Total Hip Arthroplasty

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09.23.2016
Disclosure Statement of Unapproved/Investigative Use

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Topics

- Presentation - symptoms
- Physical Examination
- Investigations - x-rays
- Treatment options
- Non operative
- Operative
- Follow up
- Complications /Dealing with complications
- Hot topics
Presentation

- Pain - groin, thigh, knee
- Stiffness - shoe and sock
- Limp
- Loss of balance
- Weakness
- Differential diagnosis
  Lumbar spine - degenerate disc disease
  Knee arthritis
  Inguinal / femoral hernia
<table>
<thead>
<tr>
<th></th>
<th>Joint reaction force at just after heel strike</th>
<th>Joint reaction force just before toe off</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td>4 x body weight</td>
<td>7 x body weight</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>2.5 x body weight</td>
<td>4 x body weight</td>
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</tbody>
</table>
Examination

* Gait – Antalgic, Trendelenburg gait
* Heel toe gait
* Range of motion – sitting, supine
* Skin
* Tenderness
* Iliopsoas irritation/ Trochanter irritation
* Limb length discrepancy ~ 2.5 cm
* Neurological function
* Vascular status
JOHN J. WILSON, MD, MS, and MASARU FURUKAWA, MD, MS, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin

Am Fam Physician. 2014 Jan 1;89(1):27-34
Radiological Investigations

X-rays
*
- AP pelvis
*
- Dedicated right of left hip
*
- Cross table lateral
*
- Judet views-45 degree oblique view
*
- Full length / alignment

Bone scan

DEXA scan
X-rays
Treatment

Non operative

- Weight loss - BMI less than 40
- Use of assistive device - opposite side
- Over the counter medications - N SAID's, Acetaminophen
- Physical therapy
- Intra-articular steroid injections - Repeat 3 months as necessary
- Education
Intra-articular hip injection

- Evidence for the use of intra-articular cortisone or hyaluronic acid injection in the hip?
- 25 articles pertaining to efficacy of corticosteroid, 22 of HA (Hyaluronic Acid) and 4 of PRP (Platelet Rich Plasma)
- Ultrasound and fluoroscopy improves the precision of intra-articular positioning of diagnostic injections
- Corticosteroids are more effective than HA and PRP in alleviating pain from hip OA

J Hip Preserv Surg. 2015 Mar 31;3(1):5-15
IASHI / Intra-articular steroid hip injection

- Intraarticular cortisone injection for osteoarthritis of the hip. Is it effective? Is it safe?

- Eight trials with 4 randomized studies in the literature- short term benefit was noted in patients refractory to pain medications


- Medical database/ Cochrane Database – May 2015

- Hip IASI may be efficacious in short-term pain reduction in those with hip OA though the quality of the evidence was relatively poor

IASHI / Intra-articular steroid hip injection

- Intraarticular cortisone injection for osteoarthritis of the hip. Is it effective? Is it safe?

- Eight trials with 4 randomized studies in the literature - short term benefit was noted in patients refractory to pain medications


- Is the infection rate in primary THA increased after steroid injection?

- 175 patients received injection, were matched with similar group who received no injection within 1 yr of total hip arthroplasty. No increased risk of superficial or deep infection

Surgery

★ Hip Arthroscopic debridement
★ Hip Fusion
★ Girdlestone / Resection Arthroplasty
★ Hip Resurfacing
★ Total Hip arthroplasty
History

* 1946 - Judet prosthesis

* 1951 - McKee & Farrar metal-on-metal replacement

* 1952 - Thompson hemiarthroplasty
Sir John Charnley (1916-1982)

- 1962: Low Friction Arthroplasty

  Heard the “squeak” of a Judet prosthesis: friction

- UHMWPe
- Stainless steel head 22.225mm
Modern developments

* Biomaterials
* Metal Alloys, Ceramic (Huber, 1970), Polymers
* Cementless fixation - porous coating (Cameron, Macnab, Pilliar, 1973)
* Cementing techniques - PMMA (Poly methyl methacrylate)
* Modular components
* Instrumentation/Technique
* Re-surfacing hip replacements?
* Metal-on-metal in again/and out
What does a surgeon consider when selecting an implant for their patient?

