Reverse Total Shoulder

Dr. Minoo Patel





AOA VIC, Lorne, 2011

Southern Health



The role of the rotator cuff

- Depress and humeral head (against the force of the deltoid)
- Keep the humeral head co-apted in the glenoid
- 'Initiate abduction' (? Forward elevation)

- Force modulator
- 'Gear-box' to the engine (extrinsic muscles – Deltoid, lats, pecs)

Cuff tear arthropathy



Cuff tear arthropathy







Prosthetic management of cuff dysfunction

- Large head
- Bi-polar design

CTA head

Reverse total shoulder

Reverse TSR – Bio-mechanics



- Centre of rotation medial and distal
- Deltoid length restored or lengthened

Reverse TSR – Bio-mechanics and the Deltoid

- 7 parts of the deltoid
- Medialisation of the joint
- Allows
 recruitment of
 parts 1 and 4 for
 elevation
- Deltoid as 'sole' motor

Deltoid

- Deltoid is the 'sole motor' for forward elevation and abduction
- Deltoid is the 'sole stabiliser'
- NO DELTOID NO REVERSE T.S.R.
- Axillary nerve

Deltoid is a poor rotator

Reverse TSR – Inherent Stability

- Normally Centrifugal forces on the glenoid
- RTSR Semi-constrained design
 - with larger socket
 - congruent articulation
 - smaller ball

History

• Paul Grammont, 1985

Grammont type (mark 3)

- DePuy Delta, Lima SMR, Tornier Aequalis, (Biomet, Smith and Nephew, Mathys)
- Grammont modifications
- Eccentric glenosphere
- Lateralised designs
- Large 'heads' $36 \rightarrow 40 \rightarrow 44$
- Plastic heads on metal humeral cup

Grammont type

A reverse total shoulder prosthesis. From left to right: the humeral stem and metaphysis, the polyethylene humeral concavity insert, the glenosphere, and the metaglene.

 60 and 65 degree humeral cups – Zimmer TM, Equinoxe

- <u>Screw-in glenoid base</u>
 <u>plates</u>
- Very lateralised humerus -Encore (Mark Frankel)
 - bad design, poor results
- Biomet Verso Grammont with screw-in glenoid + stem-less humerus

A modular system of inter-changable implants

Beware the lower centre of rotation of Reverse TSR

RTSR - Indications

- Cuff tear arthropathy
- (Milwaukee shoulder)

- Cuff tear pseudo-paralysis
- Massive cuff failure
 - dislocation with global cuff tear (elderly)

RTSR - Indications

- Revision with no cuff
- Failed trauma hemi-arthroplasty
- Post TSR cuff failure
- Revision for infection

Rheumatoid and inflammatory arthritis

RTSR - Indications

• Trauma

• Tumour

Delto-pectoral approach

- 'Familiar' (?) approach
- Deltoid preservation
- Lesser tuberosity managemant
- (Biceps management)
- Testing for joint tension & reduction stability

• Fractures – tuberosity repair is difficult

Impingement and stability checks

- release self retainers
- AB/ER no "hingeing"
- add one size bigger poly liner

The antero-superior approaches

• McKenzie, Neviaser

Modes of failure

- Dislocation
- Glenoid notching
- Glenoid loosening

- Deltoid deconditioning
- Acromion and scapular spine fractures
- Infection

Glenoid notching - Nerot / Sirveaux

Grade 0 – no notch (7)

Grade 1 – small notch (4)

11 /15 had no notching or minor notching

Grade 2 – notch with condensation (stable) (3)

Grade 3 – erosion to inferior screw (1)

Grade 4 – erosion to peg +/- early glenoid loosening (0)

Glenoid Notching

Case 2: AS, 78 year old female with four part fracture dislocation of right shoulder: Painless notching, stabilized after 12 mo., with no deterioration in range of motion

Tips to avoid failure

• Exposure, exposure, exposure

- Tilt base plate downwards, eccentric gelnospheres
- Adequate inferior clearance
- Superior screw into the base of coracoid
- Inferior screw ?
- Lateralised base plate

Tips to avoid failure

- Humerus version 0-20 retroversion
 - trauma neutral (0 deg) version
- Avoid subsidence Cemented stem trauma, porotic metaphysis
- Subscapularis management
 - tension in reduction
 - lesser tuberosity osteotomy v/s tenotomy

Tips to avoid failure

Stability, stability, stability

- Adequate tension during reduction
- Reduce with subscap. Intact antero-sup approach
- Avoid leverage (leading to dislocation) rotations (ER, IR)
- Inferior impingement long head of triceps
- Post –op regime Avoid physiotherapy

Correct angulation of the glenoid

NJRR results – TSR v/s RTSR

NJRR results – TSR v/s RTSR

Figure STO1: Cumulative Percent Revision of Primary Total Shoulder Replacement by Class

Table STO2: Yearly Cum	ulative Percent Revision of	Primary Total Shoulder Replace	ment by Class
CPR	1 Yr	2 Yrs	3 775
Total Resurfacing	3.4 (0.5, 22.1)	9.1 (2.3, 33.1)	
Total Conventional	2.7 (2.0, 3.6)	4.1 (3.1, 5.3)	5.2 (3.7, 7.4)
Total Reverse	3.2 (2.4, 4.2)	4.0 (3.0, 5.2)	5.4 (3.4, 8.4)
TOTAL SHOULDER	2.9 (2.4, 3.6)	4.1 (3.4, 4.9)	5.3 (4.0, 6.9)

Figure STO1: Cumulative Percent Revision of Primary Total Shoulder Replacement by Class

