Prosthetic Rehabilitation of Maxillectomy Defects - Clinical Outcomes

Eleni D. Roumanas DDS

Division of Advanced Prosthodontics and Weintraub Center for Reconstructive Biotechnology
UCLA School of Dentistry

American Academy of Maxillofacial Prosthetics
Orlando, Florida
October 30 - November 2, 2010
Review a few key studies on outcomes of conventional prosthetic rehabilitation of maxillectomy patients

Results of our recent study on comparisons of functional and psychologic outcomes of conventional and implant retained maxillary prostheses
MAXILLARY DEFECTS

Functional Impairments:

- Speech production (Hypernasal)
- Swallowing
- Salivary control
- Mastication

Tx. Options:

- Obturator
- Surgical closure
Maxillary Defects

Outcome Measures:

- Speech Intelligibility
- Nasality
- Articulation
- Masticatory Function
- Deglutition
- Diet - regular vs. soft
- Type of dental restoration - potential
- Aesthetics
- Period of hospitalization
- Complications, morbidity
- Overall quality of life
Speech Intelligibility Following Prosthetic Obturation of Surgically Acquired Maxillary Defects

Majid A, Weiberg B & Chalian V
JPD July, 1974

Subjects: 6 completely edentulous maxillectomy pts. Tested w/ & w/o obturator

Outcomes: Speech Intelligibility (SI)
Pts. were recorded, standardized manner
Listeners – 15 college undergraduates, blinded, no prior training

Results: Mean intelligibility w/o obturator ranged from 58-62%
Mean intelligibility w/ obturator ranged from 92-98%

Conclusion: Maxfac tx is associated with highly intelligible speech for all type of speech stimuli
# Impact of Palatal Prosthodontic Intervention on Communication Performance of Patient’s Maxillectomy Defects: A Multilevel Outcome Study

Head & Neck  June 2002

<table>
<thead>
<tr>
<th>Subjects:</th>
<th>32 consecutively treated maxillectomy pts. obtained for at least 1 month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dentition status? Obturator retention?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcomes:</th>
<th>Speech Intelligibility (SI), recorded, 3 blinded judges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Speaking Rate</td>
</tr>
<tr>
<td></td>
<td>Nasality (0-7 pt. scale)</td>
</tr>
<tr>
<td></td>
<td>Communication Effectiveness CETI (self perception)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results:</th>
<th>W/o Obturator</th>
<th>W/ Obturator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SI</td>
<td>61%</td>
<td>94%</td>
</tr>
<tr>
<td>Speaking Rate</td>
<td>138</td>
<td>164 words/min</td>
</tr>
<tr>
<td>Nasality</td>
<td>5.8</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Communication Effectiveness: 75% to before cancer diagnosis
Maxillary Defects:

<table>
<thead>
<tr>
<th></th>
<th>Intelligibility</th>
<th>Hypernasality</th>
<th>CETI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intelligibility</strong></td>
<td>----</td>
<td>-.64</td>
<td>+.56</td>
</tr>
<tr>
<td><strong>Hypernasality</strong></td>
<td>----</td>
<td>----</td>
<td>-.80</td>
</tr>
<tr>
<td><strong>CETI</strong></td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
</tbody>
</table>

- as hypernasality increased, intelligibility decreased
- as intelligibility increased, communication effectiveness increased
- as hypernasality increased, communication effectiveness decreased ***strong negative correlation
Maxillary Defects:

Sullivan M et al. Head & Neck June 2002

- All groups (except for hard/soft palate defects) achieved intelligibility scores >95%.
  (81% is considered the cut off score for speakers to transfer information on verbal comprehension tasks, Beukelman & Yorkston)

Conclusions:

- Variations in effectiveness were noted based on the site of defect and patient satisfaction with the intervention

- Patient defects involving the complete soft palate, or defects compromising the retention of the prostheses, performed more poorly than other patients.
Speech Outcomes in Patients Rehabilitated with Maxillary Obturator Prostheses After Maxillectomy

Rieger J, Wolfaardt J, Seikaly H, & Jha N

Int J Prosthodont 2002

Subjects: 12 maxillectomy pts. <half hard palate, >half hard palate, hard & soft palate

Data collection- preoperative, w/o obturator, w/ obturator

Outcomes: Nasalance (Acoustic and Aerodynamic measures)
Speech intelligibility

Results: Speech w/o obturator is significantly different from preop
Speech w/ obturator not significantly different from preop

