Conventional Surgical Techniques and Emerging Transplantation in Complex Penile Reconstruction.

American Society of Plastic Surgical Nurses
42nd Annual Convention 2016

Presented by: Name goes here
October 12, 2016
Disclosures

• I have no actual or potential conflict of interest in relation to this program/presentation.
Goals

• Discuss complex adult and adolescent penile reconstruction
• Discuss the role genital transplantation may play in reconstruction
JHH Pediatric Urology
Bladder and Cloacal Exstrophy

John Gearhart, Ranjiv Mathews, Yegappan Lakshmanan, Heather Di Carlo
Bladder Exstrophy-Epispadias Complex

Penis shortened, flattened, glans splayed, complete epispadius
Bladder Exstrophy-Epispladias Complex

- 1/30,000-50,000
- Premature rupture of the cloacal membrane
- Bladder exposed and everted,
- severe penile deformity
- Pelvic bones separated
- Urethral opening proximally on dorsum of penis
- The anterior corporal length is 50% shorter
- Bladder pelvic closure - 24-72 hrs after birth
- Epispadias - 6-12 months
Bladder Exstrophy-Epispadias Complex
Cloacal Exstrophy

- 1:250,000 births
- phallus is also separated into two halves along with the scrotum
- significant diastasis of the pubic symphysis
- prolapse of the ileum and the handgut is blind ending
- hindgut and cecum is exstrophied between two halves of the bladder
Cloacal Exstrophy
Bladder and Cloacal Exstrophy

• More common in males
• 60-70% of males with bladder exstrophy have penile insufficiency and/or ambiguous genitalia
• JHH cares for >1000 BE/CE patients
Bladder Exstrophy-Epispadias Complex and Cloacal Exstrophy
Gender Conversion During Infancy
Discordant Sexual Identity in Some Genetic Males with Cloacal Exstrophy Assigned to Female Sex at Birth

William G. Reiner, M.D., and John P. Gearhart, M.D.

Table 2. Sexual Identity of the 16 Subjects.

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Age at Initial Assessment yr</th>
<th>Sex Assigned at Birth</th>
<th>Sex at Initial Assessment</th>
<th>Sex at Last Follow-up</th>
<th>Age at Last Follow-up yr mo</th>
<th>Duration of Follow-up yr mo</th>
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<td>1</td>
<td>11</td>
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<td>F</td>
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<td>16</td>
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<td>F</td>
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<td>9</td>
<td>38</td>
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<tr>
<td>6</td>
<td>10</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>Would not discuss</td>
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<td>7</td>
<td>9</td>
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<td>Declared M</td>
<td>Unclear</td>
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<td>8</td>
<td>9</td>
<td>F</td>
<td>Declared M</td>
<td>Unclear</td>
<td>14</td>
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<tr>
<td>9</td>
<td>12</td>
<td>F</td>
<td>M</td>
<td>M</td>
<td>21</td>
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<tr>
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<td>F</td>
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<td>M</td>
<td>11</td>
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<tr>
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<td>F</td>
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<td>M</td>
<td>10</td>
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<td>F</td>
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<td>M</td>
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<td>F</td>
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<td>M</td>
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<td>16</td>
<td>5</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>12</td>
<td>83</td>
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</table>

* The subject spontaneously declared male sexual identity.
† The subject’s parents rejected his declaration of male sex.
Loss of penis or significant genital deformity will significantly influence men’s perceptions of themselves and their masculinity and ability to have a relationship.

Gender Reaffirmation
Goals of Penile Reconstruction

1. Cosmetic Appearance – Penis and Donor site
2. Voiding Function – Competent Neourethra
3. Sexual Function – Intercourse, Tactile and Erogenous Sensation
4. Improved Psychosocial Function
Bladder Exstrophy

- 15 yo male with BE
- Complete epispidius
- Multiple surgeries
- Ambiguous genitalia
- Continent umbilical stoma
Reconstructive Ladder

• Vascularized composite allotransplantation (VCA)
• Free flap
• Local flap
• Local tissue transfer
• Tissue expansion
• Skin graft
• Primary closure
• Secondary healing

Complex

Simple

October 12, 2016
State of the Art 2016

Microvascular reconstruction of complex penile defects using flaps

Traumatic, Congenital and Oncologic Complex Penile Defects
Microvascular Penile Reconstruction
Phalloplasty Flap Options

