Hip and Knee Arthroplasty: The Details in the OR and Afterwards Make a Difference

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Department of Orthopaedics and Rehabilitation

I (and/or my co-authors) have nothing to disclose.

Goals and Objectives

At the conclusion of this session, participants should be able to:

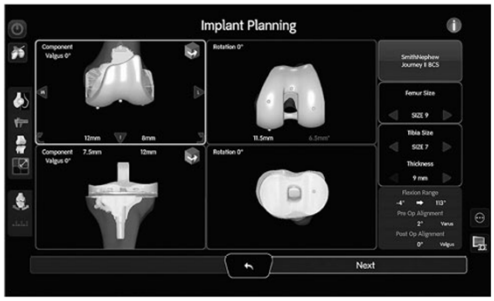
- Identify important considerations for surgical planning
- Discuss appropriate perioperative care in THA/TKA, including DVT prophylaxis and infection prophylaxis
- Review THA/TKA post-op protocols, including pain management and physical therapy

Life Expectancy

- People living and working longer
- Average life expectancy over 77
- By 2050, 86 (male) and 92 (female) expected
- 50 year old women expected to live to 82
- 65 year olds have nearly a 20 year average life expectancy

Computer Assisted Surgery / Robotics

Computer Assisted Surgery / Robotics



Computer Assisted Surgery / Robotics

- Available from most manufacturers
- Image based and imageless systems available
- Allow planning based on mechanical axis (Hip, knee, and ankle center)
- Avoids canal instrumentation
- Allows sizing, balancing, alignment, and planning prior to making first bone cut
- High degree of accuracy
- Usually adds time
- Not smaller skin incision

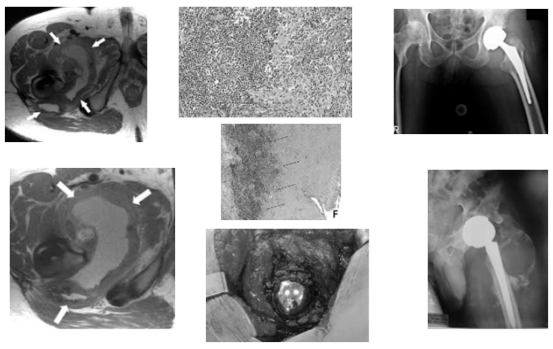
Clin Orthop Relat Res (2020) 478:266-275 DOI 10.1097/CORR.0000000000000916

Does Robotic-assisted TKA Result in Better Outcome Scores or Long-Term Survivorship Than Conventional TKA? A Randomized, Controlled Trial

Young-Hoo Kim MD, Sung-Hwan Yoon MD, Jang-Won Park MD

- Randomized trial compared robotic-assisted TKA to manual-alignment techniques
- 700 patients (750 knees) received robotic-assisted TKA and 706 patients (766 knees) received conventional TKA
- At >10 year f/u:
  - No difference in clinical or radiographic parameters
  - No difference in aseptic loosening
  - No difference in frequency of complications
- "Considering the additional time and expense associated with robotic-assisted TKA, we cannot recommend its widespread use."

ALTR / ALVAL



The New York Times

Business

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Global Business

Rolling over to Fidelity is e

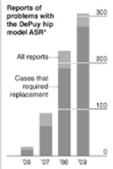
With Warning, a Hip Device Is Withdrawn

By BARRY MEIER
Published: March 9, 2010

A unit of Johnson & Johnson, just months after saying it was phasing out an artificial hip implant because of slowing sales, has warned doctors that the device appears to have a high early failure rate in some patients.

Reported Problems

Between 2006 and 2009, reports of problems with the DePuy model ASR hip replacement device rose sharply. Of the problems reported in 2009, over 90 percent required replacement.



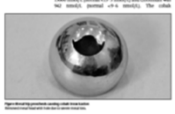
*Includes reports to F.D.A. of some cases outside the U.S.

Source: F.D.A.

The New York Times

Case Report

Cobalt intoxication diagnosed with the help of Dr House



Arthroplasty Today 3 (2017) 151–153

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ELSEVIER

ARTHROPLASTY TODAY

Case report

Cardiac transplant due to metal toxicity associated with hip arthroplasty

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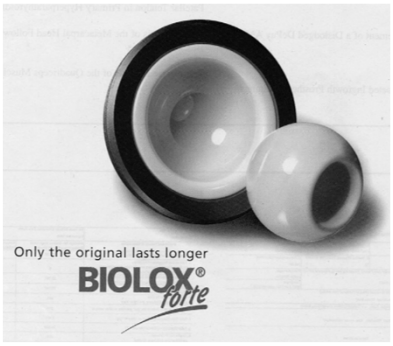
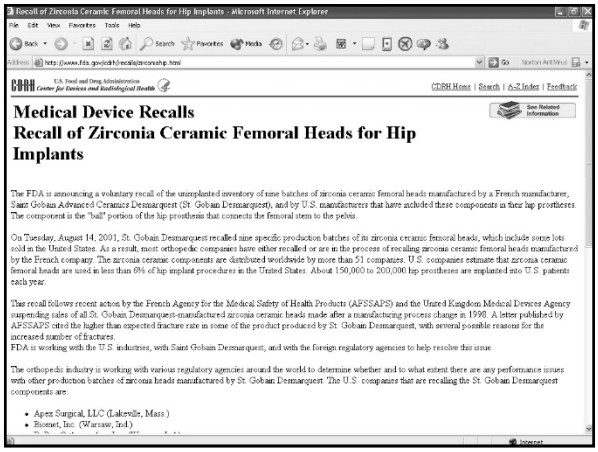
Ceramics





Recall of Zirconia Ceramic Femoral Heads for Hip Implants - Microsoft Internet Explorer

CDRH U.S. Food and Drug Administration Center for Devices and Radiological Health

CDRH Home | Search | A-Z Index | Feedback

Medical Device Recalls
Recall of Zirconia Ceramic Femoral Heads for Hip Implants

See Related Information

The FDA is announcing a voluntary recall of the unimplanted inventory of nine batches of zirconia ceramic femoral heads manufactured by a French manufacturer, Saint-Gobain Advanced Ceramics Desmarquest (St. Gobain Desmarquest), and by U.S. manufacturers that have included these components in their hip prostheses. The component is the "ball" portion of the hip prosthesis that connects the femoral stem to the pelvis.

On Tuesday, August 14, 2001, St. Gobain Desmarquest recalled nine specific production batches of its zirconia ceramic femoral heads, which include some lots sold in the United States. As a result, most orthopedic companies have either recalled or are in the process of recalling zirconia ceramic femoral heads manufactured by the French company. The zirconia ceramic components are distributed worldwide by more than 51 companies. U.S. companies estimate that zirconia ceramic femoral heads are used in less than 6% of hip implant procedures in the United States. About 150,000 to 200,000 hip prostheses are implanted into U.S. patients each year.