Pts. with soft palate involvement exhibited significantly poorer nasalance values but this did not affect their intelligibility
### Mean & Standard Deviations for Nasalance(%) & Speech Intelligibility(%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>&lt; ½ hard palate only</th>
<th>&gt; ½ hard palate only</th>
<th>hard &amp; soft palate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Nasalance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative w/ obturator</td>
<td>10</td>
<td>2.5</td>
<td>11</td>
</tr>
<tr>
<td>Preoperative w/o obturator</td>
<td>12</td>
<td>8.6</td>
<td>13</td>
</tr>
<tr>
<td>w/o obturator</td>
<td>49</td>
<td>8.2</td>
<td>59</td>
</tr>
<tr>
<td><strong>Sentence Intelligibil.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative w/ obturator</td>
<td>98</td>
<td>1.0</td>
<td>99</td>
</tr>
<tr>
<td>Preoperative w/o obturator</td>
<td>97</td>
<td>3.7</td>
<td>98</td>
</tr>
<tr>
<td>w/o obturator</td>
<td>66</td>
<td>26.1</td>
<td>40</td>
</tr>
</tbody>
</table>
Subjects: 47 subjects, telephone interview
Maxillectomy defect w/ obturator, ave. 5.2 yrs ago (SD 2.4)
94% had some soft palate resection
66% partially edentulous

Measures: Obturator Functioning Scale (OFS)
Psychosocial Adjustment to Illness Scale (PAIS)
Mental Health Inventory (MHI)
Impact of Event Scale
Family Functioning Scale

Results: Satisfactory functioning of the obturator was the most highly significant predictor of adjustment (p<.0001)

-The most significant predictors of obturator functioning was the extent of resection of their soft palate (1/3 or less, p<.001), and hard palate (1/4 or less, p<.01)
Clinical Assessment of Chewing Function of Obturator Prosthesis Wearers By Objective Measurement of Masticatory Performance and Maximum Occlusal Force

Matsuyama M, Tsukiyama Y, Tomioka M, Koyano K
Int.J Prosthodent 2006

Subjects: 20 maxillectomy patients with conventional obturator (most had residual dentition on the non-defect side)
20 dentate controls

Measures: Masticatory performance (free chewing)
Maximum bite force

Results: Masticatory performance did not differ between controls and maxillectomy group

Maximum Bite force was a poor predictor of performance

Conclusions: The presence of critical residual dentition, combined with a well functioning obturator leads to effective masticatory performance
Effects of defect configuration, size, and remaining teeth on masticatory function in post-maxillectomy patients

Koyama S, Sasaki K, Inai T, and Watanabe M.
J Oral Rehab. 2005

Subjects: 50 consecutive post-maxillectomy
26 dentate, 24 edentulous

Measures: Defect size (ratio of defect area/horizontal impression area)
Defect configuration (Aramany classification)

Results: Presence of teeth and defect configuration had significant correlation with masticatory function.

No significant correlation between the number of teeth or the size of the defect area in the dentate group.

Masticatory performance score and the size of the defect area were significantly correlated in the edentulous group.
### Efficacy of Implant-Supported Maxillofacial Prostheses

<table>
<thead>
<tr>
<th>Investigators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neal Garrett, PhD(PI)</td>
</tr>
<tr>
<td>Krishan Kapur, D.M.D.</td>
</tr>
<tr>
<td>Earl Freymiller, M.D., D.D.S.</td>
</tr>
<tr>
<td>Keith Blackwell, M.D.</td>
</tr>
<tr>
<td>Elliot Abemayor, M.D.,PhD</td>
</tr>
<tr>
<td>Eleni Roumanas, DDS(Co-PI)</td>
</tr>
<tr>
<td>John Beumer, D.D.S., MS</td>
</tr>
<tr>
<td>Bruce Garrett, PhD</td>
</tr>
<tr>
<td>Gerald Burke M.D.</td>
</tr>
<tr>
<td>Weng Kee Wong, Ph.D.</td>
</tr>
</tbody>
</table>

Supported by NIDR Grant 1RO1DE11255
Primary Aim:
To determine whether or not conventional or implant-retained dental prostheses and current surgical reconstructive procedures restore patient’s oral functions and quality of life to their status just prior to the ablative oral cancer surgery.

Study Design: Prospective, Longitudinal (within subject control)
With this design each pt. acts as his/her own control.
Primary Hypotheses:

- Conventional dental prostheses (CP) and implant-retained dental prostheses (IP) restore specified oral functions and oral perceptions to the levels prior to cancer surgery.

