TSA Glenoid Component Design and Fixation

I (and/or my co-authors) have something to disclose.

Detailed disclosure information is available via:
- "My Academy" app;
- Printed Final Program; or
- AAOS Orthopaedic Disclosure Program on the AAOS website at http://www.aaos.org/disclosure

History

First introduced in the 1970's, glenoid resurfacing has focused almost exclusively on polyethylene implants.

Fixation has been with cement
- Some ingrowth and metal-backed designs
Survival

Cemented all-poly component have an excellent track record
- 15 year survival 89-95%
No difference in survival between convex and flat-back geometries

Fox TJ, JSES, 2009
Collin, JSES, 2011

Survival

Radiolucencies
- Attritional problem that develops over time
- 7.3% per year
- 33% "radiographic failure" at 10 years
- Revision for loosening 0.8% per year
  2.5% total

Fox TJ, JSES, 2013
Papadonikolakis, JBJS, 2013
Gazielly, DF, Int Orthop, 2015
Controversies and Topics

- Radius of curvature
  - Conforming vs non-conforming
- Peg vs keel
- Ingrowth vs cement
  - Metal-backed designs
- Newer technologies

**Radius of Curvature**

Conformity refers to any mismatch in the radius of curvature in the humeral head versus the glenoid component.

- Non-conforming glenoids have a larger radius of curvature
  - Less "constrained"

**Non-conforming designs**

- More clinical evidence to support use
- Fewer radiolucencies than conforming implants
- More normal translation of the humeral head during motion
- Higher contact pressures

**Conforming design**

- More even distribution of contact pressures
- More volumetric wear
- More vulnerable to edge loading if components not perfectly placed

References:
- Armstrong, JBJS, 2013
- Karduna, JSES, 1997
- Hopkins, J Biomech Eng, 2007
- Walch, JBJS, 2002
Peg vs Keel

Biomechanics data mixed
- Preponderance suggests some advantage to pegged designs
Clinical data also inconclusive
- Some studies show no difference
- Others show advantage to pegged implants
Radiographic data favors pegged glenoids

<<Sources>>

In younger patients (<55), 10 year survival of keeled implants ~63% Fewer radiolucent lines noted in pegged components where glenoid version was fully corrected

<<Sources>>

Metal-backed Designs

Introduced to provide biologic fixation instead of relying on cement
Attractive in concept
Metal-Backed Designs

Results marked by high failure rates
- 29-54% revision rate
- Most for polyethylene wear or metallosis
- Additional 29% at clinical risk for failure

"...other reconstructive options may be more successful and durable."
"...not a viable long-term therapeutic option"

Newer Ingrowth Designs

More recent focus on anchor-peg designs that provide biologic fixation without decreasing polyethylene thickness
- Option for partially cemented hybrid fixation

Initial reports demonstrated biologic integration of bone at ingrowth/fin surface

Clinical studies reported high failure rate
- 14-21% at 2 years
- Mostly due to fractures at metal-poly interface

Improved after component redesigned
Newer Ingrowth Designs

Other ingrowth components with better outcomes
Hybrid implant with same amount of radiolucent lines as cemented pegged component
- CT scans confirmed bone ingrowth to porous titanium post
Gulotta, CORR, 2015

Newer Ingrowth Designs

Totally uncemented construct with 12% radiolucent lines at 28mo follow up
Hybrid cage implant
- 13.5% radiolucent lines at minimum 2 year follow up
- Fewer than comparison cohort of traditional pegged implants
DeWilde, JSES, 2013
Grey, Bull Hosp Jt Dis, 2013

Augmented Glenoid Components

Designed to address difficult posterior wear patterns
Angled and step-cut designs
Custom and off-the-shelf options
Augmented Glenoid Components

Conceptually attractive
- Allows correction of glenoid version
- Biomechanically, no increase in glenoid stress or strain
  - Step cut and wedge designs
- Also less bone removal for both designs versus traditional implants
- Other biomechanical evidence favors eccentric reaming over augment
  - Less edge displacement on loading
  
  References:
  - Kwon, JEE, 2012
  - Wang, CORR, 2015
  - Sabesan, JEE, 2014
  - Allred, JEE, 2016
  - Roche, Hosp Jt Dis, 2013

Augmented Glenoid Components

Short term clinical outcomes promising
- Mix of anterior and posterior wear patterns
- Similar clinical scores as non-augmented glenoids
- Higher incidence of radiolucencies in augmented glenoids

References:
- Lenart, JEE, 2015
- Wright, Bull Hosp Jt Dis, 2015

Summary

Glenoid design continues to evolve

- Cemented all-polyethylene components have a strong track record
  - Long term survival dependent on loosening
- New advances promising but long term data is needed
- Metal-backed glenoids are bad
Thank You