REVERSE SHOULDER ARTHROPLASTY (RSA)

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RSA-NORMAL SHOULDER
KINEMATICS

• Abduction/Elevation

  – Joint stability dependent on balance between Deltoid (upwards force) and Rotator Cuff (downwards force)
  – Muscle contraction causes shear (upwards humeral displacement) and compression forces (joint stability)
– Deltoid shear forces > compression forces until 60 degrees elevation!

– Abduction torque generated by Deltoid
  • At 30 degrees 70%
  • At 60 degrees 80%
  • At 90 degrees 85%
RSA-CUFF DEFICIENCY

- Deltoid lost counterbalance +/- support (SST, IST, TM, SCC)
- Loss of fulcrum for elevation
- Shear component of deltoid causes humeral upwards migration
- Unstable joint
- Deltoid fibres retract
- Remaining Function depends on remaining anterior/posterior force couple
RSA – CLASSIFICATION OF CUFF TEAR ARTHROPATHY

HAMADA et al.
• Radiographic
• Acromiohumeral Interval (AHI)
• Grade 1  AHI > 6mm
• Grade 2  AHI < 6mm
• Grade 3  2 + acetabul.
• Grade 4  3 + GHJ-OA
• Grade 5  HH-collapse

SEEBAUER et al.
• Biomechanical
• Sup. Migration and Degree of Instability
• Type 1A: centred, stable
• Type 1B: centred, medialis.
• Type 2A: decentred, lim. stable
• Type 2B: decentred, unstable
RSA-MECHANICS

• CUFF REPLACEMENT PROSTHESIS

• NO OTHER ALTERNATIVE
  – CUFF REPAIR
  – SURFACE REPLACEMENT
  – TSA
  – CTA
  – MUSCLE TRANSFERS

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RSA-EARLIER DESIGNS

• Constrained-Reversed

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RSA-EARLIER DESIGNS

- Lateral offset of center of rotation
- Shortened Deltoid-leverarm
- Designrelated limited ROM
- Shearing- und levering forces at the glenoid component - bone interface
RSA-GRAMMONT PROSTHESIS

• “In fact, our hypothesis is as simplistic as the invention of the wheel: is walking the only means of travelling?...”

Paul Grammont, Paris, 1987

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RSA-GRAMMONT PROSTHESIS

- Unconstrained
- Co-adaptation
- Large glenoid hemisphere without neck
- Small humeral cup, almost horizontally inclined
- Minimizes torque on glenoid
- Conversion of centrifugal to centripetal forces on the glenoid sphere (self stabilising system)

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RSA-GRAMMONT PROSTHESIS

- Optimization of deltoid function through Distalization and Medialization of the Center of rotation.
- Non-anatomical inclination 155°
- Small cup
RSA-GRAMMONT PROSTHESIS

- Increased recruitment of anterior and posterior deltoid fibres for abduction
- Improved deltoid lever arm
- Increased/restored deltoid tensioning
RSA-NOTCHING

SIRVEAUX

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RSA-NOTCHING

Progression in a FU-period up to 7 years
74.6% stable: 0 → 2 (no further progression / unchanged after 6-12 mo.)
19.5% progressive: 0 → (2) → 3 / 4 (Osteolysis / progressive after 24 mo.)

...CORRELATION WITH FOLLOW-UP, SURGICAL APPROACH, POLY-WEAR, RADIOLUCENT LINES (HUMERUS AND BASEPLATE)

...CLINICAL RELEVANCE???

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RSA-NOTCHING

↑ overlap ⇒ ↓ impingement

⇒ no influence on stability!

2D Biomechanical Analysis Overlap influence

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RSA-INDICATIONS

1. Arthritic shoulder with severe cuff destruction in the elderly (>75)
2. Massive cuff tear
3. Acute Fracture in the elderly
4. Fracture sequelae
5. RA
6. OA
7. Tumors
8. Failure of previous cuff surgery
9. Revision of failed, unconstrained SA
RSA-INDICATIONS
RSA - CONTRAINDICATIONS

