

AAHKS

2017 SPRING MEETING

MAY 5 – 6 • SAN FRANCISCO

The Westin St. Francis



THANK YOU TO AAHKS SPRING MEETING FACULTY

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Jiranek, MD, FACS, Co-Chair**

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Daniel J. Berry, MD
Stefano A. Bini, MD
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Thomas P. Vail, MD



VOLUNTEER FOR AAHKS 2017!

We are seeking volunteers to review abstracts, posters and surgical technique videos for the 2017 AAHKS Annual Meeting. Please contact Sigita Wolfe, Director of Education, at swolfe@aaahks.org to sign up.

Course Description

The 2017 AAHKS Spring Meeting is intended to equip practicing orthopaedic surgeons with state-of-the-art information and cutting-edge strategies aimed at enhancing the care of patients with arthritis and degenerative disease. It combines general and breakout sessions, emphasizing case-based learning in small group setting for most effective results.

Welcome ASRA and OTA



The American Society of Regional Anesthesia (ASRA) takes part in a co-branded symposium focusing on the latest trends in multimodal pain management techniques. The Orthopedic Trauma Association (OTA) collaborates with AAHKS faculty to discuss current trends and management of periprosthetic fractures around total hip and knee arthroplasty.

Objectives

- Analyze total hip and knee arthroplasty cases
- Investigate the patterns contributing to effective total hip and knee arthroplasty and revision
- Determine the strategies contributing to optimal perioperative and post-operative care, including complication management
- Consider effective practice management tips and related healthcare policy
- Report the highlights of the 2016 Annual Meeting

CME



The American Association of Hip and Knee Surgeons (AAHKS) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

The American Association of Hip and Knee Surgeons (AAHKS) designates this live activity for a maximum of *15.5 AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Spring Meeting Program Schedule

Times and topics are subject to change.

Thursday, May 4, 2017

| Time | Topic | Faculty | Room |
|------------------|--|---------|--|
| 7:00 – 9:00 p.m. | Arrivals/Registration and Opening Reception | | California East/West Foyer and California East |

Friday, May 5, 2017

| Time | Topic | Faculty | Room |
|------------------|--|---|-----------------|
| 7:00 – 7:50 a.m. | Breakfast and Case Discussions with Faculty | | California East |
| 7:50 – 8:00 a.m. | Welcome and Introduction | William A. Jiranek, MD | California West |
| 8:00–8:30 a.m. | Highlights of 2016 AAHKS Annual Meeting | Moderator: John C. Clohisy, MD Panelists: Brian S. Parsley, MD Greg G. Polkowski MD Joseph T. Moskal, MD | California West |

| | | | |
|--|--|---|---------------------|
| | | Stephen T. Duncan, MD William P. Barrett, MD | |
| 8:30–9:50 a.m. Breakout 1 | Primary Total Hip Arthroplasty THA: Simple to Complex | | Elizabethan A/B/C/D |
| 9:50–10:00 a.m. Break | | | California East |
| 10:00–11:00 a.m. Symposium I | Perioperative Optimization | Moderator: R. Michael Meneghini, MD Panelists: Bryan D. Springer MD Peter Cacavallo, MD | California West |
| 11:00a.m.– 12:20p.m. Breakout 2 | Primary Total Knee Arthroplasty TKA: Simple to Complex | | Elizabethan A/B/C/D |
| 12:20–1:00 p.m. | Lunch Presentation: Health Policy Fellow Update | Nicholas B. Frisch, MD | California West |
| 1:00–2:00 p.m. Symposium II | Periprosthetic Joint Infection | Moderator: Javad Parvizi, MD | California West |

| | | | |
|---|---|--|---|
| | | Panelists: Matthew P. Abdel, MD Thomas K. Fehring, MD | |
| 2:00–2:10 p.m. | AAHKS Research Grant Award | Javad Parvizi, MD Mark I. Froimson, MD, MBA | California West |
| 2:10–2:20 p.m. | Break | | California East |
| 2:20 – 3:40 p.m. Breakout 3 | Non-Arthroplasty Hip or UKA | | Non-arthroplasty Hip- Elizabethan A UKA- Elizabethan B/C/D |
| 3:40-4:50 p.m. Symposium III | Making the Transition to Value: Factors for Success | Moderator: Kevin J. Bozic, MD, MBA Panelists: Mark I. Froimson, MD, MBA Jay R. Lieberman, MD | California West |
| 4:50–5:00 p.m. | Closing Remarks | Bryan D. Springer, MD | California West |
| 5:00 – 6:30 p.m. | Reception | | California East |

Saturday, May 6, 2017

| Time | Topic | Faculty | Room |
|---|--|---|------------------------|
| 6:15–6:50 a.m. | Breakfast and Case Discussions with Faculty | | California West |
| 6:50–7:00 a.m. | Welcome and Introduction | William A. Jiranek, MD | California West |
| 7:00–7:30 a.m. | Highlights of the AAOS, Hip and Knee Society Closed Meetings | Moderator: Mark W. Pagnano, MD Panelists: Craig J. Della Valle, MD Steven J. MacDonald, MD Adolph V. Lombardi Jr., MD, FACS John J. Callaghan, MD | California West |
| 7:30–8:50 a.m. Breakout 4 | Revision Total Hip Arthroplasty THA: Simple to Complex | | Elizabethan A/B/C/D |
| 8:50–9:00 a.m. | Break | | California East |
| 9:00–10:00 a.m. Symposium IV | Periprosthetic Fractures of the Femur AAHKS/OTA | Moderator: Frank Liporace, MD Panelists: | California West |

| | | | |
|--|--|--|----------------------------|
| | | Richard F. Kyle, MD Daniel J. Berry, MD, Stefano A. Bini, MD | |
| 10:00a.m.– 11:20p.m. Breakout 5 | Revision Total Knee Arthroplasty TKA: Simple to Complex | | Elizabethan A/B/C/D |
| 11:20–12:00 p.m. | Lunch | | California East |
| 12:00–1:00 p.m. Symposium V | Perioperative Pain Management AAHKS/ASRA | Moderator: William A. Jiranek, MD Panelists: James I. Huddleston III, MD Jean-Louis Horn, MD | California West |
| 1:00–1:20 p.m. | Break | | California West |
| 1:20 – 2:40 p.m. Breakout 6 | Managing Complications in Hip and Knee Arthroplasty | | Elizabethan A/B/C/D |
| 2:40-3:50 p.m. Symposium VI | Step by Step: Key Choices and Techniques in the Revision THA and Revision TKA | Moderator: Daniel J. Berry, MD Panelists: John J. Callaghan, MD | California West |

| | | | |
|----------------|-----------------|--|-----------------|
| | | William L. Griffin, MD Thomas P. Vail, MD Michael P. Bolognesi, MD | |
| 3:50–4:00 p.m. | Closing Remarks | Bryan D. Springer, MD | California West |
| | | | |



**ACR-AAHKS Guideline for the Perioperative
Management
of Anti-rheumatic Medications in Patients with
Rheumatic Diseases Undergoing Elective Total Hip or
Knee Arthroplasty**

Bryan D. Springer, MD



Thank You AAHKS Members

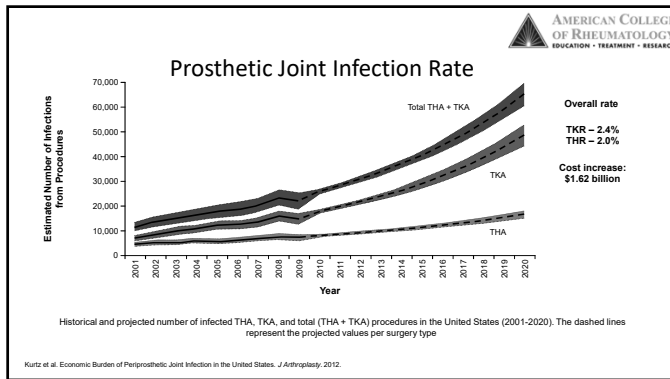
- 3 years in the making
- Weekly conference calls of Core Leadership Team
- Literature Review Team
- Expert Panel
- Voting Panel
- Patient Panel
- Chick Yates, MD
- Matt Abdel, MD
- Vin Dasa, MD
- Jeremy Gilliland, MD
- Antonio Chen, MD
- Alex Sah, MD
- Louis Stryker, MD
- Mark Goodman, MD
- Scott Sporer, MD
- Michael Mont, MD
- Peter Sculco, MD



**Rates of Arthroplasty Remain High among
Rheumatic Disease Patients**

- The widespread use of DMARDs and biologics has not decreased the utilization of arthroplasty
- 34-58% of RA patients undergo orthopedic surgery including arthroplasty over 30 years^{1,2}
- Rates of arthroplasty are increasing for SLE and Spondyloarthritis (Psoriatic, Ankylosing Spondylitis) patients³


1. Massardo. J Rheum 2002; 2. Kogutovich. ARD 2008; 3. Sander. J Arth 2014; 4. Pious. ARD 2005; 5. Meritmann-Vos. J Rheum 2014



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RA and SLE Patients have an Increased Risk of Perioperative Infections

- **RA** pooled meta-analysis
— HR **1.47-1.83** for PJI
- 90 day readmission increasing- most commonly for infection
- 2009: OR 0.89 (95% CI 0.46-1.87)
- 2010: OR 1.34 (95% CI, 0.69-2.61)
- 2011: OR 1.74 (95% CI, 1.16-2.60)
- **SLE-Sepsis** OR 3.43 (95% CI 2.48- 4.74)

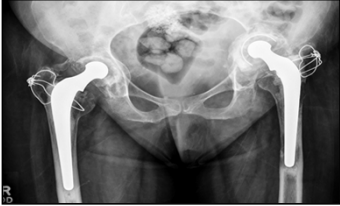


Ravi Arth & Rheum 2014; Hawker. Arth & Rheum. 2013; Chen Arch Orth Trauma Surg 2013; Singh J. Arth Care Res 2014

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Surgery in Rheumatoid Arthritis Increased medical and surgical complexity

- Disease specific risks**
- Co-morbidity burden
- Age, gender
- Disease Activity
- Disease Severity
- Overall disability
- Presence of a prosthetic joint
- **Medications: most accessible modifiable infection risk factor**



SLE Severity/Activity Predicts Post-Op Clinical Outcomes

| Outcome | Outpatient SLE N=2746 | | Hospitalization within 24 months N=1575 | | Hospitalization within 6 months N=1214 | |
|---------------|-----------------------|-----------|---|------------------|--|------------------|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| MI | 0.97 | 0.41-2.28 | 1.42 | 0.52-3.88 | 1.56 | 0.51-4.76 |
| Renal failure | 1.54 | 0.93-2.56 | 5.87 | 3.76-9.17 | 7.23 | 4.52-11.6 |
| PE | 2.29 | 0.63-8.32 | 3.63 | 0.91-14.5 | 4.86 | 1.20-19.7 |
| Sepsis | 1.14 | 0.83-1.56 | 2.99 | 2.21-4.04 | 3.43 | 2.48-4.74 |
| Stroke | 0.71 | 0.51-1.0 | 1.59 | 1.11-2.27 | 2.01 | 1.38-2.92 |
| Any above | 0.98 | 0.82-1.15 | 1.94 | 1.62-2.32 | 2.30 | 1.89-2.80 |
| 30 day | 1.36 | 0.77-2.43 | 2.26 | 1.26-4.04 | 2.39 | 1.28-4.45 |

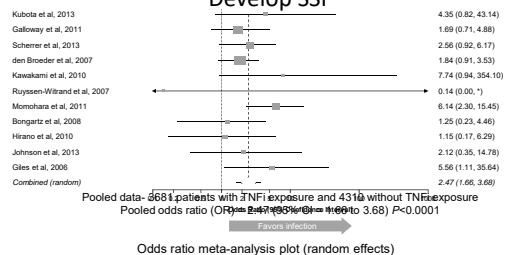
Analysis using Taiwan's national insurance research database, age and sex matched controls and Stratified by SLE severity
Lin ARD 2014

High Perioperative Exposure to Immunosuppressants

- 75% -84% of RA undergoing THR or TKR take DMARDs or biologics¹
- 80% of RA patients undergoing orthopedic surgery take glucocorticoids
- 75% pf patients with SLE are on immunosuppressant medications at the time of surgery

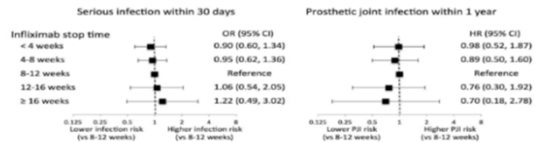
1. Goodman, J Rheum; 2014; 2. Shourt, J Rheum; 2012; 3. Johnson, J Rheum; 2013; 4. Steuer, Br J Rheum; 1997; Lovvick, J Rheum; 2015

TNFi Treated Arthroplasty Group More Likely to Develop SSI



Goodman, Rheumatology 2015

Infliximab within 4 weeks of THA or TKA was not associated with a higher risk of serious infection



Retrospective cohort study of 4288 Medicare patients who received infliximab within 6 months of THA or TKA

George AC&R 2017

Inconsistent Perioperative Use

Timing of use of anti-tumor necrosis factor (anti-TNF) medication perioperatively

| Anti-TNF | Stop Time weeks ± SD n=71 | Restart Times weeks ± SD n=23 |
|---|---------------------------------|-------------------------------------|
| Etanercept (n=59) Standard dosing: weekly | 2.4 ± 2.4 (n=39) range 1-14 | 2.1 ± 1.1 (n=15) range 1-14 |
| Golimumab (n=2) Standard dosing: monthly | 8 (n=1) range NA | 1.5 (n=1) range NA |
| Adalimumab (n=25) Standard dosing: every 2 weeks | 5 ± 5.6 (n=20) range 1-24 | 2 ± 1 (n=3) range 1-3 |
| Infliximab (n=18) Standard dosing: every 4-8 weeks | 4.8 ± 2.2 (n=11) range 2-9 | 4.4 ± 1.8 (n=4) range 2-4 |

1/2 half-life. NA: not available

Johnson et al. J Rheum. 2013.

Management of Anti-rheumatic Medication may Mitigate Risk

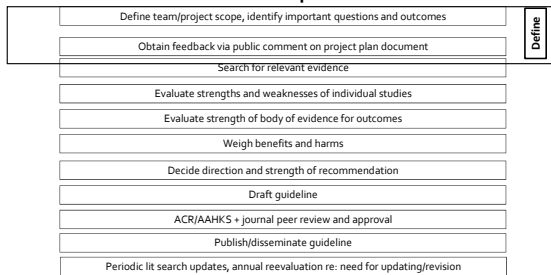
- Periprosthetic joint infection (PJI) remains one of the most common modes of failure following arthroplasty
 - Associated with increased morbidity, significant healthcare expenditure, poor function outcomes, and mortality
- Most infection risk factors are not modifiable- age, disease severity, overall disability

How to Manage These Medications ?

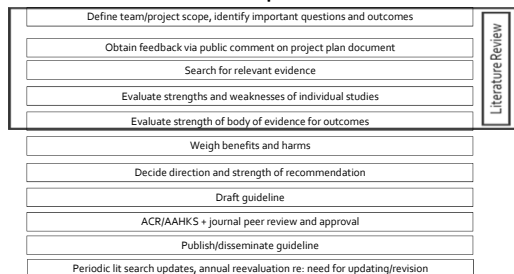
- No current guidelines to direct physicians and patients on management of these medications in the perioperative period
- Guidance is needed for common clinical situations even where data is sparse
- This project brought together major stakeholders – arthroplasty surgeons, rheumatologists, methodologists and patients



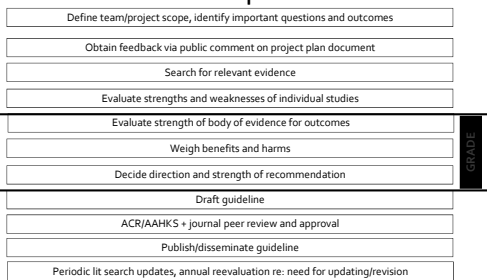
Guideline Development Process



Guideline Development Process

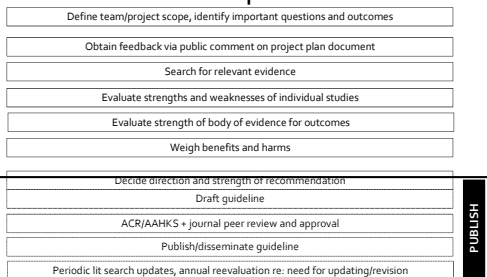


Guideline Development Process



SEARCH

Guideline Development Process



PUBLISH

Guideline Scope



- Adults with RA, SpA, including ankylosing spondylitis (AS) and psoriatic arthritis (PsA), adults with juvenile idiopathic arthritis (JIA), or SLE who are undergoing elective THA or TKA
 - Should anti-rheumatic medications be withheld prior?
 - If withheld, when should they be stopped?
 - If withheld, when should they be restarted after surgery?
 - In patients using GCs, what dose should be administered at time of surgery?

All Recommendations in this Guideline are Conditional due to the Quality of the Evidence

- There were no RCTs for periop use of biologics
- Observational studies are typically rated as low
- Conditional recommendations are preference sensitive and warrant shared decision-making
 - Require estimating the relative value patients place in the outcomes
 - Apply to the majority, but not all
 - Additional research might change the recommendation

Patient Panel: *Estimating the Relative Value of the Outcomes*

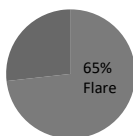
- Patient panel – 11 adults with RA and JA
 - All had THA or TKA (1-8)
 - 1 reported prosthetic joint infection

Patients carefully reviewed data, recognized that flares were quite common and infection was rare

Patients were MUCH more willing to risk flare than infection

Patient panel -100% concordant with the expert panel

Flares vs. Infection Risk?