- Conventional (CP) and implant-retained (IP) dental prostheses are equally effective in restoring specified oral functions and perceptions.
**Exclusion Criteria**

- Unable to perform tests due to lesion size or restrictive opening
- >55 Gy radiation at potential implant sites
- Remaining dentition in the maxilla, post-surgery (all edentulous)
- Insufficient bone to accommodate >10mm implants

**Treatment Failure Criteria**

- Patient does not utilize the prosthesis frequently during eating
- IP becomes tissue-supported due to implant loss
Efficacy of Implant-Retained Maxillary Obturators

- Maxillectomy, edentulous and restoration with obturator (CP)
- Implants placed (3-4)
- Restored with a tissue bar w/ 2 ERAs
- Implant-retained obturator (IP)
Treatment and Testing Protocol

Entry Data Collection (pre-surgical)

Post-Surgical (PS) Data Collection

Conventional Prosthesis (CP) Data Collection

Implant Prosthesis (IP) Data Collection

1-7 days 16-24 weeks (depending on healing, complications, need for radiation therapy)

1-4 weeks 4 months

6 months 1-3 months 4 months

Ablative and Reconstructive Surgery

Conventional Prosthesis Insertion

Phase I Implant Surgery

Phase II Implant Surgery

Implant-Supported Prosthesis Insertion

4-6 months post-reconstructive surgery (could occur before CP intervals)
Efficacy of Implant-Supported Maxillofacial Prostheses

Examinations & histories:
- Medical & Social history
- Orofacial & dental exams, study casts, radiographs
- One week dietary log

Objective assessments (Physiological)
- Masticatory Performance (Key Variable)
- Swallowing Threshold
- Oral Clearance
- Stereognosis, Two-point discrimination thresholds, Tactile threshold
- Salivary secretion rates, parotid gustatory response
- Maximum Bite Force, Masseter EMG during chewing, mandibular movements

Subjective Assessment (Psychological)
- Overall Pt. Satisfaction, Chewing Preference, Food Preference Questionnaires
- Facial Attractiveness (panel)
- Speech naturalness evaluation
Entry Characteristics

Male (N) 10
Female (N) 10
Age (\( \bar{X} \) years) 69.1
Age Range (years) 43-89
\% + Smoking 75\%
Disease Status

Primary Tumor  14
Recurrent Tumor  6
Total  20
Maxillary Defect Classification

Palatal defect description (Aramani classification):

Class I - Total Maxillectomy
(0 = No, 1 = Yes)

Class Ia - Total Maxillectomy + Soft Palate
(1 = SP¼, 2 = SP½, 3 = SP¾, 4 = SPlotal)

Class II - Partial Maxillectomy
(0 = No, 1 = Yes)

Class IIa - Partial Maxillectomy + Soft Palate
(1 = SP¼, 2 = SP½, 3 = SP¾, 4 = SPlotal)

Class III - Palatectomy
(0 = No, 1 = Yes)

Class IIIa - Palatectomy + Soft Palate
(1 = SP¼, 2 = SP½, 3 = SP¾, 4 = SPlotal)

Class IV - Total Maxillectomy Crossing Midline
(0 = No, 1 = Yes)

Class IVa - Total Maxillectomy Crossing Midline + Soft Palate
(1 = SP¼, 2 = SP½, 3 = SP¾, 4 = SPlotal)

Class V - Posterior Maxillectomy
(0 = No, 1 = Yes)

Class Va - Posterior Maxillectomy + Soft Palate
(1 = SP¼, 2 = SP½, 3 = SP¾, 4 = SPlotal)

Class VI - Total Maxillectomy
(0 = No, 1 = Yes)
## Distribution of Maxilla Defects (Aramany classification)

<table>
<thead>
<tr>
<th>Classification</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I - Total Maxillectomy</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>II – Partial Maxillectomy</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>III – Palatectomy</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>VI – Total Anterior Maxillectomy</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Soft Palate Defect</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
Efficacy of Implant-Retained Maxillary Prostheses

Enrolled: 20 pts

Expired, recurrent/metastatic dz. = 4 pts. > 32%
Alive, recurrent/metastatic dz. = 3 pts.

