Avoiding Complications in TSA:
Fracture, Instability, Neurologic

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Primary TSA

Avoiding This
Achieving This
What are the complications?

- Leschinger et al (Germany): Risk factors for intraop complications
- 275 Primary Tornier Aequalis TSA by 4 surgeons
- 22 (8%) Category I (intraop) complications
  - 4 nerve injuries
  - 2 Dislocation
  - 6 Humeral fractures
  - 5 Glenoid fractures
- ASA >/= 3 and Nicotine use significantly increased risk

Factors Effecting Complications

- Disease related factors
- Patient related factors
- Surgeon related factors

“The surgeon is the method” – Matsen

Background

- TSA growing at a rate faster than that of hip and knee arthroplasty
- Incidence of complications has remained steady, however the volume of complications and revision burden continues to rise
- Avoiding complications is most effective way to maintain a long, effective joint replacement
Step 1: Do Your Homework

- **Prep for the case**
  - Know the potential pitfalls in your patient
  - Pre-op imaging
  - BMI, Severity of shoulder specific disease
  - Team you are working with
  - Implant system
  - Back up systems in place
  - Skill level of your help... fellow/resident
  - Reasonable goals
  - Your abilities

- **Know your Design options**
  - Humerus → Diaphyseal fit; Metaphyseal fit; Stemless
  - Glenoid → Peg component; Posteriorly augmented component; bone graft

Step 2: Plan the Steps of the Case in Your Mind

- **Exposure**
  - Complete (360) subscapularis mobilization
  - Humeral release of capsule past 6 o’clock
  - Humeral osteophyte removal
  - Lateral excision with complete superior, anterior, and inferior capsule release

- **Humerus**
  - Neck cut made in anatomic inclination and version
  - Anatomic restoration of head

- **Glenoid**
  - Centering pin placed in neutral version exiting at Matsen’s point
  - Reaming to subchondral bleeding bone
  - Peg holes drilled within the vault
  - Restore to near anatomic version

Step 3: Know Where the Landmines Lie

- **Exposure**
  - Axillary nerve within deltoid laterally
  - Axillary nerve inferior to subscapularis running inferior to capsule ... AM to PI
  - Musculocutaneous nerve deep and medial to conjoint tendon
  - Axillary artery deep and medial to conjoint
  - Osteophyte removal at calcar

- **Humerus**
  - Superior and posterior rotator cuff near neck cut
  - Breaching canal and metaphysis

- **Glenoid**
  - Fracture during reaming/impacting
  - Suprascapular nerve injury during drilling
Step 4 Meticulous Patient Positioning

- Beach chair positioning to 45 degrees
  - Cerebral hypoperfusion
- Shoulder over edge of bed
  - Free circumferential movement of arm
  - Keep portion of medial scapula stabilized on the bed
- Arm positioners are helpful
- Draping to optimize infection control

Step 5: Humeral Sided Prep

- Humeral releases
  - Inferior release past 6 o'clock
- Osteophyte removal
  - Defines true anatomic neck
- Head resection along anatomic neck
  - +/- cutting guide
  - Version variable (around 30° of retroversion)
- Superior margin of resection should abut cuff insertion
  - Protect cuff during osteotomy!

How to Avoid Fracture

- Humeral fractures
  - Greater tuberosity during humeral retraction for glenoid prep, stem insertion, stem removal, or dislocation
    - Treatment: suture fixation
  - Metaphysis during stem prep or removal
    - Treatment: Cerclage cables or sutures +/- cemented stem
  - Shaft fractures during stem prep/insertion/removal or arm manipulation
    - Treatment: Fracture exposure, reduction, radial nerve exposure, cerclage
  - Athwal et al 2009: 1.5% incidence intraop humeral fractures
    - Risk factors: Women, Revision surgery, Press fit implants
- Glenoid fractures
  - Rare
  - Likely due to reaming
Pitfall: Humeral Component Malposition