ALT

RFFF

TDAP

October 12, 2016
Anterolateral Thigh Flap (ALT)
Thoracodorsal Artery Perforator Flap (Tdap)
• Radial Forearm Free Flap
Radial Forearm Free Flap Phalloplasty
Phalloplasty in Complete Aphallia and Ambiguous Genitalia

Rachel Bluebond-Langner, M.D.,¹ and Richard J. Redett, M.D.¹

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Phalloplasty in Complete Aphallia and Ambiguous Genitalia

Rachel Bluebond-Langner, M.D.,¹ and Richard J. Redett, M.D.¹
Phalloplasty in Complete Aphallia and Ambiguous Genitalia

Rachel Bluebond-Langner, M.D., and Richard J. Redett, M.D.
Release and FTSG

Local Flaps

Free Flap

Transplant?
Bladder Exstrophy
Bladder Exstrophy
Cloacal Exstrophy
Cloacal Exstrophy
Exstrophy
Release and skin grafts

Local Flaps

Free Flap

Transplant?
2.0 – 2.5 cms
Urethral Reconstruction

14 Fr Foley
Urethral Reconstruction
Trauma
Penile Cancer
• Tattooing at 3 months
• Implant at 12 months
10 Years Later

- Have we met the goals of the reconstruction?
Outcomes

• Aesthetics
• Sensation
• Voiding
• Intercourse
Outcomes

• Aesthetics
Aesthetics: B → B+
Outcomes

• Sensation
• 10 bladder and cloacal exstrophy patients reconstructed with RFFF
• 100% protective sensation
• 100% orgasm
Good return of sensitivity
  – 100% orgasm
  – 100% tactile sensitivity
Good aesthetics
No functional loss at donor site
Outcomes

- Sensation: B+ → A-
Outcomes

• Voiding
• Intercourse
Problems

- Implant (IPP) – for erection
- Urethra
10 patients
All reconstructed with RFFFP
Bladder exstrophy, cloacal exstrophy, DSD, ballistic trauma
IPP (AMS 700 CXR (Minnetonka, MA) or Coloplast (Minneapolis, MN)) placed 22.1 (average) months following RFFFP
Results

- The combined complication rate (erosion or infection or both) was five out of nine (55.6%).
- No patient had mechanical functional failure of the device.
- At the last follow-up, six patients possess stable, intact devices.
Penile Reconstruction: Is the Radial Forearm Flap Really the Standard Technique?


Table 2. Complications

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>No.</strong></td>
<td>287</td>
<td>59</td>
<td>62</td>
<td>167</td>
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<tr>
<td><strong>Flap-related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Anastomotic revision</td>
<td>34 (12)</td>
<td>8 (13.6)</td>
<td>7 (11.2)</td>
<td>19 (11.3)</td>
</tr>
<tr>
<td>Complete flap loss</td>
<td>2 (0.7)</td>
<td>1 (1.7)</td>
<td>1 (1.6)</td>
<td>0</td>
</tr>
<tr>
<td>Marginal partial necrosis (13 additional operations)</td>
<td>21 (7.3)</td>
<td>6 (10)</td>
<td>5 (8)</td>
<td>10 (6)</td>
</tr>
<tr>
<td><strong>Urologic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Early fistula (closing spontaneously)</td>
<td>51 (17.7)</td>
<td>12 (20)</td>
<td>12 (19.4)</td>
<td>27 (16.1)</td>
</tr>
<tr>
<td>Stricture treated conservatively</td>
<td>21 (7.3)</td>
<td>5 (8.4)</td>
<td>5 (8)</td>
<td>11 (6.5)</td>
</tr>
<tr>
<td><strong>Fistula/stricture requiring urethroplasty (97 additional operations)</strong></td>
<td>52 (18.1)</td>
<td>12 (20)</td>
<td>12 (19.4)</td>
<td>28 (16.7)</td>
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<tr>
<td><strong>Various</strong></td>
<td></td>
<td></td>
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<tr>
<td>Minor pulmonary embolism</td>
<td>3 (1)</td>
<td>1 (1.7)</td>
<td>2 (3.2)</td>
<td>0</td>
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<tr>
<td>Rerouting of defect on arm</td>
<td>2 (0.7)</td>
<td>1 (1.7)</td>
<td>1 (1.6)</td>
<td>0</td>
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<tr>
<td>Nerve compression (early cases)</td>
<td>2 (0.7)</td>
<td>2 (3.3)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Delayed wound healing in groin area (four additional operations)</td>
<td>32 (11.1)</td>
<td>9 (15.2)</td>
<td>7 (11.2)</td>
<td>16 (9.6)</td>
</tr>
<tr>
<td><strong>Erectile prosthesis (130 prostheses)</strong></td>
<td>130</td>
<td>21</td>
<td>32</td>
<td>77</td>
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<tr>
<td><strong>No.</strong></td>
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<tr>
<td>Revision surgery</td>
<td>58 (44.6)</td>
<td>13 (62)</td>
<td>16 (50)</td>
<td>29 (37.6)</td>
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<tr>
<td>Incapacity to perform sexual intercourse</td>
<td>26 (20)</td>
<td>6 (28.5)</td>
<td>7 (22.6)</td>
<td>13 (17)</td>
</tr>
</tbody>
</table>
Outcomes

