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## ALVEOLAR CLEFT REPAIR

## History of Alveolar Repair

- Management with bone grafting first described in the early 20<sup>th</sup> century
  - Lexer 1908, Drachter 1914
- 50 years passed without any progress
- Mid 1950's increase in primary bone grafting
- 1960's: Increasing evidence primary bone grafting had negative impact on growth
- 1970's: Secondary bone grafting introduced by Boyne/Sands and becoming treatment of choice
- 1980-90's: Continued research in donor sites, alveolar molding, GPP, growth and overall outcomes
- Early 21<sup>st</sup> Century: rhBMP-2, Stem cells, implants

## The Alveolar Defect

- Skeletal
  - Collapse and rotation of the maxillary segments
  - Cleft in alveolus to piriform rim
- Soft Tissue
  - Lack of attached tissue
  - Absent gingival anatomy
  - Oral-nasal fistula
- Dental
  - Missing permanent teeth
  - Malformed teeth
  - Supernumerary teeth
  - Impacted teeth

## Goals Of Alveolar Repair

### Success Defined By:

- 1 Grafting must achieve stability of the arch and prevent collapse of the alveolar segments
- 2 Grafting must preserve the health of the dentition and maintain bony support of teeth adjacent to the cleft
- 3 Grafting must restore continuity not only of the alveolus but also the anterior hard palate and the maxilla at the piriform rim (support for alar base)
- 4 Grafting must support the soft tissue closure of the oronasal fistula
- 5 Grafting must have adequate volume of bone matrix for erupting teeth in the line of the cleft, and for orthodontic movement of the involved teeth into appropriate "nontorqued" position in the dental arch
- 6 Grafting must allow for the successful placement of dental implant(s)

Tai et al. J Oral Maxillofac Surg 58:1241-1249, 2000

## Timing of Repair

- Early
  - Gingivo-perioplasty (with primary lip and/or palate)
  - Primary bone grafting (abandoned)
- Secondary (Traditional)
  - Age 7-13
  - Autogenous Bone v rhBMP-2
- Tertiary Repair (Late)
  - After completion of growth
  - With or without maxillary orthognathic surgery
  - ICBG with and without rhBMP2
- Completion of Repair
  - Bone and soft tissue repair
  - Dental implant placement

## Early Repair

- Gingivoperioplasty
  - Originally described in 1965 by Skoog
    - Skoog, T. The use of periosteal flaps in the repair of clefts of the primary palate. *Cleft Palate Craniofac. J.* 2: 232, 1965.
  - Advanced by Millard, Latham, Grayson
  - Closes the alveolus with the lip and/or palate
    - Combined with dentofacial orthopedic techniques to reduce the cleft width
      - NAM, Latham, Tapping, Lip Adhesion

## Gingivoperioplasty

- Success
  - Quantity of bone
  - Quality of bone
  - Normal eruption of permanent dentition
  - Elimination of fistula
- Effect on Growth
  - Dental arch
  - Maxillary
  - Facial

## Gingivoperioplasty

- Success on Bone Formation – Unilateral Clefts
  - 60% of GPP cases did not need secondary grafting  
Santiago Cleft Palate–Craniofacial Journal, January 1998, Vol. 35 No. 1
  - 73% of GPP cases did not need secondary grafting  
Sato, Plast. Reconstr. Surg. 121: 1356, 2008
  - Higher incident of secondary grafting needed in the bilateral cleft cases.
    - 66% need secondary grafts  
Santiago Cleft Palate–Craniofacial Journal, January 1998, Vol. 35 No. 1

## Gingivoperioplasty

- Success on Fistula Outcome
  - Overall GPP nearly eliminates fistula
  - GPP eliminates fistula in every case in one study  
Sato, Plast. Reconstr. Surg. 121: 1356, 2008

## Gingivoperioplasty

- Effect on Growth
  - Early GPP (Skoog)
    - Conclusive: Negative Impact
  - Millard and Latham
    - Somewhat inconclusive
      - Patient follow-up, number of patients, etc
  - Grayson
    - No negative growth outcomes
  - Matic
    - Potential for growth attenuation

## Gingivoperioplasty

- Effect on the Dentition – Quite Variable

|   |  |
|---|--|
| <p><b>Negative Outcomes</b></p> <ul style="list-style-type: none"> <li>▪ Missing primary teeth and alteration in eruption</li> <li>▪ Missing permanent central incisors and higher rate of missing lateral incisors</li> <li>▪ Malformed teeth</li> </ul> | <p><b>Positive Outcomes</b></p> <ul style="list-style-type: none"> <li>▪ Normalized eruption of primary teeth</li> <li>▪ No difference in number of missing teeth</li> <li>▪ Better periodontal health and support for permanent teeth adjacent to the cleft</li> <li>▪ Stabilized arches</li> </ul> |
|---|--|