- 65% of RA patients flare after THA and TKA
- Effect on long term arthroplasty outcome unknown



Pharmacokinetics vs Pharmacodynamics

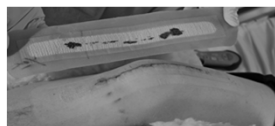
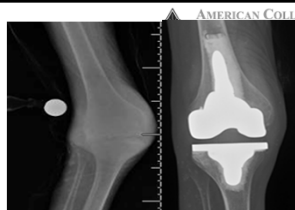
| DRUG | Serum half life | Standard dose interval |
|-------------|---|---|
| Adalimumab | 2 weeks | Every other week |
| Etanercept | 102 hours (single 25mg dose) | Weekly or twice weekly |
| Golimumab | 2 weeks | Monthly (SQ) Every 8 weeks (IV) |
| Infliximab | 7.7-9.5 days | Every 4-8 weeks |
| Abatacept | 13.1 days (IV) 14.3 days (SQ) | Monthly (IV) Weekly (SQ) |
| Tocilizumab | Up to 11 days (4mg/kg IV) Up to 13 days (8mg/kg IV, 162 mg weekly) 5 days (162 mg eow SQ) | Every 4 weeks (IV) Every other week or weekly (SQ) |
| Secukinumab | 22-31 days | Every 4 weeks |
| Ustekinumab | 14.9-45.6 days | Every 12 weeks |
| Rituximab | 18 days | Two doses every 4-6 months |

1. RA, SpA, JIA or SLE: Continue methotrexate, leflunomide, hydroxychloroquine, and/or sulfasalazine

- RCTs of continuing vs. discontinuing DMARDs revealed decreased risk of infections when DMARDs were continued, (RR of 0.39 (95% CI 0.17-0.91)
- Infection risk low DMARDs in settings other than THA and TKA
- Continuing DMARDs decreases the risk of flare [RR 0.06 (95% CI 0.0-1.10)]

Grennan ARD 2001; Tanaka J Clin Rheum2003; Lopez-Oliva Coch Rev 2014;

- 54 yo woman with severe RA with R knee pain and deformity, on weekly methotrexate, adalimumab every 2 weeks, and prednisone 7.5 mg daily.
- She was indicated for TKR, which was performed 2 1/2 weeks after the last dose of adalimumab, she continued MTX, and received prednisone 7.5 mg on the morning of surgery.
- Surgery was uneventful, she resumed adalimumab on post-op day 14, after sending a photo of the wound to her surgeon



Withhold all biologics prior to surgery**Plan the surgery at the end of the dosing cycle for that specific medication**

EXAMPLE: SLE patients treated with rituximab every 6 months would schedule their surgery when possible in the week after the first withheld dose during month 7. Patients receiving belimumab, which is given every 4 weeks, would schedule their surgery during week 5

EXAMPLE: Patients treated with adalimumab, routinely dosed at 2-week intervals, would plan their surgery during week 3, while patients treated with infliximab, when dosed every 8 weeks, would schedule their surgery in the week after the first withheld dose during week 9

Rationale: Withhold Biologics

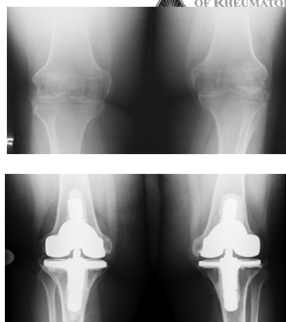
- Not answered in the literature
- The evidence from non-surgical RCTs demonstrated an increase in infection risk associated with use of all biologics
 - Most odds/hazards/risk ratios ~ 1.5 (range, 0.61 to 8.87)
- SLR did not support a differential risk for serious infection among biologics

Rationale: Withhold Biologics

- Infection risk for biologics is strongly associated with high-dose therapy (higher than standard) and may not be associated with low-dose biologics
- Serum half-life may not correspond to the duration of the immune-suppressant effect, so the dosing cycle was chosen as more relevant

Singh JA et al. Lancet. 2015;386:258-65; Nestorov I. Semin Arthritis Rheum. 2005;34(5 Suppl1):12-8; Jinesh S. Inflammopharmacology. 2015;23(2-3):71-7; Weisman H. Clin Ther. 2003;25(6):1700-21; Breedveld F. J Clin Pharmacol. 2007;47(9):1119-28. Lopez-Olivo MA. Cochrane Database of Systematic Reviews 2015, Issue 1. Art. No.: CD007356

- 44 yo woman with sero-positive RA presented in a wheelchair on leflunomide and golimumab.
- Exam revealed flexion deformities of both knees. She was indicated for BTKR.
- Leflunomide was continued and the surgery was planned 5 weeks after her golimumab dose.
- Her course was complicated by a PE, but she ultimately did well and by week 3 was ambulating with a walker. Her meds were re-started post-op week 2.



Rationale: Withhold Biologics in SLE

- Not answered in the literature
- Observational studies -patients with active or severe SLE are at a higher risk for post-op adverse events
- Rituximab is not FDA approved for use in SLE
- Belimumab is not approved for manifestations of severe SLE
- Data did not support separating the biologics

Ginzler EM. J Rheumatol. 2014;41(2):300-9. Ramos-Casals M; Lupus. 2009;18(9):767-76. Murray E. Clin Rheumatol. 2010;29(7):707-16; Roberts JE. J Rheumatol 2016;43(8):1498-502; Lin JA. Ann Rheum Dis 2014;73(9):1646-51.

3. RA, SpA, or JIA: Withhold tofacitinib at least 7 days prior to surgery

- SLR and meta-analysis show an increased risk of serious infections
 - Incidence rate (IR) 2.91 (95% CI 2.27-3.74)
- Little is known about the duration of immunosuppression
- Indirect translational data suggests that host defense returns to normal at 7 days

Strand V. Arthritis Res Ther. 2015;17:362; 99. Boyle DL. Et al. Ann Rheum Dis. 2015;74(6):1311-6. Cohen S. Arthritis Rheumatol. 2014;66(11):2924-37.

4. Severe SLE: Continue mycophenolic acid, azathioprine, cyclosporine, or tacrolimus

- Indirect evidence with organ transplant patients who continue anti-rejection therapy
- **Caveat** – time course of organ rejection after withholding immunosuppressant medication may be different from the time to SLE flare
- Decisions regarding elective surgery in patients with severe SLE should be made on an individual basis with the patient's rheumatologist

Palmisano AC, Int Orthop. 2016 ; Klement MR, J Arthroplasty. 2016

5. SLE (not-severe): Withhold the current dose of mycophenolic acid, azathioprine, mizoribine, cyclosporine, or tacrolimus

- Withhold 7 days prior to surgery through 3-5 days after surgery, in absence of wound healing complications or any infection

6. Restart biologic therapy once the wound shows evidence of healing (≈ 14 days), sutures/staples are out, no significant swelling, erythema or drainage, no clinical evidence of non-surgical site infections

- The decision to restart therapy should be based on evaluation of the patient's wound status and clinical judgment for absence of surgical and non-surgical site infections

7. Continue the current daily dose of glucocorticoids in adult patients with RA, SpA, or SLE, who are receiving glucocorticoids for their rheumatic condition, rather than administering perioperative supra-physiologic glucocorticoid doses

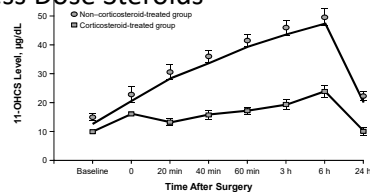
Rationale: Glucocorticoids

- SLR of RCT and observational studies demonstrated no significant hemodynamic difference, between patients given their daily glucocorticoid dose compared to those receiving “stress-dose steroids”
- Observational studies demonstrate an increase in infection risk following TJA for users of chronic glucocorticoids above 15 mg/day.
- Optimizing the patient for elective THA and TKA should include minimizing the daily glucocorticoid dose prior to surgery

Harpaz R. MMWR Recomm Rep. 2008;57(RR-5):1-30. Marik PE. Arch Surg 2008;143(12):1222-6. Somayaji R. Open Rheumatol J 2013;7:119-24.

No Hemodynamic Difference with Stress Dose Steroids

- 2 RCTs
- Chronic steroid treatment: CS stopped pre-op
 - Lower steroid levels
 - Stable hemodynamics



Plasma 11-hydroxycorticosteroid (11-OHCS) response to surgery in non-corticosteroid- and corticosteroid-treated patients with rheumatoid arthritis. Data from Jasani et al.

Jasani. QJ Med 1968; Glowatzki. Surg 1967; Tomason. J Clin Pharmacol 1999; Marik. Arch Surg 2008.

Rationale: Glucocorticoids

- The recommendation specifically refers to adults who are receiving glucocorticoids for their rheumatic condition
- Does not refer to patients with JIA who may have received glucocorticoids during development
- Does not refer to patients receiving glucocorticoids for primary adrenal insufficiency or primary hypothalamic disease.

Guideline Strengths

- This project brought together major stakeholders – orthopaedists, rheumatologists, methodologists and patients – to create a patient-centric, expert-led group to determine optimal management of these high-risk patients through a group consensus process, and established a framework for further research
- Clear preference of the patient panel guided the strength and direction of the recommendations

Limitations

- Paucity of high-quality, direct evidence re: medications and perioperative risk
- Used indirect evidence from RCTs performed on patients who were not undergoing surgery to determine infection risk associated with included drugs and applied the data to these recommendations

Summary: Anti-rheumatic Medications and Arthroplasty

- Rate of arthroplasty remains high for patients with rheumatic diseases
- Use of DMARDs and biologics high at the time of surgery
- Complications are increased
- TNFi: increased infection risk consistently observed and significant when data are pooled
- Insufficient evidence to separate biologics
- Additional factors such as disease activity and severity, as well as smoking, corticosteroid use and diabetes may influence this increased risk

Conclusions

Unique perioperative challenges

- Optimal perioperative management requires close collaboration between orthopedists and rheumatologists
- Infection: medications appear to contribute to the risk of infection
 - Traditional DMARDs- MTX, HCQ, LEF appear safe in the perioperative period
 - Biologics should be withheld prior to surgery
 - SLE may need different management strategy

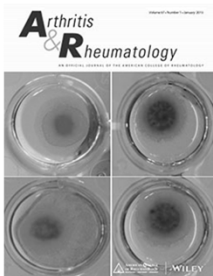
NEED FOR RESEARCH

- There is little direct evidence for medication related adverse events after THA or TKA
- Low incidence of surgical site infection increases practical challenges
- Will need multicenter studies to address these questions



Joint Publication of Guidelines

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Perioperative Optimization

AAHKS 2017

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Disclosures

- Faris Medical – consultant
- DJO - consultant

Topics

- What is a Orthopedic Perioperative Specialist?
- Diabetes Screening
- Inpatient Diabetes Management
- Nutrition Screening

Perfect Patient

- Ideal weight
- Non-smoker
- Exercises regularly
- Proper nutrition
- Controlled cholesterol
- Controlled BP
- Controlled medical problems
- See MDs regularly



Typical Patient

- Obese
- Sedentary
- Non-compliant
- Diabetes
- CAD
- Poor nutrition



Good old days



1. Aspirin 325mg po bid
2. Mefenamic acid ER 250mg po bid
3. Cough syrup
4. Simvastatin 40mg po qd
5. Metoprolol 50mg po bid plus 1 more tablet po at Wed & Sun
6. Terfenadine 300mg po qd
7. Furosemide 40mg po bid
8. Fentanyl 50mcg po qid
9. Alprazolam 0.5mg 1-tablet po qid as needed for sleep anxiety
10. Allopurinol Maximum Strength 300mg HCL 150mg po bid
11. Dicyclanil 200mg po qid
12. 12-fine taste allergy tablets
13. Hydrocortisone acetate 10mg po qid po allergy symptoms
14. Hydrocortisone acetate 10mg po bid allergy symptoms
15. Hydrocortisone acetate 1.25% applied to affected area 1-4x daily po itching
16. Acetaminophen 250mg po qid as needed for chronic irritation
17. Motilium Gac prokinetics 250mg chew po
18. Ambiotic + Paraflex Maximum Strength Sterile Saline Solution 100mL
19. Sulfate polymyxin B HCL
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100. Sulfate polymyxin B HCL

25. Folic Acid 100mcg
26. Phosphatidyl Choline with B-12 & C
27. Omega-3 Fatty Acids Fish Oil 1200mg
28. D-3 100mcg
29. Zinc 75mg
30. Digestal 600mg
31. L-Lysine 500mg
32. Vitamin E 400IU
33. Chromium 200mcg
34. Selenium 200mcg
35. Biotin 5000mcg
36. Co-Q10 Plus B-Complex Co-Enzyme 100mg
37. No-Fish Nicotinamide
38. Food Caramine 10,000
39. Vitamin B-12 1000mcg
40. Gingko Biloba 360mg
41. L-Allyl Choline with Magnesium Plus 5-HTP
42. Evening Primrose Oil
43. L-Valine 1000mg
44. Metabolite B-High Energy Meal
45. Metabolite B-High Energy Meal
46. Pro-Lact Creatine Complex
47. Spin-Test High Protein Energy Meal
48. Spin-Test High Protein Energy Meal
49. Life Transfer Factor
50. Copper Substance 22mg
51. L-Alanine 1000mg
52. L-Alanine 1000mg
53. L-Alanine 1000mg
54. L-Alanine 1000mg
55. L-Alanine 1000mg
56. L-Alanine 1000mg
57. L-Alanine 1000mg
58. L-Alanine 1000mg
59. L-Alanine 1000mg
60. L-Alanine 1000mg



- Improved outcomes
- Fewer delays/cancellations
- Decreased length of stays
- Reduced testing
- Increased patient satisfaction

Perioperative Medicine

The challenge is not how to manage a medical problem but rather how to manage the problem with an *orthopedic* patient.



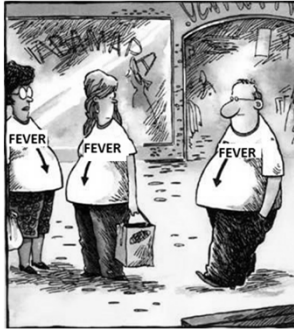
Perioperative Medicine

The Effects of a Hospitalist Comanagement Model for Joint Arthroplasty Patients in a Teaching Facility

"Any potential benefit of a hospitalist comanagement model for this patient population may be outweighed by increased cost."

The Effects of a Hospitalist Comanagement Model for Joint Arthroplasty Patients in a Teaching Facility. By: Daphtner NL, Briski DC, Lacro LT, Meyer MS, Ochener JJ, Chimento GP. The Journal Of Arthroplasty. 1532-8406; 2016 Mar; Vol. 31, Issue 3

Perioperative Medicine



Routine Workup of Postoperative Pyrexia Following Total Joint Arthroplasty Is Only Necessary in Select Circumstances

- 25k patients
- POP occurred 46% of TJA
- 0.2% had positive CXR
- CXR responsible for \$4,613,182.00 (99.5% of total workup costs)
- \$384,431.83/year

Routine Workup of Postoperative Pyrexia Following Total Joint Arthroplasty Is Only Necessary in Select Circumstances. By: Yoo JH, Restrepo C, Chen AF, Parvizi J. The Journal Of Arthroplasty. 1532-8406, 2016 Sep 28

Perioperative Medicine

Number of tests/procedures/consults ordered on 1,000+ patients:

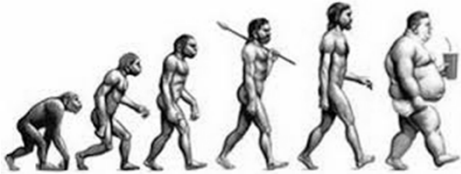
- CT angiograms: less than 5
- Renal ultrasounds: less than 5
- Head CT: less than 5
- Cardiology consults: less than 5
- Non dialysis renal consults: less than 5
- Hematology consults: less than 5



- What is a Orthopedic Perioperative Specialist?
- Diabetes Screening
- Inpatient Diabetes Management
- Nutrition Screening

[illegible]

Diabetes and Hyperglycemia



Diabetes and Hyperglycemia⁷⁻¹⁸

- There have been many studies linking diabetes with increased risk⁷⁻¹⁸
 - Deep infection
 - MI
 - DVT
 - PE
 - Readmission
 - Mortality
 - Length of stay
 - Cost

Diabetes and Hyperglycemia

Study limitations:

- Retrospective studies
- Wide variance of study designs and outcome measures
- Lack of correction for comorbidities
- Inconsistent patient populations
- Small N of complication rates

Diabetes and Hyperglycemia

Two questions:

- Is it truly a risk factor?

- What is the risk factor?
 - Hyperglycemia
 - Diabetes
 - Uncontrolled diabetes
 - Diabetes with secondary disease

Diabetes and Hyperglycemia

Surgical Outcomes of Total Knee Replacement
According to Diabetes Status and Glycemic
Control, 2001 to 2009.

Journal of Bone & Joint Surgery Am. 2013 Feb 27.

Conclusions: No significantly increased risk of:

- Revision
- Deep infection
- DVT
- Incident MI
- All cause rehospitalization

Diabetes and Hyperglycemia

Relationship of Hyperglycemia and Surgical-Site
Infection in Orthopaedic Surgery.

Richards, J et al. Journal of Bone & Joint Surgery - American Volume. 2012 Jul 3;94(13):1181-6.

- Retrospective study of fractures in NON diabetic patients
- Hyperglycemia (BS>200 x 2) *was* an independent risk factor for thirty-day surgical-site infection

Diabetes and Hyperglycemia

What's a good minimum preoperative cutoff?

Diabetes and Hyperglycemia

What's a good minimum preoperative cutoff?

- A1c <8.0 (Average BS of 180 last 2-3 months)

Diabetes and Hyperglycemia

What's a good minimum preoperative cutoff?

- A1c <8.0 (Average BS of 180 last 2-3 months)
- 90% of qid BS <180 for one week

Diabetes and Hyperglycemia

What's a good minimum preoperative cutoff?

- A1c <8.0 (Average BS of 180 last 2-3 months)
- 90% of qid BS <180 for one week
- Fructosamine (Average BS last 1-2 weeks)

Diabetes and Hyperglycemia

Who should be screened?

Diabetes and Hyperglycemia

Who should be screened?

ADA Standards of Medicare Care in DM - 2017

- Suggest that all patients with a prior diagnosis of diabetes or hyperglycemia have A1c if not performed in the prior 3 months.

Diabetes and Hyperglycemia

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The Prevalence of Diabetes Mellitus and Routine Hemoglobin A1c Screening in Elective Total Joint Arthroplasty Patients - J of Arthro. Capozzi et al. 1-2017

Diabetes and Hyperglycemia

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The Prevalence of Diabetes Mellitus and Routine Hemoglobin A1c Screening in Elective Total Joint Arthroplasty Patients - J of Arthro. Capozzi et al. 1-2017

- 33.6% of pts. had previously undiagnosed dysglycemic patients

Diabetes and Hyperglycemia

Who should be screened?

ADA: BMI > 25kg/m² AND one risk factor (45, 1st degree relative, sedentary, HTN, high risk group, GDM, dyslipidemia, PCO, vascular disease)

USPTF: 40 to 70 AND overweight

CDC: 45 OR 1st degree relative, sedentary, GDM, high risk ethnic group, risk factors

Topics

- What is a Orthopedic Perioperative Specialist?
- Diabetes Screening
- Inpatient Diabetes Management
- Nutrition Screening

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

- Withhold oral medications starting the morning of surgery

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

- Withhold oral medications starting the morning of surgery
- Insulin with basal, correctional, and carb coverage

Diabetes and Hyperglycemia

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ADA Standards of Medicare Care in DM - 2017

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 - CPOE recommended

Diabetes and Hyperglycemia

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Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

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- Insulin with basal, correctional, and carb coverage
 - CPOE recommended
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 - Could resume orals when stable

Diabetes and Hyperglycemia

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 - Reduce chronic meds at d/c if needed

Diabetes and Hyperglycemia

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ADA Standards of Medicare Care in DM - 2017

- Withhold oral medications starting the morning of surgery
- Insulin with basal, correctional, and carb coverage
 - CPOE recommended
 - Sliding scales strongly discouraged
 - Could resume orals when stable
 - Reduce chronic meds at d/c if needed
- Target glucose range for the perioperative period should be 80–180 mg/dL (4.4–10.0 mmol/L).

