Resection and Hemi-Arthroplasty of the Shoulder in the Treatment of Prosthetic Joint Infection after TSA

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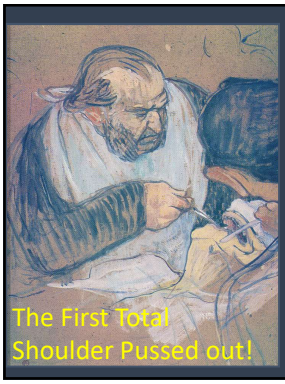
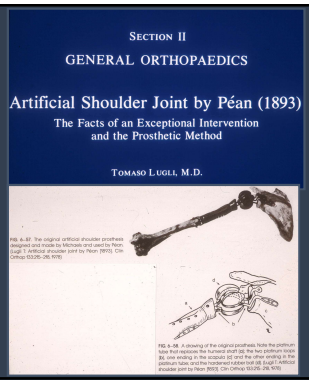
Disclosures

- Consultant

Arthrex, Implant Cast, Fx Ortho, Wright Medical
Fellowship support Arthrex Implant Cast



The First Total Shoulder Pussed out!



SECTION II
GENERAL ORTHOPAEDICS

Artificial Shoulder Joint by Péan (1893)
The Facts of an Exceptional Intervention and the Prosthetic Method

TOMASO LUGLI M.D.

Pean's Greatest Contribution

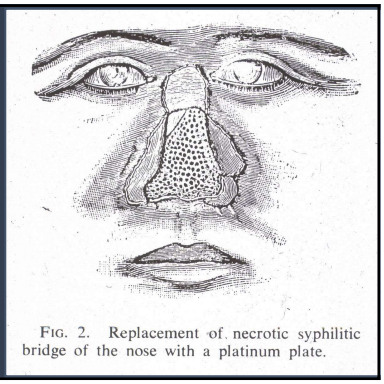


FIG. 2. Replacement of necrotic syphilitic bridge of the nose with a platinum plate.

Introduction

- Shoulder arthroplasty becoming more common.
- Number of failed arthroplasties increasing as well
- Infection is the most serious and major cause for revision in first two years after arthroplasty[2]
  - Up to 4% of all unconstrained arthroplasties[3]
  - Up to 84.6% of all revisions by Muh et al[4]
  - 0.7-2.7% of TSA[1]
  - 1.3% of hemiarthroplasties[1]
  - 2-18.8% of RTSA[5]
  - 15.4% of revision procedures become infected

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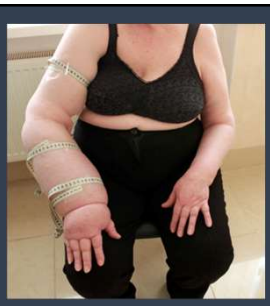
Introduction (cont)

- At risk patients include:
  - RA
  - Renal and liver failure
  - Chronic hypoxia or lymphedema
  - IVDA
  - Advancing age
  - DM
  - History of infection or trauma[8]
  - Poor nutritional support
  - Chronic disease
  - Immunosuppressed[3,9-11]



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Introduction (cont)

- Other causes of failed arthroplasty include loosening, fracture, mechanical failure
- Failure after RTSA leaves few options due to loss of bone stock and soft tissue derangement[4]
- Compared to other joints such as hips and knees, adequate function relies heavily on retaining ROM
  - Often difficult in setting of PJI[10]
- Limited (impossible) goals of Neer, Watson, and Stanton
  - Outcome of shoulder replacement consider successful when:
  - No pain at rest, intermittent moderate pain with vigorous activity, active elevation to 90º, external rotation to 20º

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Patient Presentation - Imaging

- Patients may present with systemic sxs, shoulder pain, swelling, draining sinus, warmth
- X-rays often normal with early infection, may see periosteal reaction, pseudosubluxation, or osteopenia in late presentations[9]
- PET scan may be useful in equivocal cases, 98% sensitive and specific for PJI

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Patient Presentation - Labs

- WBC not sensitive or specific
- ESR and CRP useful for screening and monitoring infection
  - Both may be normal with P. acnes
- Aspiration and/or tissue culture should be routinely performed
  - Hold for a minimum 21 days to isolate P acnes, 4 weeks for fungal, 8 for mycobacterium[8]
  - WBC >50k w/ >75% PMN or >5 PMN per HPF concerning[9]
  - Negative in up to 25% of infectious cases[9]