RTSR r/v rates by sex

Men do worse

Table STO16: Yearly Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

NJRR:	Ν	J	R	R:
-------	---	---	---	----

CPR	1 Yr	2 Yrs	3 Yrs
<65	2.8 (0.7, 10.8)	2.8 (0.7, 10.8)	
65-74	3.5 (1.9, 6.4)	4.2 (2.3, 7.7)	
≥75	2.7 (1.6, 4.5)	3.4 (2.0, 5.6)	3.4 (2.0, 5.6)

Figure STO7: Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

15

0

0

0

0

0

594

≥75

322

102

0

0

0

RTSR r/v rates by age

Table STO14: Yearly Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

CPR	1 Yr	2 Yrs	3 Yrs
Fracture/Dislocation	4.3 (2.1, 8.4)	5.3 (2.7, 10.1)	
Osteoarthritis	3.0 (2.0, 4.3)	3.6 (2.5, 5.3)	6.0 (2.7, 13.0)
Rheumatoid Arthritis	3.7 (0.9, 14.0)	3.7 (0.9, 14.0)	
Rotator Cuff Arthropathy	3.6 (2.1, 6.3)	4.7 (2.8, 8.0)	6.2 (3.4, 11.3)
Other (5)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	

Note: Only prostheses with over 50 procedures have been listed.

Figure STO6: Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

Years Since Primary Procedure

Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs	9 Yrs
Fracture/Dislocation	214	112	32	5	0	0	0	0	0	0
Osteoarthritis	1005	546	188	26	1	0	0	0	0	0
Rotator Cuff Arthropathy	451	210	83	24	2	0	0	0	0	0

RTSR r/v rates by primary indication

NJRR:

Trauma reverses do worse Table \$TO19: Revision Rates of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs (95% CI)
Cemented	0	23	38	0.00 (0.00, 9.64)
Cementless	24	765	903	2.66 (1.70, 3.95)
Hybrid (Glenoid Cemented)	0	3	4	0.00 (0.00, 88.64)
Hybrid (Glenoid Cementless)	6	214	266	2.25 (0.83, 4.90)
TOTAL	30	1005	1212	2.47 (1.67, 3.53)

Table STO20: Yearly Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)

CPR	1 Yr	2 Yrs	3 Yrs
Cemented	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	
Cementless	3.2 (2.1, 4.8)	3.8 (2.5, 5.7)	6.8 (2.8, 16.1)
Hybrid (Glenoid Cementless)	2.6 (1.1, 6.1)	3.6 (1.6, 8.3)	3.6 (1.6, 8.3)

Figure STO9: Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)

Cemented v/s press fit stems

- subsidence
- loosening

Which implant?

Table STO21: Revision Rates of Primary Total Reverse Shoulder Replacement

Humeral Stem	Glenoid Component	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs (95 Cl)
Aequalis	Aequalis	8	229	282	2.84 (1.22, 5.59)
Delta CTA	Delta CTA	5	84	192	2.61 (0.85, 6.09)
Delta Xtend	Delta Xtend	→10	631	662	1.51 (0.72, 2.78)
Promos	Promos	0	31	15	0.00 (0.00, 23.93)
SMR	SMR	31	688	826	3.75 (2.55, 5.33)
Trabecular Metal	Trabecular Metal	3	121	143	2.10 (0.43, 6.15)
Other (3)		0	5	11	0.00 (0.00, 34.65)
TOTAL		57	1789	2130	2.68 (2.03, 3.47)

Note: Only prostheses with over 25 procedures have been listed.

Table STO22: Yearly Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement

Humeral Stem	Glenoid Component	1 Yr	2 Yrs	3 Yrs
Aequalis	Aequalis	2.9 (1.3, 6.3)	2.9 (1.3, 6.3)	9.4 (3.4, 24.8)
Delta CTA	Delta CTA	6.1 (2.6, 14.1)	6.1 (2.6, 14.1)	6.1 (2.6, 14.1)
Delta Xtend	Delta Xtend	1.5 (0.7, 3.0)	2.4 (1.2, 4.7)	2.4 (1.2, 4.7)
Promos	Promos			
SMR	SMR	4.6 (3.2, 6.7)	5.8 (4.1, 8.3)	5.8 (4.1, 8.3)
Trabecular Metal	I Trabecular Metal	3.1 (1.0, 9.3)	3.1 (1.0, 9.3)	
Other (3)		0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	

Note: Only prostheses with over 25 procedures have been listed.

Cemented v/s metal backed glenoids

Arthrex Univers standard TSR – metal backed glenoid

Figure SIP1: Cumulative Percent Revision of Individual Total Conventional Shoulder newly identified

Newly Identified

Lima SMR - reverse TSR

Figure SIP2: Cumulative Percent Revision of Individual Total Reverse Shoulder re-identified and still used

Years Since Primary Procedure

Table STO14: Yearly Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

CPR	1 Yr	2 Yrs	3 Yrs
Fracture/Dislocation	4.3 (2.1, 8.4)	5.3 (2.7, 10.1)	
Osteoarthritis	3.0 (2.0, 4.3)	3.6 (2.5, 5.3)	6.0 (2.7, 13.0)
Rheumatoid Arthritis	3.7 (0.9, 14.0)	3.7 (0.9, 14.0)	
Rotator Cuff Arthropathy	3.6 (2.1, 6.3)	4.7 (2.8, 8.0)	6.2 (3.4, 11.3)
Other (5)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	

Note: Only prostheses with over 50 procedures have been listed.

Figure \$TO6: Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs	9 Yrs
Fracture/Dislocation	214	112	32	5	0	0	0	0	0	0
Osteoarthritis	1005	546	188	26	1	0	0	0	0	0
Rotator Cuff Arthropathy	451	210	83	24	2	0	0	0	0	0

RTSR r/v rates by primary indication

NJRR:

