Space closure vs implant-borne crowns for congenitally missing maxillary lateral incisors: 

**Is there really anything new?**

With utmost appreciation and gratitude dedicated to Dr. R. Vanarsdall and Dr. D. Misch.

**Latest orthodontic scientific evidence...**


No difference is found in overall clinical results if recontouring and bleaching is performed.

**Esthetics**

OSC results are esthetic if recontouring and bleaching is performed.

Rosa M et al. Prog Orthod 2013

AJODO Video of the month

**September 2016**


**2005**

**2015**
Clinically significant esthetic improvements for implant-borne crowns were perceived by all 3 respondent groups.

Any new systematic reviews?

I. Treatment for agenesis of maxillary lateral incisors: a systematic review evaluation all studies on the topic between 1965 and 2011


II. Prosthodontic replacement vs space closure for maxillary lateral incisor agenesis: a systematic review of all studies from 1975-2015


III. Treatment options for congenitally missing lateral incisors: a systematic review of all studies on the topic between 1975 and 2015


III. A systematic review of all studies on the topic from 1975-2015

Up to date only 5 studies directly comparing the two therapeutic options.

The absence of randomised controlled trials and the limited number of prospective and retrospective studies comparing the two different therapeutic options make it difficult to draw definitive conclusions about the superiority of one treatment option over the other, regarding the biological, functional and aesthetic outcomes.

According to this systematic review, both therapeutic options are acceptable.


Latest orthodontic scientific evidence

Scientific perio-implanto-prosthodontic evidence...

is inconclusive

is there anything new?
I. "Overall healthy and stable peri-implant tissue conditions, a paramount criterion when it comes to esthetic implant crowns, were consistently encountered and maintained longitudinally." 

II. "Contour augmentation with GBR was able to establish and maintain a facial bone wall in 95% of patients." 

Orthodontic site development is often insufficient 

Ridge-volume deficiency increased 14 fold over 5.6 yrs 0.3mm私服 (11), 1.8mm私服 (13) 

Ridge width decreased 13-15%, height decreased 6-12%, 2-fold increase of labial concavity 0.6-2.3 fold 

Alveolar bone width decreased 17%, labial concavity increased 0.8-2.3 fold 

GBR should be more frequently performed for implants substituting congenitally missing I2s 

III. "While the implant papilla may be maintained or re-established to the normal level with the thin biotype, it can seldom be recreated with the thin biotype."

The preservation or augmentation of the soft tissue prior to implant placement is of paramount importance in order to obtain optimal gingival contours surrounding the definitive restorations.

Orthodontic space closure including first premolar intrusion and canine extrusion in patients with missing lateral incisors does not incur risks for periodontal tissue deterioration or TMD in the long term (10 years) compared with patients with no missing teeth.

Aim of the study

I. to evaluate if the implementation of correct 3D implant placement (eventually with hard and/or soft tissue contour augmentation) can establish and maintain excellent esthetic and periodontal conditions after a functional period of at least 5 years in patients with congenitally missing maxillary lateral incisors

II. to compare these results to the outcomes of orthodontic space closure with canine substitution and recontouring after a similar posttreatment time, and

III. to assess patients' satisfaction with the final treatment outcomes in both groups.

Material & Methods

- 32 consecutively treated patients between Aug 2006 – Oct 2011
- uni- or bilateral agenesis of U2
- > 5 years post-treatment
- 16 (13f, 3m) treated with OSC
- 16 (10f, 6m) treated with implant-borne crowns (20 implants)
  - 10 with hard tissue graft – 8 DBBM, 2 autologous bone
  - 3 with hard & soft tissue graft
  - 3 with soft-tissue graft
- same orthodontist & implantologist/prosthodontist

Clinical assessments in both patient groups

- facial and palatal plaque index (PI) according to Quigley and Hein
- probing depth (PD) at 4 sites (mesial, distal, midfacial, palatal)
- dichotomous score for bleeding on probing (BP) within 15 seconds
  0=no bleeding, 1=bleeding
- any gingival marginal recession

- gingival biotype according to the TRAN method proposed by De Rouck et al. measured on the facial aspect of the upper right central incisor.