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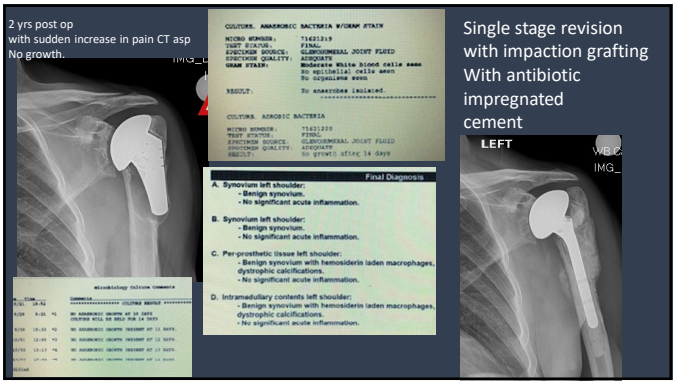
2 yrs post op
with sudden increase in pain CT asp
No growth.



Single stage revision with impaction grafting With antibiotic impregnated cement

Treatment Modalities

- Antibiotic Suppression
  - For those unable to undergo surgery or as adjunct to resection with recalcitrant infection
  - Failure rates of 60-75%[9]
- Early arthroscopic or open debridement
  - Good results in up to 90%[13]
- Arthrodesis and amputation

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Single-Stage Revision

- For low virulence organisms, offers reduced LOS and cost with shorter period of abx
- Need to identify organism and their sensitivities for success[2]
- Revision from hemiarthroplasty to RTSA shown to have higher Constant score at final follow-up[2]
  - Preoperative stiffness predicted poor functional outcome in converting anatomic to RTSA[5]
  - Anatomic TSA may have poor function as debridement may impair rotator cuff function[5]
  - Success rate as high as 94%[2]
- Advantages: reduced cost, shortened hospital stay (10.6 vs. 26.1 compared to two-stage[2]), only one procedure

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Antibiotic Spacer Alone

- One study by Verhelst et al found no improvement in infection eradication or functional outcome w/ use of a spacer vs resection alone[13]
- Better function is seen with larger head spacers but more periprosthetic fractures in those with good mobility[14]
- Advantages: reduced cost and morbidity of forgoing second procedure, second stage is an option, good for relatively low-demand patient
- Disadvantages: conventional all-cement spacer may cause glenohumeral frictional pain, lack of motion, possible glenoid erosion (although no evidence seen radiographically at 2 years with prefabricated spacer in one study by Stine[14]), possibility for limited shoulder function[6,13]

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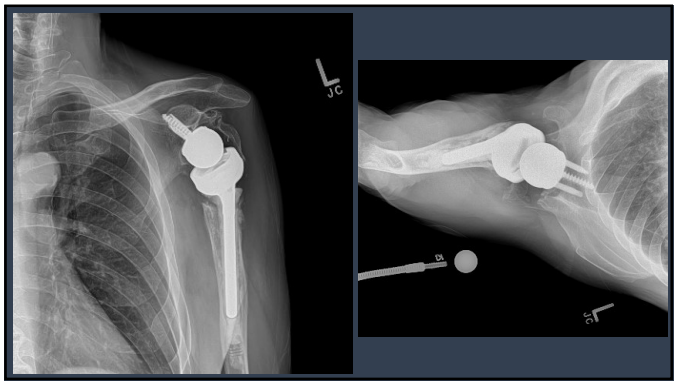
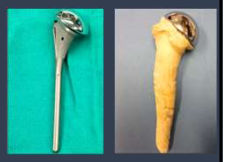


Hemiarthroplasty with Antibiotic Coated Stem (Functional Spacer)

- Results similar to two-stage revision Levy et al[6]
- Size 6 hemiarthroplasty stem coated with antibiotic cement prior to implantation,
- 14 patients, 9 with function and pain relief adequate enough that they declined second stage revision
  - 89% were satisfied with this procedure with no recurrent infections, average forward flexion of 90º and abduction of 70º



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Hemiarthroplasty with Antibiotic Coated Stem (Functional Spacer)

- Advantages: avoid morbidity, cost, maintain soft tissue compliance, avoid glenoid bone loss and scar tissue, allows reaming/debridement of glenoid, improved function over resection[11]
- Disadvantages: may be more costly than handmade spacer, may loosen over time

