Learning objectives of this presentation

1. Be aware of evaluation systems to appraise the qualities of the soft tissues in patients having received a single crown
2. Be familiar with the effects of various clinical variables on peri-implant soft tissue appearance and cortical bone loss
3. Be acquainted with clinical research focused on dimensional relationships between the implant-crown-complex and clinical and radiographical landmarks
1. Evaluation of esthetic outcomes

A satisfactory esthetic outcome?

- High smile line (A.K.A. "gummy smile")
- Low smile line

A.K.A. "Gummy smile"
2. Evaluation of esthetic outcomes in implant dentistry

Established evaluation system:
1971 USPHS / Ryge criteria – "US Public Health Service" (Cvar & Ryge)
1977 CDA criteria – "California Dental Association"

Specifically to implant-retained reconstructions in the esthetic zones
2005 ICAI – "Implant Crown Aesthetic Index" (Meijer et al. COIR)

1. Mesiodistal dimension of the crown: must be in harmony with the adjacent and contralateral tooth, 5 points (Slight - slight undercontour - no deviation - slight - gross overcontour)
2. Position of the incisal edge of the crown: must be in harmony with the adjacent and contralateral tooth, 5 points (gross - slight undercontour - no deviation - slight - gross overcontour)
3. Labial convexity of the crown: must be in harmony with the adjacent and contralateral tooth, 5 points (gross - slight undercontour - no deviation - slight - gross overcontour)
4. Colour and translucency of the crown: must be in harmony with the adjacent and contralateral tooth, 3 points (gross - slight - no mismatch)
5. Surface of the crown: characteristics of the crown such as roughness and ridges must be in harmony with the adjacent and contralateral tooth, 3 points (gross - slight - no mismatch)
Established categorical evaluation system
1971 USPHS criteria – “US Public Health Service” (Cvar & Ryge)
1977 CDA criteria – “California Dental Association”

Specifically to implant-retained reconstructions in the esthetic zones
2005 ICA – “Implant Crown Aesthetic Index” (Meijer et al. COIR)
2005 PES – “Pink esthetic score” (Fürhauser et al. COIR)
2009 PES/WES – “Pink and white esthetic score” (Belser et al. J.Perio)
2010 CEI – “Complex esthetic index” (Juodzbalys & Wang J. Perio)

2. Evaluation of esthetic outcomes in implant dentistry

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<th>0</th>
<th>1</th>
<th>2</th>
</tr>
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<tbody>
<tr>
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<td>Complete</td>
</tr>
<tr>
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</tr>
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<td>Natural, matching reference tooth</td>
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From: Fürhauser et al. 2009

2. Evaluation of esthetic outcomes in implant dentistry

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From: Juodzbalys & Wang J. Perio 2010
Measure of degree of perfection vs. reality?

Criteria for scoring esthetical outcome may at times create a challenge. The single implant-supported crowns "stand out positively", but should by definition be scored "low" because they do not blend in with the remaining teeth and gingiva contours.

2. Evaluation of esthetic outcomes in implant dentistry

Established categorical evaluation systems:
- 1971 CDA criteria - "US Public Health Service" (Crow & Ruge)
- 1977 CDA criteria - "California Dental Association"

Specifically to implant-retained reconstructions in the aesthetic zones:
- 2005 PES - "Pink aesthetic score" (Fürhauser et al. COIR)
- 2009 PES/WES - "Pink and white aesthetic score" (Belser et al. J.Perio)
- 2010 CEI - "Complex aesthetic index" (Jundt/Kalin & Wong J.Perio)

Specifically to implant-retained reconstructions and papillae:
- 1997 PI - "Jemt Papilla Index" score (Jemt Int. J. Per. Res. Dent)

I.e., position of the soft-tissue crest relative to the apical location of the tooth-implant-crown contact area.

Score: 0 (1) 1 (2) 2 (3) 3 (4)

3. Learning objectives of this presentation

1. Be aware of evaluation systems to appraise the qualities of the soft tissues in patients having received a single crown.

2. Be familiar with the effects of various clinical variables on peri-implant soft tissue appearance and cortical bone loss.

3. Be acquainted with clinical research focused on dimensional relationships between the implant-crown complex and clinical and radiographical landmarks.
2. Effects of clinical variables on peri-implant soft tissue appearance and cortical bone loss

We may today expect predictable esthetic outcomes due to refinements over the years:

— Alternative surgical and restorative treatment strategies
— Innovative implant system components and biomaterials

Alternative surgical and restorative treatment strategies for healed sites / missing teeth

Soft tissue augmentation procedures at second-stage surgery: a systematic review
90ies advice for placement (in a healed site)

Place as vertically as possible (avoid non-axial loading!)