Implants refused = 3 pts. > 18%
Withdrawn (other reasons) = 1 pts

Total = (11/20) 55%

15/20 CP (75%) delivered (12 tested – 60%)
Only 5/20 (25%) made it to IP

High subject loss prior to IP delivery
- Limited number of implant sites
- Higher implant failures in irradiated maxilla
Masticatory Tests

- Three portions, 3 grams each, for each test with peanuts on the defect and non-defect chewing side

- Subject chews each portion on the specified side for 20 strokes
Recovered particles were separated by U.S. standard sieves (4.0, 1.7, 0.85 and 0.425 mm) and volumes were determined.

- **Fine particles** were defined as smaller than 1.7 mm for peanuts.

Masticatory performance scores calculated as the ratio of fine particles to the total volume of recovered food, and expressed as a percent.
<table>
<thead>
<tr>
<th>DENTITION STATUS</th>
<th>PERFORMANCE %</th>
<th>STROKES #</th>
<th>EFFICIENCY %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Dentition (32)</td>
<td>88</td>
<td>12</td>
<td>166</td>
</tr>
<tr>
<td>Excluding 3\textsuperscript{rd} molars (28)</td>
<td>78</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>(Standard Performance)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing 3\textsuperscript{rd} + 1\textsuperscript{st} or 2\textsuperscript{nd} molar (26)</td>
<td>55</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>Denture Wearer</td>
<td>35</td>
<td>86</td>
<td>23</td>
</tr>
</tbody>
</table>
**Masticatory Performance**

\[ N=12 \]

(‘0’ score if not able to chew)

<table>
<thead>
<tr>
<th>Interval</th>
<th>Defect</th>
<th>Intact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>Post-Surgery</td>
<td>3.7</td>
<td>6.5</td>
</tr>
<tr>
<td>Post-CP</td>
<td>7.3</td>
<td>12.7</td>
</tr>
</tbody>
</table>

*No significant difference across intervals*
Masticatory Performance

N=5

(‘0’ score if not able to chew)

% performance

* p<0.01

Defect
Intact
### Frequency Distribution of Subjects Able to Chew

<table>
<thead>
<tr>
<th></th>
<th>Entry</th>
<th>Post-Surg</th>
<th>Post-CP</th>
<th>Post-IP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Defect Side</strong></td>
<td>25%</td>
<td>17%</td>
<td>42%</td>
<td>100%</td>
</tr>
<tr>
<td>(3/12)</td>
<td>(2/12)</td>
<td>(5/12)</td>
<td>(5/5)</td>
<td></td>
</tr>
<tr>
<td><strong>Non-defect Side</strong></td>
<td>33%</td>
<td>25%</td>
<td>67%</td>
<td>100%</td>
</tr>
<tr>
<td>(4/12)</td>
<td>(3/12)</td>
<td>(8/12)</td>
<td>(5/5)</td>
<td></td>
</tr>
</tbody>
</table>
Patient Satisfaction Questionnaire Items

- Do you experience any discomfort when you chew?
  1. I experience no discomfort when chewing
  2. I experience slight discomfort when chewing
  3. I experience moderate discomfort when chewing
  4. I experience great discomfort when I chew

- Chewing, food choices, taste, difficulty with food particles

- Speech, odor, cleaning, drooling, dryness, facial appearance, social life

- Security and satisfaction with dentures
## Mean Patient Satisfaction at Each Interval

*(n=12 to 5)*

<table>
<thead>
<tr>
<th>Question</th>
<th>Entry</th>
<th>Post-Surg.</th>
<th>Post-CP</th>
<th>Post-IP</th>
<th>Fisher Exact P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chewing comfort</td>
<td>2.3</td>
<td>2.3</td>
<td>2.4</td>
<td>2.3</td>
<td>0.84</td>
</tr>
<tr>
<td>Chewing ability</td>
<td>2.8</td>
<td>2.7</td>
<td>2.5</td>
<td>2.0</td>
<td>0.78</td>
</tr>
<tr>
<td>Eating enjoyment</td>
<td>1.8</td>
<td>1.8</td>
<td>1.6</td>
<td>1.5</td>
<td>0.34</td>
</tr>
<tr>
<td>Food choice</td>
<td>2.9</td>
<td>2.9</td>
<td>2.5</td>
<td>2.0</td>
<td>0.58</td>
</tr>
<tr>
<td>Social life</td>
<td>2.5</td>
<td>1.9</td>
<td>1.9</td>
<td>1.8</td>
<td>0.92</td>
</tr>
<tr>
<td>Particle under tongue</td>
<td>1.6</td>
<td>1.7</td>
<td>1.9</td>
<td>1.5</td>
<td>0.91</td>
</tr>
<tr>
<td>Particle inside cheeks</td>
<td>1.6</td>
<td>2.1</td>
<td>2.7</td>
<td>2.0</td>
<td>0.28</td>
</tr>
</tbody>
</table>
# Mean Patient Satisfaction at Each Interval