The recall follows recent action by the French Agency for the Medical Safety of Health Products (AFSSAPS) and the United Kingdom Medical Devices Agency suspending sales of all St. Gobain Desmarquest-manufactured zirconia ceramic heads made after a manufacturing process change in 1990. A letter published by AFSSAPS cited the higher than expected fracture rate in some of the product produced by St. Gobain Desmarquest, with several possible reasons for the increased number of fractures.
FDA is working with the U.S. industries, with Saint Gobain Desmarquest, and with the foreign regulatory agencies to help resolve this issue.

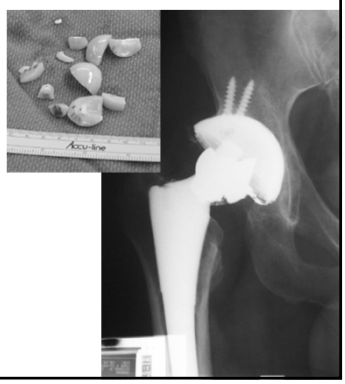
The orthopedic industry is working with various regulatory agencies around the world to determine whether and to what extent there are any performance issues with other production batches of zirconia heads manufactured by St. Gobain Desmarquest. The U.S. companies that are recalling the St. Gobain Desmarquest components are:

- Apex Surgical, LLC (Lakeville, Mass.)
- Biomet, Inc. (Warsaw, Ind.)

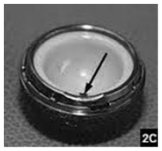
Internet

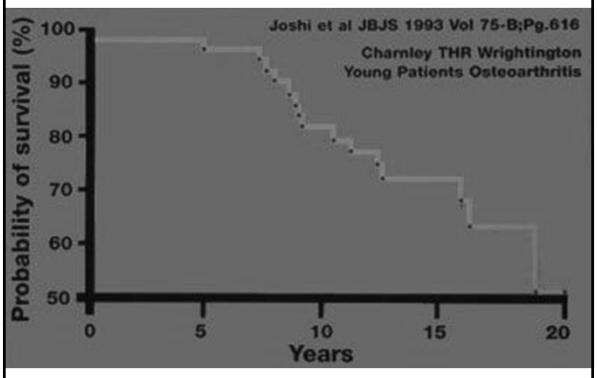
Ceramics – Disadvantages

- Fractures
  - Risk with modern components <0.05%
- Difficulty in designing taper locks
- Rigid
  - Direct transmission of energy to bone
- Expensive
- Noise – Squeaking hips (10-20%)



Squeaking Ceramics





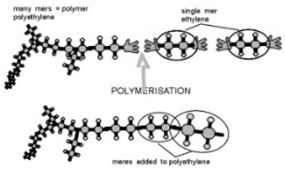
Bearing History

- 1880's – soft tissue interposition
- 1894 – ivory
- 1920's – mold arthroplasty
- 1930's – metal –metal
- 1950's – Teflon
- 1962 – high density polyethylene
  the standard for the next 50+ years

Sir John Charnley

Polyethylene – What is it?

- Polymer of ethylene molecules C_2H_4
- Fine powder consolidated at elevated temp or pressure
  - – Ram extrusion
  - – Molding followed by machining
  - – Direct molding into final shape



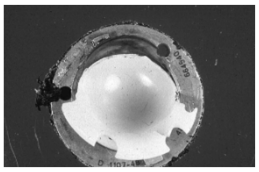
UHMWPE: 160 000 to 210 000 meres

Advantages of Poly

- Abrasion resistance
- Impact strength
- Shock absorption
- Low coefficient of friction
- Chemical inertness
- Resistance to stress cracking
- Inexpensive

The Problem with Poly

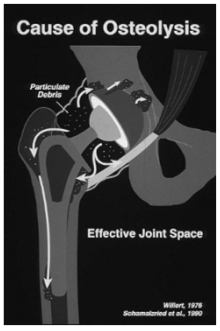
- Wear debris
  - Abrasive and adhesive wear
  - 75 to 250 microns linear wear / year
  - 500 billion particles / year
  - 500,000 particles / step
  - Submicron particles
    - 85% < 1 micron
    - 4% > 2 microns

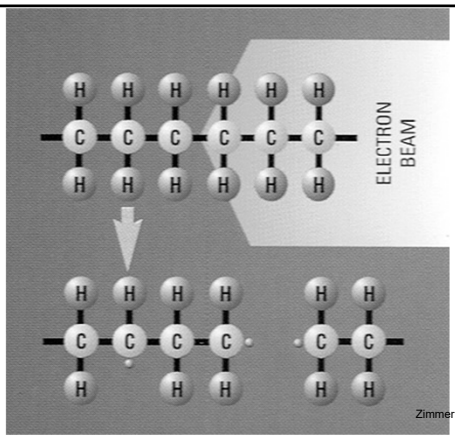


The biggest long term problem in THA is polyethylene wear and the resultant osteolysis.

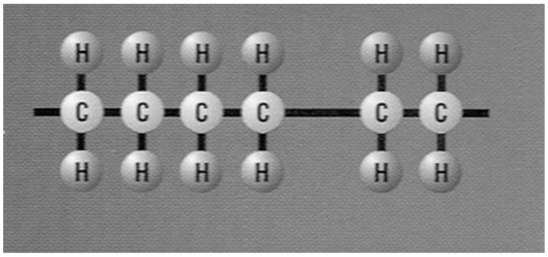
Attempts to Correct This

- Avoid thin poly
- Avoid modularity or make connections stable
- Polished backside surfaces
- Avoid screw holes
- Avoid impingement
- Decrease effective joint space
- Avoid poly