Patient Factors
- Age
- Bone Quality (Type A, B or C Femurs)
- Activity Level
- Weight - BMI < 40
- Current Health Status
- Bone/Soft Tissue Deformities
- Cost (Patient Demand Matching/Hospital Contracts)
Total Hip Arthroplasty

Dorr Type A - Champagne

Dorr Type B - Tapered

Dorr Type C - Stove Pipe
Total Hip Arthroplasty

Charnley Design

Ling Design
"Basic Cemented Stem Technique"

Cement + another material - can fail/ Embolus/ Hypotension

- Broaching
- Plug Canal
- Cement Insertion
- Stem Insertion

Be Aware of drop in blood pressure. Resuscitation!!
Advances

* Canal preparation
* Cement restrictor
* Pulse lavage
* Vacuum mixing
* Cement gun (1971)
* Pressurisation
Total Hip Arthroplasty

Proximally Porous Coated

Fit and Fill

Fracture - female
“Basic Proximally Coated Surgical Technique”

- Tapered Femoral Reaming
- Broaching
- Stem Insertion
Total Hip Arthroplasty

Mueller (Wedge Design) - Tri-lock

Minimally invasive

Bone preserving

Difficult for type A bone
Bone -Conserving Stems
Lateral Flare Design

4.2 y 96-99%

Khanuja H, Mont M et al JBJS (Am) 2014;96: 1742-52
Bone -Conserving Stems- Short Conventional

Khanuja H, Mont M et al JBJS (Am) 2014;96: 1742-52
Porous/HA Coated Acetabular Shells (No-Hole, Tri-Spike, 3-Hole, Multi Hole, and Revision)
Bearing Wear Cycles (microns per one million cycles)

- Metal head on cross-linked poly 4.2 microns per year
- Ceramic head on Cross-linked poly 2.8 microns per year
- Metal on Metal 2.5 microns per year
- Ceramic on Ceramic < 1 micron per year

(3rd generation zirconia/alumina composite 2004 (Biolox delta)-74% alumina and 25% zirconia)
Randomized clinical trial that compares, in a young population - **MOP Vs COC**

140 (116 patients) - 12.3 (9-15) years.

At final FU, 107 hips were available for clinical evaluation.

Eight (11.6%) revisions were performed in the polyethylene group versus 1 (1.4%) in the ceramic group (p = 0.017).

Mean annual polyethylene wear was 0.19mm/year; wear was not measurable in the ceramic group.

Results MOP Vs COP

- The mean wear rates for the ceramic group and the metal group were $0.086 \pm 0.05 \text{ mm/yr}$ and $0.137 \pm 0.05 \text{ mm/yr}$, respectively ($p = 0.0015$) in matched pair young patient (avg. age 55 y) at 17 years (15-25)

- One reoperation in the ceramic group for distal femoral osteolysis, 3 in the metal group - 2 liner exchange, 1 acetabular component rv.

50 CUP + 4 liner, # 7 Std offset stem, +5 head, NC 13mm
AP pelvis - 28 yo male
MRI
Post op 6 months
Complex primary - 59 yo male
Complex primary - 59 yo male

BE PREPARED FOR MORE OPERATIVE TIME AND ACETABULAR RECONSTRUCTION, LIMB LENGTH DISCREPANCY, NERVE INJURY
Pre op Planning
Post Op
54 yo female
Pre op planning
6 months post op
5 1/2 month post op
67 yo male
CT recon images
CT recon images
7 months post op
7 months post op
Total hip for fractures

- Eight trials totalling 986 patients were retrieved. After THA 4% underwent revision surgery versus 7% after HA. The one-year mortality was equal in both groups: 13% (THA) versus 15% (HA). Equal rates were found for major (25% in THA versus 24% in HA) and minor complications (13% THA versus 14% HA).

- Dislocation rates were 9% after THA versus 3% after HA.

## Mini Posterior Vs Direct Anterior

<table>
<thead>
<tr>
<th>Location &amp; length of incision</th>
<th>Muscle preservation</th>
<th>Risk of nerve damage</th>
<th>Risk of fracture</th>
<th>Risk of dislocation &amp; hip precautions</th>
<th>Good candidate</th>
<th>Length of surgery</th>
<th>Hospital stay</th>
<th>Postoperative complications</th>
<th>Return to sedentary work</th>
<th>Return to physical work</th>
<th>Return to sports (light/vigorous)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just behind the hip, along the outer buttock area 4–6 inches.</td>
<td>• The gluteus maximus • The piriformis and superior gemeli muscles (2 of 4 external rotators of the hip)</td>
<td>Very small risk to sciatic nerve.</td>
<td>Low risk of fracture due to easier exposure.</td>
<td>Low risk but may be as high as 9%. Dislocations are usually anterior and can occur with external rotation of the leg during any activity.</td>
<td>Majority of patients</td>
<td>60–90 minutes</td>
<td>2–3 days</td>
<td>Risk to normal structures, blood clots to legs or lungs, infection, death, anesthesia risks.</td>
<td>2 weeks</td>
<td>3 months</td>
<td>6 weeks/3 months</td>
</tr>
</tbody>
</table>
Post op management

