemically modified SLA titanium surface. *J Biomed Mater Res* 78:291-297, 2006
- Rupp, Scheideler, Olshanska, de Wild, Wieland, Geis-Gerstorfer: Enhancing surface free energy and hydrophilicity through chemical modification of microstructured titanium implant surfaces. *J Biomed Mater Res A* 76:323-334, 2006.
- Bornstein, Valderrama, Jones, Wilson, Selbl, Cochran: Bone apposition around two different sandblasted and acid-etched titanium implant surfaces: A histomorphometric study in canine mandibles. *Clin Oral Implants Res* 19: 233-241, 2008

Clinical Problem: How to measure Implant Stability?

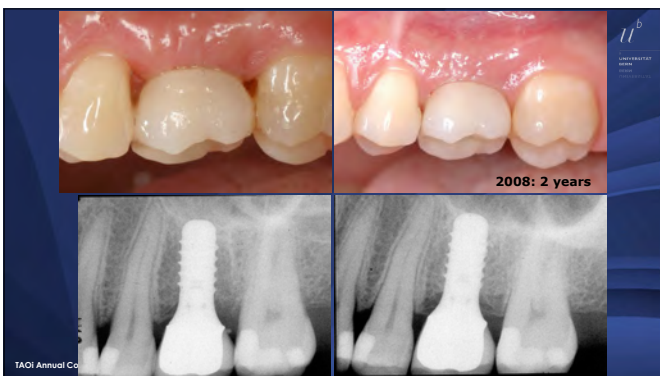
- Periotest values**
 - Has been used for years for longterm studies with implants
 - Can only be used with restored implants
- Insertion torque values (in Nm)**
 - Used for years by the BoneMark group
 - Values between 30 to 100 Nm are considered good
 - Disadvantage: No follow-up measurement is possible
- Resonance frequency analysis (RFA), ISQ values**
 - Introduced in 1996 by Meredith
 - Improved over the years, currently 3rd generation instrument











Clinical Studies with the SLActive Surface



Bornstein MM, Hart C, Halbritter S, Morton D, Buser D: Early Loading of Nonsubmerged Titanium Implants with a Chemically Modified Sand-Blasted and Acid-Etched Surface: 6-Month Results of a Prospective Case Series Study in the Posterior Mandible Focusing on Peri-Implant Crestal Bone Changes and Implant Stability Quotient (ISQ) Values. Clin Impl Dent Rel Res 11:338-347, 2009

Morton D, Bornstein MM, Witteben J, Martin WC, Ruskin JD, Buser D: Early loading after 21-days of healing of non-submerged titanium implants with a chemically modified sandblasted and acid-etched surface: 2-year results of a prospective 2-center study. Clin Impl Dent Rel Res 12:9-17, 2009

Bornstein MM, Witteben J, Bragger U, Buser D: Early loading at 21 days of non-submerged titanium implants with a chemically modified sandblasted and acid-etched surface: 3 years results of a prospective study in the posterior mandible. J Periodontol 81:809-818, 2010

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Bornstein, Hart, Halbritter, Morton, Buser: Early Loading of Nonsubmerged Titanium Implants with a Chemically Modified Sand-Blasted and Acid-Etched Surface: 6-Month Results of a Prospective Case Series Study in the Posterior Mandible Focusing on Peri-Implant Crestal Bone Changes and Implant Stability Quotient (ISQ) Values. Clin Impl Dent Rel Res 11:338-347, 2009

Material and Methods

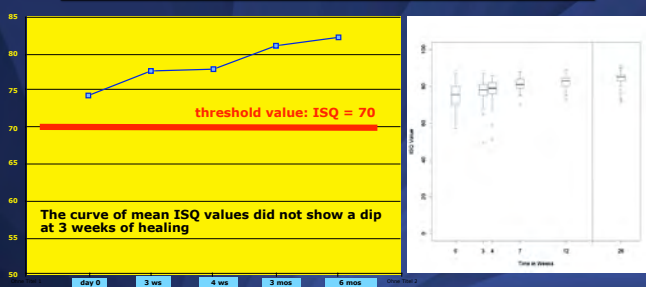
- 56 implants with a modSLA surface were inserted in posterior mandibular sites of 40 patients
- Standard implant placement without bone augmentation procedures
- Implant loading at day 21 using provisional restorations in occlusal contact
- Follow-up exams at 4, 7, 12 and 26 weeks
- ✓ Standard clinical parameters and DIB values
- ✓ ISQ values to assess implant stability over time