\( n=12 \text{ to } 5 \)

<table>
<thead>
<tr>
<th>Question</th>
<th>Entry</th>
<th>Post-Surg.</th>
<th>Post-CP</th>
<th>Post-IP</th>
<th>Fisher Exact P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect on taste</td>
<td>1.5</td>
<td>2.0</td>
<td>1.7</td>
<td>2.3</td>
<td>0.69</td>
</tr>
<tr>
<td>Effect on speech</td>
<td>1.7</td>
<td>2.2</td>
<td>1.8</td>
<td>2.3</td>
<td>0.46</td>
</tr>
<tr>
<td>Mouth odor</td>
<td>2.0</td>
<td>1.3</td>
<td>1.4</td>
<td>1.3</td>
<td>0.40</td>
</tr>
<tr>
<td>Ease cleaning</td>
<td>1.3</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Cleanliness satisfaction</td>
<td>2.6</td>
<td>3.3</td>
<td>1.1</td>
<td>1.3</td>
<td>0.52</td>
</tr>
<tr>
<td>Appearance</td>
<td>2.3</td>
<td>2.3</td>
<td>1.9</td>
<td>1.8</td>
<td>0.78</td>
</tr>
<tr>
<td>Appearance/social life</td>
<td>1.7</td>
<td>1.6</td>
<td>1.4</td>
<td>1.3</td>
<td>1.00</td>
</tr>
</tbody>
</table>
### Mean Patient Satisfaction at Each Interval (n=12 to 5)

<table>
<thead>
<tr>
<th>Question</th>
<th>Entry</th>
<th>Post-Surg.</th>
<th>Post-CP</th>
<th>Post-IP</th>
<th>Fisher Exact P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryness</td>
<td>1.8</td>
<td>2.6</td>
<td>2.4</td>
<td>2.5</td>
<td>0.60</td>
</tr>
<tr>
<td>Drooling</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
<td>1.0</td>
<td>0.82</td>
</tr>
<tr>
<td>Denture use for eating</td>
<td>1.9</td>
<td>1.3</td>
<td>1.3</td>
<td>1.0</td>
<td>0.45</td>
</tr>
<tr>
<td>Security with dentures</td>
<td>1.4</td>
<td>2.1</td>
<td>2.0</td>
<td>1.5</td>
<td>0.95</td>
</tr>
<tr>
<td>Satisfaction with dentures</td>
<td>2.3</td>
<td>2.9</td>
<td>2.0</td>
<td>1.3</td>
<td>0.83</td>
</tr>
</tbody>
</table>
Discussion

- **Greater sample size** would permit an increase in number of participants completing both CP and IP, resulting in greater ability to evaluate **subgroups** of patients. (defect size, expand to include other dentition categories…)

- The **within subjects design** without randomization of treatment order creates an effect of **longer adaptation** period to the surgical intervention at the time of evaluation of the IP compared to CP
Impairment in masticatory ability remains following treatment with both interim and definitive CP.

The CP can provide some improvement in chewing ability, but just to the compromised functional level prior to surgical intervention.

The IP provides greater retention and stability of the prosthesis leading to improved utilization for mastication and superior performance on both defect and non-defect sides compared to the CP.

With the IP, the improvement was restored to the level seen in conventional edentulous patients restored with implant supported dentures.
Conclusions

- No significant differences were seen in patient perceptions of prosthesis function or satisfaction.

  However, subjects completing IP treatment reported improved chewing ability and overall satisfaction with the prosthesis (limited sample).

- Significant loss of participants due to recurrent disease or death before prosthetic restoration can be completed indicates that this outcome must be considered in deciding the timing of implant prosthetic procedures.
Three key thoughts....

- Small sample sizes – limited confidence of results
- Implant support makes a difference in masticatory function (at least in the edentulous maxilla)
- High recurrence and metastasis rates – limited people receive the advantage
Recognition of Support

- National Institute of Dental and Craniofacial Research, Grant R01DE11255
- National Center for Research Resources, Grant CO6 RR-14529
- Weintraub Center for Reconstructive Biotechnology
- UCLA Maxillofacial Prosthetics
UCLA
1929 - 2010