Large Acetabular Defects: Cages and Custom Implants

John A. Abraham MD
Orthopedic Oncology and Adult Reconstruction
Rothman Institute
Philadelphia, PA

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Disclosures

- Zimmer Biomet: Consultant, Product Review, Surgical Technique

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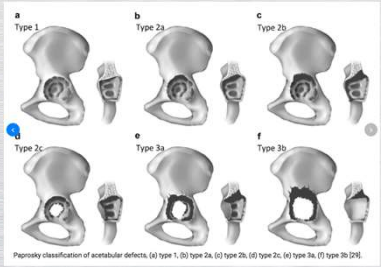
Acetabular Defect Classification

- Paprosky Classification



Paprosky classification of acetabular defects, (a) type 1, (b) type 2a, (c) type 2b, (d) type 2c, (e) type 3a, (f) type 3b [29].

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Treatment Algorithm

- Type I and II defects can generally be treated with hemispherical cups, grafts, and augments
- Type IIIA (”up and out”) and IIIB (“up and in”) and discontinuity defects are more difficult, and require other reconstructive solutions
- Cages, Cup Cages, and Custom made Triflange implants are some of the possible choices for these defects
- Pelvic discontinuity generally requires one of these types of implants, and/or plating of the pelvis

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Cage Reconstruction

- Thin metal flanges and shell to bridge defect from ilium to ischium
- Flanges are malleable
- Ischium flange may have screws or a “spike” which can be driven into the ischium or into the obturator foramen or screwed into ischium
- Polyethylene liner is cemented into the cage in the appropriate flexion and version

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- Technique
  - Achieve adequate exposure
  - Contour cage as needed
  - Insert ischial spike into ischium (start with osteotome)
  - Lay ilium flanges onto ilium and secure with screws
  - Cement liner into position, pressurize

Cage Outcomes

Author	N=	Follow up in yrs	Mech Failure rate
Berry et al	42	5.0	24
Zehnter et al	27	7.2	18
Peters et al	28	2.8	0
Rosson et al	66	5.0	8
Perka et al	62	5.5	8
Gross et al	13	10.5	23

Adapted from AAOS Advanced Hip Reconstruction 2

Perform well initially but high likelihood of long term failure

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Cage Problems

- Loosening
  - Up to 49% reported at 7 years
- Dislocation
  - 15%-30%
- Implant Breakage
  - No ingrowth
  - Set up for long term failure
- Sciatic Nerve Injury

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Cup-Cage Construct

- First reported in 2005
- Two components: highly porous hemispheric cup against maximum bone contact area, supported by a cage
- Polyethylene liner cemented into cup-cage to unitize construct
- Cage provides initial stability and offloads cup to promote maximal bone ingrowth
- Once cup is ingrown, the cage becomes unnecessary and is less likely to fail

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Indications

- Paprosky IIIA, IIIB
- Discontinuity
- Any other situation in which adequate cup-bone contact cannot be achieved
  - 50% contact with large hemispheric cup alone
- Cases which are more urgent and cannot wait for custom made solution
- Has been reported post XRT, post fracture

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Authors	N=	Indication	Mean Age	Mean F/U (mos)	Results
Kosashvili 2009	26	Pelvic DC	65	45	No loosening in 23 hips 3 Lost to F/U
Chana-Rodriguez 2012	6	Elderly Acetabular Fx	77	25	100% fractures healed
Joglekar 2012	3	Pelvic XRT Post Ca	71	60	No loosening in 100%
Khan 2012	7	Post Malignancy	60	56	No loosening in 100%
Rogers 2012	42	Pelvic DC	68	35	4 revised: 2 for loosening 2 for instability **86.3% 8yr survival**
Tangstaporn 2013	7	Failed Cage	61	57	2 required revision
Abloghasemian 2014	26	Pelvic DC	65	82	4 failed from septic or aseptic loosening **87.2% 7yr survival**

Adapted from AAOS Advanced Hip Reconstruction 2

Problems and Pitfalls

- Instability (15-30%)
- Infection
- Constrained liner may pull on implant prior to adequate ingrowth, consider delayed conversion
- Sciatic N and Sup Glut N risk

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Custom Implant: Triflange

- Triflange implants are custom made for each individual patient based on a CT scan of the acetabular defect.
- Ilium, Ischium and Pubis flanges
- Custom Screw types, locations, and directions
- Specialty additions like HA coating and porous metal regions can be specified.