Two-Stage Revision

- Advantages:
  - Gold standard (60-90% success) with highest likelihood of restoring function[3]
  - Use of a spacer allows preservation of function and soft-tissue tension, decreases pain, and allows rehabilitation prior to definitive implantation[9]
  - Conversion of hemiarthroplasty to reverse can be done with improvement in motion and function[9]

Rush Rod to by pass a cocomtant fracture in this case prior to revision but not an uncommon problem with complete cement removal in the context of infection

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2 stage reimplantation




Two-Stage Revision

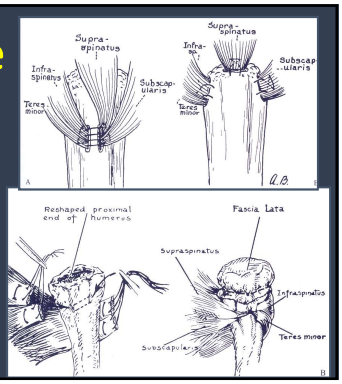
- Disadvantages:
  - Can compromise soft tissue envelope leading to poor function and continued pain, higher rate of major surgical complications in the second stage[15]
- Therefore, I Prefer a 1 stage revision with life time suppression when possible in older patients

Resection Arthroplasty

- Historically, was reserved for:
  - Non-reducible fractures of the humeral head
  - Septic arthritis with osteomyelitis
  - Severe glenohumeral arthritis[4,12]
- Nové-Josserand in 1916 stated that shoulder function was obliterated with resection[1]
- Even today, this procedure is done as a palliative measure with little hope to improve function

Jones Procedure

- Reconstructive operation for non-reducible fractures of the head of the humerus. Ann Surg 1933; 97 :217. Little Rock, AR
- The shoulder joint – observations on the anatomy and physiology: with an analysis of a reconstructive operation following extensive injury. Surg Gynecol Obstet 1942; 75:433. Beverly Hills, CA



Resection Arthroplasty

My Indication: The Patient who you want to do only one operation on for Host (medical and Psychological)or Organism Factors

- Failed arthroplasties or exchange arthroplasties [12]
- PJI Virulent infections
- Medically frail patients
- Poor bone stock Advanced inflammatory arthropathies[3]
- Uncorrectable glenohumeral instability
- Intractable pain[7] there are some patients with painful reverses where the etiology of their pain cannot be determined

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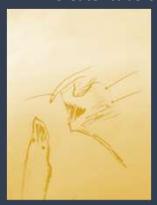
Authors technique pearls for improving function with resection arthroplasty Create pencil in cup type fulcrum either:

humerus to inferior glenoid

Greater tuberosity into glenoid vault



When residual Humerus is too deficient to stay under Glenoid reshape both to fit the Humerus inside of the glenoid vault

Description of Procedure

- Delto-pectoral approach, thorough debridement of GH and SA spaces
- Extensive synovectomy
- May add additional lateral deltoid split to access SA synovium[12]
- Removal of prosthesis and other foreign material such as cement and anchors
- Variable amount of humeral resection dictated by extent of infection
- Partial manual reaming of glenoid
- Preservation of tuberosities if possible may prevent anterosuperior subluxation and provide better function[13]

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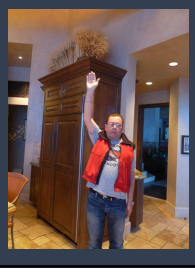
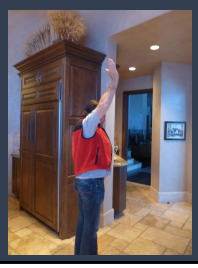
Pencil in cup Humerus in Glenoid

Repair the cuff if possible
Abduction Pillow for 6 weeks
Slow advancement of exercise
Passive ROM usually not an issue
Functional active ROM requies a fulcrum

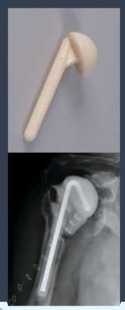
Post Resection and axillary nerve release with intact cuff s.epi TSA


J.S. 1 yr s/p resection arthroplasty cuff deficient and teres intact subscap gone .