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

- Strong emphasis on avoiding hypoglycemia but using long acting basal insulin when needed

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

- Strong emphasis on avoiding hypoglycemia but using long acting basal insulin when needed
- ADA now defines clinically significant hypoglycemia as glucose values <54mg/dL (70 trigger for adjustment)

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

- Strong emphasis on avoiding hypoglycemia but using long acting basal insulin when needed
- ADA now defines clinically significant hypoglycemia as glucose values <54mg/dL (70 trigger for adjustment)
- Severe hypoglycemia is defined as that associated with severe cognitive impairment regardless of blood glucose level

Diabetes and Hyperglycemia

Postoperative Inpatient Management:

ADA Standards of Medicare Care in DM - 2017

- Strong emphasis on avoiding hypoglycemia but using long acting basal insulin when needed
- ADA now defines clinically significant hypoglycemia as glucose values <54mg/dL (70 trigger for adjustment)
- Severe hypoglycemia is defined as that associated with severe cognitive impairment regardless of blood glucose level
- The ADA does not endorse any single meal plan or specified percentages of macronutrients, and the term "ADA diet" should no longer be used.

Topics

- What is a Orthopedic Perioperative Specialist?
- Diabetes Screening
- Inpatient Diabetes Management
- Nutrition Screening



Nutrition

The Questions:

Nutrition

The Questions:

- How is malnutrition defined?

Nutrition

The Questions:

- How is malnutrition defined?
- How much malnutrition increases postop complications?

Nutrition

The Questions:

- How is malnutrition defined?
- How much malnutrition increases postop complications?
- Does correcting malnutrition decrease complications?

Nutrition

How is malnourishment diagnosed?

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:
 - Insufficient energy intake
 - Weight loss
 - Localized or generalized fluid that may mask weight loss
 - Loss of subcutaneous fat
 - Loss of muscle mass
 - Decreased hand strength

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:
- Screening tools

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:
- Screening tools
 - Mini Nutrition Assessment Short Form (MNA-SF)
 - The Malnutrition Universal Screening Tool (MUST)
 - The Nutrition Risk Screening 2002 (NRS-2002)
 - The Subjective Global Assessment of Nutritional Status
 - The Nutritional Risk Screening Tool
 - Rainey-MacDonald nutritional index

Nutrition

Screening Tools

Comparing the adequacy of the MNA-SF, NRS-2002 and MUST nutritional tools in assessing malnutrition in hip fracture operated elderly patients

- All screening tools were adequate in assessing malnutrition parameters in hip fracture operated elderly patients
- Only the MNA-SF could also predict readmissions and mortality

Comparing the adequacy of the MNA-SF, NRS-2002 and MUST nutritional tools in assessing malnutrition in hip fracture operated elderly patients. By: Karen-Hakim T, Weiss A, Herikowitz A, Ozerem L, Ashur R, Gross Nervo BF, Schleutinger A, Fridman S, Salai M, Bekosovsky Y. Clinical Nutrition (Edinburgh, Scotland). 1532-1983, 2016 Oct. Vol. 35, Issue 5

Nutrition

How is malnourishment diagnosed?

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- Screening tools

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:
- Screening tools
- LABS (albumin, transferrin, pre-albumin, lymphocytes)

Nutrition

There are many recent studies showing low albumin (<3.5 g/dl) have worse outcomes:

- Hypoalbuminaemia-a marker of malnutrition and predictor of postoperative complications and mortality after hip fractures - Injury 2017 Feb
- Hypoalbuminemia independently Predicts Surgical Site Infection, pneumonia, LOS, and readmission after Total joint arthroplasty - J. of Arthroplasty 8-2016
- Malnutrition and Total Joint Arthroplasty- J Nat Sci 6-2016
- Malnutrition Increases With Obesity and Is a Stronger Independent Risk Factor for Postoperative Complications A Propensity- J. Of Arthroplasty 4-2016
- Malnutrition a marker for increased complications, mortality, and length of stay after total shoulder arthroplasty-J Shoulder and Elbow Surgery 2-2016
- Effect of Malnutrition and Morbid Obesity on Complication Rates Following Primary Total Joint Arthroplasty - J Surg Orthop Adv 2016

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:
- Screening tools
- LABS (albumin, transferrin, pre-albumin, lymphocytes)

Nutrition

How is malnourishment diagnosed?

- Academy of Nutrition/ASPEN recommend 2 or more for diagnosis:
- Screening tools
- LABS (albumin, transferrin, pre-albumin, lymphocytes)
 - Nutrition labs falsely abnormal
 - Associated with inflammatory processes
 - Negative acute phase reactants
 - Can be low for other non-diagnosed illnesses

Nutrition

Does routine supplementation or correcting “malnutrition” decrease complications?

Nutrition

Does routine supplementation or correcting “malnutrition” decrease complications?

- There are studies showing benefit with immunonutrition supplementation with GI surgery

Nutrition

Does routine supplementation or correcting “malnutrition” decrease complications?

- There are studies showing benefit with immunonutrition supplementation with GI surgery
 - Methodological flaws
 - Variance of supplementations
 - Surgical patients with highest risks were excluded

Nutrition

Does routine supplementation or correcting “malnutrition” decrease complications?

- There are studies showing benefit with immunonutrition supplementation with GI surgery
 - Methodological flaws
 - Variance of supplementations
 - Surgical patients with highest risks were excluded
- Minimal/no studies showing correction of the malnutrition parameter improves outcomes with TJA

Nutrition

Conclusions?

- Variability of defining “malnutrition”

Nutrition

Conclusions?

- Variability of defining “malnutrition”
- Minimal supportive studies showing correction lead to improve outcomes with TJA

Nutrition

Conclusions?

- Variability of defining “malnutrition”
- Minimal supportive studies showing correction lead to improve outcomes with TJA
- Supplements choice? Cost?

Nutrition

Conclusions?

- Variability of defining “malnutrition”
- Minimal supportive studies showing correction lead to improve outcomes with TJA
- Supplements choice? Cost?
- Until higher quality data demonstrating unequivocal benefit are available, nutritional supplementation cannot be recommended as a routine addition to surgical patients.



Thank you.

ppcaccav@yahoo.com

What Is the Role of 1 vs 2 Stage in Periprosthetic Infection?

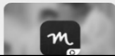
Thomas K. Fehring, MD
2017
OrthoCarolina Hip and Knee Center
Charlotte, NC

OrthoCarolina
HIP AND KNEE CENTER

AAOS

**I (and/or my co-authors) have
something to disclose.**

Detailed disclosure information is available via:

"My Academy" app; 

PERIPROSTHETIC INFECTION

Scope Of The Problem

2020

- 49,000 PJI Projected
- Projected Costs - \$1.6 Billion

Kurtz, JBS 2007



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PREVENTION STRATEGIES- CRITICAL

- Perioperative Antibiotics
- Pre Op Decolonization Protocols
- Chlorhexidine Wipes
- OR Traffic Reduction
- Laminar Flow
- Occlusive Post Op Dressings

PATIENT OPTIMIZATION

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PATIENT OPTIMIZATION- CRITICAL

Modifiable Risk Factors

- HgB A1C < 8
- BMI < 40
- Albumin > 3.5
- Smoking Cessation



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MSIS INFECTION CRITERIA

- Sinus tract communicating with the prosthesis or Positive Culture on 2 separate tissues or fluid samples or
- Three of the following 5 criteria exist
 - Sedrate > 30 + CRP > 10
 - Synovial WBC > 2000
 - Synovial PMN's > 75%
 - One positive culture
 - > 5 Neutrophils in 5 high power histologic fields

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SYNOVIAL BIOMARKERS

- Alpha Defensin
 - Leukocyte Esterase
 - Synovial CRP
 - IL-6
 - Next Generation Sequencing
- Helpful in culture negative infections

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TREATMENT OPTIONS

- I & D & Poly Exchange
- 2 Stage Re-implantation
- 1 Stage Re-implantation



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Periprosthetic Knee Sepsis The Role of Irrigation and Debridement

MARK B. HARTMAN, M.D., THOMAS K. FEHRING, M.D.,
LINDA JORDAN, M.S., AND H. JAMES NORTON, PH.D.

61 % Reinfection Rate

Failure of Irrigation and Debridement for Early Postoperative
Periprosthetic Infection

Thomas K. Fehring MD, Susan M. Odum MEd, Keith R. Berend MD,
William A. Jiranek MD, Javad Parvizi MD, Kevin J. Boile MD,
Craig J. Della Valle MD, Terence J. Ghee MD

Clin Orthop Relat Res, December, 1991

64 % Reinfection rate

Clin Orthop Rel Res 471, 2013

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Irrigation and Debridement for Periprosthetic Infections

Does the Organism Matter?

Susan M. Odum, MEd,* Thomas K. Fehring, MD,†‡ Adolph V. Lombardi, MD,§
 Ben M. Zmislowski, BS,¶ Nicholas M. Brown, BS,¶ Jeffrey T. Luma, MD,¶
 Keith A. Fehring, MD,**¹ and Erik N. Hansen, MD,†¹
 and The Periprosthetic Infection Consortium¹

Strep 71% failure all other organisms 67%

J Arthroplasty, Sept 2011

The Fate of Acute Methicillin-Resistant *Staphylococcus aureus* Periprosthetic Knee Infections Treated by Open Debridement and Retention of Components

Thomas Bradbury, MD,* Thomas K. Fehring, MD,† Michael Taunton, MD,‡
 Arlen Hansen, MD,‡ Khalid Azzam, MD,‡ Javad Parvizi, MD,§
 and Susan M. Odum, MEd||

J Arthroplasty, Sept 2009

84 % Reinfection Rate

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SERIAL DEBRIDEMENT LITERATURE

Estes, et al., CORR 2010 Mont, et al., J Arthroplasty, 1997

- 2 stage debridement with beads between stages
- 2 perioperative
- 18 acute hematogenous
- 18/20 successful

- 10 acute perioperative infections 7/10 - 2 or 3 debridements
- All successful

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THE PROBLEM → BIOFILM

- Dooms I & D Poly Exchange Results
- Bacterial colonies attach to the implant
- Secrete a protective matrix that protects the bacteria from external threats such as antibiotics or the immune system
- Once mature they shed free planktonic bacteria which start new colonies on the implant
- Antibiotics can only kill the free planktonic bacteria

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2 STAGE RE-IMPLANATATION

The Chitranjan Ranawat Award

Fate of Two-stage Reimplantation After Failed Irrigation and Debridement for Periprosthetic Knee Infection

J. Christopher Sherrill MD, Thomas K. Fehring MD, Susan Odum MEd,
Erik Hansen MD, Benjamin Zlotolowski BS, Anne Dennis BS,
Niraj Kshirsagar MD, the Periprosthetic Infection Consortium

Clin Orthop Relat Res January 2011

30% Reinfection rate

Two-Stage Reimplantation for Periprosthetic Knee Infection Involving Resistant Organisms

By Yogenh Mittal, MD, Thomas K. Fehring, MD, Arlen Hanssens, MD,
Camelia Marculescu, MD, Susan M. Odum, MEd, and Douglas Charnay, MD

86% Success rate

J Bone Joint Surg 89-A, June, 2007

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1 STAGE RE-IMPLANATATION

- One Stage vs. Two Stage- Controversial
Implant extraction only removes
Implant related Biofilm
 - Soft tissue Biofilm must also be removed through meticulous
debridement
- ? Can local Biofilm attach to a newly implanted prosthesis?

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EUROPEAN ONE STAGE STUDIES

Clin Orthop Relat Res 474:441-447
DOI 10.1007/s11999-016-5406-2

Clinical Orthopaedics
and Related Research



SYMPOSIUM: 2015 KNEE SOCIETY PROCEEDINGS

Can Good Infection Control Be Obtained in One-stage Exchange of the Infected TKA to a Rotating Hinge Design? 10-year Results

Alien Zahar MD, Daniel O. Kandhoff MD, PhD, Tili O. Khatir MD,
Theodoros A. Gekhter MD

Clin Ortho Relat Res 474; 2016

- 70 patients minimum 9 year f/u
- Radical resection of bone
- Hinged implants used exclusively ~93% infection free
- 16% lost to f/u
- 16% loose implants

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EUROPEAN ONE STAGE STUDIES

Single-Stage Hip and Knee Exchange for Periprosthetic Joint Infection
David A. Geesey, MChB, MRCS (Eng) *, Sujith Komari, MBBS, MD (Res), FRCS (Orth) *,
Fares S. Haddad, MD (Res), FRCS (Orth), FFSEM ±^{1,2,3,4}

¹ Department of Orthopaedic Surgery, University College London Hospital, London, UK

² The Princess of Wales Hospital, Cardiff, UK

³ Institute of Joint, Limb and Spinal, Biomechanics Institute, London, UK

⁴ Institute of Joint, Limb and Spinal, Biomechanics Institute, London, UK

- 100% Success rate
- 11 Periprosthetic Hip Infections
- 28 Periprosthetic Knee Infections
- 5 year f/u
- Exclusion criteria
 - Significant comorbidities
 - Resistant organisms
 - Presence of sinus tract
 - Peripheral Vascular disease

J Arthroplasty. 2015

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ONE STAGE VS. 2 STAGE WHICH IS BEST?

- One Stage data encouraging but difficult to interpret due to limited numbers, organism exclusion & comorbid patient exclusion
- Two Stage is the gold standard in U.S. but the reinfection rate is closer to 80% than the 90% often quoted
- **Patient convenience & Economic ramifications of 2 Stage Demand reevaluation**

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Economic Burden of Periprosthetic Joint Infection in the United States

Steven M. Kurtz, PhD,*† Edmund Lau, MS,‡ Heather Watson, PhD,§
Jordana K. Schmier, MA,§ and Javad Parvizi, MD

The Journal of Arthroplasty Vol. 27 No. 8 Suppl. 1 2012

- Nationwide inpatient sample study
- Annual cost in 2009 - 566 million
- Projected to exceed 1.62 Billion by 2020
- Gold standard in U.S- 2 Stage

J Arthroplasty. 2012

Do health economics mandate an investigation concerning 1 Stage ?

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OREF SPONORED STUDY

TFEHRING PL

- Prospective randomized multicenter study One stage vs. Two stage treatment for Periprosthetic hip & knee infections

Initial Sites

- OrthoCarolina
- Rush
- Rothman
- Cleveland Clinic
- HSS

Additional Sites

- USC
- UCSF
- Emory
- Ochsner Clinic
- UT Chattanooga
- Univ. of Michigan
- Univ. of Iowa

OrthoCarolina
HIP AND KNEE CENTER

ONE STAGE vs. 2 STAGE STUDY

Inclusion Criteria

- Primary surgery
- Infection/MSIS criteria
- Known organism
- Resistant organisms
- Previous I & D

Exclusion Criteria

- Fungal Infection
- Immunosuppressed patients
- Extensive soft tissue defect
- Revision surgery

- Re-prep/Re-drape Protocol
- All host classified/ MSIS criteria
- 350 patients

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ONE STAGE VS. TWO STAGE

Go with the status quo or an unknown quantity with significant risk but a possible upside



It's time to settle this controversy

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WHAT DO WE NEED?

A prospective randomized multicenter study excluding only fungal organisms and immunosuppressed patients



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ONE STAGE VS. TWO STAGE

WE'LL LET YOU KNOW




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AUDIENCE RESPONSE QUESTION

I would consider doing a One Stage Preimplantation for a Periprosthetic Hip or Knee Infection.

1. If the organism was a sensitive staph or strep in a healthy patient.
2. In an elderly infirmed patient with multiple medical problems regardless of organism
3. In any patient even one with a resistant organism if not immunosuppressed
4. #1 & #2 only
5. Never I would prefer a 2 Stage Approach

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Fixation of Periprosthetic TKR

Fx's: What to look for, What to consider, What to do...


Frank A. Liporace, MD

Chairman- Dept. Of Orthopaedics
Chief Orthopedic Trauma & Adult Reconstruction
Jersey City Medical Ctr / RWJ Barnabas Health

Associate Professor - New York University




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Disclosure

- Design Team
 - Depuy / Synthes
 - Biomet
- Educational Consultant
 - Depuy
 - Biomet




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Etiology

- 0.3 to 2.5% TKR's
- Risk Factors
 - Osteopenia
 - Osteolysis
 - Having a TKR
 - Decreased BMD 6-12 mo post-TKR
 - ? Benefits of alendronate (Wang CJ, et al: JBJS 2003)
 - Notching? (0.5-52% TKR's)
 - 1.5% of notched femurs (Gujarathi N, et al: Acta Orthop 2009)
- Low vs High Energy Mechanisms



Morbidity and MORTALITY
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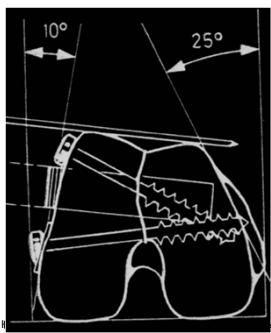
Considerations



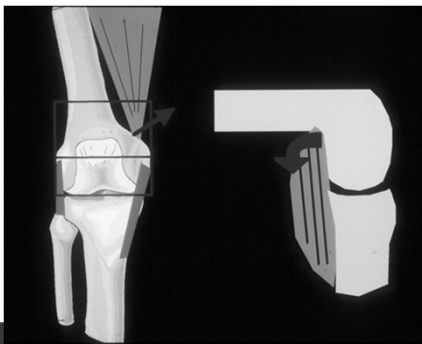
- Fracture location
- Implant stability
- Bone quality

Anatomy

Trapezoid cross section



Deforming Forces



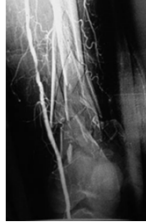
Radiographic Evaluation



- Good Quality AP and Lateral

- CT scan

- Angiography
 - Asymmetric pulses
 - ABI <0.9



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Fractures of the Distal Third of the Femur



A Comparison of Methods of Treatment

By Marcus J. Stewart, David Sisk, Sidney L. Wallace

JBJS June 1966 !!!

- 20 year review of 442 fractures
- 213 with at least 1 year of follow-up
- 144 treated closed and 69 treated with ORIF
- 67% good or excellent with closed treatment
- 54% good or excellent with ORIF

Conservatism should be taught and practiced more universally ?????



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Supracondylar Fractures of the Adult Femur



A study of 110 cases

By Charles Neer, Ashby Grantham, and Marvin Shelton

JBJS 1967 !!!

- **90% satisfactory with closed treatment**

- 52% satisfactory with ORIF

- “Most patients were satisfied as long as they had strong extensor power and could flex the knee to **70 degrees.**”



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In 2017...



