Innovations in Shoulder Surgery

Disclosure

- Stryker
  - Paid consultation
- DePuy Synthes
  - Paid consultation
- NewClip Technics
  - Royalties
  - Paid Consultation
- DJO
  - Paid consultation

Innovation Requires Teamwork

- Engineers
- Surgeons
- Design Teams
Fixation

- 2 main types
  - Cemented
  - Uncemented/press-fit

Materials

Cemented Fixation
Uncemented Fixation

Pre-op Planning Software
Robotic Assistance
PSI

Cemented Fixation
Uncemented Fixation

The Effect of the Surgeon

Pre-op Planning Software
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2 main types
- Cemented
- Uncemented/press-fit
Cemented Fixation

Cement releases heat as it cures, which can cause osteonecrosis when it exceeds the critical value of 56°C.

Glennoid cementing may generate sufficient heat to endanger the surrounding bone.

Showed the amount of cement used in glenoid component implantation correlated with the area of bone at risk of thermal necrosis.

Temperatures ranged from 48.2° - 76.8°C with an average of 64.7°C.

Thermal Necrosis

2 FEA studies of thermal effects of cement.

When the cement mantle is very thin, no necrosis occurs.

Showed that the thicker the cement mantle, the higher the temperature of the surface of the bone.

- At 7mm thick, the peak temperature was 55°C.
- When mantle was thick, up to 6% of bone became necrotic.

The “Black-and-Tan” Technique

Developed to limit thermal effects cement may have on the healing tuberosities.

Cement the canal, then remove the proximal 2cm of cement & replace with bone chip grafts from the humeral head.


Jonathan E. Zyw, MD
My Experience

Basic science study
Used 7 matched pairs of humeri with 4-part proximal humerus fracture models

2 groups for HA for fracture
- Traditional full cementation
- Black-and-Tan technique

My Experience

- Tuberosity-shaft temp. was significantly lower with the Black-and-Tan technique (39.7°C) than with full cementation (55.7°C)
- Distally, no difference
- So why use cement?
Uncemented Fixation

Also referred to as "press-fit"
Relies on bony ongrowth and/or ingrowth of the prosthesis for stability of the construct

Ongrowth → occurs when bone attaches to the surface & requires a roughened surface

Ingrowth → occurs when bone grows inside a material & requires a porous surface

Ongrowth vs. Ingrowth

Implants with roughened surfaces like grit blast & plasma spray create attachment areas on the component
Coating of HA promotes bone growth

Implants that incorporate porous metals are ideal for bone ingrowth
Porous metal has an open cell structure
Especially good if it can mimic the structure of the cancellous bone matrix
Acquire CT images that meet the requirements for the system you’re using

DICOM exported images are sent for post-processing and analysis

Used to build virtual model of patient anatomy for use in pre-op planning

When the operative plan is finalized and approved by surgeon, the software generates the blueprint which is subsequently manufactured to those specifications
Robotic Assistance

Backed by more than 50 peer-reviewed clinical publications
Enables surgeon to have a more predictable surgical experience
MARRIES pre-op planning to intra-op virtual adjustments that are then carried out by robotic arm
Experience Matters

Examined outcomes after the first 60 consecutive RSAs implanted by a single surgeon with this prosthetic design.

While all patients improved post-operatively, study found the gains in the SST score, FF, & ABD were lower for the first 15 than the next 45.

5 of 8 re-operations were performed after the first 15 cases.

Experience influences efficacy.

Decision-Making Matters

Clinical vignettes created for 274 patients treated with ≤1-year follow-up.

Reviewed by 3 fellowship-trained shoulder surgeons to evaluate the effect of uncertainty.

Unanimous agreement on op/non-op treatment: 70.5%.

Only 63.5% of patients actually received the treatment selected (p = .001).

Patients for whom unanimous agreement matched actual treatment in the ORIF group showed significant improvement of FF & ABD.

Case Example

46-year-old right handed male corrections officer.

Presents 25 days s/p altercation with an inmate.

Has been treated non-op in a sling until this point.

No significant medical history.
Case Example: Radiographs

Case Example: CT

Treatment Options?
1. ORIF with impaction of fragments 0%
2. ORIF with some allograft strut 0%
3. Arthroplasty 0%
4. Non-op treatment 0%
Conclusions

- Better engineered materials have improved implant design.
- Surgeon experience has evolved to allow for more precise implantation of joint replacements.
- PSI & possibly robotic assistance allow surgeons to implant joints in very complex surgical scenarios.
- Innovative technology continues to foster the advancement of shoulder surgery, however, there's no replacement for intra-operative surgeon decision-making.