- PREVIOUS INFECTION
- NON-FUNCTIONING DELTOID MUSCLE
RSA - Study Day

• **LIVE SURGERY** of Primary and Revision RSA
• Lectures covering
  – Indications
  – Techniques
  – Results…of primary and revision RSA
• Evening Meal and Case Discussion
  Invited Guest Speaker and Surgeon
  Prof. A. Ekelund (Sweden)

• **Date:** 25-02-2010  **Venue:** QE, Gateshead

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RSA-RESULTS

• Short follow up (7 years, NICE)
• Post-op elevation: 55 → 121 degr.
• Constant score 17 → 59
• ER 7 → 11
• Patient satisfied 78%
• No/mild pain 67%
• CTA patient RSA> Hemi

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RSA-RESULTS

- Re-operation rate 0-15%
- …when prosthetic revision 20-60%
- Most results reported on elderly (avg. 72) with limited activity levels!
- Notching in 74%...but no effect on function!
- No revision for loosening (…infection and #)

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RSA-COMPLICATIONS

Primary : Revision = 1:3

1. Intra-operative
   • Scapula (glenoid) fracture (<1%)
   • Humeral fracture (same as TSA)
   • Vascular injuries (<1%)
   • Nerve lesions (up to 5%)

2. Post-operative
   • Haematoma (dead space)
   • Dislocation (4.8%, under-tensioning, bone resection, approach, version)
   • Subsidence (?cemented stem?)
   • Disassembly
   • Fractures
   • Loosening
   • Notching
   • Infections
RSA-COMPLICATIONS

• No improvement on rotation
  – Medialisation
    • Slackening of remaining RC
    • Reduction of posterior deltoid fibres

• TM…most important for functional outcome

• RSA…combined with LD/TMa ➔ restore ER
RSA-COMPLICATIONS

• Instability:
  – Deltoid under-tensioning, impingement, approach, haematoma, revision

• Fracture:
  – Acromion…fatigue fracture, deltoid over-tensioning
  – Glenoid… pre-op CT, bone grafting, Hemi

• Fixation failure:
  – Glenoid…placement, approach
  – Humerus…cementation, prox. bone loss
RSA-COMPLICATIONS

• Scapula notching:
  – Concerns remain for polyethylene wear…?
  – ?…”price to pay” suggest
  – Low placement of glenosphere
  – Humeral stem in neutral rotation
  – Deltopectoral approach
RSA-COMPLICATIONS

• Infection:
  – Similar to TSA
  – < 1% (primary)
  – Staph. Aureus, Propionibacterium acnes
  – Early…debride + AB’s
  – Late…r/o implants + AB’s +/- 2\textsuperscript{nd} stage

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“Give me something different, for there is a chance of its being better.”

Ernest Codman, The Shoulder, Boston 1934
Reverse total shoulder arthroplasty after failed rotator cuff surgery.

Delta III reverse shoulder arthroplasty: radiological outcome for acute complex fractures of the proximal humerus in elderly patients.
  - Cazeneuve JF, Cristofari DJ. Rev Chir Orthop Traumatol. 2009 Sep;95(5):325-9

Reverse shoulder prosthesis as revision surgery after fractures of the proximal humerus, treated initially by internal fixation or hemiarthroplasty.

Reverse total shoulder arthroplasty.

Subscapularis insufficiency and the risk of shoulder dislocation after reverse shoulder arthroplasty.

Three or four parts complex proximal humerus fractures: hemiarthroplasty versus reverse prosthesis: a comparative study of 40 cases.

Reverse total shoulder arthroplasty for acute fractures and failed management after proximal humeral fractures.

Scapular notching in reverse shoulder arthroplasty.
RSA-LITERATURE

- Latissimus dorsi transfer to restore external rotation with reverse shoulder arthroplasty: a biomechanical study.

- The treatment of deep shoulder infection and glenohumeral instability with debridement, reverse shoulder arthroplasty and postoperative antibiotics.

- Reverse shoulder arthroplasty combined with a modified latissimus dorsi and teres major tendon transfer for shoulder pseudoparalysis associated with dropping arm.

- Reverse total shoulder arthroplasty: a review of results according to etiology.

- The reverse total shoulder arthroplasty.

- Impact of fatty infiltration of the teres minor muscle on the outcome of reverse total shoulder arthroplasty.


- Roentgenographic findings in massive rotator cuff tears. A long-term observation.

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