## Gingivoperioplasty

- Overall
  - Holds promise for superior alveolar repair
  - Requires a *dedicated and well trained team* for best results
  - Surgeon dependent – technique sensitive

## Secondary Bone Grafting

Current preferred method of repair

- Timing
  - Early
    - Age 7-9: At the time of central incisor eruption
  - Late
    - Age 9-11: Canine root 2/3<sup>rd</sup>s formed
- Autogenous Donor Sites
  - Iliac Crest                    » Rib
  - Cranium                      » Tibia
  - Mandible
- rhBMP-2

## Secondary Bone Grafting

Donor Sites – Autogenous Bone

- Iliac Crest Bone Graft
  - Boyne 1972 – first introduction of secondary graft
  - Considered the “Gold Standard”
- Mandibular Bone Graft
  - Bosker 1980
- Cranial Bone Graft
  - Tessier 1982
  - J.D. Smith 1973

## Difference in Graft Donor Sites

| ICBG                    | Mandible                | Cranial                 |
|-------------------------|-------------------------|-------------------------|
| ▪ Visible scar          | ▪ No visible scar       | ▪ Visible scar          |
| ▪ Pain                  | ▪ Pain                  | ▪ Less pain             |
| ▪ Gait disturbance      | ▪ No gait issues        | ▪ No gait issues        |
| ▪ Second surgical field | ▪ Single surgical field | ▪ Single surgical field |
| ▪ Reliable quantity     | ▪ Quantity?             | ▪ Reliable quantity     |
| ▪ Reliable quality      | ▪ Reliable quality      | ▪ Reliable quality      |
| ▪ Reliable success      | ▪ Reliable success      | ▪ Successful            |

Cleft Palate-Craniofacial Journal, March 2001, Vol. 38 No. 2      PLASTIC AND RECONSTRUCTIVE SURGERY, September 1991  
Vol. 96, No. 4 / ILIAC AND CRANIAL BONE GRAFTING

## Secondary Bone Grafting

Considerations...

- Impact on Growth
  - Timing of the graft important
  - Operative technique?
- Selection criteria?
  - Significant growth retardation – need orthognathic surgery – wait to graft?
  - Absence of lateral incisor/impacted canine – wait to graft?
  - Large, unfavorable clefts – 2 stage repair? Single stage with tongue flap?

## Secondary Bone Grafting

- Further Topics of Consideration
  - Flap design – degree of periosteal elevation
  - BCLCP – stage repair?
  - Splinting post repair
  - Dressing
  - PO diet
  - Antibiotics

## Secondary Bone Grafting

### Facial Growth Outcomes in the Grafted Patient

-  Ross (1987) – multicenter comparison of UCLCP grafted patients age 4-10
  - Marked deficiency in anterior upper-facial height compared to non-grafted patients at age 15
  - Grafted group age 9-12 showed no difference in non-grafted group.
  - Confounded study
-  Brättstrom et al (1992) – comparison of 85 UCLCP pts with primary graft, secondary graft, and no graft
  - Primary – poor growth
  - Secondary – after incisors before canine had better growth
  - Non-grafted patients had the best growth

## Secondary Bone Grafting

### Facial Growth Outcomes in the Grafted Patient

-  Semb (1988) — National Center of Logopedics, Oslo, Norway
  - no difference in growth among UCLCP children grafted between the ages of 8 and 12 compared to non-grafted patients

## The CLEFT PALATE-CRANIOFACIAL Journal

### Effect of Alveolar Bone Grafting in the Mixed Dentition on Maxillary Growth in Complete Unilateral Cleft Lip and Palate Patients

John Daskalogiannakis, D.D.S., M.Sc.

R. Bruce Ross, D.D.S., M.Sc.

The Cleft Palate-Craniofacial Journal: Vol. 34, No. 5, pp. 455-458. 1997



## The CLEFT PALATE-CRANIOFACIAL Journal

- Grafted group: 8.4-12.9yrs (10.3)
- Lateral cephs taken pre-grafting and 5-6years post grafting

John Daskalogiannakis, D.D.S., M.Sc.

R. Bruce Ross, D.D.S., M.Sc.

The Cleft Palate-Craniofacial Journal: Vol. 34, No. 5, pp. 455-458. 1997

## Conclusions

- Secondary bone grafting in the UCLCP patient in the age range 8-13yrs of age does not seem to negatively impact the vertical or AP maxillary growth and development.

John Daskalogiannakis, D.D.S., M.Sc.