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FDA

- Several companies can manufacture custom made triflange-type implants.
- One company, Zimmer-Biomet, has FDA approval for this implant as long as the flanges fall within specific zones.
- Other companies require that the surgeon utilize the FDA Compassionate Use pathway, but are currently applying for a similar FDA approval
- Time to get implant in your hands is about the same by these two pathways

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Cost

- One frequently mentioned concern is cost
- Study on cost demonstrates cost is about equivalent to a porous revision cup plus two augments
- Cost is highly variable based on hospital contracts
- Overall cost is not dramatically higher than other revision solutions for the severity of the problem
- To save costs, don't use a triflange when its not needed
  - evaluate 3D model to make decision to go ahead with manufacturing

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Triflange Outcomes

Author	N=	Approach	Mean Age (yrs)	Follow up (yrs)	Outcome
Christie et al (2001)	67	Posterior	59	4.5	No mech fail 15% dislocation 8% revision
Joshi et al (2002)	27	Triradiate	68	5	No mech fail 3% revision 3% sciatic inj
Holt and Dennis (2004)	26	Posterior, plus Troch Osteotomy	68	4.5	3% mech fail 6% loosening 7.8% dislocation
DeBoer et al (2007)	20	Posterior	56	10	No mech fail 30% dislocation 25% revision 5% ischium/sciatic problems

Adapted from AAOS Advanced Hip Reconstruction 2

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Triflange Outcomes

Authors	N=	Approach	Mean Age	Follow up (yrs)	Outcomes
Taunton et al (2012)	57	Posterior	61	5	1.8% mech fail 21% dislocation 17.4% revision
Wind et al(2013)	19	Posterior	58	2.6	11% removed 16% complication 26% dislocation 32% reoperation
Berasi et al (2015)	24	Lateral	67	4.8	17% revision 8% infection 8% fracture No instability

Adapted from AAOS Advanced Hip Reconstruction 2

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Triflange Technique

- Obtain CT scan according to protocol
- Review CAD design with engineer, make specifications (1-2wks)
- Review Rapid Prototype physical model
- Manufacturing (6-8wks)
- Implantation

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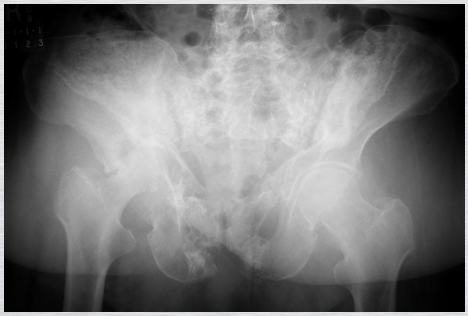
82yo F Pelvic sidewall XRT