+ buccal grafting

OR

place palatinally to make “ridge-lap crown”

OR

Place in the centre axis of the remaining alveolar bone → often angulated abutment need

Alternative surgical and restorative treatment strategies for remaining hopeless tooth / root

1. Remaining tooth extracted +/ augment
2. Remaining tooth root +/ augment
3. Remaining tooth root +/ augment

Load Temp./perm. prosthesis

Extract placed +/ augment

Implanted +/ augment

Soft tissue building
2. Effects of clinical variables on peri-implant soft tissue appearance and cortical bone loss

We may today expect predictable esthetic outcomes due to refinements over the years:
- Alternative surgical and restorative treatment strategies
- Innovative implant system components and biomaterials
Implant placement strategies – immediate or early?

'90ies
1. +/- Augmentation
2. Auto-allograft
3. +/- membrane
4. ((HA-)cylindric)

Stepped implants

late '90ies
Wide implants
(Narrow implants)
Implant placement strategies – immediate or early?

1. 4-8 w. healing postextract
2. Tissue-level (→ bone level)
3. Buccal grafts – Auto- +Xenograft particles
4. Collagen membrane
5. Submerge 8-12 w.

2011 → pioneered by U.Bern

A deductive reasoning approach

Premise: A 1.5 mm wide “circumferential crater” exists around all implants, including on the buccal side. Hence,

1. The bone thickness should be at least 2 mm, preferably 4 mm
2. If < 2mm bone is available, part of the buccal bone plate will be lost after remodeling, with the consequence of a high risk of soft tissue recession.
3. Such a large amount of bone buccally does not exist normally, and has to be created with augmentation procedures in almost every esthetically demanding case.

Influential paper

The evidence of the premise is weak

see: Zhang et al. IJPR 2014

Amount of bone needed to accommodate circumferential crater without loss of height in buccal mucosal margin;

1. Dotted line = original degree of B-L resorption
2. From: Grunder et al. IJPRD 2005
3. Thickness that bone on buccal side of implant should have to support gingival margin despite horizontal crater formation.

“Saucerization” – influence by the implant design?

BioHorizon 3i Osseotite NT
4x12 mm 4x13 mm 3.8x11.5 mm 4x9 mm 3.75x18 mm 3.3x12 mm

Endopore: BioHorizon 3i
4x12 mm 4x13 mm 3.8x11.5 mm 4x9 mm 3.75x18 mm 3.3x12 mm

Brånemark Std.
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Brånemark Std.
4x12 mm 4x13 mm 3.8x11.5 mm 4x9 mm 3.75x18 mm 3.3x12 mm

“Influence by the implant design?"
“Saucerization” – influence by the implant design or by anatomy?

2. Effects of clinical variables on peri-implant soft tissue appearance and cortical bone loss

We may today expect predictable esthetic outcomes due to refinements over the years:
- Alternative surgical and restorative treatment strategies
- Innovative implant system components and biomaterials.

The parameters to achieve the best possible appearance of peri-implant soft-tissues?

Potential effect of site or surgery variables on outcome?

1. Tissue biotype / thickness
2. Incision / flap design
3. Ostectomy procedure
4. Implant position, vertical & adjacent tissues
5. Torque / primary stability
6. Flap handling
7. Suturing technique
8. Cover screw / tenting abutment
Potential effect of site or surgery variables on outcome?

1. Tissue biotype / thickness – thin vs thick

- Thin biotype gingiva is more prone to recession
  - Kan et al. IJOMI 2011
  - da Rosa et al. IPRD 2014
  - Cardarolipi et al. IPRD 2015
  - Zuiderveld et al. 2014

2. Incision / flap design - use

- Trapezoidal instead of intra-sulcular incision (Gomez-Roman IJOMI 2001)
- Split-finger approach (Misch et al. Imp Dent 2004)

3. Osteotomy procedure

4. Implant position, vertical & adjacent tissues

5. Torque / primary stability

6. Flap handling

7. Suturing technique

8. Cover screw / “tenting” abutment


“Platform-switching” Abutment connect-disconnect

If also immediate placement:

- Extraction reason
- Extraction technique
- Socket debridement
- Socket preservation

Evidence is inconclusive, conflicting or lacking
<table>
<thead>
<tr>
<th>Reduced Risk</th>
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Studying esthetic outcome and anatomic dimensions

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<tr>
<th>Observation studies (i.e., measured at a single point of time)</th>
<th>Clinical variables, e.g.</th>
<th>Bone and soft tissue levels and appearance may be associated with different variables</th>
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Outcome measure (i.e., measured as a change from baseline)

| Bone level                                                   | Clinic Radiographic     | Different variables may cause or influence bone and soft tissue levels and appearance changes |
| Buccally                                                     | Clinic Radiographic     | Different variables may cause or influence bone and soft tissue levels and appearance changes |
| Proximally                                                   | Clinic Radiographic     | Different variables may cause or influence bone and soft tissue levels and appearance changes |
| Soft tissue                                                  | Clinic Photographs/Models | Different variables may cause or influence bone and soft tissue levels and appearance changes |
| Appearance                                                   | Clinic Photographs/Models | Different variables may cause or influence bone and soft tissue levels and appearance changes |
| Level                                                        | Clinic Photographs/Models | Different variables may cause or influence bone and soft tissue levels and appearance changes |
| Buccally - Proximally                                        | Clinic Photographs/Models | Different variables may cause or influence bone and soft tissue levels and appearance changes |

**Simplistic versus complex (multivariate) statistics**

1. Generalized estimating equations (GEE)
2. General linear modelling (GLM)
3. Multilevel analyses (AKA mixed / hierarchical / random effects models)

**Association?**

J. Perio 2003, n=45 pat.


Bivariate statistics

**Association?** YES


Bivariate statistics

**Association?** YES
### Studying esthetic outcome and anatomic dimensions

#### Observation (i.e., single point of time)

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Bone and soft tissue levels and appearance may be associated with different variables.