- Aim for discharge ~ 2 day Vs Day surgery
- Mobilize as soon as able
- Pain control, Neurovascular checks
- Foleys catheter discontinued day 1 post surgery
- DVT prophylaxis – low molecular heparin/ aspirin/warfarin/mechanical compression
- Spirometry
- Fall and dislocation precautions
- Weight bearing – In general full weight bearing. Check instructions
- Follow up – 2 weeks, 4 weeks, 3 months, 6 months-9 months, annual
Complications

* Nerve injury - Sciatic (peroneal division) upto 3%
  - Stretch/ hematoma / direct/ idiopathic (40%)

* Fracture - intra op fracture with uncemented implants
  - 3.7.-4.9%


* Limb length discrepancy
  - 3-6 months wait
Limb Length Discrepancy

★ 19 % incidence of limb length discrepancy (LLD) > 10 mm, has been reported.


★ Up to 30 % of patients may perceive LLD but only about half are symptomatic

* 37 yo female
* Left THA in situ
  (previous hx of DDH & length equalization, left abductor mechanism reconstruction)
* Left LLD 3.1 cm
Final result
Osteolysis cascade
Total Hip Arthroplasty - R. Thakral, M.D.

54 yo male
9 months post op
Total Hip Arthroplasty

9 months post op
77 yo male
Intra op pictures
# Dislocation - Risk factors

<table>
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<tr>
<th>Patient factors</th>
<th>Surgical factors</th>
</tr>
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<tbody>
<tr>
<td>Gender - female</td>
<td>Approach used</td>
</tr>
<tr>
<td>Age</td>
<td>Soft tissue repair</td>
</tr>
<tr>
<td>Neurological disorders</td>
<td>Soft tissue tension</td>
</tr>
<tr>
<td>Cognitive function</td>
<td>Component position</td>
</tr>
<tr>
<td>Muscle weakness</td>
<td>Component size/ type</td>
</tr>
<tr>
<td>Prior hip related surgery</td>
<td>Impingement</td>
</tr>
<tr>
<td>Alcohol related causes</td>
<td>Experience of operating surgeon</td>
</tr>
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_Werner BC, Brown TB. Instability after total hip arthroplasty, World J Orthop 2012_

Dislocation rate - Direct lateral 0.55 %
- Transtrochanteric 1.27%
- Anterolateral 2.18%
- Posterior 3.23 %, 1.2-2.03 % with capsule repair
  - (DAA 1.2%)
50 yo female
Total Hip Arthroplasty - R. Thakral, M.D.
* Polyethylene liner
  * Augmentation
  * Constrained
Total Hip Arthroplasty - R. Thakral, M.D.
Infection
One stage vs Two stage

- In this retrospective study we assessed 82 consecutive patients who underwent two-stage revision for septic total hip (45 patients) or one-stage aseptic revision arthroplasty (37 patients).

- Overall survival in the aseptic group was 85.6% at 9.8 years, 82.7% at 10.1 years for the septic group, with a repeat revision rate of 8.1% and 6.7%, respectively.

57 yo female
Post op ~3 months
Peri-prosthetic fracture
2 weeks + s/p DAA THA
Computer assisted - Total Hip Arthroplasty
Total Hip Arthroplasty

- Computer Assisted Surgery
  - Hope to improve surgical outcomes by providing information to the surgeon that will allow for a more predictable placement of implants
  - Improve implant longevity (wear)
  - Improve leg length concerns
  - Improve dislocation rates
Total Hip Arthroplasty

* Computer Assisted Surgery
  * Pro’s
    * Improves placement of the Acetabular Cup (reduce dislocation)
    * Provides a reliable point of reference for surgeon
    * bone defects
    * deformities
  * Con’s
    * Cost
    * Learning Curve
Navigation Vs Conventional