- Urethral repair: C-
- Implant longevity: C-
Goals of Penile Reconstruction

1. Cosmetic Appearance – Penis and Donor site – B+
2. Voiding Function – Competent Neourethra – C-
3. Sexual Function – Intercourse, Tactile and Erogenous Sensation – A- → C-
4. Improved Psychosocial Function – B-
Challenge ourselves to innovate
Future State of the Art
Reconstruction of Complex Penile and Scrotal Defects

- Reconstructive transplantation
- Regenerative medicine
The Rise of Reconstructive Transplantation

“replace like with like”

- Cadaveric Donated human tissue
- Replace exactly what is lost
- Require immunosuppression
Multidisciplinary Reconstructive Transplantation Team

- Psychologist/Psychiatrists
- Urologists
- Reconstructive Plastic Surgeons
- Ethicists
- Nursing
- Transplant Medicine
- ID
- Ethicist
Goal of Penile Allotransplant Program

- Provide an advanced reconstructive option for patients with penile loss that
  1. Improves function over standard techniques
  2. Is available to patients who are not candidates for standard reconstruction – other extremity injuries and amputations
  3. Is safe and reliable – surgical technique and immunoregulation
Critical Considerations

- Do we have reliable techniques to perform the transplant?
- Will penile transplant offer improvement over conventional techniques?
- Can we justify life long immunosuppression for a penile transplant?
- Ethical considerations
Technical Reliability
Fig. 1 - Penile transplantation. (A) Preoperative views of penile defect. (B) Donor's penis after being well irrigated. (C) The transplanted penis had excellent cosmetic appearance and circulation at day 1. (D) The transplanted penis became congested and showed evidence of venous stasis and edema; capillary filling remained satisfactory at day 3 postoperatively. (E) The transplanted penis's cosmetic appearance with segmental epidermis necrosis at day 14.
Stellenbosch University and Tygerberg Hospital

Doctors perform first successful penis transplant

Surgeons from Stellenbosch University and Tygerberg Hospital in Cape Town, South Africa, say they performed the first successful penis transplant operation on Dec. 11, 2014. STELLENBOSCH UNIVERSITY

How penis was transplanted

The University of Stellenbosch announced yesterday surgeons there have performed the world’s first successful penis transplant.

1. When the organ was harvested from the donor, the entire penis was carefully dissected keeping blood vessels, nerves and other connecting structures intact.

2. These were carefully marked and connected to the recipient’s correlating tissue ten hours later during the transplant, using a microscope (micro surgery).

3. The surgeons connected three blood vessels to ensure sufficient blood flow to the transplanted organ, two dorsal nerves to restore sensation, the urethra which enables the recipient to urinate through the penis, and the corpus cavernosum, which will allow the patient to obtain an erection.

4. The patient received immunosuppression medication to help prevent the body from rejecting the transplanted organ.

Source: University of Stellenbosch

Dr. Andre Van der Merwe

October 12, 2016
A Preliminary Report of Penile Transplantation


Weilie Hu*, Jun Lu, Lichao Zhang, Wen Wu, Haibo Nie, Yunsong Zhu, Zhixiong Deng, Yongbing Zhao, Wen Sheng, Qiyou Chao, Xiaofu Qiu, Jinghua Yang, Ying Bai

Fig. 1 – Penile transplantation. (A) Preoperative views of penile defect. (B) Donor’s penis after being well irrigated. (C) The transplanted penis had excellent cosmetic appearance and circulation at day 1. (D) The transplanted penis became congested and showed evidence of venous stasis and edema; capillary filling remained satisfactory at day 3 postoperatively. (E) The transplanted penis’s cosmetic appearance with segmental epidermis necrosis at day 14.
We reviewed all recently reported cases of penile replantation and found the incidence of skin necrosis to be 77.8 percent.