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<th>Study (Year)</th>
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<th>Statistic</th>
<th>Association?</th>
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**Vela et al., IJPRD 2012**

n=50 pat.

Bivariate statistics

**Association?** YES

---

#### Similar data and diagrams for other studies:

- **Choquet et al., J Perio 2001**
  - n=26 pat.
  - Bivariate statistics
  - Association? YES
- **Kawai & Almeida, Cleft P-C 2008**
  - n=40 pat.
  - Bivariate statistics
  - Association? YES
- **Peng et al., IJPRD 2013**
  - n=25 pat.
  - Bivariate statistics
  - Association? YES
- **Kourkouta et al., COIR 2009**
  - n=15 pat.
  - Bivariate statistics
  - Association? YES
- **Lops & Romeo, COIR 2008**
  - n=46 pat.
  - Bivariate statistics
  - Association? YES
- **Lops & Romeo, COIR 2008**
  - n=46 pat.
  - Bivariate statistics
  - Association? YES
- **Chang & Wennstrom, COIR 2013**
  - n=32 pat.
  - Multivariate stats
  - Association? YES

---
A satisfactory esthetic outcome as an effect of bone level?

**Studying esthetic outcome and anatomic dimensions**

**Outcome measure (i.e. measured as a change from baseline)**

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Different variables may cause or influence bone and soft tissue levels and appearance changes.

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**Association?**

- Different variables may cause or influence bone and soft tissue levels and appearance changes.

**Association?**

- Different variables may cause or influence bone and soft tissue levels and appearance changes.
Studying bone levels and anatomic dimensions

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<th>Area</th>
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<th>Proximal</th>
<th>Clinic</th>
<th>Radiographic</th>
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<td>Clinic</td>
<td>Radiographic</td>
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</tbody>
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Jame LIP 2008
n=36 pat.
Multivariate stats
Association? NO
Cardosa et al. COIR 2003
n=29 pat.
Multivariate stats
Association? NO
Chapuis et al. COIR 2015
n=25 pat.
Multivariate stats
Association? NO

Bone level
Buccally
Clinic
Radiographic
Proximally
Clinic
Radiographic

Soft tissue:
Appearance
Clinic
Photographic

Studying esthetic outcome and anatomic dimensions

Outcome measure (i.e. measured as a change from baseline)

The advent of use of cbCT, pre- & post-placement

Miyamoto & Obama (2011)
Bouri et al. (2012-2014)
Ree et al. (2012)
Voss et al. (2012)
Bauer et al. (2013a,b)
Corti et al. (2013)
Fu et al. (2014-2015)e
Kocius et al. (2015, 2014)
Kaminaka et al. (2015-2016)
Schropp et al. (2015, 2014)
Hasan et al. (2015)
Juma et al. (2015)
Chapuis et al. (2015a)
Kuczek et al. (2015c)
Khali et al. (2015a)
Kucht et al. (2015-2014e)

N= 61 pat.
Bivariate stats,
Pre-post 5-9 yrs
Hor. dist. of "saucer": TL: 1.0 mm
BL: 0.6 mm

Graphical display of 1.5 mm wide "saucers" claimed to be present around all implants
From: Grunder et al. IJPRD 2005
**Buccal bone v/z. gingival thickness v/z. esthetics?**

Correlation between buccal bone and gingival thickness is only moderate.

From: De Bruyckere et al. JCP 2015

Younes et al. COIR 2016

**Gingival thickness, Thin v/z thick biotype?**

**BUT!**

cbCT accuracy of ≤1.2 mm peri-implant buccal bone.

Within present limitations, acceptable and stable aesthetics are not jeopardized by a thin or missing buccal bone.

**Poor** (Schulte et al. 2002)

**Poor** (Spin-Netto et al. 2011)

**Poor** (Hens et al. 2013)

**Modified** (Juriansz et al. 2016)

**Summarizing – Take home message**

1. Evaluation systems to appraise the qualities of the soft tissues in patients having received a single crown

**PES & PES/WES** have been validated and appear to predominate in use.

2. The effects of various clinical variables on peri-implant soft tissue appearance and cortical bone loss

Effects of many variables singularly and in combination are largely unknown, principally due to small datasets and short study duration.

3. Clinical research focused on dimensional relationships between the implant-crown-complex and clinical and radiographical landmarks

Cross-sectional studies with simplistic statistics indicate associations, while longitudinal studies with adequate multi-level multivariate statistics provide less conclusive data.
Thank you for your kind attention