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"Double Bubble" Design

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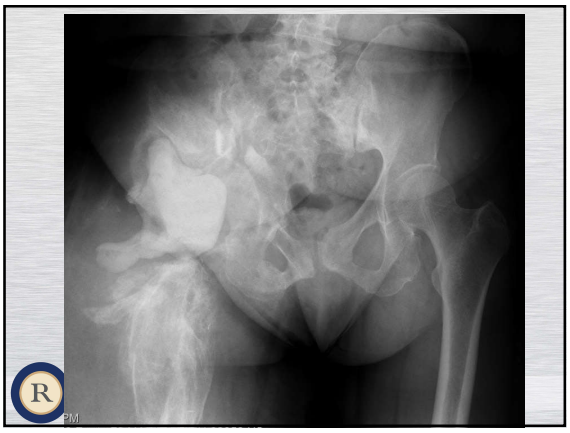
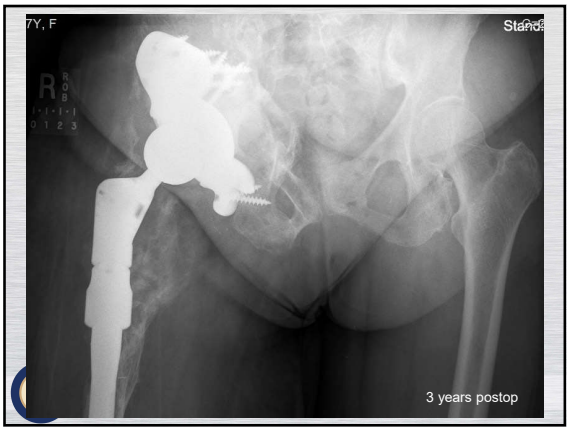
Failed Revision:

- 74yoF
- Prior trauma, resultant bone deformity
- Initial THA for post traumatic arthritis
- Revision for aseptic loosening, instability
- Postoperative protrusio
- Attempted revision, aborted when screw was found to be in iliac vein
- ICU stabilization and refer to "a guy who specializes in this exact problem…"
- Some cases may be best to do in 2 stages





Custom implants for Failed Cage

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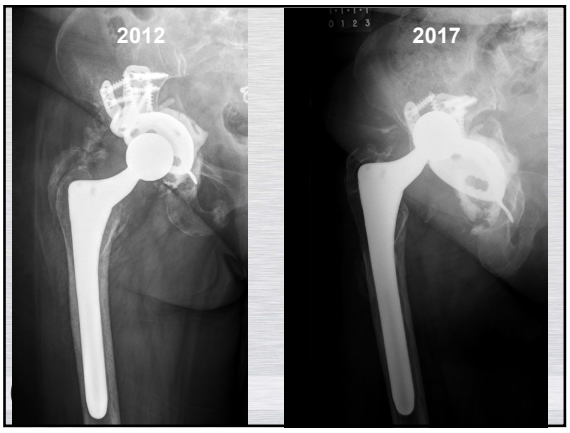
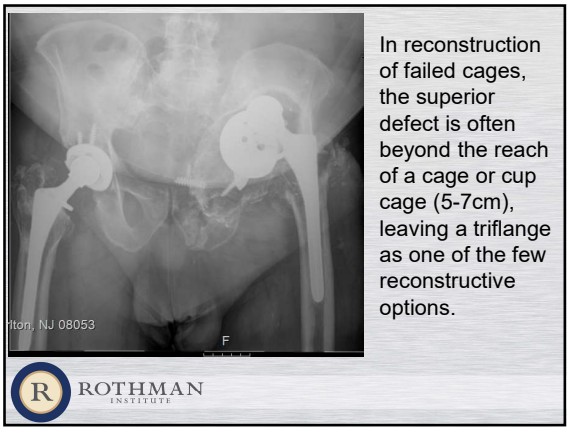

2012
2017


"Home Run" Screws
1 year


In reconstruction of failed cages, the superior defect is often beyond the reach of a cage or cup cage (5-7cm), leaving a triflange as one of the few reconstructive options.
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Pubic Flange not critical (my opinion)

Custom Implants for Tumor

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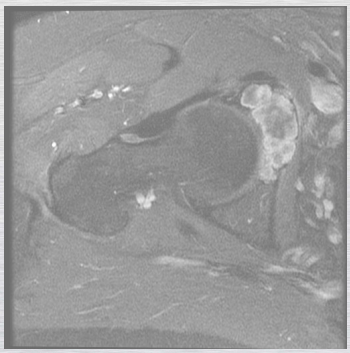