•WE SHOULD OPERATE unless:

- Patient too medically unfit
- Completely undisplaced fracture?



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Goals of Treatment

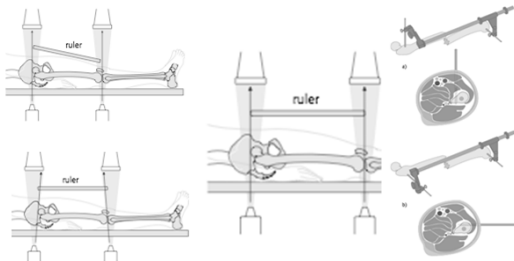


- Stable fixation** of the meta-diaphyseal fracture
- Avoid complications:** malunion, nonunion, infection, arthrofibrosis
- Allow early movement** and rehabilitation
 - Minimize disability and maximize return to function



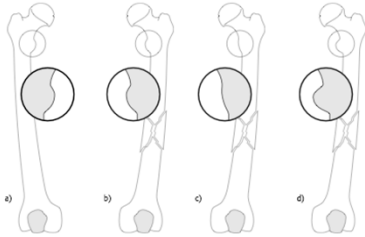
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Achieving goals

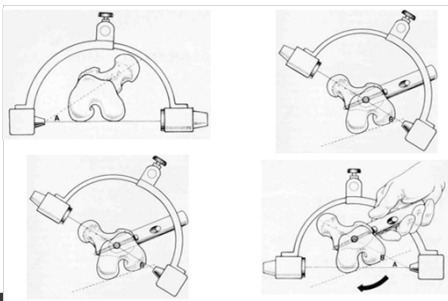


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Achieving goals



Achieving goals



TKA Classification

Rothman Institute 2006



Type I : Good Bone Stock, Well Fixed Component

- IA non displaced-potential nonoperative (Rorabeck I)
- IB Displaced fx- operative (Rorabeck II)

Type II: Good Bone stock but loose or poorly positioned component

- Revision with long stem components

Type III: Good or Poor bone stock with loose component

- Revision TKA (Rorabeck III)

>Kim, et al. CORR.446. 2006

>Rorabeck & Taylor. Orthop Clin North Am, 30. 1999.

Decision Matrix



| Bone Stock Implant | Good | Bad |
|---------------------------|-----------------------|--------------------------------|
| Good | Nail vs. Plate | Revise vs. ORIF/Augment |
| Bad* | Revise | Revise with long stem |



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Options



- IMN
- ORIF
- Supplements
 - CaPhos
 - Allograft
 - BG substitutes
- Revision TKR



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Options



- What's best to decrease r.r. nonunion?
 - IMN
 - Locked implants
 - Conventional plating / struts
 - Non-op

415 case meta-analysis
 •IMN
 •Locked implants
• Herrera DA, et al: Acta Orthop 2008



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LISS vs Blade Plate



Higgins TF et al (JOT 2007)

•LISS

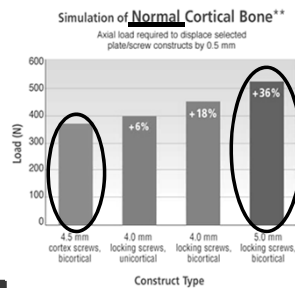
- Less subsidence
- Greater resistance to failure
- Findings regardless of BMD

- LISS w/ multiple fixed angle devices that are multiplanar



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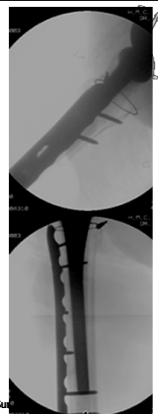
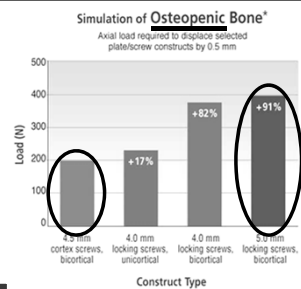
Uni vs Bicortical screws... Locking implants...



** Simulation of normal cortical bone performed with 40 lb/ft³ foam

Orthopaedic Surgery

Osteoporotic Bone



* Simulation of osteopenic bone performed with 15 lb/ft³ foam

Orthopaedic Surgery

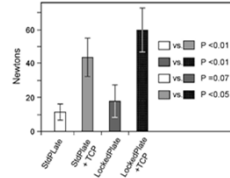
Options



•Can we increase pull-out strength w/
ORIF and osteopenia?

•PMMA or TCP w/ locking screws

•5x increased pull-out strength to
conventional plating



Collinge et al. JOT 2007

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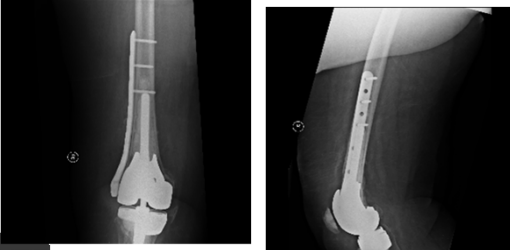
Patient NC



Patient NC



NC – F/U



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Should 90-90 strut-plate be standard?

Biomechanical Evaluation of Periprosthetic Femoral Fracture Fixation

By Rad Zdero, PhD, Richard Walker, MD, James P. Waddell, MD, FRCS(C), and Emil H. Schemitsch, MD, FRCS(C)

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- 90-90 strut / plate stronger than
 - Conventional plate
 - Locked plate ± cables
- Biomechanical study with THR's
- WHAT ABOUT THE BLOOD SUPPLY???

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Problem – Should we double plate?



Varus Collapse and shortening

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Double-Plating of Comminuted, Unstable Fractures of the Distal Part of the Femur



- Sanders et al. J. Bone and Joint Surg. 1991
 - 9 patients
 - Functional outcomes
 - 5 good results
 - 4 fair results
 - 1 patient with > 100° knee flexion
 - Neurovascular concerns medially



• WHAT ABOUT THE BLOOD SUPPLY???



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Double-Plating of Comminuted, Unstable Fractures of the Distal Part of the Femur



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• WHAT ABOUT THE BLOOD SUPPLY???



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Saving the Blood Supply

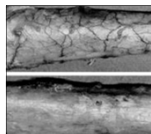


- 10 cadaveric femurs

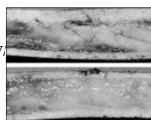
- CPO vs MIPPO
 - 16 hole LC-DCP

- Dye injection

- ALL MIPPO specimens w/ intact nutrient and perforating arteries



MIPPO - peri



CPO - peri

MIPPO - IM

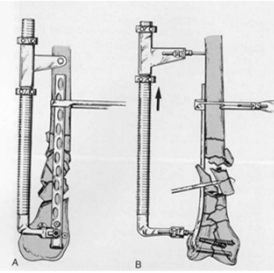
CPO - IM

(Pamuk & Krettek, JOT, 1999; Injury 1997)



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Indirect Reduction of Metaphyseal Component



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Effect of Keeping Periosteum

- Maintenance of b.s.
- Higher union rates
- Lower complications
- Less bone grafting



(Wenda, Injury 1997; Krettek, Injury 1997;
Krettek, Unfallchirurg, 1996; Bolhofner JOT 1996
Kinast & Bolhofner, Clin Orthop, 1989)

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Indirect Reduction Techniques

Bolhofner: JOT 1996

57 fractures treated by MIPPO with single plate

- Union and FWB at 10.7 wks.
- **100% union (2 delayed)**
- **84% good or excellent with > 100 degrees motion**
-
- **5% < 90 degrees motion**

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Clinical Results



- MIPPO w/ DCS in distal femur
 - 14 cases all MIPPO with DCS
 - 1 died 6wks post-op
- Limited exposure
 - Indirect reduction techniques
 - No bone graft used
- 12 /13 healed w/o 2nd procedure
 - 1 plate / screw failure



(Krettek, Injury, 1997)

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Clinical Results



- 59 patients (~74yo)
 - Lateral plating
- MIPPO techniques
- NO allograft struts
- 58 healed w/o 2nd procedure
- 49 returned to pre-injury status
- IMMEDIATE post-op motion



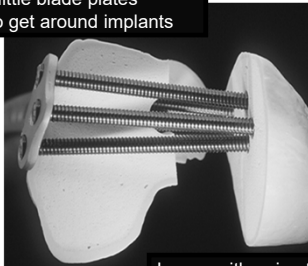
(Pocock M and Borrelli J: Injury 2007)

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DF Implants



- Multiple "little blade plates"
- Difficult to get around implants



Issues with unicortical shaft screws



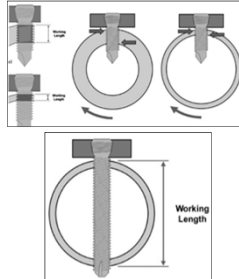
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Locked Screws & Osteoporosis



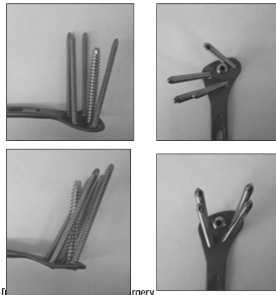
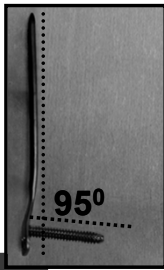
- Cortical thickness
- Canal dilatation
- Working Length
 - Screw
- Bi-cortical Lock

(Gautier, Injury, 2003)



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Fixed angle device with angular options???



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Is polyaxial locking strong enough???



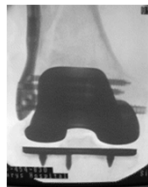
Copyright © 2007 by The Journal of Bone and Joint Surgery, Inc.

Results of Polyaxial Locked-Plate Fixation of Periarticular Fractures of the Knee


By George Hadjidakis, MD, Stephen A. Sems, MD, David Huebner, MD, Daniel Harwin, MD, and Bruce Levy, MD

- 56 peri-articular knee fractures
- 12 open
- All treated w/ POLY-AX plate


- 94% union
- No varus progression
- No screw or plate failures




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What about the tibia?



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Tibia TKR fx's

- Intra-op
 - Metaphyseal
 - Tubercle osteotomy
- Post-op
 - Non-displaced
 - Displaced

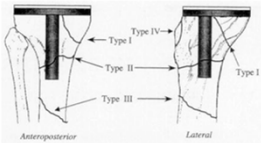




Figure 1. Mayo fracture classification of periprosthetic tibial fractures.



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Tibia TKR fx's

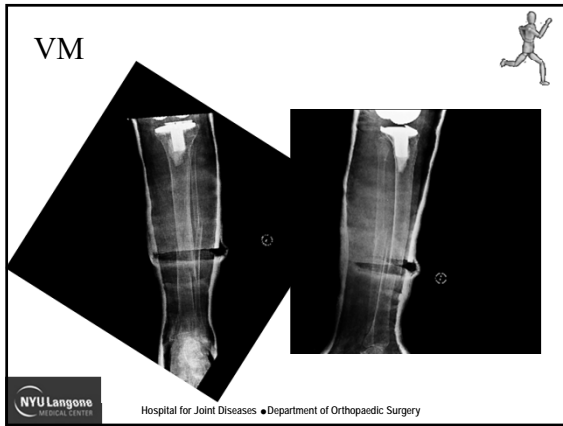
- Intra-op
 - Metaphyseal
 - Tubercle osteotomy
- Post-op
 - Non-displaced
 - Displaced

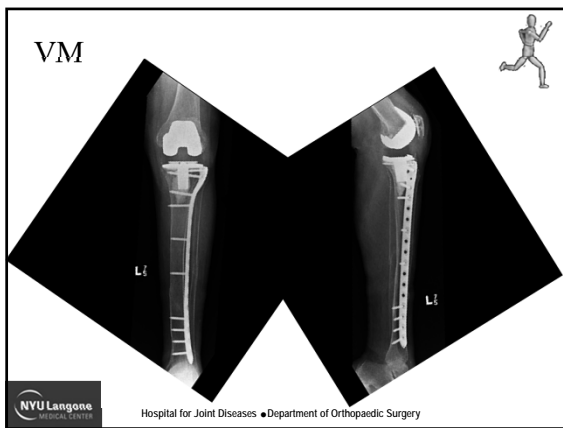
| Major Anatomic Pattern | Subcategory |
|---------------------------|--------------------------|
| I. Tibial plateau | A. Well fixed prosthesis |
| II. Adjacent to stem | B. Loose prosthesis |
| III. Distal to prosthesis | C. Intraoperative |
| IV. Tibial tubercle | |

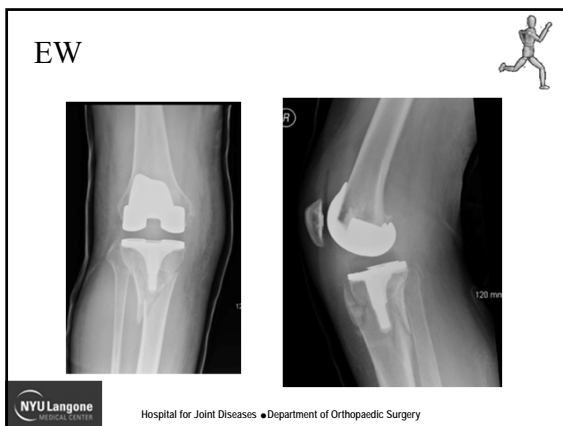
Reproduced with permission from Felix NA, Stuart MJ, Hansen AD. Periprosthetic fractures of the tibia associated total knee arthroplasty. Clin Orthop Relat Res. 1997;345:113-124.

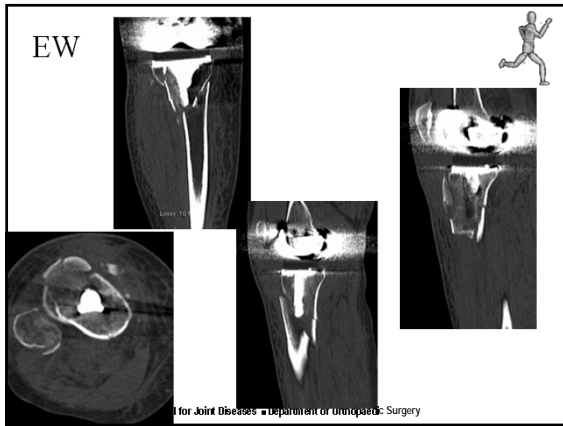


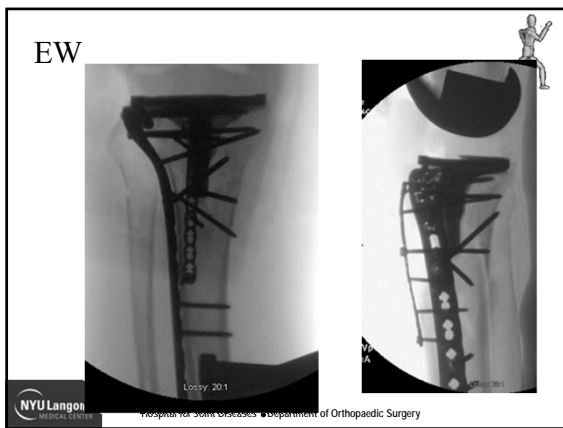
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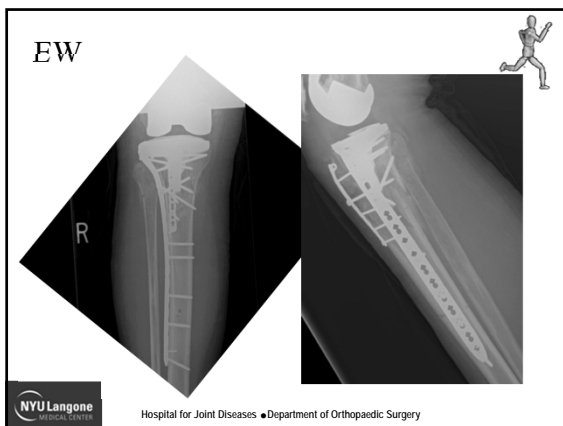




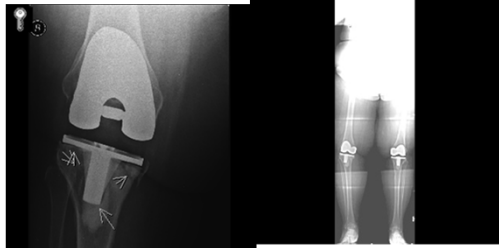




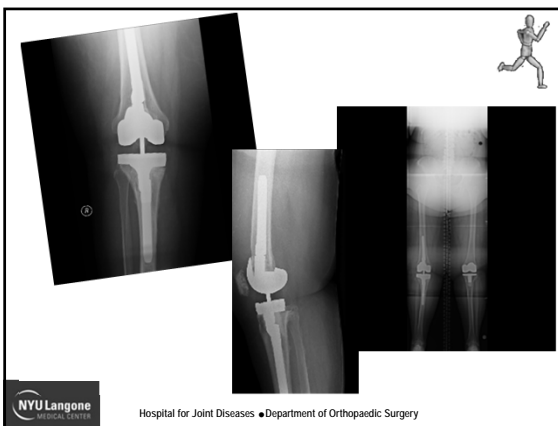




AS



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Inter-prosthetic Fx



- Between TKR and THR
- Between TKR and Hip Fixation

Span Femur with LONG PLATE !!!



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MF



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MF



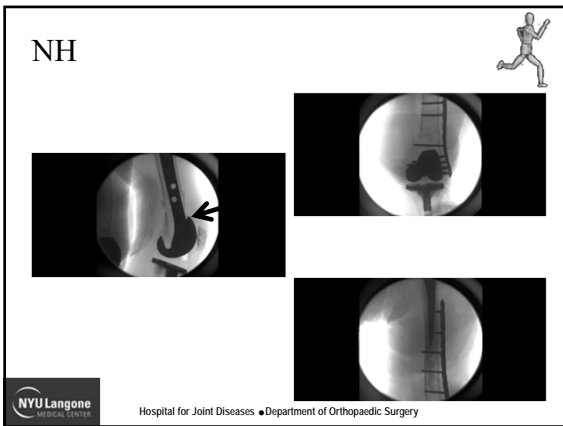
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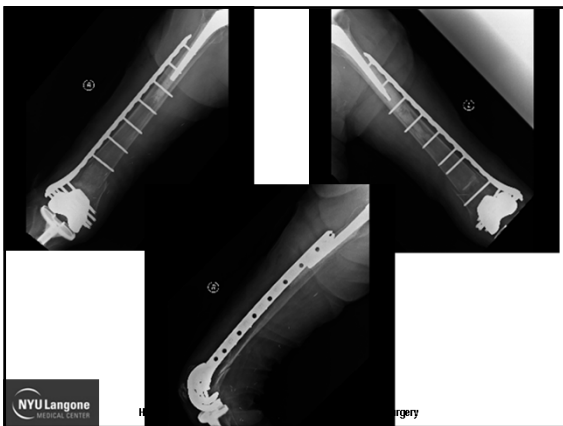
NH



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IMN



- Retrograde
- Antegrade

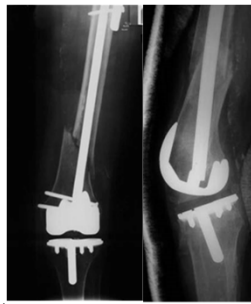


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Retrograde Nailing



- Less invasive ?
- Technically difficult
- Purchase
- Stability



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Retrograde Nailing



- BUT...
- Ineffective or complicated w/ "boxed" TKR
- Limited distal fixation (osteoporosis)
- Increase risk prosthetic infection
- Increase risk of polyethylene damage / 3rd body



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Intramedullary Nails



- Are they more stable than plates?
- Traditionally suggested to be biomechanically more advantageous to plates → SHAFT FX's
- Immediate WB'ing ?