Radiographic assessments in the Implant group

- Periapical radiographs at final crown delivery (T1) and at follow-up (T2)
- Rx calibrated to actual implant size for evaluation of DIB (first bone-to-implant contact) measured on the mesial & distal to calculate the change from baseline to follow-up. *

Professional esthetic assessments PES

<table>
<thead>
<tr>
<th>PES</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. mesial papilla</td>
<td>missing</td>
</tr>
<tr>
<td>2. distal papilla</td>
<td>missing</td>
</tr>
<tr>
<td>3. soft tissue contour</td>
<td>unnatural</td>
</tr>
<tr>
<td>4. soft tissue level discrepancy</td>
<td>&gt;2mm discrepancy</td>
</tr>
<tr>
<td>5. alveolar process, soft tissue color &amp; texture</td>
<td>clear difference</td>
</tr>
</tbody>
</table>

Pink esthetic score maximum = 10

Professional esthetic assessments WES

<table>
<thead>
<tr>
<th>WES</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. tooth form</td>
<td>major discrepancy</td>
</tr>
<tr>
<td>2. outline and volume</td>
<td></td>
</tr>
<tr>
<td>3. color-hue and value</td>
<td></td>
</tr>
<tr>
<td>4. surface texture</td>
<td></td>
</tr>
<tr>
<td>5. translucency</td>
<td></td>
</tr>
</tbody>
</table>

White esthetic score maximum = 10

Sum PES/WES maximum = 20

Statistics

- Difference for age & observation time between groups - Mann Whitney U test
- Descriptive statistics including mean values, standard deviations and ranges
- PI and Bleeding - Mann-Whitney U test
- Frequency of recessions between groups - Chi Square test
- PD and severity of recessions - MANOVA with dependent variables
- Mesial-distal DIB differences at baseline and at follow-up - repeated measures ANOVA
- Reproducibility for PES-WES variables - Wilcoxon test for paired data
- Single PES & WES & Sum PES/WES between OSC-IMP group - MANOVA with dependent variables
- Comparison of the VAS OSC-IMP - Mann Whitney U test
- Correlation PES/WES and VAS - One-tail Spearman test

All results with p<0.05 were considered significant.
All statistical analyses were performed with SPSS (22.0 version) and GraphPad Prism (6.0 version)

Patients' esthetic assessment VAS

How satisfied are you with the appearance of your upper front teeth?

Completely satisfied 0 1 2 3 4 5 6 7 8 9 10 Totally unsatisfied

100 mm

Age & observation time

<table>
<thead>
<tr>
<th>OSC</th>
<th>IMP</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at end of tx</td>
<td>20 y ± 7y 6m</td>
<td>24y 6m ± 9y 1m</td>
</tr>
<tr>
<td>Age at follow-up</td>
<td>26y 4m ± 7y 7m</td>
<td>30y 1m ± 8y 9m</td>
</tr>
<tr>
<td>Observation time</td>
<td>5y 9m ± 1y 3m</td>
<td>6y 4m ± 1y 2m</td>
</tr>
</tbody>
</table>

Means, SD and mean differences p for Age at end of tx, at follow-up and observation time in the OSC and IMP group; p*<0.05.

IMP patients older, similar observation time
General clinical findings

**OSC group**
- 8x second canine bleaching
- 2x devital canine
- 5x abfractions of canine composite, 4x abfractions of premolar composite

**IMP group**
- 100% implant success
- no mobility, no suppuration, no signs of peri-implant tissue inflammation, no radiological translucency
- No prosthodontic failures
- no screw loosening, no decementation, no chipping

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**Pocket Depth (PD)**

<table>
<thead>
<tr>
<th>Tooth</th>
<th>OSC</th>
<th>mean</th>
<th>SD</th>
<th>IMP</th>
<th>mean</th>
<th>SD</th>
<th>mean diff.</th>
<th>p</th>
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<tbody>
<tr>
<td>14</td>
<td>2.25</td>
<td>0.24</td>
<td>13</td>
<td>2.42</td>
<td>0.08</td>
<td>0.69</td>
<td>0.009</td>
<td></td>
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<tr>
<td>15</td>
<td>2.3</td>
<td>0.4</td>
<td>12</td>
<td>2.3</td>
<td>0.25</td>
<td>0.81</td>
<td>0.127</td>
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<td>16</td>
<td>2.23</td>
<td>0.23</td>
<td>11</td>
<td>2.28</td>
<td>0.07</td>
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<tr>
<td>21</td>
<td>2.22</td>
<td>0.24</td>
<td>21</td>
<td>2.28</td>
<td>0.12</td>
<td>0.11</td>
<td>0.369</td>
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<tr>
<td>23</td>
<td>2.23</td>
<td>0.15</td>
<td>22</td>
<td>2.38</td>
<td>0.04</td>
<td>0.56</td>
<td>0.155</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>2.23</td>
<td>0.24</td>
<td>23</td>
<td>2.38</td>
<td>0.09</td>
<td>0.56</td>
<td>0.079</td>
<td></td>
</tr>
</tbody>
</table>

Means, SD and mean differences p between OSC-IMP tooth couples for Pocket Depth (PD); p*<0.05.