When we excluded cases in which a skin bridge was clearly present, the calculated incidence of skin necrosis rose to 87.5 percent.

Poor recovery of sensation, low ability to achieve erection
Penile Vascular Anatomy

Cavernous artery (Deep artery of penis)
Circumflex artery
Dorsal artery
Corpus cavernosum
Internal pudendal arteries
Corpus cavernosum
Bulbar artery
Corpus spongiosum
Glans
Bulbourethral artery
Using the Dorsal, Cavernosal, and External Pudendal Arteries for Penile Transplantation: Technical Considerations and Perfusion Territories


Fig. 1. Arterial anatomy supplying deep structures of the penis.
Fig. 5. Penile grafts with red dye perfused through the dorsal artery and blue dye through the cavernosal arteries. Skin on the glans and distal shaft stained blue from the dorsal artery. *(Left)* Corpus cavernosum sectioned longitudinally revealing primarily blue staining from the cavernosal arteries. *(Right)* Corpus spongiosum sectioned longitudinally revealing red staining from the dorsal artery.
RECONSTRUCTIVE

Using the Dorsal, Cavernosal, and External Pudendal Arteries for Penile Transplantation: Technical Considerations and Perfusion Territories


Fig. 3. Illustration depicting external pudendal vascular anatomy. Gr, greater; Ext, external.
**RECONSTRUCTIVE**


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Green Dye – External Pudendal Artery  
Shaft skin, half of scrotum, inner thigh and suprapubic region

Blue Dye – Dorsal Artery  
Glans and distal shaft with no overlap of E.P.

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**Fig. 6.** Green dye injected into the external pudendal artery perfused shaft skin circumferentially to the corona, and ipsilateral inner thigh, groin, suprapubic, and scrotal skin.  
(Left) Dye injected only into external pudendal artery.  
(Right) Blue dye injected into the dorsal artery staining skin of the glans and distal shaft without overlap with green from the external pudendal artery.
Using the Dorsal, Cavernosal, and External Pudendal Arteries for Penile Transplantation: Technical Considerations and Perfusion Territories


<table>
<thead>
<tr>
<th>Artery</th>
<th>Principal Perfusion Territory</th>
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<tr>
<td>Dorsal</td>
<td>Glans and Corpus Spongiosum</td>
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<tr>
<td>Cavernosal</td>
<td>Corpus Cavernosum</td>
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<tr>
<td>External Pudendal</td>
<td>Shaft Skin</td>
</tr>
</tbody>
</table>

**Fig. 7.** Perfusion territories observed from the dorsal, cavernosal, and external pudendal arteries.

Sami H. Tuffaha, M.D.
Justin M. Sacks, M.D.
Jaimie T. Shores, M.D.
Gerald Brandacher, M.D.
W. P. Andrew Lee, M.D.
Damon S. Cooney, M.D., Ph.D.
Richard J. Redett, M.D.
Fig. 8. Recommended strategy for vascularizing penile allografts. *(Left)* Midshaft or distal shaft transplantation: dorsal and cavernosal arteries. *(Center)* Proximal shaft: dorsal, cavernosal, and external pudendal arteries with skin bridge. *(Right)* Proximal shaft with surrounding defect: dorsal, cavernosal, and external pudendal arteries with additional skin to resurface the defect.
Ethical Considerations

“Immunosuppression for a penis?”
Ethical Considerations

• Bioethicists involved from beginning of protocol development.
  – Met regularly starting Summer 2013
  – Goal: To anticipate & proactively address concerns that might be expressed by
    • The medical community
    • The general population

• Bioethicists’ input has been incorporated into the protocol.

• Truly informed consent
Single Drug Minimization for Immunosuppression

**Induction**
- Campath-1H

**Spaced dose weaning**

**Tacrolimus Monotherapy**

**Cadaveric**
- VCA Hand/Face

**Donor BM Cell Infusion**
- (Day 10-15)
Ethical Considerations

- Early on, limit the transplant to those men who have no other reconstructive options
- Minimize immunosuppression
1. Will penile transplant offer improvement over conventional techniques?
   Yes – aesthetics, urination, erection

2. Reliability
   Yes, with recent anatomic studies and actual transplants

3. Can we justify immunosuppression for a penile transplant?
   Yes, in some patients (limited donor sites, extensive defects, failed conventional reconstruction)