- 20 cases in each group
- Mean anteversion of 17.4° in the navigated group and 14.5° in the control group (P=.215)
- Mean inclination of 41.7° and 42.2° (P=.633); a mean deviation from the desired anteversion (15°) of 5.5° and 6.6° (P=.429)
- The acetabular component position's tomography analyses were similar whether using the imageless navigation or performing it conventionally

Comparison of robotic-assisted and conventional acetabular cup placement in THA

- 160 THAs
- Sixty-two patients (38.8%) underwent THA using a conventional posterior approach, 69 (43.1%) underwent robotic-assisted THA using the posterior approach, and 29 (18.1%) underwent radiographic-guided anterior-approach THAs. From September 2008 to June 2011, all patients were offered anterior or posterior approaches regardless of BMI and anatomy.

- One hundred percent (50/50) of the robotic-assisted THAs were within the safe zone described by Lewinnek et al. compared with 80% (40/50) of the conventional THAs (p = 0.001).

Questions
Total Knee Arthroplasty

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- Investigations – x-rays
- Treatment options
- Non operative
- Operative
- Follow up
- Complications / Dealing with complications
Clinical Presentation

- Pain
- Deformity
- Stiffness
- Instability
- Swelling - inflammatory arthritis
- Mechanical symptoms - locking, giving way, intermittent swelling
Physical Examination

- Gait – heel to toe pattern, varus/valgus thrust
- Walking aid, shoe wear pattern
- Look for any swelling – baker’s cyst
- Tenderness – retropatellar, joint line
- Range of motion (0-135 degree) – extensor mechanism, active and passive ROM
- Special tests – Lachman (ACL), Posterior drawer (PCL), McMurray’s (meniscal pathology)
Surgical exposure

- Skin
- Deep
Clinical Exam

Radiological investigation

- AP
- Lateral
- Skyline/ Merchants/ Patellar view
- Others- obliques/ 45 deg. flexion

- MRI – no real role
- CT- planning for reconstruction/ fracture healing
Non operative treatment options

- Pain medications – OTC pain medication, NSAID’s
- Supplements – glucosamine / chondroitin sulphate
- Weight loss
- Physical therapy
- Brace – off loader
- Assist device / cane
- Injections- steroids/ viscosupplements / PRP/ bone marrow
Operative

- Arthroscopy - mechanical symptoms, loose body, unstable cartilage
- Osteotomy
- HTO
- Ideal candidate - < 50 y. Less deformity (< or = 10 varus, FFC 10 deg, ROM 90 flexion)
- Contraindications
  - Cruciate deficiency not contraindication
  - Inflammatory arthritis, deformity, varus thrust, more than 1 compartment arthritis.
AMSSM scientific statement concerning viscosupplementation injections for knee osteoarthritis: importance for individual patient outcomes

* All relevant articles from 1960 to August 2014
* Viscosupplementation injection (hyaluronic acid, HA) versus steroid (intra-articular corticosteroids, IAS) and placebo (intra-articular placebo, IAP)
* Those participants receiving HA were 15% and 11% more likely to respond to treatment by OMERACT-OARSI criteria than those receiving IAS or IAP, respectively (p<0.05 for both)

Does Timing of Previous Intra-Articular Steroid Injection Affect the Post-Operative Rate of Infection in Total Knee Arthroplasty?

- National Inpatient Sample database

- The incidence of infection within 3 months (2.6%, OR 2.0 [1.6-2.5], P < 0.0001) and 6 months (3.41%, OR 1.5 [1.2-1.8], P < 0.0001) after TKA within 3 months of knee injection was significantly higher than our control cohort

Operative

* HTO - CW - problems patella baja, loss post tibia slope
* - OW - collapse, non union
* Supracondylar

Contraindication - same, Valgus > 15 deg
Uni-compartmental arthritis

- The ideal patient - < 60, wt < 82 kg (< 6%)
- Cruciate intact
- AM joint arthritis, FFD < 10, varus <10, valgus <5, ARC of motion at least 90 deg. flexion
- Advantages - faster recovery, less blood loss, higher satisfaction rate, reduced LOS
- Type - mobile bearing (15 y 93%) vs fixed bearing (10 y 96%)
- Aim - correct varus deformity 1-5 degree
Uni-compartmental arthritis

* Complications:

  Stress fracture – tibia/ hemarthrosis
  Poly wear/ spin out
  Impingement pain – tibial spine / patella
PF joint arthritis