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**Gingival Recessions**

- In both groups gingival recessions did not exceed 2mm
- More frequent in OSC group* (χ² = 6.501,1; p= 0.0108*)

<table>
<thead>
<tr>
<th>OSC Rec</th>
<th>sites</th>
<th>mean</th>
<th>SD</th>
<th>IMP Rec</th>
<th>sites</th>
<th>mean</th>
<th>SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>tooth</td>
<td>n</td>
<td>mm</td>
<td>mm</td>
<td>tooth</td>
<td>n</td>
<td>mm</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>0.63</td>
<td>0.62</td>
<td>13</td>
<td>2</td>
<td>0.13</td>
<td>0.34</td>
<td>0.008*</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>0.13</td>
<td>0.5</td>
<td>12</td>
<td>3</td>
<td>0.25</td>
<td>0.58</td>
<td>0.518</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td>0.25</td>
<td>0.58</td>
<td>21</td>
<td>1</td>
<td>0.06</td>
<td>0.25</td>
<td>0.325</td>
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<tr>
<td>23</td>
<td>4</td>
<td>0.31</td>
<td>0.6</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.047**</td>
</tr>
<tr>
<td>24</td>
<td>5</td>
<td>0.56</td>
<td>0.96</td>
<td>23</td>
<td>2</td>
<td>0.13</td>
<td>0.34</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Significantly more recessions of OSC right first premolar & and left canine
No difference of overall severity between OSC and IMP

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**Distance Implant-Bone (DIB)**

At T2 a mean DIB of 0.33 mm increase was assessed.
No difference between the mesial and distal side.
Committee on Strategies for Small-Number-Participant Clinical Research Trials
Board on Health Sciences Policy

Small Clinical Trials: Issues and Challenges
The National Academies of Science, Engineering and Medicine, Washington D.C., 2001

1. Whenever feasible, clinical trials should be designed and performed so that they have adequate statistical power.

2. However, when the clinical context does not provide a sufficient number of research participants for a trial with adequate statistical power, but the research question has great clinical significance, research can still proceed under certain conditions.

3. Small clinical trials might be warranted for the study of rare diseases, unique study populations (e.g., astronauts), individually tailored therapies, in environments that are isolated, in emergency situations, and in instances of public health urgency.

4. However, the conclusions derived from such studies may require careful consideration of the assumptions and inferences, given the small number of participants.
Superior results compared to most existing studies evaluating post-extraction implants in the esthetic zone

- **PES** of 7.8 (SD 0.88) and **WES** of 6.9 (SD 1.47) after 3-4 years
  - Belser UC et al. J Periodontol 2009
- **PES** of 7.9 ± 1.7, **WES** 7.0 ± 1.5 after 1 year
  - Fucek E et al. Quintessence Int 2013
- Mean Sum **PES/WES** 14.4 after 6 years

**SUM** **PES/WES** of 14.44; SD 2.34 (range: 9-20) after 4 years

Slightly superior results compared to two studies reporting on 20 implants for congenitally missing maxillary lateral incisors

- **PES** 8.72 vs 8.35 without any grafting
- **WES** 8.91 vs 8.80

**SUM** **PES/WES** 17.63 vs 17.15


No matter which treatment approach is chosen, both require **a highly skilled and perfectly orchestrated team** and excellent long-term patient compliance for excellent and stable results.

And even then implant/prosthodontic or orthodontic failures can occur, which might be very cumbersome to recuperate.

Restoration/orthodontics related issues

- Restoration/Orthodontics related issues
  - Forsberg C.M. Eur J Orthod 1, 1979
  - Bondevik O. Angle Orthodontist 68/1, 1998
  - Thilander B., Eur J Orthod 31, 2009
  - infraocclusion
Infraocclusion ... or?

Wrong crown design

Loss of torque

Prosthodontic failure & orthodontic relapse

Although single-tooth implants in the esthetic zone can deliver comparable results to space closure in the middle term, if executed by a well-orchestrated and highly skilled team.

For situations where both approaches are applicable, orthodontic space closure is advantageous over implant-borne crowns, regarding the potential risk of infraocclusion over time.

Space closure vs implant-borne crowns for congenitally missing maxillary lateral incisors: Is there really anything new?