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Comparison of the LISS and a retrograde inserted supracondylar intramedullary nail for fixation of a periprosthetic distal femur fracture proximal to a total knee arthroplasty



Bong M et al J Arthroplasty 2002

- Laboratory biomechanical model
- Nail
 - Greater resistance to varus load and torsional load
- LISS
 - Greater resistance to valgus load w/ bone loss



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Comparison of the LISS and a retrograde inserted supracondylar intramedullary nail for fixation of a periprosthetic distal femur fracture proximal to a total knee arthroplasty



Bong M et al J Arthroplasty 2002

- BUT...
- Did not address osteoporotic model
- Did not address all types TKR or LOW peri-prosthetic fracture
- Did not address model w/ varus bone loss



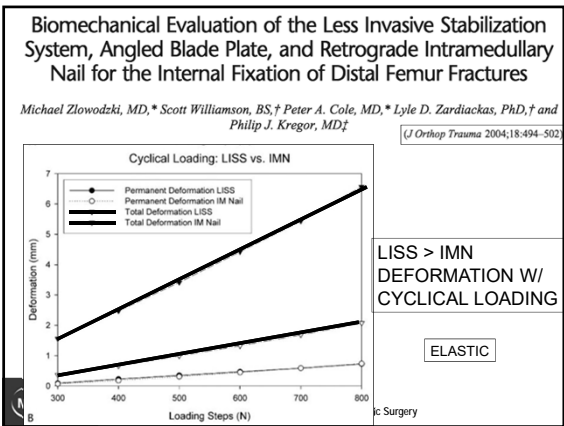
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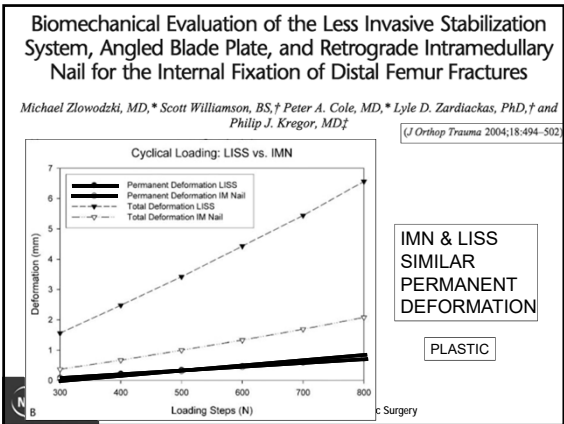
Biomechanical Evaluation of the Less Invasive Stabilization System, Angled Blade Plate, and Retrograde Intramedullary Nail for the Internal Fixation of Distal Femur Fractures

Michael Zlowodzki, MD,* Scott Williamson, BS,† Peter A. Cole, MD,* Lyle D. Zardiackas, PhD,† and Philip J. Kregor, MD‡

(J Orthop Trauma 2004;18:494-502)

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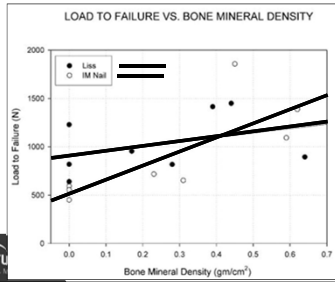




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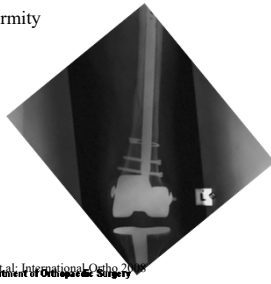
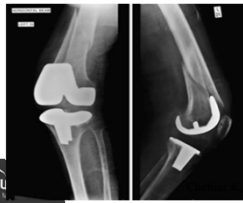
AXIAL LOADING:

IMN < LISS
LOAD-TO-FAILURE
LOW BMD

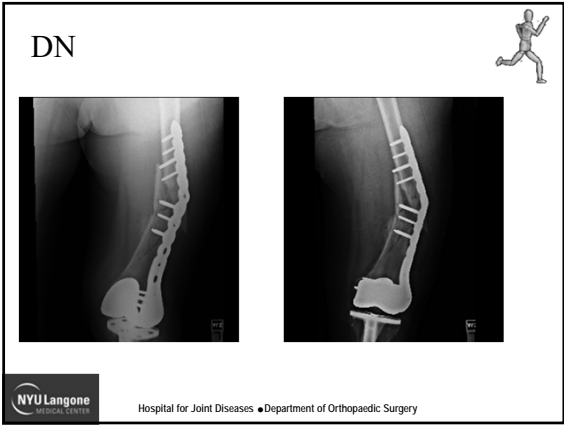
IMN > LISS
LOAD-TO-FAILURE
HIGH BMD

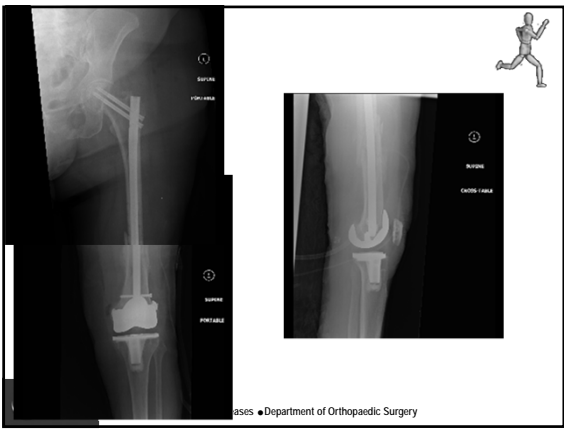
Retrograde IMN

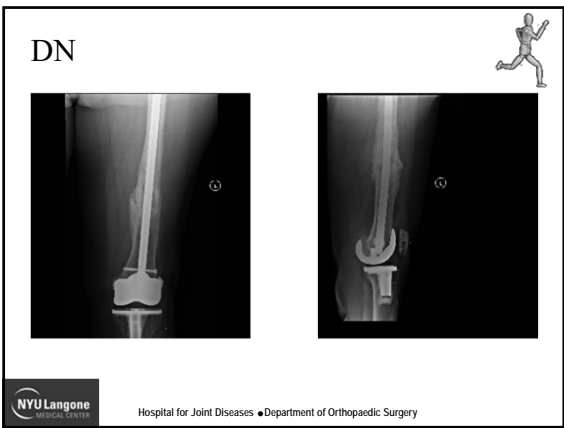
- Require accurate reduction
- May require supplemental fixation
- High union rates
- Risk valgus and extension deformity




Antegrade IMN












Extreme Nailing




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Nailed Cementoplasty





Bobak, The Journal of Arthroplasty, 2010
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Distal Femoral Plating Technique

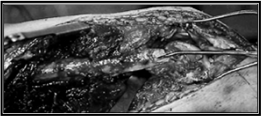


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GOALS

- Biologic preserving !!!
- Respect soft tissues

Biologic Felony





- Restoration of:
 - Mechanical axis
 - Length
 - Alignment / Rotation




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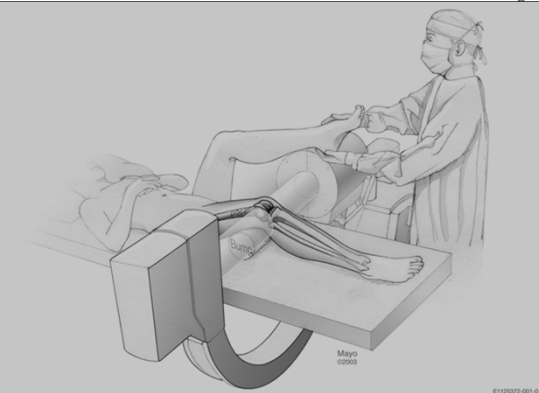
Non-articular or Simple Split


- Lateral approach
- ****Limited surgical dissection*
- Percutaneous plate insertion*
- Metaphysis Indirect Reduction*
 - Bumps
 - Femoral Distractor
 - Percutaneous Pins
 - External fixator







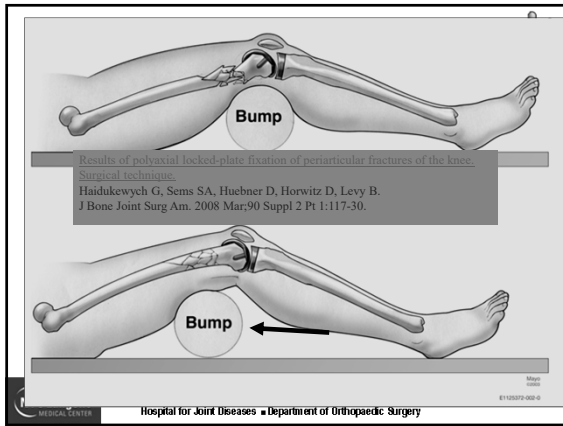
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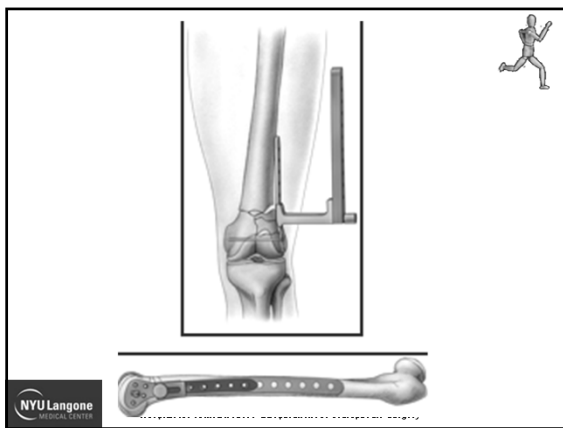


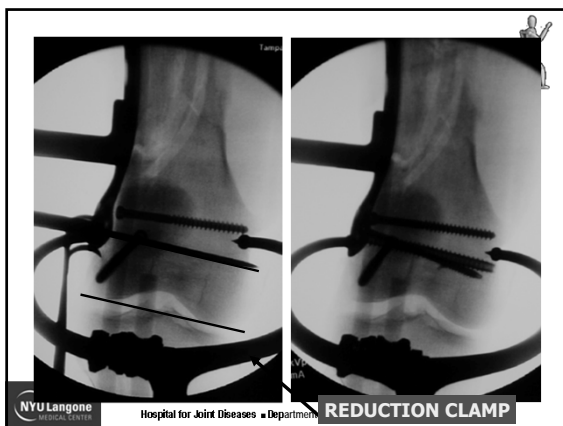


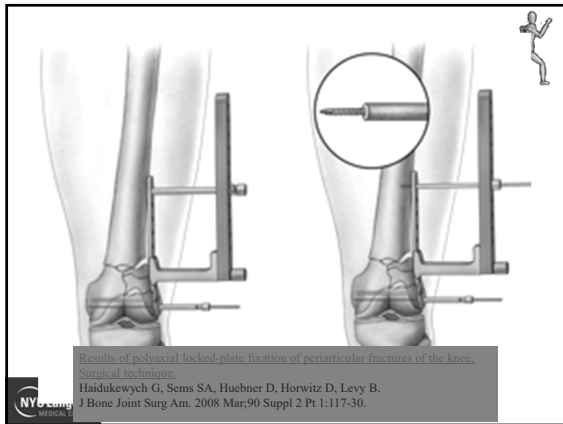


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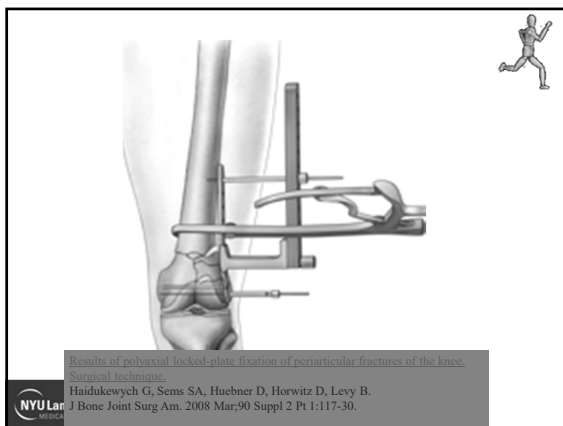




Plate Placement Problems




- Prior to complete plate fixation, must confirm appropriate location *distally and proximally!!!*




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Plate Placement Problems




- Prior to complete plate fixation, must confirm appropriate location *distally and proximally!!!*



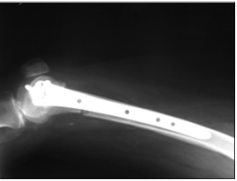



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Plate Placement Problems




- Prior to complete plate fixation, must confirm appropriate location *distally and proximally!!!*






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Plate Placement Problems




MALALIGNMENTS

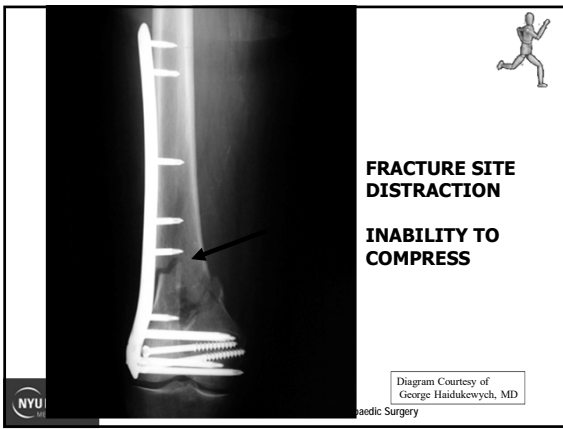
USUALLY VALGUS

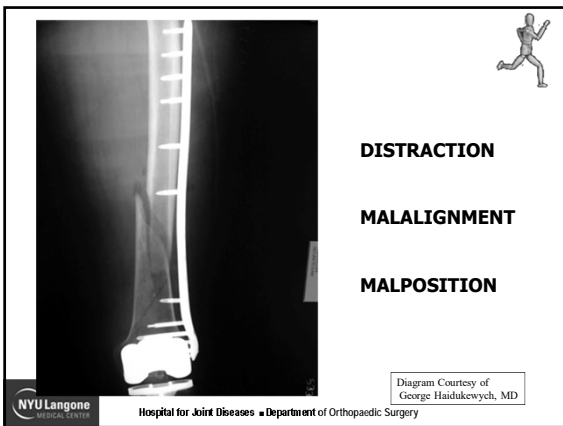



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Diagram Courtesy of
George Haidukewych, MD









NONUNION
LOSS OF FIXATION

Diagram Courtesy of
George Haidukewych, MD

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- CHALLENGES


- SITUATIONS FOR SPECIAL CONSIDERATION

-SALVAGES

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RetrolMN for PP FEMUR FXs

- Distal 1/3 Fx's around Primary TKR
- No "box" (CR)
- If "box" (PS) with:
 - Removable polyethylene plug
 - Pre-existing hole
 - Try to avoid "making a hole" with a metal cutting burr
- Less Invasive?
- More biologically friendly?



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CHALLENGES



- Lack of access
 - "Box" (PS) without ability to pass
 - Revision TKR
 - THR above
- Iatrogenic damage
 - Patella or tibia polyethylene
- Limited Distal Fixation
- Limited offerings that actually "Dial-in-Deformity"
 - Worse with CR or PS ???



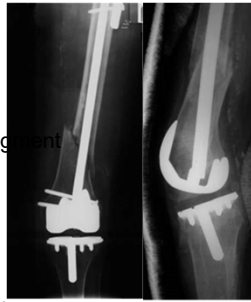
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DEFORMITY



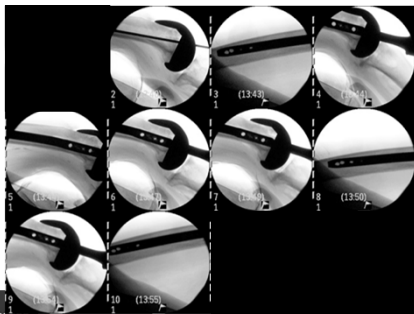
Due to entry access
APEX-POSTERIOR

Lack of purchase in distal fragment
VALGUS

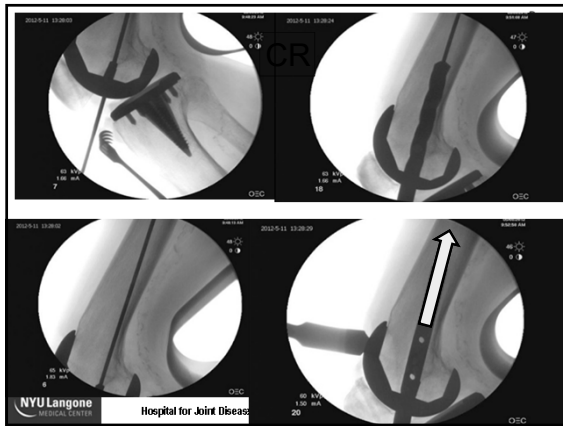


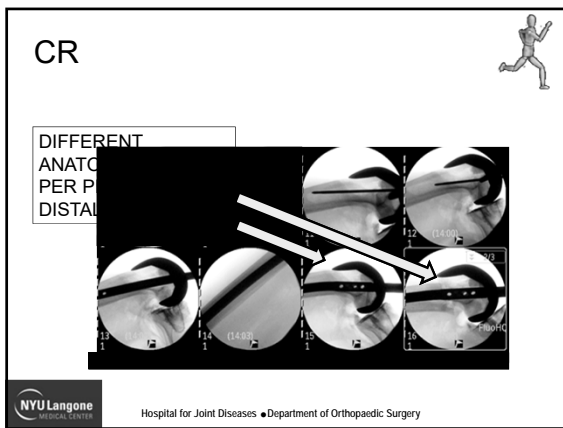
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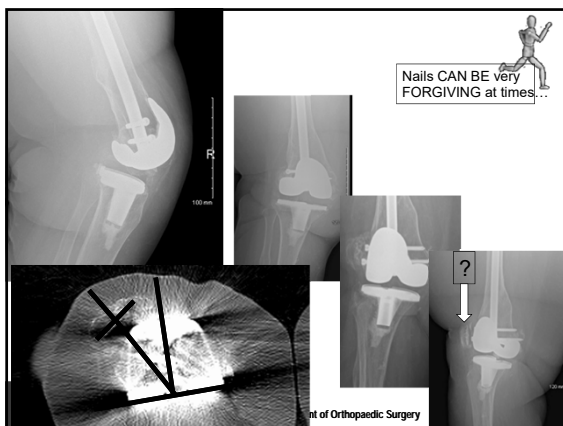
PS