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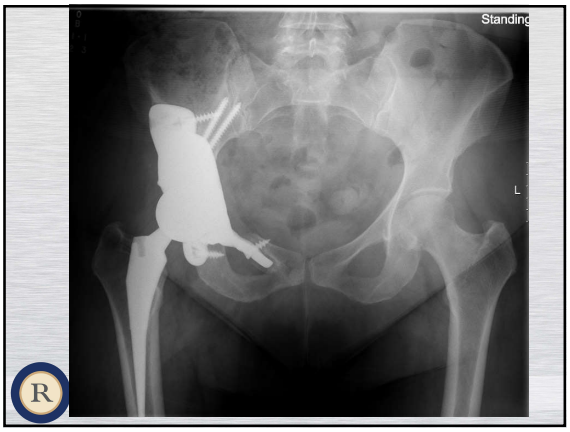
Standing
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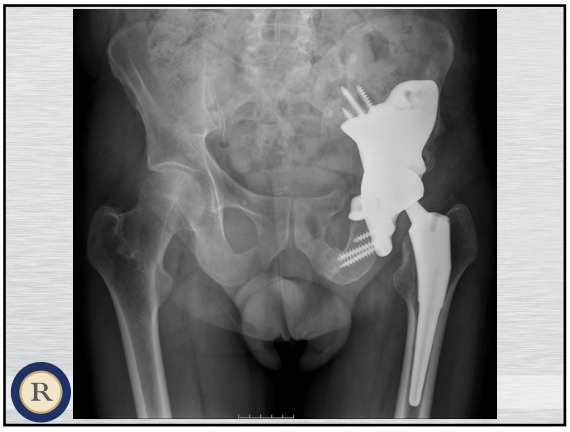
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Post infection reconstruction

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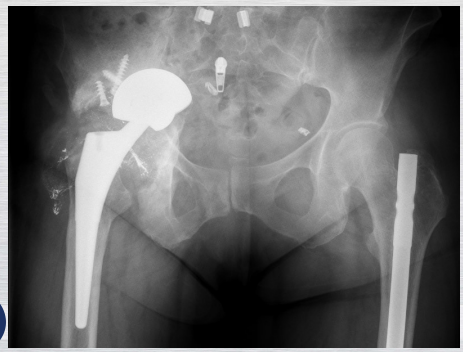
Acute THA for acetabular fx, two subsequent revisions, Sciatic N injury, 44yoF



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Triflange Pearls

- Design:
  - Don't rely on flanges alone, try to get some implant bone contact inside the acetabular defect "Double Bubble"
  - Think about instability and how to counter it with design
  - Consider using locking screws for flanges if bicortical bite cannot be achieved
  - Incorporate 1-2 "home run" screws into posterior column
  - Plan all screw sizes and directions preoperatively to minimize risk

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General Reconstructive Pearls

- Operative:
  - Dissect out and protect sciatic nerve, but minimize handling
  - Consider troch osteotomy if tension on Sup. Gluteal N. is limiting
  - Use the pubic flange as a marker to make sure implant is positioned properly
  - Maximize number of screws in ischium, I aim for at least 4
  - Stage Constrained liner if needed, 3 months
- Postop
  - Use drains to minimize hematoma, Stimulan?
  - ToeTouch weight bearing for 8 weeks minimum

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Future Directions

- 3D printing of custom implants
- Reduction in manufacturing time
- Incorporation of porous metals
- Long term outcomes not yet clearly defined

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Summary

- All options are reasonable choices for large scale defects in the pelvis
- Cup-Cages are a better choice than a standard cage in most cases
- For some cases, such as tumors, the defect may be beyond the reach of a cage and these usually require a triflange type implant
- Surgical technique is challenging and must be carefully thought out for each case

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THANK YOU

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Jefferson
Kimmel Cancer Center Network