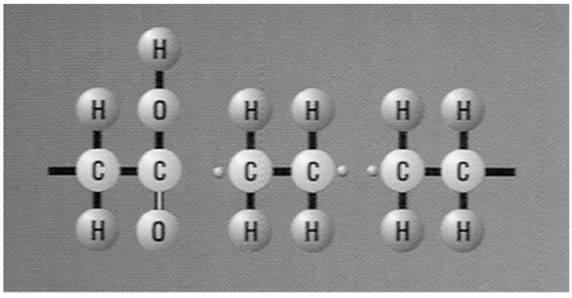




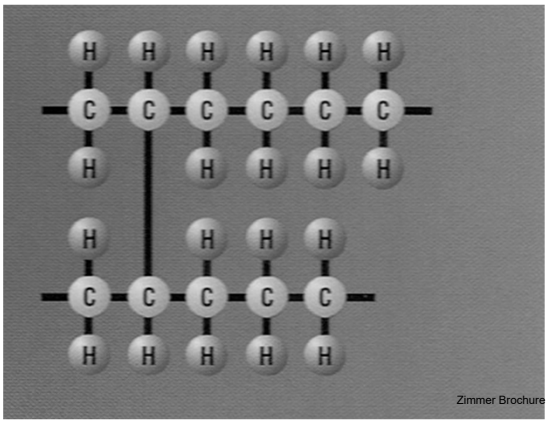
Zimmer Brochure



Zimmer Brochure



Zimmer Brochure

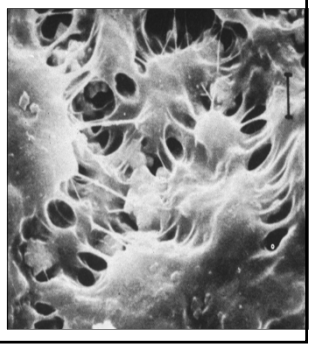


Crosslinked Polyethylene

- Radiation causes free radicals
  - May combine with oxygen - Oxidation
    - Polymer chains break
    - Crystalline structure disturbed
    - Mechanical properties deteriorate
  - May combine with each other - Cross linking
- Heating (annealing) helps to reduce oxidation
  - 150 degrees C for 16 hours
  - Outer layer of oxidized material removed

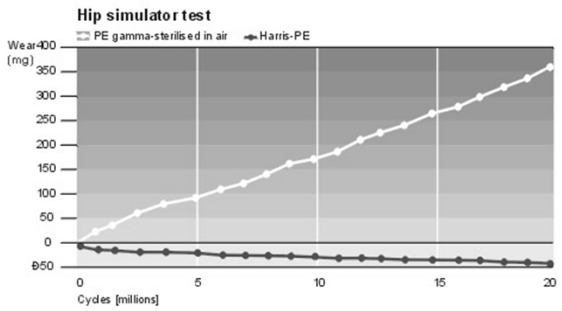
Crosslinked Polyethylene

- Prevents surface deformation
- Increases wear resistance
- Reduces sensitivity to abrasion



Crosslinked Poly - Advantages

- Minimal wear in lab simulations
- No significant change in material properties
- Allows for use of larger heads
  - Reduced dislocation rates
  - Reduced need for skirts
  - Improved ROM



Zimmer Brochure

THE OTTO AUFRANC AWARD

Highly Cross-linked Polyethylene in Total Hip Arthroplasty

Randomized Evaluation of Penetration Rate in Cemented and Uncemented Sockets Using Radiostereometric Analysis

Georgios Digas, MD, PhD; Johan Kärrholm, MD, PhD; Jonas Thanner, MD, PhD; Henrik Malchau, MD, PhD; and Peter Herberts, MD, PhD

- Prospective, randomized
- Bilateral hips –
  - N = 32 (Longevity & Conventional)
- Unilateral hips
  - N= 62 (all poly cups- Durasul or conventional)

Radiostereotmetry: Tantalum markers implanted into acetabulum and liner at time of surgery

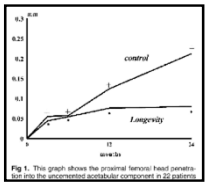


Fig 1. This graph shows the proximal femoral head penetration into the uncemented acetabular component in 22 patients.

Longevity

1 yr – 0.08 vs 0.08 mm

>1yr- 0.12 vs 0.21 mm

p<0.005

Durasul

1 yr – 0.09 vs 0.13 mm

>1yr- 0.13 vs 0.25 mm

p<0.002

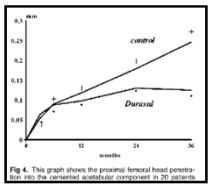


Fig 4. This graph shows the proximal femoral head penetration into the cemented acetabular component in 26 patients.

Continued Improved Wear with an Annealed Highly Cross-linked Polyethylene

William N. Capello MD, James A. D'Antonio MD, Rama Ramakrishnan MS, Marybeth Naughton BS

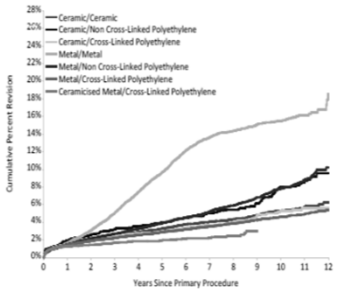
- Clin Orthop Relat Res (2011) 469:825–830
- 42 hips at 8.6 years
- 0.031 mm linear wear per year for XLPE versus 0.141 mm for conventional (78% reduction)
- No osteolysis in XLPE versus 50% in conventional
- No mechanical failure

MUSC Experience

- Over the past decade, >99% of our THA's have been either ceramic or metal on XPLE.
- >90% of primaries are cementless, proximally porous coated stems with porous cups.
- No revisions for any bearing surface related issue (wear, osteolysis, bearing failure)
- Minimal wear on follow-up x-rays
- Our implant of choice for all hip replacement patients

Australian Registry 2013 Report

Figure HT25: Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)



Pre-op (Holding)

- Nursing check in
  - Review consent, confirm site
  - SCD for non-operative leg
  - Chlorhexidine wipes
  - Clip surgical site
  - Betadine to surgical site
  - IV and initiate Vancomycin, if needed
  - Blood, meds, other orders
  - Empty bladder before going to OR
- Anesthesia team
  - Review consent
  - Discuss anesthesia plan
  - Peripheral nerve blocks
  - Confirm Vanco, if needed
- Surgical team
  - Review consent
  - Mark surgical site
  - Discuss surgery and answer questions
  - Discuss discharge plan
  - Confirm all of above as being done

Operative Considerations

Prophylactic antibiotics
Infection prevention
Blood management
Surgical approaches

OR Prevention of Infection - Disclaimer

There is little Level 1 evidence to support many of the things we do in the operating room to prevent infections.

There is too little time to begin to cover all of the literature on this topic.

A consistent, logical, thoughtful approach seems to have the highest impact on establishing culture and improving outcomes.