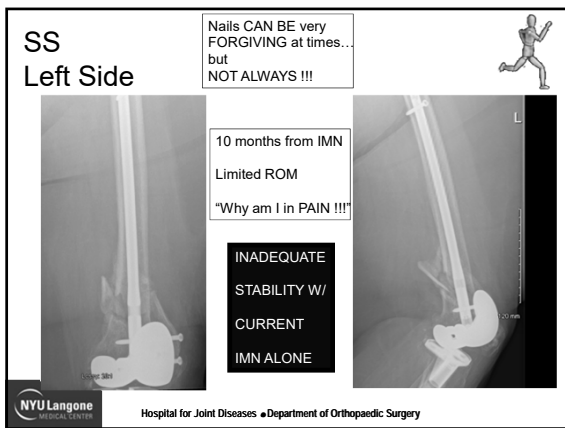
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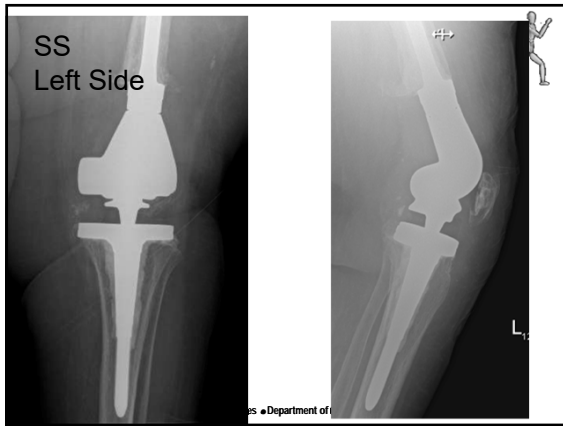












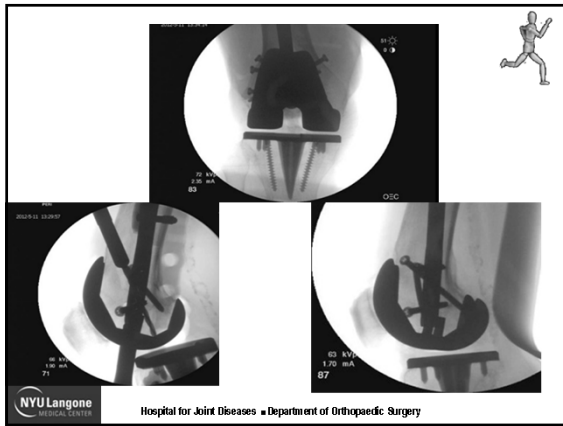
SOME ANSWERS FOR DENSITY OF FIXATION

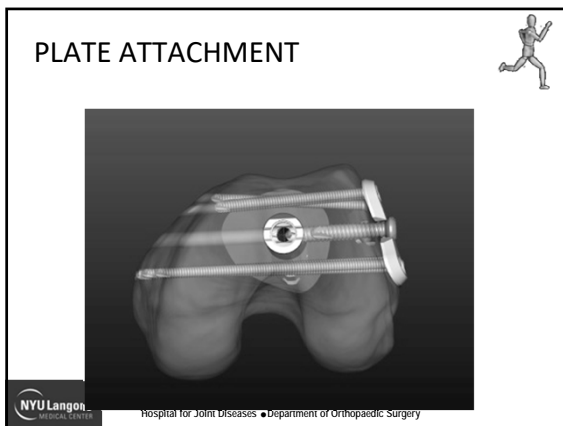
- Multi-lock screws
 - Multi-directional support with fixed angle screw within a screw
 - LISS vs Blade idea
- Screw configuration
 - Additional screws
 - Take advantage of PM and PL condyles
- Plate attachment to Nail
 - ALL OF THE ABOVE !!!

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SCREW CONFIGURATION

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WHERE COULD WE GO WITH THIS?

• Plate – Nail combo's

- Fx "needing" a nail with a THR above or rev TKR below
- Metaphyseal Nonunions requiring better fixation


Koval KJ, Seligson D, Rosen H, Fee K. J Orthop Trauma. 1995;9(4):285-91.
 Distal femoral nonunion: treatment with a retrograde inserted locked intramedullary Nail
 • 25% union rate of nonunions with retrograde IMN alone

- Osteoporosis
- Avoid deformity (Distal Femur, Proximal & Distal Tibia)
- "Dial-in" stability

LINKED NAIL / PLATE COMBOS...

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Patient BP

Periprosthetic tibia

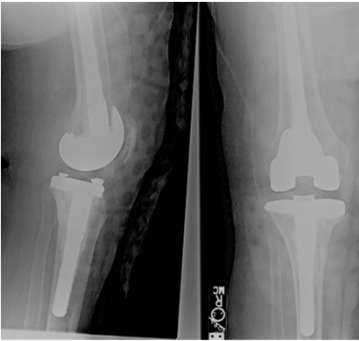
Subtroch fx above stemmed tkr




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Original Revision – 6 months Prior






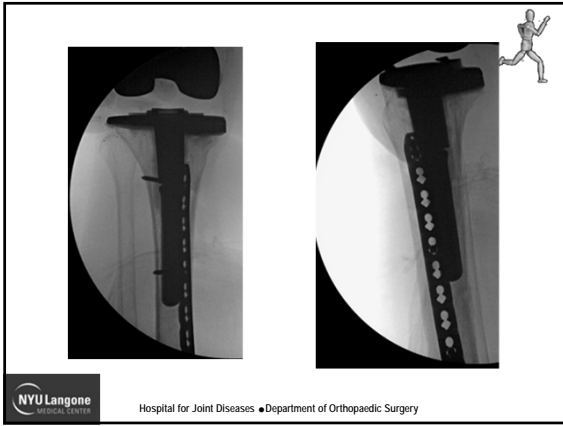
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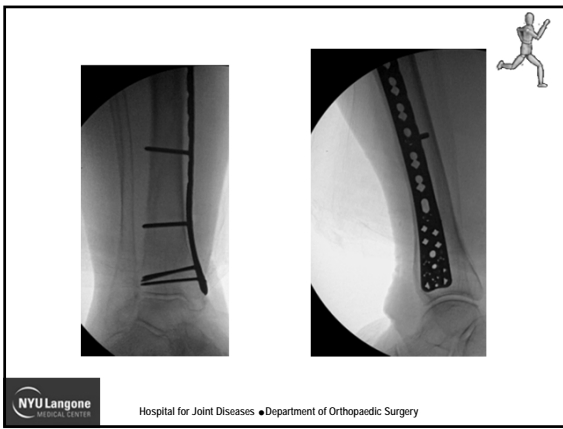


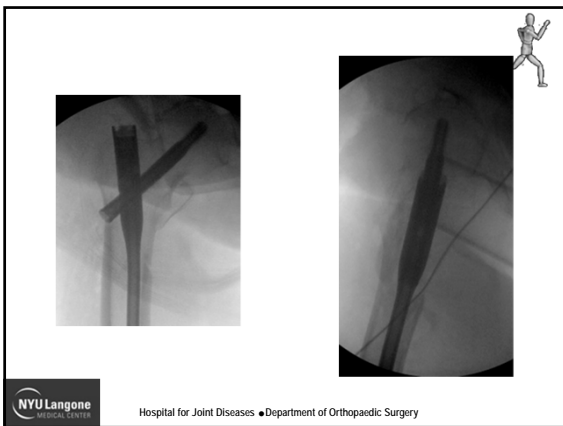


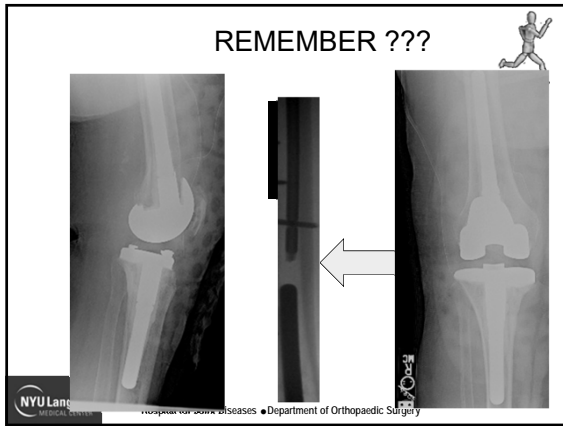


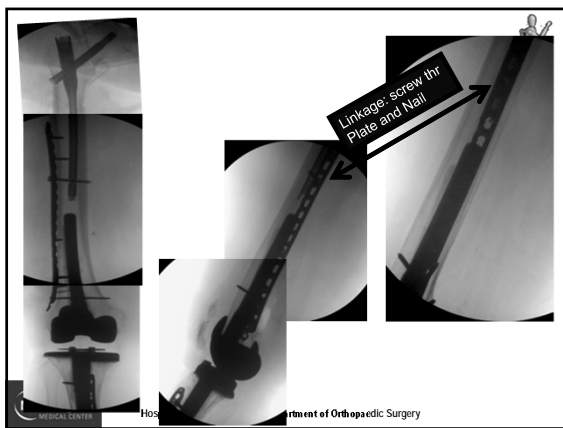
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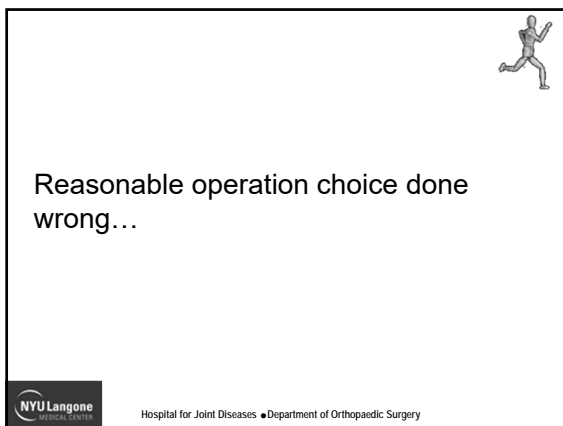


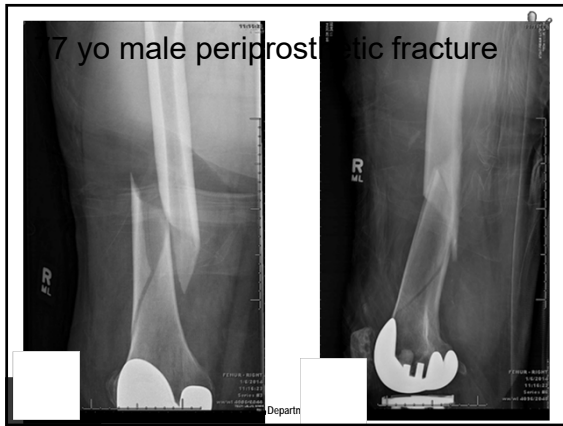


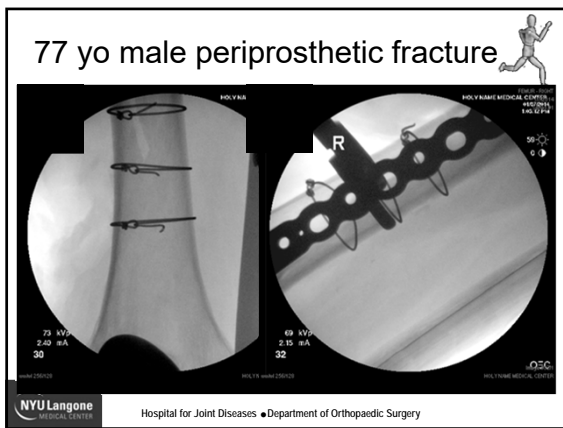


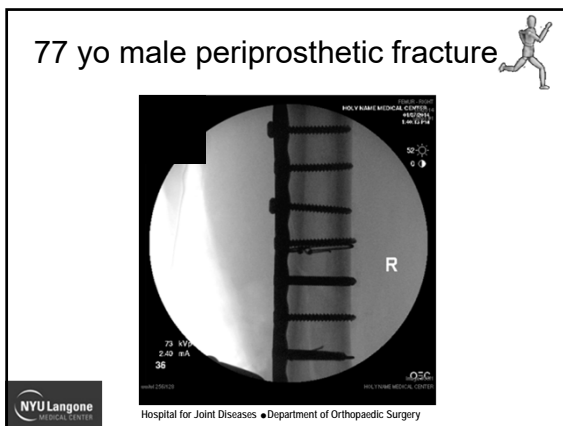




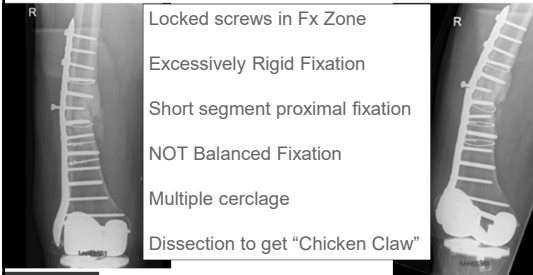








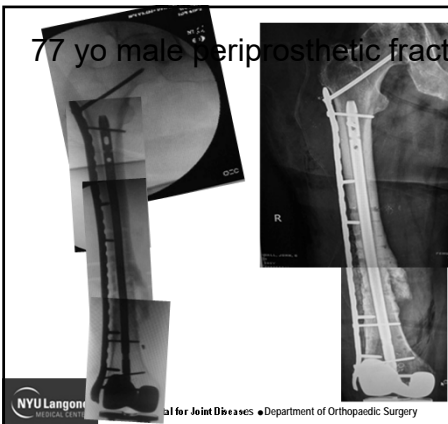
77 yo male periprosthetic fracture



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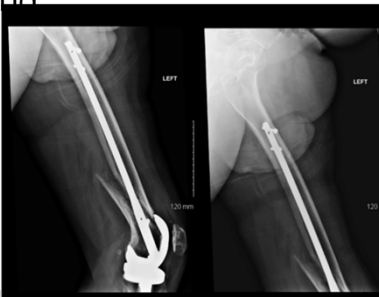
77 yo male periprosthetic fracture



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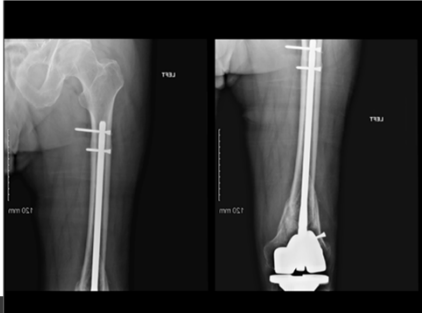
EV – vacation in Mexico gone wrong



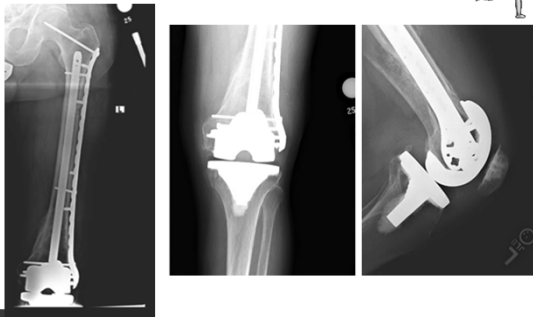
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EV



EV



JV – 77 yo male

3 time failed distal femoral nonunion

ALL surgeries with lateral plate

Previous Hip Fx short hip IMN above

SOLUTION ???



STEP 1 – BIOPSY (significant history)



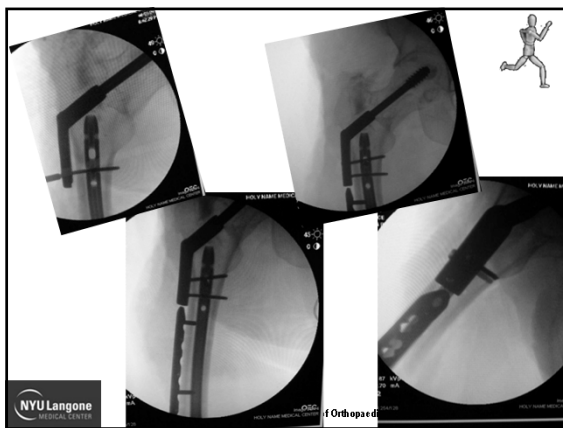
Bone Stimulator



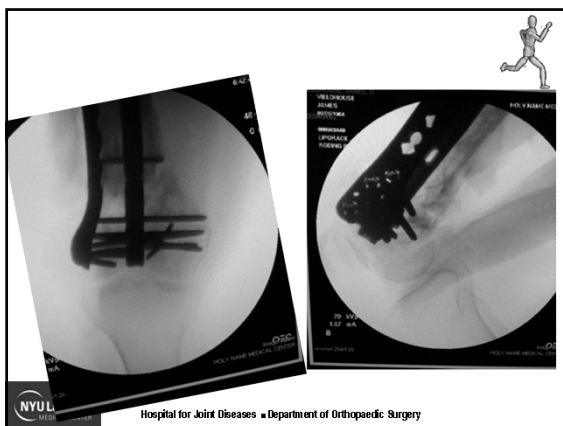
NOTE ALLOGRAFT FIBULA INTRAMEDULLARY STRUT
NEGATIVE FOR INFECTION



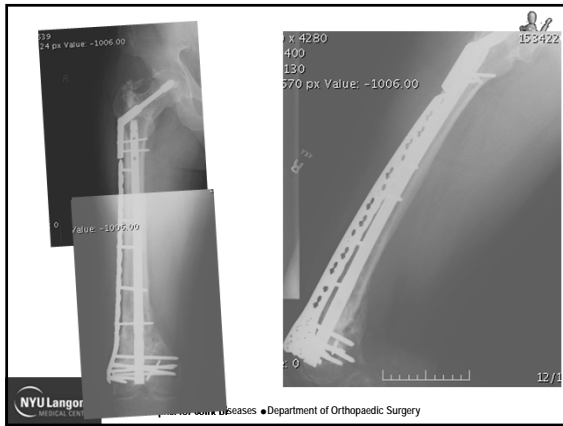
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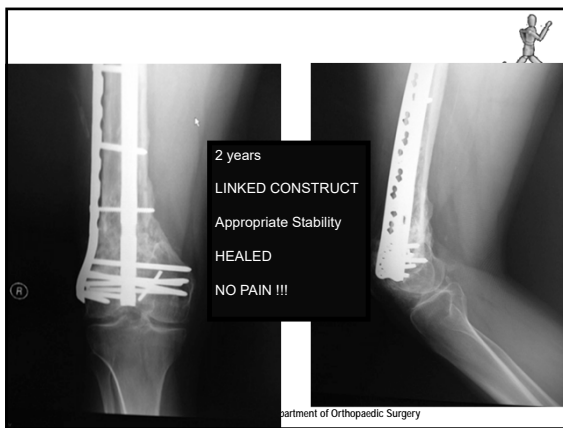