Results

- No implant failures resulting in a 6-months success rate of 100%
- 2 spinning implants at day 21 requiring an extended healing period
- ISQ values were very helpful to determine implant stability during initial healing
- Clinical and radiographic parameters were in line with previous studies

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ISQ Values during 6 months of Follow-up



Bornstein et al. 2009

Loading Protocols in Implant Dentistry

ITI Consensus Conference 2008

Standard sites



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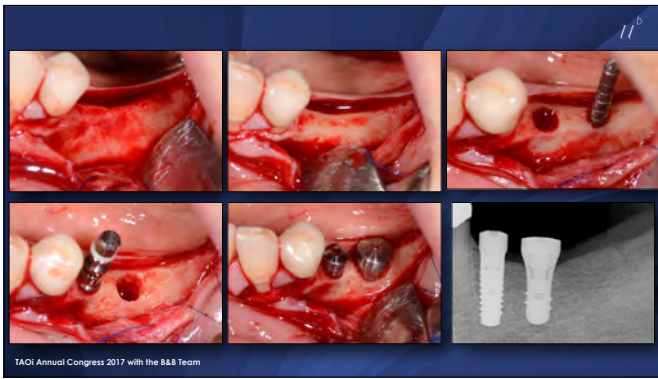
The NNC Roxolid Implant is an excellent addition of the Portfolio

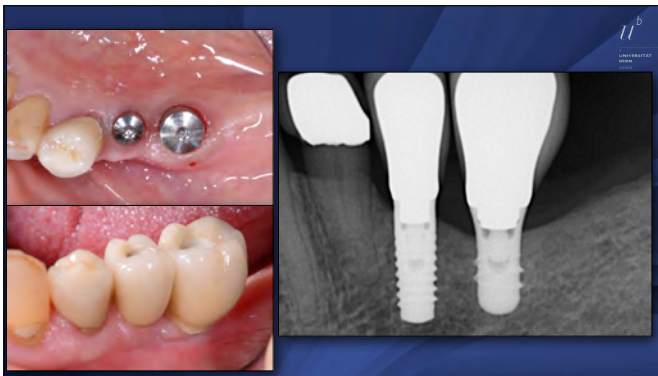


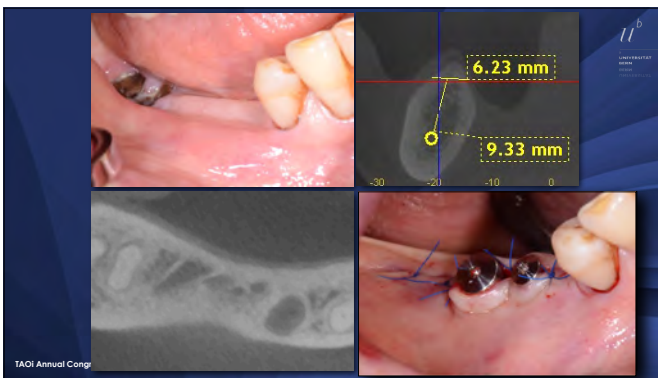
Characteristics of NNC Implants

- Small diameter Implant (3.3 mm)
- Extra strength due to Ti-Zr alloy (Roxolid)
- We love to use it in borderline cases with reduced crest width (>5mm)
- Excellent implant in particular for elderly patients
- In 2014-16, we inserted 561 NNC implants in our clinic (25%)

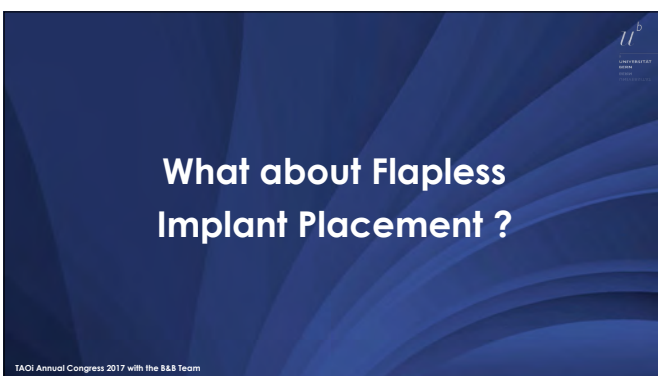
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Various Surgical Procedures