OR Order of Operations

- No sterile equipment opened prior to patient arrival
- Circulator writes Name, MRN, DOB, Procedure, Antibiotic timing on White Board
- Patient brought to OR by anesthesia team
  - Hair covering, masks for all personnel. Shirts tucked, Boots (?)
  - No outside jackets
- Transfer to OR table
  - Stretcher and all linens out of room
- Administration of anesthetic
  - Surgical team reviews radiographs, templates, history, equipment
- Position bed, establish barrier between anesthesia and surgical site (sheet) before opening any equipment
- Scrub and circulator / facilitator begin opening equipment
- Surgical team (MDs, PAs) prepares patient
  - Positioning, lights, leg suspension, tourniquet, Blue U drape, Pre-prep
- Antibiotics during pre-prep

OR Order of Operations

- Time out
  - Circulator reviews consent
  - Introductions
  - Surgeon discusses case
    - Surgical plan, time, EBL, needed equipment and blood products, specimens, drains, recovery / discharge plan, anything unusual
  - Anesthesia concerns
  - Scrub tech concerns
- Surgical team scrubs while OR nurses continue opening equipment
- Sterile gloves for prep (no gowns for person applying prep)
- Down and top sheets, stockinette, drape, impervious skin covering, change gloves, mark, suction/cautery/pulse lavage.
- No forced air warmers until all drapes on
- Operate!
- Change gloves every hour and before implants
- No change of personnel unless absolutely necessary
- Chlorhexidine irrigation and saline pulse lavage
- Chlorhexidine prep at final skin closure
- Impervious dressing

Pathogenesis of O.R. Infections

Skin
Airborne Sources / instruments / gloves
Hematogenous
Most common organisms
- Staph Aureus and Staph Epidermidis
- Enterococcus, Streptococcus, GNR's

Glycocalyx biofilms on orthopaedic implants allow non-pathologic organisms to lead to infection
Development of infection depends on virulence of organism, load of contamination, host factors, and local environment.

Host or systemic factors

Systemic antibiotics
MRSA / MSSA isolation and decolonization
Glucose control
Nutritional support
Body temperature
Oxygenation
Shaving / Clipping
Prepping / Draping / Skin isolation

Prophylactic Antibiotics - History

- History
  - Conflicting data prior to mid 1970's
  - "Prophylactic" antibiotics typically given hours or days after surgery
  - 1961 – Burke reported that adequate tissue levels at time of inoculation prevented infection in Guinea pigs
  - Bowers, JBJS 1973
    - Canine model showed high cephaloridine levels in hematoma if given 30 minutes prior to surgery with no infection
    - Starting administration 6 hours post-op could not achieve bacterial sterility
    - Starting after 24 hours were universally infected
  - Pavel, JBJS 1974
    - Prospective, placebo-controlled study of 1591 clean operations using pre and intra-op cephaloridine
    - Decreased infection risk from 5% to 2.8%
  - Charnley – 7% in 1960 to 0.5% in 1970 without antibiotics

Prophylactic Antibiotics
JBJS CCR 2009 – Meehan, et al

- Given to prevent surgical infection when infection is not believed to be present, but risk is present.
- Goal is to achieve serum and tissue levels that exceed the MIC for organisms likely to be encountered during the operation.
- Augments hosts immune system by increasing the amount of contamination required to cause infection

Prophylactic Antibiotics - Timing

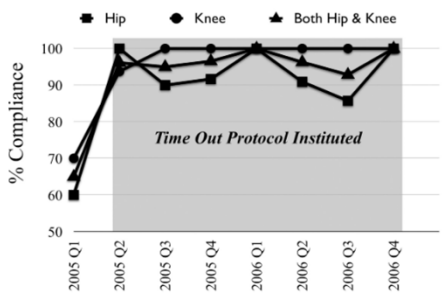
- Within 60 minutes prior to incision
- Peak levels reached within 20 minutes of administration
- Vancomycin can start up 2 hours prior
- Additional dose if procedure exceeds half-life of antibiotic or substantial blood loss.
- AAOS Recommendations

TABLE I Recommendations by the American Academy of Orthopaedic Surgeons for Repeat Doses of Antibiotics[88]

Antibiotic	Frequency of Administration
Cefazolin	Every 2-5 hours
Cefuroxime	Every 3-4 hours
Clindamycin	Every 3-6 hours
Vancomycin	Every 6-12 hours

Ensuring Appropriate Timing of Antimicrobial Prophylaxis

By Andrew D. Rosenberg, MD, Daniel Wambold, MD, Linede Kraemer, RN, MA, CNOR, Maureen Begley-Keyes, BS, RN, CPHRM, CPHQ, Scott L. Zuckerman, Neeraj Singh, BA, Max M. Cohen, MD, and Michele V. Bennett, RN, MA, ONC



Prophylactic Antibiotics - Choice

- Choice should cover must common organisms
  - PCN, Cephalosporins, vancomycin, animoglycosides are bactericidal
  - Clindamycin is bacteriostatic
  - Cefalozin of cefuroxime for sensitive staph.
  - Vancomycin or clindamycin for allergic patients.
    - Cross reactivity between PCN and cephalosporins historically 10%.
    - Current anaphylaxis to cephalosporins estimated between 0.0001% and 0.1%

Prophylactic Antibiotics - Choice

Cefazolin

- Has been antibiotic of choice for 3 decades
- Excellent distribution profiles in bone, muscle, synovium, and hematoma
- Rapid MIC levels in tissue
- Rare anaphylactic reactions
- 2 grams for adults < 120 Kg; 3 grams if > 120 Kg

Prophylactic Antibiotics – Choice

- Vancomycin
  - Reaches high concentrations in tissue within minutes
  - 5-13% Red man syndrome with rapid infusion
  - 15 mg/Kg for normal renal function
  - Useful for
    - Known colonization with resistant organism
    - Facilities with recent outbreaks of MRSA
    - Anaphylaxis to Penicillin or Cephalosporins
    - May be warranted in high risk patients
  - Risks
    - Development of VRE colonization
    - <1% ototoxicity or nephrotoxicity
    - Hypersensitivity, neutropenia, drug fever - rare

Prophylactic Antibiotics – AAOS Position – June 2004

- Antibiotic selection
  - Cefazolin or cefuroxime
  - Reserve clindamycin or vancomycin for confirmed beta-lactam allergies, MRSA colonization, or outbreaks
- Timing and dosage
  - Within 1 hour of start time, 2 hours for vanc.
  - Completely infused before tourniquet inflation
  - 2 grams cefazolin for patients > 80 Kg
  - Redose during surgery as needed
- Duration
  - Discontinue within 24 hours of the end of surgery
  - Antibiotics not proven to be beneficial for retained catheters or drains

Pre-operative Screening for MRSA

Allows modification of choice of antibiotics for MRSA colonized patients

Role of nasal mupirocin remains unclear

Successful in Netherlands

- 0.78% Staph isolates are MRSA

Unreported MUSC data suggests decreased MRSA infection rates in pre-screened patients

Real life at MUSC

MRSA screening and decolonization

Cefazolin 2 or 3 grams at time of "time-out" – After positioning, immediately before handwashing.

Re-dose at 3-4 hours.

Vancomycin 15mg/kg started in holding and completed prior to beginning of procedure for MRSA+ or severe allergy.

Antibiotics stopped within 24 hours (except revisions with pending cultures)

Order example:

- Cefazolin 2 Gram IV x 3 doses – begin on (DOS) at (time) – 6 hours after last dose in OR (time). Must complete before (time, date) – 24 hours after end of surgery (time).