- Undersized head → Bone impinges
- Oversized head → Cuff Tension
- Too little offset → Soft Tissue Laxity
- Too much offset → Cuff Tension
- Height too low → Tuberosity impinges
- Height too high → Cuff Tension

Neck Shaft Angle

- Varus cut = inferior head position

Step 6: Understand and Properly Prep for Glenoid Morphology

<table>
<thead>
<tr>
<th>Recognition key</th>
<th>PSI, virtual planning</th>
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<tbody>
<tr>
<td>Can lead to:</td>
<td></td>
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<tr>
<td>Peg perforation</td>
<td></td>
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<tr>
<td>Posterior instability</td>
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<tr>
<td>Earlier glenoid failure</td>
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Pitfall: Posterior Glenoid Wear

**Strategies for management**
- Eccentric reaming (up to 15°)
- Augmented glenoid component
- Posterior grafting for greater than 9 mm bone loss

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**Step 7: Spend Time Trialing**

- **Try before you Buy**
  - Dial in eccentricity of humeral head component
  - Assess smoothness of glenohumeral motion
  - Assess cuff tension
  - 50% posterior translation
  - Loosest shoulder will ever be is in surgery.
  - **Err on loose not tight.**
  - **UNDERSIZE OR REVIZE**

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**Lateral GlenoHumeral Offset**

- Effected by head size
- LGHO affects tissue tension
  - Rotator cuff length (strength)
  - Deltoid moment arm (strength)
  - Capsular length (range of motion)
Avoiding Instability

• First assessment at reduction with trial or final implants
  • Matsen 40 50 60 rule with arm in scapular plane
  • 40 degrees ER, 50% translation; 60 degrees internal rotation at 90 abduction

• If unstable and cuts appropriate → increase humeral head size
  • Increase head height if available

• Did the glenoid need to be augmented?
  • Bone graft versus polyethylene augment

• Posterior capsulorrhaphy
  • Assess with trials prior to final implants
  • Anchors in posterior glenoid and reef capsule (rare in my experience)

Nerve Injuries

• Reported between 0.6 – 16.7% in primary shoulder arthroplasty

• Traction injury → More likely

• Direct injury → Cement extrusion, Laceration, Suture .....unlikely

Avoiding direct injury

• Axillary nerve is at risk when working inferior to the subscapularis
  • Care should always be taken to protect the nerve or palpate it when working close
  • Recommend against static retractors directly on nerves
  • I avoid paralysis
  • Use bougie around nerve

• Axillary nerve also at risk in lateral and anterior deltoid
  • Muscle should be elevated deep to deltoid fascia and avoid intramuscular dissection to avoid de-nervation of muscles

• Musculocutaneous nerve direct injury is rare, but the location of the nerve should still be palpated
Avoiding traction injury

• Nerve Monitoring
  • Provides alerts for intraoperative nerve injury

• Considered controversial

• Malik et al 2014
  • 7/21 (33%) primary or revision TSA had intraop nerve tension change
  • All but one returned to normal by end of case ⇒ no lasting deficit
  • Male gender more common and median nerve most affected

• Naga et al 2007 (Neer Award)
  • 17/30 (56%) of patients had signal changes intraop
  • 76% of alerts returned to baseline after arm repositioning
  • Only 2 patients had deficits that did not recover
  • Monitoring can give the opportunity to reposition the arm when nerves are at risk of damage

IONM Results 2016 ASES Abboud et al

• 440 arthroplasty cases included
  • 215 primary anatomic TSA, 95 primary reverse TSA, 34 primary hemiarthroplasty, 56 revision arthroplasty

• 5 post-operative transient nerve injuries (1.1%)
  • Radial nerve (2), axillary (2), mixed brachial plexus (1)
  • All occurred in anatomic arthroplasties more primaries

• All nerve injuries resolved within 1 year

Conclusions

• Complications during TSA are rare, but disastrous

• More common intraoperative complications are fracture, instability, and nerve injury

• Complications can be avoiding with meticulous surgical detail

• When these complications do occur, the ability to manage them and produce a good outcome is challenging but feasible
THANK YOU.