Surgical Procedure	2002-04	%	2008-10	%	2014-16	%
Implants Standard, open flap	878	48.3	877	38.2	856	37.9
Implants Standard, flapless	0	0.0	34	1.5	29	1.3
Implants with GBR	722	39.7	962	42.2	972	43.0
simultaneous GBR	599	33.0	889	39.0	887	39.0
staged GBR	123	6.7	73	3.2	85	3.2
Implants with SFE	217	11.9	402	17.8	403	17.8
simultaneous osteotome tx	35	1.9	63	2.8	35	2.8
simultaneous window tx	122	6.7	195	8.6	233	8.6
staged window tx	60	3.3	145	6.4	135	6.4
Implants with GBR & SFE	939	51.7	1364	60.0	1375	60.8
Total	1' 817	100.0	2' 279	100.0	2261	100.0

Bornstein et al. 2008; Engel-Brugger et al. 2015; Ducommun et al. (in manuscript)

Flapless Surgery in Implant Dentistry

- Brain-guided flapless implant placement can be done freehand by an experienced implant surgeon
 - ✓ Anatomy can be difficult
 - ✓ The surgery can be tricky due to poor visualization
 - ✓ Proper case selection is important to maintain successful outcomes at a high level
 - ✓ You need a thick facial bone wall at the extraction site
- Computer-guided flapless surgery based on cad-cam technology
 - ✓ The surgery is easier
 - ✓ The preoperative analysis is more demanding
 - ✓ 3-dimensional radiographs are necessary (CBCT or Dental-Cr 3)
 - ✓ Costs are increasing

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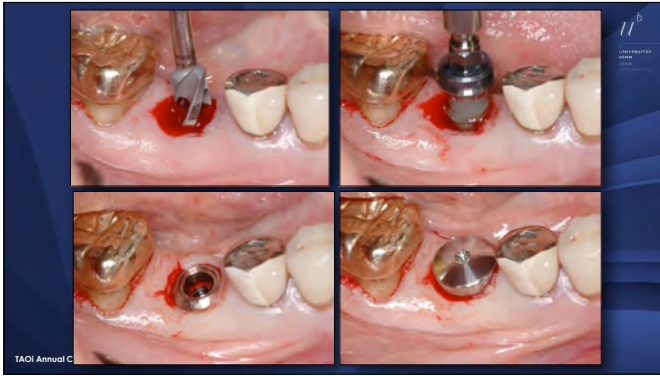
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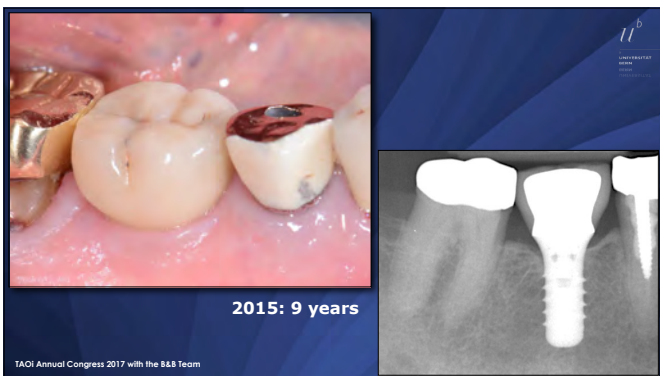
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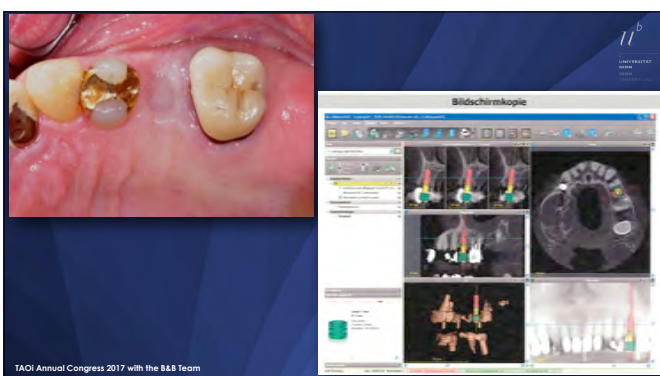