Description of Procedure
Antibiotic Spacer addition

- Multiple cultures and biopsies should be obtained prior to antibiotic administration, usage of drains recommended by many authors[3,4,9,12]
  - Frozen section, permanent histology, gram stain, culture
  - Four samples: two from capsule, one from prosthesis-bone interface, one from medullary canal[9]
  - May also sonicate explanted prosthesis to identify bacteria in biofilm[9]
- Vancomycin-laden cement may be placed in humeral shaft and retained if infection is obvious[1]
  - Patients may have improved pain/function from spacer placement



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Description of Procedure (cont)

- Subscapularis (if present) can be sutured to humerus to act as interposition[1]
- Gloves are changed and new drapes placed prior to closure[3]
- Limit placement of hardware such as anchors to avoid introduction of foreign bodies
- Closure with monofilament suture

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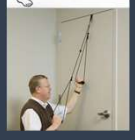
Postoperative Care Per the literature

- IV antibiotic stewardship per infectious disease specialists until CRP levels are normal, continue PO for additional 6 weeks[3,12 at least]
- Sling, begin pendulum and gentle ROM immediately, full elbow/wrist/hand motion[3,12]
- Pulleys and passive motion started at 2 weeks, advanced to active assist at 5 weeks, and full active motion and light strengthening at 12 weeks[3]



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Outcomes - Eradication of Infection

- 0/7 and 0/18 with clinical signs of infection at final follow-up[3,7,12]
- In a study by Coste et al, infection persisted in up to 30% of patients undergoing resection alone[10]

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Outcomes – Range of Motion and Functional Outcome

- Patients should expect a loss in their ROM
  - Typically below 90º of abduction
  - Limitation in external rotation
- Debeer et al[12] active abduction and elevation was <70º with marked reductions in strength
- Muh et al[4] decrease in active flexion of 60º→45º, and active external rotation of 16º→9º
- Rispoli et al[7] flexion 39º→70º no change in internal/external rotation, although only 2/18 had "success" based on Neer's criteria
- Stevens et al[1] flex 90º→63º and external rotation 40º→27º

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Outcomes – Range of Motion and Functional Outcome

- Braman et al found mean forward flexion of 28º and external rotation of 8º postoperatively
  - All patients undergoing resection after postarthroplasty infection were able to have functional range of motion (able to reach contralateral axilla, back pocket, mouth, and perform perineal care)[3]

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Outcomes – Range of Motion and Functional Outcome

- Resection in the setting of TSA had better forward flexion than resection after RTSA[4]
  - Thought to be due to minimal remaining musculature
- Reimplantation offers superior functional results, and has been performed successfully up to 5.5 years after resection[16,17]

Table IV Functional outcomes after resection arthroplasty subjectively reported on the survey

Patient	Shoulder function worse/better/same than day before surgery	ADLs still able to perform	ADLs that are difficult
1	Better	Brushing teeth, brushing hair, washing dishes, bathing, personal hygiene	Not much use at all with my right arm
2	Better	Brushing teeth, brushing hair, washing dishes, bathing, personal hygiene	Curling and styling hair
3	Same	Brushing teeth, brushing hair, washing dishes, bathing, personal hygiene	None
4	Worse	Washing dishes, shower, brush hair	Curling and drying hair, dressing, can't lift up to microwave, heavy dishes, pots and pans
5	Better	Brushing teeth, brushing hair, washing dishes, bathing, personal hygiene	None
6	Worse	Most everything	None
7	Same	Brushing teeth, comb hair, limited to holding a blow dryer, shower with help	Washing dishes, folding laundry, washing floors, dusting, vacuuming, using a broom

ADL, activities of daily living.

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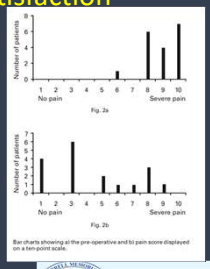
Outcomes – Pain Relief and Satisfaction

- Pain relief often good but can still be unpredictable[12]
- Most patients able to control pain with NSAID alone[3]
- Patients typically comfortable with arm held passively at the side[7]
- 6/7 had rated their pain relief as "good"[12]
- 12/18 had their pain levels significantly decrease from 8.8→4.5($p<0.001$)[7]
- VAS scores improved from 6→3[4]
- 6/7 Patients satisfied with their result[3]
- 6/7 would do it again[1]



Bar charts showing a) the pre-operative and b) pain score displayed on a ten-point scale.

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Conclusions

- Resection arthroplasty is a salvage procedure reserved for the elderly with poor mental and physical condition[12]
- However, with proper patient selection and preoperative counseling, pain control and high satisfaction is possible
- For revision of an infected reverse with bone loss spacer vs antibiotic cemented cta head in increased Retrotorsion to keep it under the acromion or coracoid
- If the patient is amenable, a one or two-stage revision is preferable as this offers the best compromise between preservation of function and eradication of infection[10]

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Thank You

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