Hypothermia

Rationale:

- Core temperatures outside the normal range pose a risk in all patients undergoing surgery.
- According to the Clinical Guidelines for the Prevention of Unplanned Perioperative Hypothermia by the American Society of PeriAnesthesia Nurses (ASPAN, 2001), published research has correlated impaired wound healing, adverse cardiac events, altered drug metabolism, and coagulopathies with unplanned perioperative hypothermia.
- Kurtz, et al (1996), found that incidence of culture-positive surgical site infections among those with mild perioperative hypothermia was three times higher than the normothermic perioperative patients. In this study, mild perioperative hypothermia was associated with delayed wound closure and prolonged hospitalization.
- Mahoney and Odom (1999), demonstrated that hypothermia is associated with a significant increase in adverse outcomes, including an increased incidence of infections. The authors also concluded that hypothermia is associated with an increased chance of blood products administration, myocardial infarction, and mechanical ventilation. These adverse outcomes resulted in prolonged hospital stays and increased healthcare expenditures.

RLO at MUSC

Forced air warmers
Temp monitors
Pre-warm OR
Warm blankets / cover patients
Ongoing battle between Anesthesia and scrubbed personnel

Surgical Issues – Hair Removal

- Increased risk if infection if shaving done night before surgery
- Clippers reduce post-operative infection rates over shaving
- No difference in hair removal versus no hair removal.
- Tanner J, Woodings D, Moncaster K. Preoperative hair removal to reduce surgical site infection. Cochrane Database Syst Rev. 2006;2:CD004122.

Surgical Issues – Skin Prep.

Chlorhexidine gluconate and iodophors both disrupt bacterial cell membranes, but chlorhexidine is more long-lasting.

Iodophors can be inactivated by blood or serum proteins.

Alcohol germicidal, but no residual activity.

No difference in efficacy in some studies, conflicting in others

"The current literature strongly suggests that chlorhexidine gluconate is superior to povidone-iodine for preoperative antisepsis for patients." Fletcher, 2007

"Skin preparation solution is an important factor in the prevention of surgical-site infections. Iodophor-based compounds may be superior to chlorhexidine for this purpose in general surgery patients." Swenson, 2009

Surgical Issues – Occlusive Drapes

No conclusive evidence of benefit

Geelhoed GW, Sharpe K, Simon GL. A comparative study of surgical skin preparation methods. Surg Gynecol Obstet. 1983;157:265-8.

Ritter MA, Campbell ED. Retrospective evaluation of an iodophor incorporated antimicrobial plastic adhesive wound drape. Clin Orthop Relat Res. 1988;228:307-8.

Jacobson C, Osmon DR, Hanssen A, Trousdale RT, Pagnano MW, Pyrek J, Berbari E, Naessens J. Prevention of wound contamination using DuraPrep solution plus Ioban 2 drapes. Clin Orthop Relat Res. 2005;439:32-7.

RLO at MUSC

Chlorhexidine shower at home

Pre-prep done in holding (Betadine)

If needed, clippers used in OR

Chlorhexidine/Alcohol pre-prep at time of "time-out"

Chlorhexidine/Alcohol entire extremity by scrubbed, gloved, ungowned surgeon

Start at surgical site and work outward

"No touch" skin technique

Iodine impregnated occlusive drape to seal skin and cloth drape together.

Airborne bacteria

Room traffic / doors
Blocks in Holding
Open equipment
Shedding
- Outside scrubs
- Body exhaust
- Boots
- Beards and hair

Airflow
UV lights
OR time
Scheduling / Turnover cleaning

Intraoperative bacterial contamination in operations for joint replacement

N. Davis, A. Curry, A. K. Gambhir, H. Panigrahi, C. R. C. Walker, E. G. L. Wilkins, M. A. Worsley, P. R. Kay

From the Bone Infection Group, University of Manchester, North Manchester General Hospital, Manchester, England

- Samples from 100 primary THA and TKA
- 63% overall contamination rate
  - 11.4% suction tips
  - 14.5% light handles
  - 9.4% skin blades
  - 3.2% inside blades
  - 28.7% prep gloves – "Over-gloves should be used during the preparation and changed before application of an adhesive plastic drape."
  - 17% surgical gowns
  - 10% fascia suture needles – "implying that these cases are deeply contaminated"
- 76% Coag negative staph.
- Only 1 deep infection – not with contaminating organism

Surgical Issues – OR Environment

Decreased circulating CFUs and incidence of infection with:
- Laminar Flow – 90% reduction
- UV light
- High-volume air exchange
- Eliminating open doors / traffic
- Synthetic gowns
- Eliminating open implants > 2 hours
- Reducing OR time

Ears and beards shed most bacteria
Men shed more than women

Surgical Issues – Room Traffic

Positive correlations with

- Number of residents present
- Proximity of door to OR equipment
- Number of times door opened
- Laterality of TKA's (proximity to door)

Body Exhaust Suits

Mostly personal protection

Variable data

Not sterile

- CORR 469:11, 2011
- 22% + culture at time 0
- 47% + at end of procedure
- 43% CNS, S. Aureus, and MRSA
- "change gloves if the PPS is touched or adjusted during the procedure."

RLO at MUSC

Blocks done in holding

Vertical laminar flow rooms with high exchange and HEPA filters

No UV lights

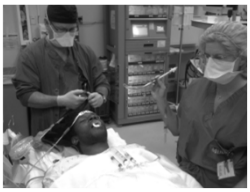
No forced air warmers until after fully draped

Body exhaust suits, tucked in tops, boot covers, synthetic gowns, covered hair and beards

All traffic from sterile corridor (minimize)

Instruments not opened before patient arrival

Keep traffic away from sterile areas!



Instrument contamination

Wrapping / containerization
Flash sterilization
Skin knife
Wash basin
Light handles
Double and re-gloving

Surgical Issues – Flash Sterilization

Should be used only for dropped instruments or emergency situations

Avoidance requires accurate posting, timely delivery of loaner sets, adequate on hand supplies, and minimal set contamination (wrap holes, filter issues, bioburden)

Splash Basins

J of Infection 52:231-232, 2006

21 TJA cases, laminar flow, 24h abx.

Cultured 100ml fluid from basin at end of case.

5 (23.8%) positive cultures

- CNS, Pseudomonas, Neisseria, etc.

No clinical infections

"This study emphasizes that the orthopaedic community should stop using the splash basin since it increases the risk of wound contamination. We suggest that the surgical instruments should be left on the main instrument trolley until the end of surgery. It also underlines the importance of adhering to rigorous protocol in theatre management and the need for continued vigilance in the prevention of implant related infection."