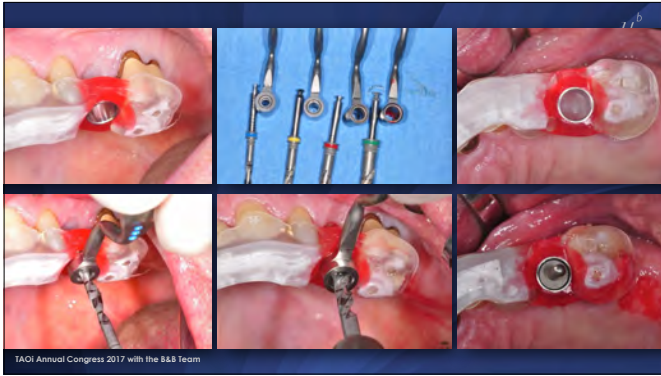


Flapless Surgery in Implant Dentistry

- Brain-guided flapless implant placement can be done firsthand by an experienced implant surgeon
 - ✓ Anatomy can be difficult
 - ✓ The surgery can be tricky due to poor visualization
 - ✓ Proper case selection is important to maintain successful outcomes of a flapless
 - ✓ You need a thick facial bone wall at the extraction site
- Computer-assisted implant surgery, flap-less approach
 - ✓ The surgery is easier
 - ✓ The preoperative analysis is more demanding
 - ✓ A 3-dimensional radiographs is necessary (CBCT)
 - ✓ Costs are increasing

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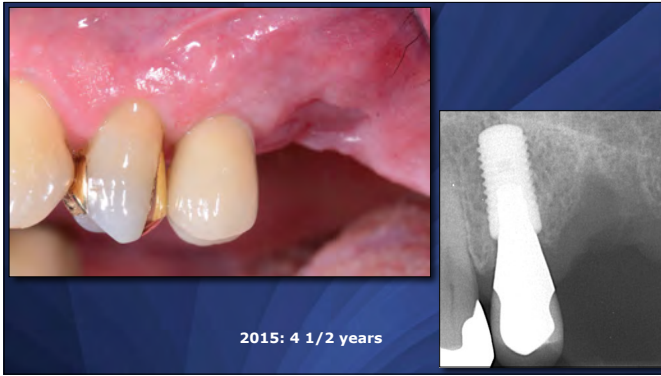