Orthopaedic



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JZ

Distal Femoral Fx 10 yrs ago w/ 4 time nonunion s/p platings above TKR

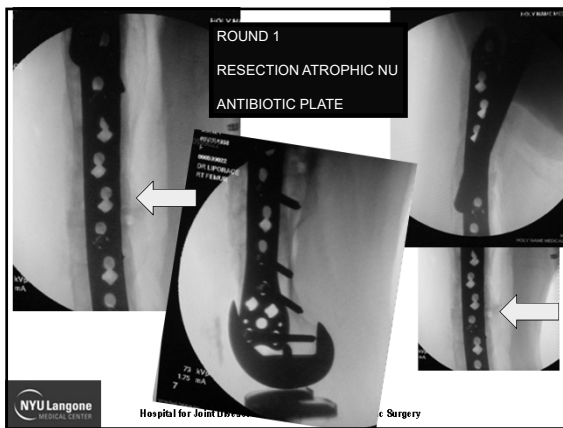
THR above that had previous fx at stem tip

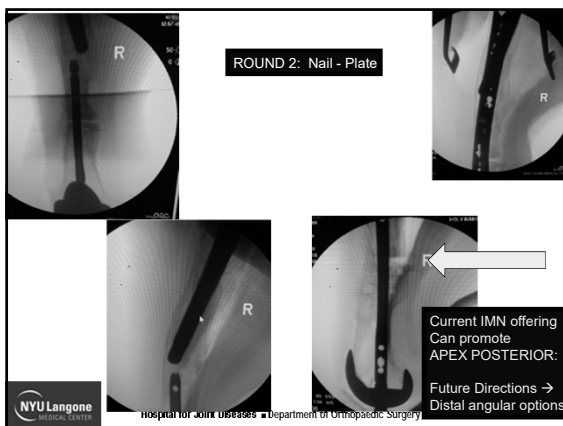
Non-ambulator x 2.5 years

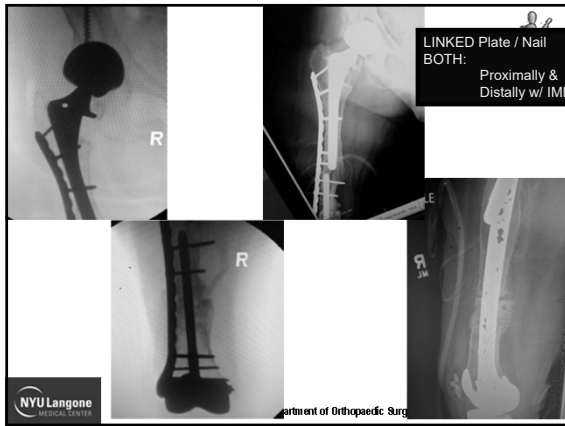
INFECTED

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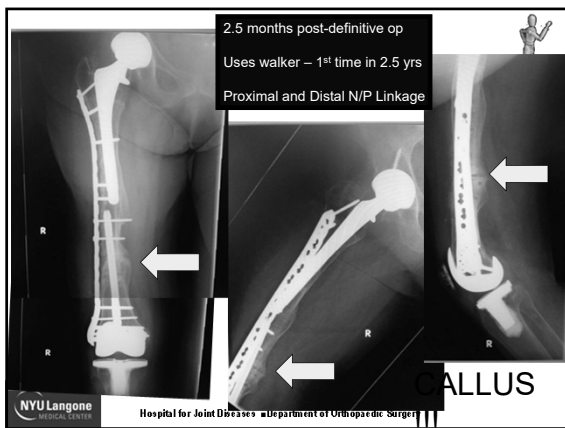




PLATE-NAIL SUMMARY

- Improve "reliability" and "feasibility" of current retrograde IMN usage
 - Improve stability – DISTAL FRAGMENT
 - Decrease late deformity
- Allow for improvement with ease of REDUCTION
- PREVENTATIVE Tx of potential Interprosthetic fx
- Allow for expanded IMN nailing indications
- Can "dial-in" desired amount of STABILITY





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Future directions



- Implants to accommodate tibia IM fixation
- Modular implants
 - Modular Plate
 - Modular Nail / Plate or Locking washer
- Mating Implants
 - TKR with THR above

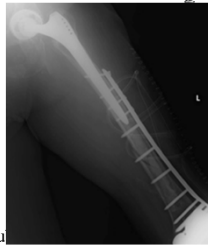


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Top 5 DO's



- Complete radiographs
 - Implant or bone incompetence
- Distal Femur Fx's if implant stable
 - INDIRECT reduction techniques
- Distal Femur Fx's retrograde IMN
 - Check box status
 - “Healthy” incision
 - Don't ream polyethylene
 - Don't leave remainings in joint
- Consider polyaxial implants and bone su



TKR above, span both implants

(Platzter P, et al: Injury 2010)

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Top 5 DON'Ts



- Don't accept axis deviations → implant wear
- Don't leave loose implants
- Don't use incompetent fixation
 - Allograft with cables ONLY
 - Wires only
 - Screws only or NON-Balanced plate fixation
- Don't delay post-op ROM
- Don't delay surgery in elderly
 - Systemic manifestations similar to hip fx's



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PERIPROSTHETIC FEMUR FRACTURES
AFTER THA:
Treatment with Revision

Daniel J. Berry, MD
LZ Gund Professor
Department of
Orthopedic Surgery
Mayo Clinic
Rochester, MN



Presenter Disclosure Information

- The author has received royalties from DePuy related to certain hip products
- The author's institution receives research support from: DePuy, Zimmer, Stryker, Biomet, Smith-Nephew

PERIPROSTHETIC FX: THA
Introduction

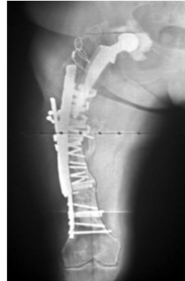
- The infrequency and complexity of these problems often leads to suboptimal management



PERIPROSTHETIC FX: THA
Introduction

Fortunately...

- We don't see much of this anymore:



PERIPROSTHETIC FX: THA
Introduction

- But we still see this...



Nonunion

PERIPROSTHETIC FX: THA
Introduction

- And we still see this...



Loose

PERIPROSTHETIC FX: THA

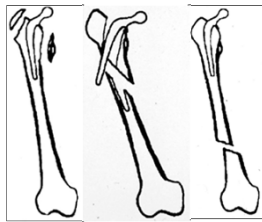
- Current Management?



PERIPROSTHETIC FX: THA Vancouver Classification

Fracture Location Guides Treatment:

- Peritrochanteric
- Around stem
- Well distal to stem





PERIPROSTHETIC FX: THA Fractures Around Stem

Fractures Around Stem:

- Little role for nonoperative Rx
- Prolonged recovery
- Just delays--and makes more difficult--the inevitable operation
- Risk of malunion, nonunion








PERIPROSTHETIC FX: THA

Non Operative Treatment: Problems

Malunion

Non union



Fracture Around Stem


Stem Fixed → ORIF

Stem Loose → Revise

Stem Loose Bone Poor → Revise

PERIPROSTHETIC FX: THA

Fractures Around Stem



Fracture Around Stem

Stem Fixed → ORIF

Stem Loose → Revise

Stem Loose Bone Poor → Revise

PERIPROSTHETIC FX: THA

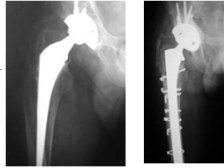
Loose Stem

PERIPROSTHETIC FX: THA

Loose Stem

Revision Principles:

- Use fracture for access to remove implant
- Bypass fracture, usually with long stem
- Stabilize fracture
- Get stable implant fixation
- Respect biology: Avoid stripping muscle

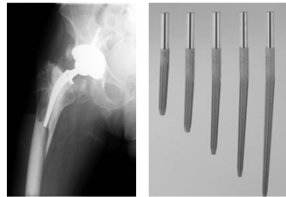


PERIPROSTHETIC FEMUR

FRACTURES: Vancouver B₂/B₃

Fractures Around Loose Stems:

- With modular tapered fluted, modular stems *we can treat B₂ and B₃ fractures the same!*





Preop



3 Months

PERIPROSTHETIC FEMUR FRACTURES: Vancouver B₂/B₃

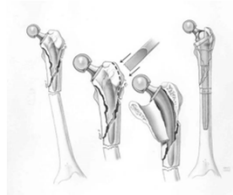
- Bypass fracture with fluted tapered stem → get distal axial and rotational stability
- Reassemble fracture around proximal stem as scaffold



PERIPROSTHETIC FEMUR FRACTURES: Vancouver B₂/B₃

Key points:

- Access failed implant and joint through fracture or osteotomy
- Keep all fracture fragments vascular
- Goal: Reasonable but not anatomic reduction



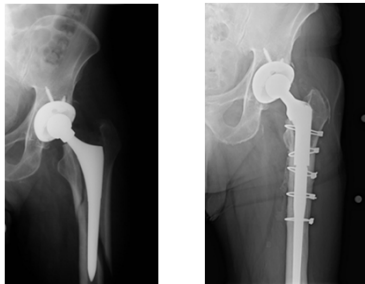
PERIPROSTHETIC FEMUR FRACTURES: Vancouver B₂/B₃

Keys to Success:

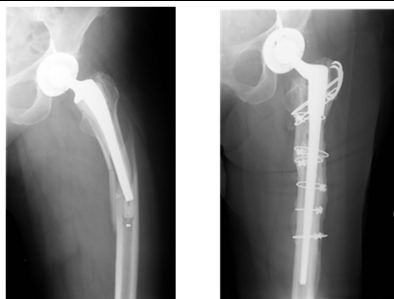
- Absolute axial and rotational stability distal to fracture
- Ream distal femur aggressively
- Prophylactic cerclage below fracture



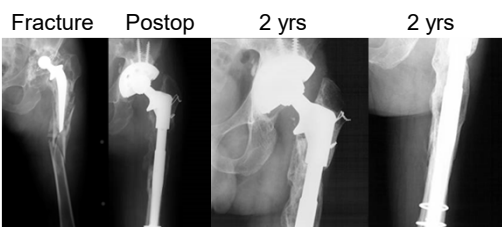
PERIPROSTHETIC FEMUR
FRACTURES: Vancouver B₂



PERIPROSTHETIC FEMUR
FRACTURES: Vancouver B₂



PERIPROSTHETIC FEMUR
FRACTURES: Vancouver B₃



PERIPROSTHETIC FEMUR FRACTURES: Results

Mayo Experience:

- 44 B₂/B₃ fxs
- Healing 43/44
- Stable stem 43/44

Vancouver Experience:

- Similar!



Abdel, Lewallen, Berry, CORR 2014;472:599

PERIPROSTHETIC FX: THA Pitfalls



Fracture



Immediate postop



Loose

Avoid Undersizing Stem

PERIPROSTHETIC FX: THA Pitfalls



Preop



2 Years



2 Years

Migration of Proximal Bone Fragments

PERIPROSTHETIC FEMUR FRACTURES: Conclusions

Modern Techniques:

- Simplified treatment
- Higher level of success



Revision

PERIPROSTHETIC FX: THA Conclusions

Modern Techniques:

- Emphasis on simultaneously creating ***strong durable mechanical constructs*** and
- Optimizing ***biologic environment*** for ***fracture healing***



EARLY POSTOP FRACTURES



PERIPROSTHETIC FX: THA
Early Postop Femur Fracture

Incidence Has Increased in Recent Years:

- More wedge shaped uncemented stems
- Smaller exposures → missed intraop fxs
- Quicker rehab, earlier weight bearing, more falls



PERIPROSTHETIC FX: THA
Etiology of Early Postop Fractures

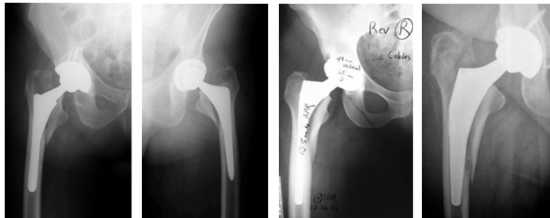
Etiology:

- Unrecognized intraop fracture that displaces under load
- Fall or stumble that creates new fracture before stem is bone ingrown



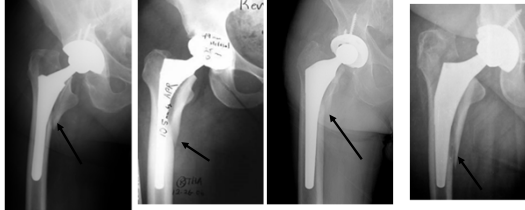
PERIPROSTHETIC FX: THA
Early Postop Femur Fracture

- Most are associated with *uncemented proximally coated wedge shaped stems*



PERIPROSTHETIC FX: THA Fracture Patterns

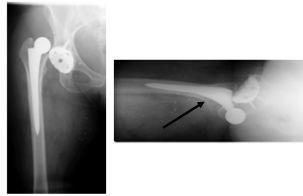
Stereotypical Pattern: triangle of posterior medial cortex with lesser trochanter



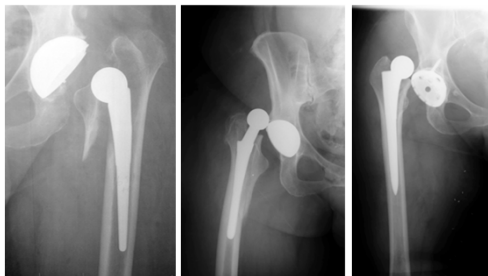
PERIPROSTHETIC FX: THA Fracture Patterns

Typical Pattern:

- Loose
- Subsided
- Retroverted

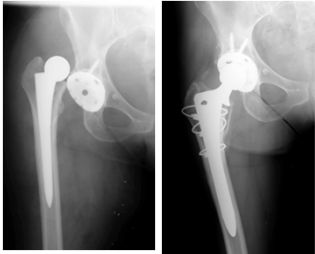


PERIPROSTHETIC FX: THA Fracture Patterns: Fracture-Dislocation





PERIPROSTHETIC FX: THA
Treatment

- Remove implant, fix fracture, revise stem
- Results mostly good



PERIPROSTHETIC FX: THA
Early Fracture Prevention

- Identify and treat intraop fractures
- Prophylactic cerclage in selected patients
- Warn patients on rapid rehab protocols to avoid falls




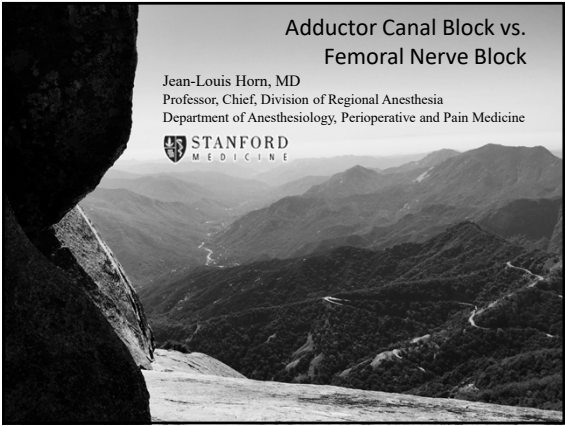
280 lb maleProphylactic cerclage



Adductor Canal Block vs. Femoral Nerve Block


Jean-Louis Horn, MD
Professor, Chief, Division of Regional Anesthesia
Department of Anesthesiology, Perioperative and Pain Medicine

 **STANFORD**
MEDICINE



Disclosure


- Consultant for Teleflex Medical
- Consultant for Yalyard Health
- Consultant for Edan Medical
- Research support from Zyno Medical



"Under disclosure rules, I'm required to tell you I own stock in the company whose drug I'm prescribing."

Overview

- *Adductor Canal blocks: the rationale*
- Precautions
- Conclusions



First the Femoral Nerve block

• Femoral nerve block **was** the gold standard

Paul, J.E., Arya et.al (2010) Femoral nerve block improves analgesia outcomes after total knee arthroplasty: a meta-analysis of randomized controlled trials. *Anesthesiology*, 2010;113 (5), 1144-1162

Less pain at rest and during PT
Less analgesic drug
Better ROM
Shorter LOS,
Less nausea
Less sedation
Less pruritus
Higher satisfaction

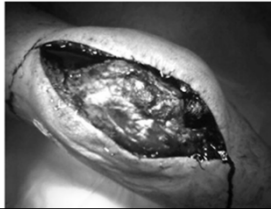


Femoral Nerve Block for Total Knee Replacement —a Word of Caution – (Surgeon Perspective)

Case series of 5 patients with a combined spinal/FNB for TKA

- 4 Wound disruption
- 1 peri-prosthetic fracture

*Kandasami M et al.
Knee 2009,16(2):98-100*



Major Complications Associated with Femoral nerve Catheters for Knee Arthroplasty — a Word of Caution (Surgeon Perspective)

Case study of 1190 patients with a continuous CFNB for TKA

- First 469 patients received a 2-3 days infusion
- The next 721 patients had their infusion stopped 12 hrs after surgery
- 9 Femoral nerve palsies
(2 in group 1 and 7 in group 2)
- 8 major falls,
no differences between groups

*Feibel RJ et al.
J of Arthr. 2009,24(6):132-7*

The Association Between Lower Extremity Continuous Peripheral Nerve Blocks and Patient Falls after Knee and Hip Arthroplasty

Pooled data from 3 previous randomized, placebo-controlled, blinded studies of CPNB after knee and hip surgery

- 0/86 fall in saline group
- 7 falls in 6 patients/85 in ropivacaine group
- Although only 1 patient is attributing the fall to weakness
- No patient sustained an injury

Ilfeld BM, et al. JBJS 2007;120(3);551-563



Inpatient Falls after Total Knee Arthroplasty: The Role of Anesthesia Type and Peripheral Nerve Blocks

Review 190,000 TKA.
1.6% had in-hospital fall

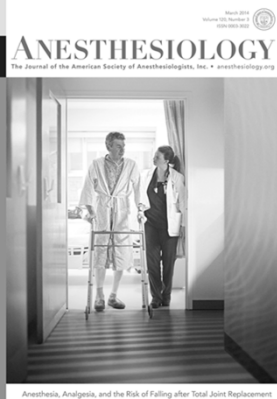
- Risks:
 - Advanced age
 - Male sex
 - Increased co-morbidity
 - Use of GA without neuraxial
- Non-factors
 - Neuraxial with/without GA
 - Peripheral nerve block use



Memtsoudis, S. et al. Anesthesiology. 2014;120(3);551-563

Then in 2014 Anesthesiology

- Femoral nerve block
and concern for fall



Volunteer Study

- Jaeger et al – 2012, compared with contra-lateral placebo
 - Volunteer study
 - AC block produces quadriceps strength reduction of 8%
 - Femoral nerve block produces quadriceps strength reduction of 49%
 - Significant difference
 - No surgery or tourniquet effect