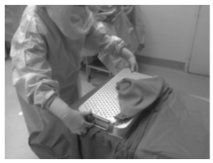
RLO at MUSC

Struggled with SPD issues for years
- Worse with off-site processing
- High incidence of contaminated trays (noticed before use)
- Education, improved wrapping, containerization, padded corners

No wash basins

Skin knife

Double glove and change after draping, before implants, and hourly



Host contamination

Pulse lavage
Antibiotic cement
Antibiotic suture
Systemic antibiotics

Pulse lavage

Hargrove, et al. J Hosp Infection, 2006
356 Hemiarthroplasties with 2L NS washout
Jug / syringe – 15.6% infection (5.2% deep)
Pulse lavage – 5.6% infection (1.8% deep)

"The use of pulse lavage has never been shown to reduce infection rates in total joint replacement. The quoted infection rate for total hip replacements is 0.5–1.5%. If the use of pulse lavage reduced a quoted 1% infection rate to 0.5%, a prospective study of over 30,000 hips would be necessary to prove its success."

Antibiotic Cement

Negligible reduction in fatigue strength
Costs about $300 more per batch than plain
Numerous studies support use in high-risk population and revisions
Chiu JBJS 2009
- Vancomycin cement for 183 revision TKA without "clean-air"
- 7% in plain cement versus 0% in ALBC (P=0.013)

FDA-approved for revision after infection
Questionable benefit in routine primaries
Gandhi, et al JOA 2009
- 1625 patients with primary TKA
  - 2.2% ABLC vs. 3.1% Plain (not sig)

Jiranek WA, et al JBJS 2006.
- Would require reduction in rate of infection from 1.5% to 0.3% to be cost effective.
- An increase in usage in the US to 50% would cost $117 Million

RLO at MUSC

Pulse lavage with bacitracin and polymyxin saline (not for all MD's)
Betadine irrigation
Irrisept (Chlorhexadine)
Antibiotic cement in high-risk TKA's

Surgical Issues - Drains

Higher incidence of retrograde bacterial contamination with conduit drains versus suction drains.
High incidence of contamination beyond 24 hours
No difference in infection rates
More bruising & wound drainage w/o drains, but more transfusions with
No clear advantage in using drains in TJA

Perioperative Issues – Urinary Catheters

UTI's are most frequent nosocomial infections
0.5 – 20% risk of UTI with single catheterization
8 – 30% transient bacteremia with catheterization
Urinary retention common in TJA patients
Up to 48 hours is equivalent to intermittent catheterization
26% of patients develop UTI after 48 hours of catheterization
JBJS 1976 Donovan, et al

- 359 retrospective and 100 prospective patients on cephalosporin
- 8X more likely to develop UTI if catheter present
- Most caused by Pseudomonas or Enterobacter
- 1 had acute hematogenous infection of TJA from UTI

RLO at MUSC

Foley (if used) removed POD 1
Drain for some TKA's, removed within 24 hours
Staples for most wounds
Impervious Aquacel dressing
Dressing change POD7

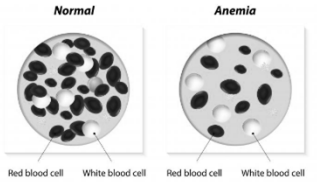
I don't want a transfusion.
I want my relative to give blood for me.
I want to predonate my own blood.

ABLA

stands for

Acute Blood Loss Anemia

Abbreviations.com



Risks of Blood Transfusions

JAAOS 2002 Keating and Meding

Viral infection
- HIV 1:1,000,000
- HBV 1:100,000
- HCV 1:500 to 1:5,000
- HTLV I and II 1:200,000
- CMV and bacterial contamination Varies; 1:2,500

Transfusion reaction
- Fatal hemolytic reaction <1:600,000
- Nonfatal hemolytic reaction 1:6,000
- Fever or urticaria 1:100
- Allergic reaction 1:100
- Graft-versus-host disease Rare

Alloimmunization Common

Immunosuppression
- Infection Increased after surgery
- Cancer Inconclusive

Blood Transfusions and Postoperative Infections in Patients Undergoing Elective Surgery

Surgical Infections 2006;7:S33-35

Transfusion was single most powerful risk factor for infection in 2809 colorectal resections (OR=5.3 to 6.2)

Primary THA and TKA have 12x risk of infection if allogeneic transfusion

Explored evidence behind WBC mediated immunosuppression, free serum iron, storage time, metalloproteinase-1.

Intraoperative Hemostasis

Acute Normovolemic Hemodilution
Tourniquet
Hypotensive Anesthesia
Regional anesthesia
Avoidance of hypothermia
Blood salvage / Cell Saver
Good hemostatic technique
Bipolar Sealer (Aquamantys)
Topical hemostatic agents
Intravenous antifibrinolytics

Tranexamic and Aminocarpoic Acid

Lysine analogues
Inhibit binding of lysine residues on fibrin to plasmin or plasminogen
Prevent fibrinolysis (more significant with tourniquet)
Inhibit clot breakdown
Do not affect coagulation

INDICATIONS AND USAGE

- CYKLOKAPRON Injection is indicated in patients with hemophilia for short-term use (two to eight days) to reduce or prevent hemorrhage and reduce the need for replacement therapy during and following tooth extraction.

CONTRAINDICATIONS CYKLOKAPRON

- Injection is contraindicated:
  - 1. In patients with acquired defective color vision, since this prohibits measuring one endpoint that should be followed as a measure of toxicity (see WARNINGS).
  - 2. In patients with subarachnoid hemorrhage. Anecdotal experience indicates that cerebral edema and cerebral infarction may be caused by CYKLOKAPRON in such patients.
  - 3. In patients with active intravascular clotting.
  - 4. In patients with hypersensitivity to tranexamic acid or any of the ingredients.