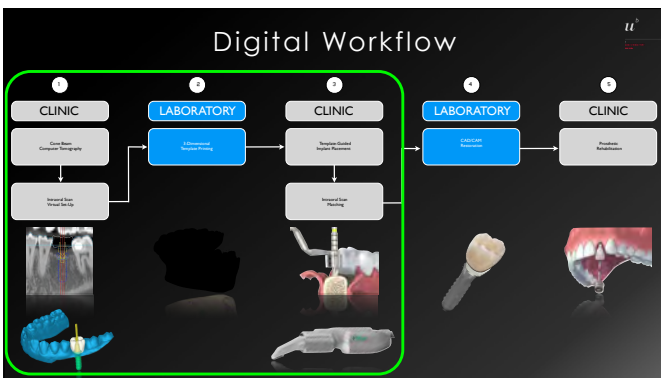


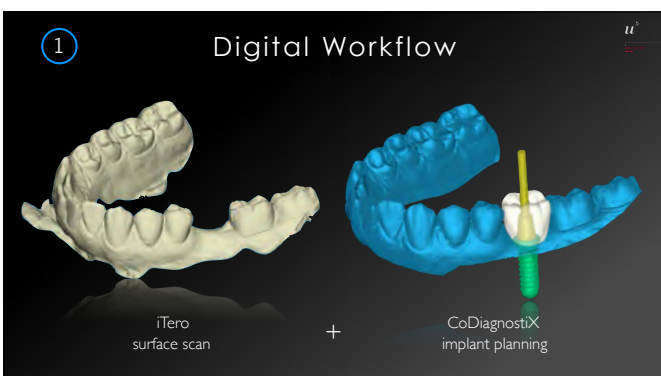




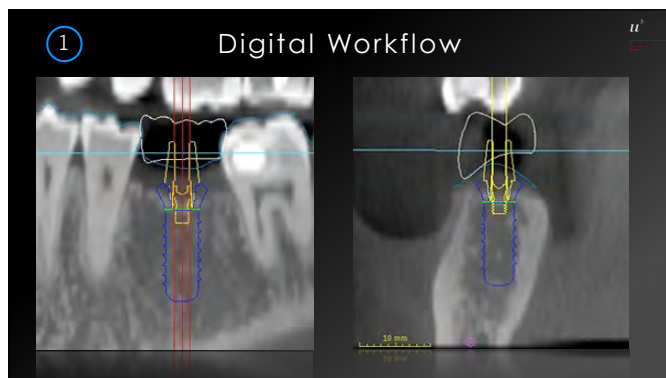




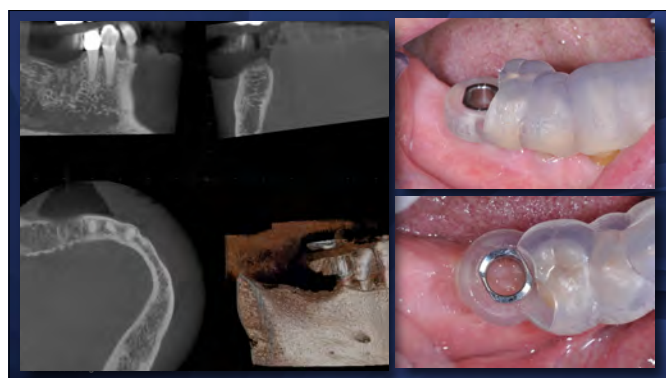


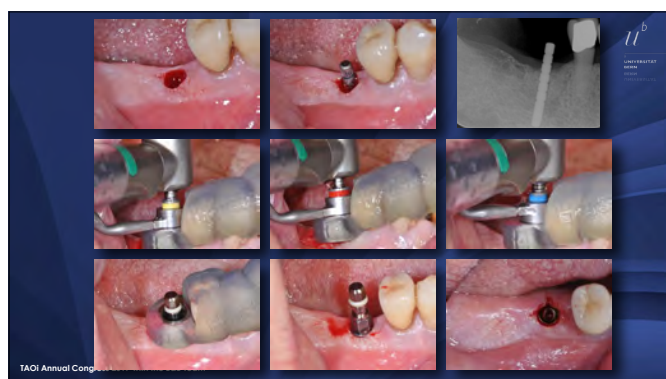


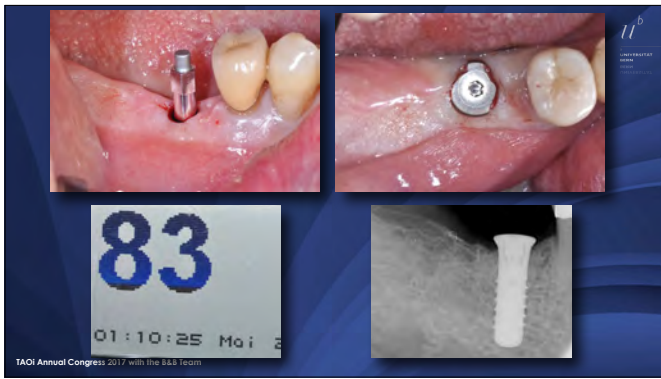




















Conclusions for the Posterior Mandible

- **Implant placement in posterior sites follows the same surgical principles as established more than 20 years ago**
- **A low-trauma surgical technique is recommended**
 - ✓ Careful handling of bone and soft tissues
- **Implant placement in appropriate prosthetic positions is a «must»**
 - ✓ Restoration-driven implant placement
- **Achievement of primary stability is important**
 - ✓ Use of screw-type implants
- **In sites without bone defects, a non-submerged implant healing has been successfully used in over 20 years**
 - ✓ Less morbidity for patients, reduction of cost

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Conclusions: Implant selection

- **The tissue level implant is still the work horse in daily practice**
 - ✓ The hybrid design with a machined collar is a big advantage
 - ✓ The Derks et al. (2015) papers clearly document this
 - ✓ The University of Bern will have published 5 studies with 10-year data by the end of 2017 with Tissue Level implant documenting excellent long-term stability
- **The Bone Level implant is mainly used for esthetic single tooth replacement and for the replacement of 11/21**
- **The most often Tissue Level implant is the standard diameter with a length of 10 mm**
- **The development of shorter and diameter-reduced implants has widened the indications for implant therapy**
 - ✓ They allow the reduction of bone augmentation procedures
 - ✓ The small-diameter NNC Roxolid implant is a very nice addition

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Conclusions: Basic Surgical Principles in posterior Sites

- **In ideal anatomical situations, flap-less implant placement is performed**
 - ✓ Today, CAIS is used
 - ✓ In posterior sites, we are somewhere around 5% of cases today
 - ✓ The main implant site is the 1st molar in the mandible

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Conclusions

- **The concept of early loading at 8 weeks in posterior sites is well documented with the SLA and Osseotite implant surface**
- **This approach is cost-effective, patient friendly and can be mastered by average talented clinicians**
- **A further reduction of the healing time is feasible with a chemically modified SLActive surface in standard implant sites without bone grafting**
- **A 4 week healing period increases the attractiveness of the early loading concept further**
- **Immediate loading in posterior sites has no use in our patients**
- **Case selection is crucial measuring ISQ values to objectively examine implant stability during initial wound healing**

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