* Elderly - total joint
* Young- PF joint arthroplasty
* Restore Q angle
Total knee arthroplasty

- Indications
- Age - any
- Better results - > 70 y compared to < 50 y
TKA
Total knee arthroplasty

- Coronal balancing
- Release concave side
- Varus- osteophytes, deep MCL, PMC, capsule, semimembranosus
- Superficial MCL
- Posterior fibers- release if tight in extension
- Anterior fibers release if tight in flexion
Total knee arthroplasty

- Coronal balancing
- Release concave side
- Valgus - osteophytes, capsule
- Relase IT band if tight in extension
- Popliteus release if tight in flexion
- LCL - last
- Keep back up
Total Knee Arthroplasty

- Traditional
- Computer Assisted
- Robotic
Complex Knee

- Severe deformity > 15 - 20 degree
- Stiffness/Contractures/ ankylosed
- Extra- articular deformity / combination
- Prior hardware
- Geographic knee- multiple prior skin incisions
- Inflammatory arthropathy /advanced changes
- Neuromuscular condition- Charcot joint/ Parkinson’s disease
- Major bone loss due to arthritis or fracture
- Major deformity of the knee
- Compromised function of quadriceps
TKA- common surgical approaches

Alternate approach
Deformity

- Coronal $< 10^\circ$, Sagittal $> 20^\circ$ - Modified bone resection in the knee joint

- Coronal $> 10^\circ$, Sagittal $> 20^\circ$
  
  Staged - correction followed by TKA

  Single stage - prefer closing wedge/ORIF and TKA
Quadriiceps snip

- 45° medial to lateral
- Strength difference when compared to non operated knee no difference with TKA knee
- Recovers well


V-Y patella or quadriceps turn down

- Recovers
- 5-10° extension lag
- Tensioning – close in 30° flexion/ gravity drop – 90°


Tibial tubercle osteotomy

- 8 cm long, 2 cm wide
- Lateral hinge
- 23% complications rate - non-union to proximal migration, fractures, extension lag
- Secure with obliquely oriented wires/screws

Performance
Seventy-eight revision TKA patients were compared with 80 primary TKA patients.

Revision TKA showed 49% increased surgical time compared with primary TKA. Estimated blood loss was increased 91%. Increased complications.

Tibial and femoral bone loss was associated with increased surgical time as was use of longer stemmed tibial components.

Medicare reimbursement only averages a 29% increase from primary TKA.

51% increase in surgeon work effort was demonstrated, with an increased complication rate.

The authors postulate that revision TKA requires 51% and likely more effort.

K.J. Bunn et al. Quantifying and Predicting Surgeon Work Effort for Primary and Revision Total Knee Arthroplasty The Journal of Arthroplasty xxx (2016) 1e4
Implants

- PS (posterior stabilized) Knee
- Varus/Valgus stabilized knee with stems
  (Augments, Cones, sleeves)
- Rotating Hinge
- Segment replacement/Mega/Tumor prosthesis
• 61 yo active male
• Right tibia plateau ORI F in 2003
• Right knee stiffness and pain
• ROM 5-70, Varus 20 degree
Double deformity - from arthritis and fracture union
60 yo female
84 yo female
54 yo female BMI 57
Post op protocol different

* Use of brace - knee immobilizer/hinge brace
* Weight bearing status
Outcome of post traumatic arthritis

Authors identified 531 patients from joint database who underwent a TKA following a peri-articular fracture from 1990 to 2012; comparing outcomes to 19,641 patients undergoing primary TKA for osteoarthritis.

Post up follow up

- Continuous Passive Motion (CPM) vs No CPM
- Physical therapy ~ 6 weeks
- Mobilize as soon as able
- Antibiotics for 24 hours
- D/C Foley catheter / Drain ~ 24 hours
- Aim for discharge 2-3 days vs Day surgery
- DVT prophylaxis - low molecular weight heparin/ warfarin/ fondaparinux/ others - 14 days - 6 weeks
- Clinic visit- 2 weeks/ 4 weeks / 3 months/ 1 year/ annual
Complications

* Infection – superficial / deep
* Blood clots / Pulmonary embolus
* Stiffness/ arthrofibrosis- MUA 6 weeks – 3 months
* Neurovascular injury – tourniquet related, nerve injury (peroneal) – valgus knee
* Fracture
* Malalignment
* Continued residual pain
* Complex Regional Pain syndrome
Fall and fractures
Peri-prosthetic fracture
Questions