MUSC Tranexamic Acid Protocol

- All Primary and Revision THA, TKA, TSA
- 20mg/Kg IV TXA with maximum of 2g
- All patients except thromboembolic disease within 6 months
- THA and TSA – Administer before scrubbing
- TKA administer when inserting implants, or before tourniquet deflation

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Primary Arthroplasty

Process Improvement Project Using Tranexamic Acid Is Cost-Effective in Reducing Blood Loss and Transfusions After Total Hip and Total Knee Arthroplasty

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cost saving
quality improvement
surgical blood loss

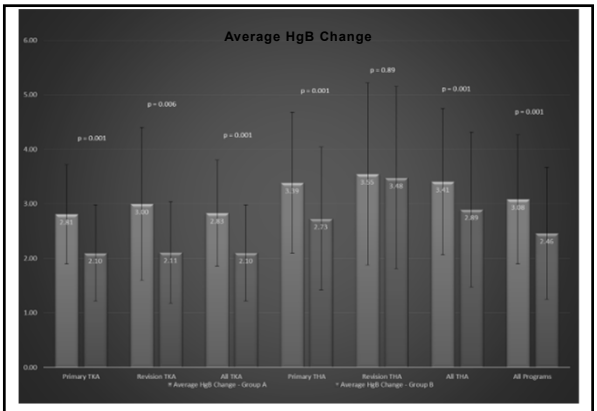
ABSTRACT

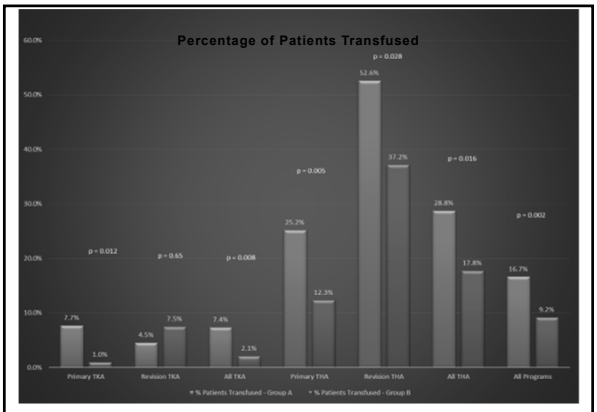
Background: Tranexamic acid (TXA) has been associated with decreased blood loss and transfusion after total hip arthroplasty (THA) and total knee arthroplasty (TKA). The purpose of this study was to examine both transfusion utilization and the economic impact of a Process Improvement Project implementing TXA for THA and TKA.

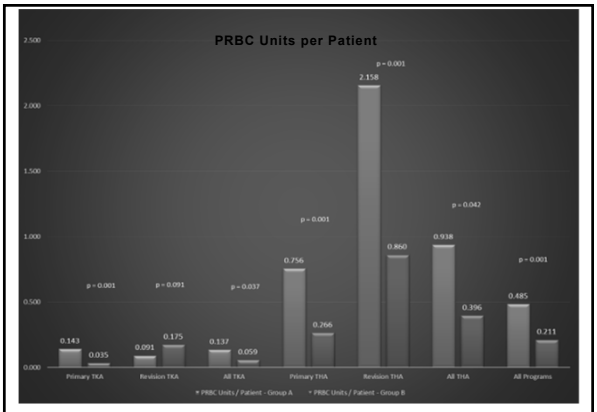
Methods: After standardization of TXA administration in THA and TKA patients, retrospective data were compared from 12 consecutive months before (group A, n = 336 procedures) and after (group B, n = 436 procedures) project initiation.

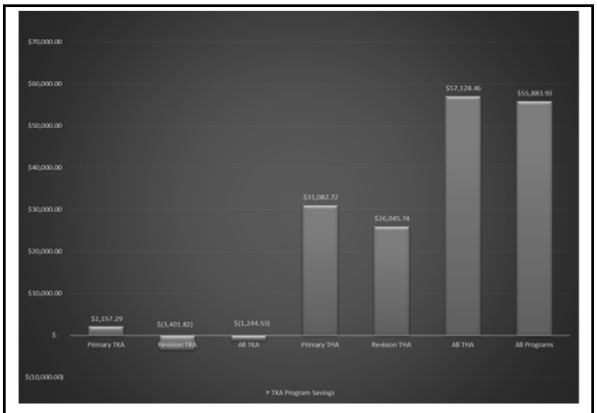
Results: TXA administration increased with project implementation (group A = 3.57%, group B = 86.01%) and was associated with reductions in perioperative hemoglobin decrement (20.2%), patients transfused (45%), and number of units transfused per patient (61.9%). Cost savings were notable per patient ($128) and annually program wide ($55,884) with the primary THA subgroup contributing the most to the savings. No increase in adverse effects was observed.

Conclusion: Standardized administration of TXA is an effective and economically favorable blood-reduction strategy for patients undergoing elective THA or TKA. Although reduction in transfusions with TXA may be greater after TKA, the economic and clinical impact of transfusion reduction is more substantial in THA patients.




Percentage of Patients Transfused
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
p = 0.012
p = 0.65
p = 0.008
p = 0.005
p = 0.028
p = 0.016
p = 0.002
7.7%
1.0%
4.5%
7.5%
7.4%
2.1%
25.7%
12.3%
52.6%
37.2%
28.8%
17.8%
16.7%
9.2%
Primary TKA
Revision TKA
All TKA
Primary THA
Revision THA
All THA
All Programs
% Patients Transfused - Group A
% Patients Transfused - Group B


PRBC Units per Patient
2.500
2.000
1.500
1.000
0.500
0.000
p = 0.001
p = 0.091
p = 0.037
p = 0.001
p = 0.001
p = 0.042
p = 0.001
0.143
0.035
0.091
0.175
0.137
0.059
0.756
0.266
2.158
0.860
0.938
0.396
0.485
0.211
Primary TKA
Revision TKA
All TKA
Primary THA
Revision THA
All THA
All Programs
PRBC Units / Patient - Group A
PRBC Units / Patient - Group B


$70,000.00
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$(10,000.00)
$2,157.29
$(3,401.82)
$(1,244.53)
$31,082.72
$26,045.74
$57,124.46
$55,883.93
Primary TKA
Revision TKA
All TKA
Primary THA
Revision THA
All THA
All Programs
TXA Program Savings

TXA Protocol Summary

- A multidisciplinary Process Improvement Project with a standardized approach to using tranexamic acid resulted in greatly increased the use of this blood management strategy.
- This resulted in significantly decreased blood loss and need for transfusion in total joint patients.
- 72% reduction of transfusions in TKA patients
- Largest cost savings in THA patients
- There were no resultant significant increases in complications or readmissions.
- Patients receiving TXA prior to the protocol had a higher complication rate than those receiving TXA after the protocol (16.67% vs. 3.2%; p=0.014).
- Value was created by both increasing Quality and decreasing Costs with a program cost savings of $55,884.
- Creates further opportunities for cost savings (decreased pre-op crossmatching, decreased blood draws, etc).

"My friend had an arthroscopic knee replacement and went home the same day.
He only missed one day from work."

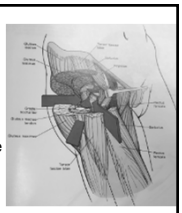

Minimally Invasive Total Knee Replacement Surgery Patients Go Home Same Day

"outpatient total knee replacement through arthroscopy was safe with no short-term readmission or complications related to early discharge. New clinical guidelines, including improvements in anesthetic techniques, postoperative pain management, and rehabilitation protocols, will make performing outpatient total knee arthroscopy a realistic goal."