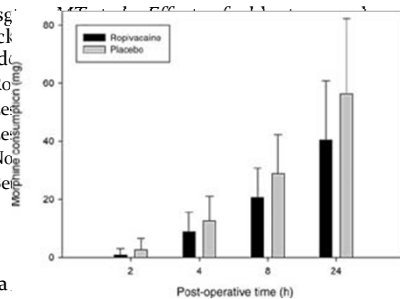
ACB vs Placebo

- Jensstrup MT et al – Effects of adductor-canal-blockade on pain and ambulation after TKA: a randomized study
 - Ropi vs. placebo
 - Less opioid
 - Less pain during flexion
 - No diff for pain at rest
 - Better rehab

- Acta Anaesth Scan 2012;56(3):357-64

ACB vs Placebo

- Jensg block rand
- Ro
- Le
- Le
- No
- Be



- Acta

Continuous Ultrasound-Guided Adductor Canal Block for Total Knee Arthroplasty: A Randomized, Double-Blind Trial

Hanson, Neil A. MD¹; Allen, Cindy Jo RN²; Hostetter, Lucy S. MD³; Nagy, Ryan MD⁴; Derby, Ryan E. MD, MPH⁵; Sileo, April E. MS⁶; Arslanian, Alex BS⁷; Auyang, David B. MD⁸

JGIM 2012

The Effects of Ultrasound-Guided Adductor Canal Block Versus Femoral Nerve Block on Quadriceps Strength and Fall Risk

- Femoral nerve block reduces the quadriceps strength more than AC block 91% vs 11%, no difference in adductor strength
- Balance scores reduced from 56 to 37 with FNB. No reduction with ACB
- Kwofie et al RAPM 2013;38(4),321-5

AC vs Fem

- Jaeger P et al – Adductor Canal Block versus Femoral Nerve Block for Analgesia after TKA: a Randomized, Double-blind Study
 - Spinal anesthesia (n=48)
 - Continuous AC vs Fem catheter
 - 30 ml ropi 0.5% initial dose
 - 8ml/hr ropi 0.2%
 - Strength from baseline 52% vs. 18%
 - No difference for pain or opioid for the first 24 hrs
- RAPM 2013;38(6),526-32

AC vs Fem

- Jaeger P et al – Adductor Canal Block versus Femoral Nerve Block for Analgesia after TKA: a Randomized, Double-blind Study
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 - Strength from baseline 52% vs. 18%
 - No difference for pain or opioid for the first 24 hrs
- RAPM 2013;38(6),526-32

Adductor Canal Block *versus* Femoral Nerve Block for Total Knee Arthroplasty: A Prospective, Randomized, Controlled Trial

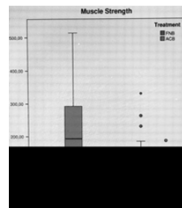
- Kim DH et al – Adductor Canal Block versus Femoral Nerve Block for TKA
 - CSE anesthesia (n=93)
 - Single injection Fem vs AC (randomized, DB)
 - 30 ml bupi 0.25% for Fem and 15 ml for AC
 - At 6-8hrs: Fem vs. AC
 - strength: significant decrease
 - pain or opioids: no difference
 - At 24-48hrs: no more strength difference
- Anesthesiology 2014;120,540-50

Effect of Adductor Canal Block Versus Femoral Nerve Block on Quadriceps Strength, Mobilization, and Pain After Total Knee Arthroplasty A Randomized, Blinded Study

Ulrik Grevstad, MD, et al.

50 TKA pt with severe movement-related pain
DB RDMZ 0.2% ropi ACC vs fem

1 strength
2 ambu
3 pain

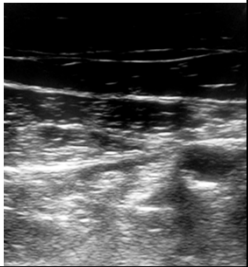


Adductor canal block provides a clinically relevant and statistically significant increase in quadriceps muscle strength for patients in severe pain after TKA

| Adductor canal block for knee surgical procedures: review article | | | | |
|---|--|---|---|---|
| Maulin U. Vora MBBS (Resident)*, Thomas A. Nicholas MD Cale A. Kassel MD (Instructor)*, Stuart A. Grant MB, CHB (Professor)* | | | | |
| Journal of Clinical Anesthesia (2016) 35, 295–303 | | | | |
| Table 2 Meta-analysis comparing ACB vs FNB in TKA | | | | |
| Study outcome | Dong et al [47] | Husain et al [48] | Kuang et al [46] | Li et al [49] |
| VAS at rest 0–4 h | No difference MD = 5.22 95% CI = -0.93, 11.37 | No difference MD = -0.07 95% CI = -2.89, 2.45 | No difference MD = -0.03 95% CI = -0.18, 0.12 | ACB better MD = -0.17 95% CI = -0.27 to -0.07 |
| VAS at rest 24 h | No difference MD = 1.34 95% CI = -2.35, 5.04 | No difference MD = -0.04 95% CI = -0.73, 0.65 | ACB better MD = -0.39 95% CI = -0.5, -0.27 | ACB better MD = -0.81 95% CI = -0.53, -0.29 |
| VAS at rest 48 h | No difference MD = -0.02 95% CI = -1.50, 0.25 | No difference MD = -0.06 95% CI = -0.33, 0.21 | No difference MD = -0.06 95% CI = -0.15, 0.03 | No difference MD = -0.06 95% CI = -0.15, 0.03 |
| VAS with activity 0–4 h | No difference MD = 3.68 95% CI = -2.88, 10.24 | NA | No difference MD = 0.07 95% CI = -0.14, 0.27 | No difference MD = 0.00 95% CI = -0.09, 0.09 |
| VAS with activity 24 h | No difference MD = -0.66 95% CI = -1.67, 0.35 | NA | No difference MD = 0.02 95% CI = -0.14, 0.17 | No difference MD = 0.04 95% CI = -0.11, 0.20 |
| VAS with activity 48 h | No difference MD = -0.85 95% CI = -1.95, 0.23 | NA | No difference MD = -0.08 95% CI = -0.18, 0.03 | No difference MD = -0.08 95% CI = -0.18 to 0.03 |
| Opoid consumption | No difference MD = -1.1 95% CI = -5.13, 7.50 | NA | No difference 48 h MD = -1.96 95% CI = -10.42, 6.62 | No difference MD = -1.42 95% CI = -8.41, 5.58 |
| Quadriceps strength | No difference MD = 96.27 95% CI = -42.69, 235.24 | NA | NA | ACB better (+60 y) MD = 37.46 95% CI = 12.27, 62.24 (+60 y) MD = 32.63 95% CI = 6.72, 58.99 |
| Adductor strength* | No difference MD = 17.82 95% CI = -6.40, 42.09 | NA | NA | ACB better (+60 y) MD = 1.51 95% CI = -0.12, 3.15 (+60 y) MD = -4.87 95% CI = -16.13, 6.38 |
| TUG test | NA | NA | ACB better MD = -0.40 95% CI = -0.73, -0.08 | ACB better (+60 y) MD = -3.1 95% CI = -6.65, -0.55 |

Overview

- Adductor Canal blocks: the rationale
- Precautions
- Conclusions



Delayed Motor Block

- AC block can easily spread proximal to affect motor branches of the femoral nerve

Veal, C., et al., *Delayed quadriceps weakness after continuous adductor canal block for total knee arthroplasty: a case report.* Acta Anaesthesiol Scand, 2013.

Day of surgery: ambulation without assistance
20 hr after an 8ml/hr ropi 0.2% produced profound quad weakness
2 ml dye spread to the fem nerve

Immediate Motor Block

- AC block can easily spread proximal to affect motor branches of the femoral nerve

Chen J., L.J.B., Hadzic A., Reiss W., Resta-Flarer F., *Adductor canal block can result in motor block of the quadriceps muscle*. Regional Anesthesia and Pain Medicine, 2014. **39**(2): p. 170-171.

Rescue single injection AC with 20 ml of ropi 0.5%
Motor block last for 20 hrs and the sensory for 48 hrs

Impairment of Sciatic Nerve Function During Adductor Canal Block

AC block can spread distal to affect motor branches of the sciatic nerve

Gautier P et al.
RAPM 2015 40(1):85-6

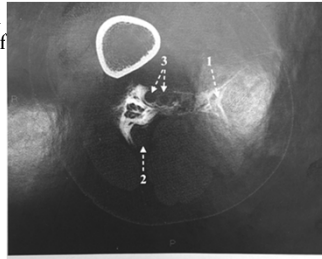


FIGURE 1. Computed tomography scan cross-sectional view of the lower limb. Shown is distal spread of contrast (1), sciatic nerve (2), and popliteal vessels (3).

Conclusions

- ACB vs FNB with post knee injection
 - Less motor blockade with better rehab condition
 - Similar analgesia after major knee surgery
- Possible delayed quadriceps weakness
- Add multimodal analgesia
- Potential problems:
 - Femoral artery injury?
 - Saphenous neuropathy?
- No block asleep or under spinal !!!



KEY CHOICES AND TECHNIQUES IN
REVISION THA AND TKA
Step-by-Step Decisions

Moderator: Daniel J Berry, Mayo Clinic
Panelists: John J Callaghan
William L Griffin
Thomas P Vail
Michael P Bolognesi



Presenter Disclosure Information

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- Board of Governors, Mayo Clinic; Board of Directors, AJRR; Presidential line, Hip Society

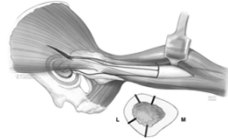
TOUGH REVISION THA AND TKA

REVISION THA



TOUGH REVISION THA AND TKA

EXPOSURE



TOUGH REVISION THA AND TKA THAR: Exposure

Old Skin Incisions:

- Which ones do you use?



TOUGH REVISION THA AND TKA THAR: Exposure

- In revision THA, how often do you perform an *extended greater trochanteric osteotomy*?
- Under what circumstances?



-
- The figure contains two main diagrams illustrating Endoscopic Tibial Osteotomy (ETO) techniques:
- Laterally based ETO:** The top diagram shows a lateral view of the knee joint with a large osteotomy performed on the lateral aspect of the tibia. A smaller inset diagram shows a cross-section of the tibia with labels for 'Anterior', 'Posterior', 'Medial', and 'Lateral' directions, indicating the location of the lateral osteotomy.
 - Anteriorly based ETO:** The bottom diagram shows an anterior view of the knee joint with a large osteotomy performed on the anterior aspect of the tibia. A smaller inset diagram shows a cross-section of the tibia with labels for 'Anterior', 'Posterior', 'Medial', and 'Lateral' directions, indicating the location of the anterior osteotomy.

[illegible]

-



TOUGH REVISION THA AND TKA THAR: Implant Removal

- Well fixed uncemented stem removal?



TOUGH REVISION THA AND TKA THAR: Implant Removal

- Well fixed broken stem removal?



TOUGH REVISION THA AND TKA Implant Removal

- Well-fixed fluted tapered stem removal?



TOUGH REVISION THA AND TKA

BONE LOSS



TOUGH REVISION THA AND TKA THAR: Acetabular Bone Loss

Mild-Moderate Bone Loss:

- What is your “go to” technique?



Loose cup

TOUGH REVISION THA AND TKA THAR: Acetabular Bone Loss

- Do you always use an “enhanced” ingrowth surface in revisions?



Failed “impaction grafting”

TOUGH REVISION THA AND TKA Acetabular Bone Loss

- When you have major **medial** segmental loss, what is your preferred reconstruction method?
 - cancellous graft
 - bulk graft
 - metal augments



TOUGH REVISION THA AND TKA THAR: Acetabular Bone Loss

- When you have major **lateral** segmental acetabular bone loss, what are your indications for:
 - highly porous metal augments?
 - bulk bone allograft?



TOUGH REVISION THA AND TKA Acetabular Bone Loss

- When do you need more than a hemisphere?
- Any indications for custom triflange cup?

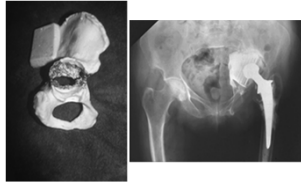


Failed "impaction grafting"

TOUGH REVISION THA AND TKA THAR: Acetabular Bone Loss

Pelvic Discontinuity:

- Go to method?



TOUGH REVISION THA AND TKA THAR: Femoral Bone Loss

Mild-Moderate Bone Loss:

- What is your “go to” method in **mild** femoral bone loss?



Loose subsided stem

TOUGH REVISION THA AND TKA Femoral Bone Loss

- What is your “go to” category of stem when there is notable femoral bone loss?
 - fluted tapered modular
 - extensively coated
 - cemented long stem
 - impaction grafting



TOUGH REVISION THA AND TKA Femoral Bone Loss

- Is there a role for impacting grafting?
- For bulk proximal femoral allograft?



TOUGH REVISION THA AND TKA

HIP STABILITY



TOUGH REVISION THA AND TKA Joint Stability

- In revisions, when do you use:
 - large fixed head?
 - dual mobility?
 - constrained?



TOUGH REVISION THA AND TKA

Joint Stability

- Revision for recurrent dislocation:
 - large head?
 - dual mobility?
 - constraint?



TOUGH REVISION THA AND TKA

HISTORY OF INFECTION



TOUGH REVISION THA AND TKA

Infection

Question:

- Do you typically use a one stage or a two stage protocol for infected THA?




THORNTON CLINIC


TOUGH REVISION THA AND TKA
Infection

Question:

- During **two stage** treatment, do you prefer articulated or non articulated spacers?



Articulated




Non articulated

THORNTON CLINIC

TOUGH REVISION THA AND TKA
Infection

Question:

- During two stage treatment, what is your typical resection **interval**?




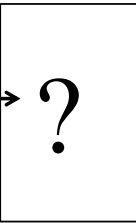
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TOUGH REVISION THA AND TKA
Infection

Question:

- Femoral fixation at reimplantation
 - cemented?
 - uncemented?





TOUGH REVISION THA AND TKA

POSTOP MANAGEMENT

TOUGH REVISION THA AND TKA Postop

Postop:

- Hip guide brace?
- Weight bearing
 - cup revision with bone loss
 - femoral revision with bone loss



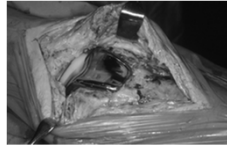
TOUGH REVISION THA AND TKA

REVISION TKA



TOUGH REVISION THA AND TKA

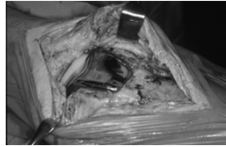
EXPOSURE



TOUGH REVISION THA AND TKA TKAR: Exposure

Your “go to” exposure
when things are tight?

- Quad snip
- Tibial tubercle osteotomy



TOUGH REVISION THA AND TKA

IMPLANT REMOVAL



TOUGH REVISION THA AND TKA TKAR: Implant Removal

Implant Removal in Revision TKA:

- Multiply Revised Knee:
 - technical tips to:
 - speed removal
 - avoid complications



TOUGH REVISION THA AND TKA TKAR: Implant Removal

- Do you ever need to do something exotic like “osteotomy” to get out well-fixed stemmed implants?




Infected

TOUGH REVISION THA AND TKA

IMPLANT FIXATION BONE LOSS







TOUGH REVISION THA AND TKA

TKAR: Bone Loss/Fixation

Options to Improve Fixation/Manage Bone Loss:

- Cemented stems
- Uncemented stems
- Metaphyseal cones/sleeves
- Bone graft






TOUGH REVISION THA AND TKA


TKAR: Bone Loss - Fixation


Cemented Versus Uncemented Stems?

- Balance of fixation versus
- Removability



Vs.







TOUGH REVISION THA AND TKA

TKAR: Bone Loss - Fixation

- How do you get *fixation* in sclerotic canal damaged by previous stem?



Loose




Loose

THORNTON CLINIC

TOUGH REVISION THA AND TKA
TKAR: Bone Loss - Fixation

One Good Method:


- Metaphyseal cone
- Impacting grafting



THORNTON CLINIC

TOUGH REVISION THA AND TKA
TKAR: Bone Loss - Fixation


- When do you use metaphyseal sleeves or porous metal cones?



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TOUGH REVISION THA AND TKA
TKAR: Bone Loss - Fixation

- When do you use particulate bone graft?




Particulate graft

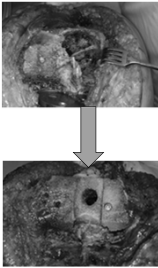
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TOUGH REVISION THA AND TKA
TKAR: Bone Loss - Fixation

- When do you use small-medium size bulk bone allograft?




Femoral Head Graft



THORNTON CLINIC

TOUGH REVISION THA AND TKA
TKAR: Bone Loss - Fixation

- When do you use massive bulk bone allograft?





Distal Femoral Allograft

THORNTON CLINIC

TOUGH REVISION THA AND TKA
TKAR: Bone Loss - Fixation

- When do you go to distal femoral replacement?



TOUGH REVISION THA AND TKA

STABILITY/CONSTRAINT



TOUGH REVISION THA AND TKA

TKAR: Implant Constraint

What % of implants for multiply revised knees?

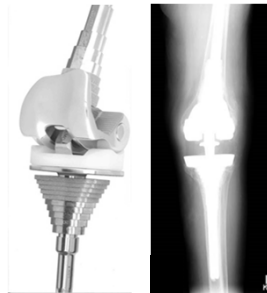
- PS
- Constrained condylar
- Hinge



TOUGH REVISION THA AND TKA

TKAR: Implant Constraint


- Indications for hinge?



THORNTON CLINIC

TOUGH REVISION THA AND TKA
TKAR: Implant Constraint

• Role of ligament augmentation/
ligament allograft?

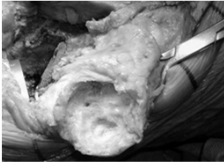


No MCL

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TOUGH REVISION THA AND TKA

EXTENSOR MECHANISM



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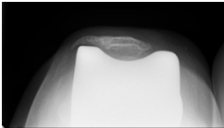
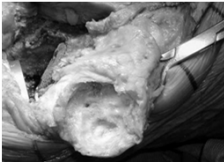
TOUGH REVISION THA AND TKA
TKAR: Extensor Mechanism

What do you do with the
very deficient patella?

• Leave unresurfaced?

• Bone graft with pouch?

• Gull wing osteotomy?



TOUGH REVISION THA AND TKA TKAR: Extensor Mechanism

Extensor Mechanism
Deficiency:

- Role of allograft?
- Role of marlex mesh reconstruction?



TOUGH REVISION THA AND TKA

Hope You Have Enjoyed the Course
Thank You

Disclosures

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American Association of Hip and Knee Surgeons: Board or committee member

International Congress for Joint Reconstruction: Board or committee member

Journal of Bone and Joint Surgery - British: Editorial or governing board

Mid-America Orthopaedic Association: Board or committee member

Minnesota Orthopaedic Society: Board or committee member

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Stryker: Paid consultant

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Ceramtec: Paid presenter or speaker

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Sigita Wolfe

(This individual reported nothing to disclose); AAHKS Staff

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