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## Secondary Bone Grafting

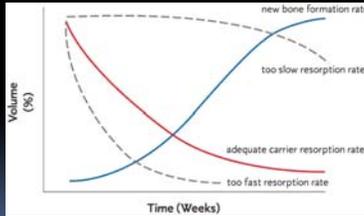
- rhBMP-2
  - Recombinant Human Bone Morphogenic Protein 2
  - First discovered in 1965 by Dr. Marshall Urist
  - Now available for clinical use via Medtronic as Infuse® Bone Graft

## rhBMP-2

- Growth Factor
  - From the superfamily TGF-B
  - Several different BMPs induce bone formation
    - 2, 4, 7
- BMP-2 acts early in the cascade of events and directly triggers mesenchymal cells to become osteoblasts

## rhBMP-2

- The bovine ACS (absorbable collagen sponge) is important for the clinical effects of BMP-2. Binds 95% in 15 minutes. Elutes the BMP-2 for 8-10 days. Fully resorbed in 4-10 weeks.



Release kinetics studies show that the ACS releases bound rhBMP-2 in a time period optimal for bone formation

Oral and Maxillofacial Surgery

## rhBMP-2

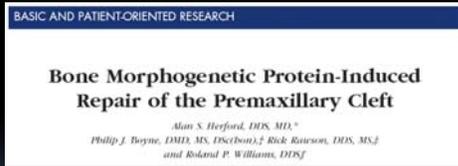
### Important steps to success

- Create appropriate space for rhBMP 2 + ACS
  - The ACS cannot maintain the space alone
- Must ensure access to cells
  - Periosteum
  - Adjacent bleeding bone
- Proper preparation of the material

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## rhBMP-2

- The Science in Alveolar Clefts



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*J Oral Maxillofac Surg* 65:2136-2141, 2007

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## rhBMP-2

### Average Bone Fill

- ICBG: 78% bone fill
- rhBMP-2: 72% bone fill

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## rhBMP-2

- Benefits
  - Eliminates need for second (donor) surgical site
  - Eliminates donor site morbidity
  - Decreased OR time
  - Decreased hospital LOS
  - Decreased health care cost

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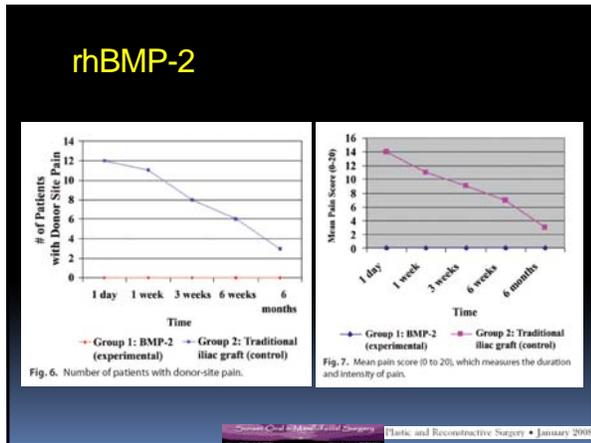
## rhBMP-2

### Reduced Morbidity and Improved Healing with Bone Morphogenetic Protein-2 in Older Patients with Alveolar Cleft Defects

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 Rebekah K. Ashley, B.S.,  
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### rhBMP-2

|                           | Outpatient Status* | Length of Stay (days)† | Cost‡    |
|---------------------------|--------------------|------------------------|----------|
| Group 1: BMP-2            | 78% (7/9)          | 0.4 ± 0.4              | \$11,100 |
| Group 2: Iliac bone graft | 0% (0/12)          | 1.8 ± 0.8              | \$27,800 |

\*The percentage of patients discharged on the same day as surgery.  
 †Mean cost based on surgeon, facility, and anesthesia fees.

### Effective Alternative to ICBG

Conclusions are the same as JOMS 2007

- Eliminates need for second (donor) surgical site
- Eliminates donor site morbidity
- Decrease in surgical site complications
- Decreased OR time
- Decreased hospital LOS
- Decreased health care cost

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### Long-term follow-up of dental implants placed in a grafted alveolar cleft: evaluation of alveolar bone height

Tetsu Takahashi, DDS, PhD,<sup>1</sup> Tetsuji Inai, DDS, PhD,<sup>2</sup> Shoko Kochi, DDS, PhD,<sup>3</sup> Masayuki Fukuda, DDS, PhD,<sup>4</sup> Tai Yamaguchi, DDS, PhD,<sup>5</sup> Keiko Matsui, DDS, PhD,<sup>6</sup> Seishi Echigo, DDS, PhD,<sup>6</sup> and Makoto Watanabe, DDS, PhD,<sup>6</sup> Kitakyushu, Sendai, and Akita, Japan  
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(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:297-302)

- Retrospective study
- 23 implants placed in 21 patients
  - 5 patients not eligible for inclusion
- 16 patients (8 male, 8 female)

Oral Surgery, Oral Medicine, Oral Pathology, and Endodontology

Plastic and Reconstructive Surgery • January 2009

### Secondary Soft Tissue Management

- Keratinized grafting in cleft site
  - Improve peri-implant tissue health
- Scar revision
  - Improve vestibule characteristics
- Connective tissue grafting
  - Improve prosthetic appearance

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