Minimally Invasive Surgery

- A smaller skin incision does not mean the surgery is less invasive.
- Benefits mostly cosmetic.
- Possibly a slightly decreased recovery time.
- Higher risk of complications for some techniques.
- Do the operation, using proven techniques, through the smallest possible incision that allows proper placement of the implants and the best long term outcome.

Hip Approaches



- Posterolateral
  - Common, well-known, good femoral exposure
  - Highest dislocation rate (posterior)
- Direct lateral (transgluteal)
  - Lowest dislocation rate, good acetabular exposure
  - Highest rate of abductor dysfunction
- Direct anterior
  - Internervous plane (Sartorius and Tensor), marketable, Good acetabular exposure.
  - Difficult femoral exposure, long learning curve, specialized table / flouro, complications

Post Operative Management

Optimal Length of Stay
Pain Management
DVT Prevention
Physical Therapy
Expectation Management

MUSC Medical University of South Carolina

Optimal Length of Stay Following Total Joint Arthroplasty to Reduce Readmission Rates

Patricia A. Kirkland[1], William R. Barfield[1], Harry A. Demos[1], Vincent D. Pellegrini, Jr.[1], Jacob M. Drew[2]
[1]Department of Orthopaedics, Medical University of South Carolina
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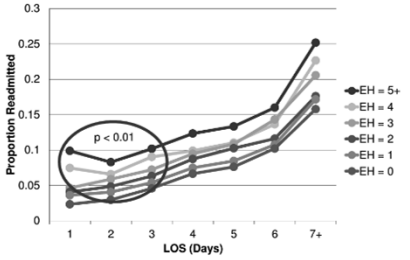
Figure 2. Chance of Readmission for Specific EH and LOS



Home, Not "Rehab"

Subacute rehab associated with
- Higher costs
- Lower patient satisfaction
- Decreased mobilization
- Slower recovery
- Higher readmission and complication rates
- Worse Patient Reported Outcomes

Reserved for patients with no support system who do not meet PT goals for functional independence

Make sure they understand that it is a "nursing home".

Pain Management

Spinal Anesthesia
Regional Nerve Blocks
- Adductor canal for TKA
- Lumbar plexus for THA

Cryotherapy
Multi-modal pain management
- NSAIDS (Celecoxib) 400mg in holding, 200mg BID (except CRI)
- Acetaminophen 650mg QID (except liver disease)
- Gabapentin 300mg TID (start in holding) if < 80 years old
- Oxycodone / Hydrocodone / Tramadol PRN
- Rarely use IV Opioids

Local blocks
- Bupivacane, Epinephrine, Clonidine, Morphine, Ketorolac, Cortocosteroids

Opioid reduction (Rx #30-40) Most are finished or on Tramadol by 2 weeks

DVT Prevention

Historical DVT rate 40-50% with 3-6% Fatal PE
Symptomatic DVT: 0.5% of THA, 1% TKA
Symptomatic PE: 0.14% of THA, 0.27% of TKA
Mostly after discharge
Prophylaxis is Standard of Care
- Mechanical (SCD, Foot Pumps)
  - Compliance dependent
- Warfarin – Anti Vitamin K (Factors II, VII, IX, X)
- Aspirin – Anti-platelet, anti-inflammatory
- Heparinoids (LMWH) – Anti-III Binding
- Anti Xa (Rivaroxaban), Anti IIa (Dabigatran)

PE Prevention after hiP and kneE Replacement
PCORI Multicenter Clinical Trial of 25,000 patients at 25 centers
Aspirin / Warfarin / Rivaroxaban for 28 days
Clinical endpoint: Mortality, VTE, bleeding, reoperation, functional outcomes
No differences so far….
Mortality 16/7000 (0.23%)

PT Protocols

Same day ambulation
Bed exercises
Independent OOB and ambulation, stairs prior to D/C
WBAT with walker → cane by 2 weeks
Limited home PT
Transition to outpatient PT ASAP (TKA)
Limited hip precautions (THA)
- Pillow between legs
- No extremes of rotation
- No abduction against gravity

Same Day Discharge Hip, Knee, Shoulder Arthroplasty Patient Selection Pre-op Clinic Guidelines

- All Patients must go through Pre-op Clinic and Pre- op Optimization Protocol :
  - Patient meets accepted Pre-op Risk Stratification (may include Outpatient Arthroplasty Risk Assessment/OARA Score)
    - assessed in outpatient clinic by surgeon at time of discussion with patient
    - assessed in pre-op TJR clinic
  - Patient meets pre-op optimization parameters: no smoking, adequate nutrition, etc.
- These patients will be screened to participate in the PePPER Trial, unless otherwise indicated by surgeon (Hip/Knee)
- Patient agrees to discharge to home, per discussion with surgeon
- Verified home support for the first few post-op days
- Patient must ambulate independently without use of an assistive device
- Local patients only: Patient must live within 1-1.5 hour travel time to home at discharge
- Patient must have DME arranged Pre- Admission
- Home Health services will be set up to start morning of POD 1 (day after discharge) as needed
  - Physical Therapy- establish goals, exercises per protocols, wound check, home safety
  - For patients identified as able to start with outpatient PT, this will be arranged as requested

Same Day Discharge Hip, Knee, Shoulder Arthroplasty Patient Selection Pre-op Clinic Guidelines

Medical Exclusions

- No age limit if patient medically healthy, motivated, caregiver home support
- ASA 3 classification- if poorly controlled underlying condition
- Bleeding disorders
- Pre-op Hemoglobin less than 12
- Poorly controlled /severe cardiac or pulmonary comorbidities (i.e.: heart failure, history of MI within 1 year, dysrhythmia, CHF, CAD, COPD, hx respiratory failure)
- CKD- consider function
- IF CKD 3a mild to moderate w/ GFR 55-60 may be appropriate for SDD
- Cirrhosis
- Uncontrolled DM Type I or Type II
- OSA w/ history of poor compliance
- BMI >40 should be considered if otherwise healthy
- Chronic opioid use
- Functional neurologic impairments
- Dependent functional status
- Reduced Pre-op cognitive capacity, history of post op delirium
- Urologic medical history/History urinary retention
- History of inadequate pain control

Residual Pain after TKA

- 75-80% of patients are satisfied or very satisfied with their TKA
- Very few report that their knee is “normal”
  - Unlike THA patients
- Residual pain, stiffness, swelling are most common complaints
- Some report “stiffness”, despite excellent ROM
- Expectation management is critical

Summary

What matters most

- Patient motivation
- Surgeon experience
- Implants and bearings
- Hospital volume
- Pain management
- Appropriate prevention and management of complications
- Rehab / return to function

What matters less

- Patient age
- Consumer advertising
- Smaller incisions
- Computer navigation and robotics (?)
- Rapid discharge (?)