EVIDENCE-BASED EXAMINATION AND MANAGEMENT OF
JOINT ARTHROPLASTIES

Presented by C&M OrthoSports Inc
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Hosted by
Downstate Medical Center and the Brooklyn / Staten Island
District of the New York Physical Therapy Association

April 15, 2018

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EVIDENCE-BASED EXAMINATION AND MANAGEMENT OF HIP, AND KNEE JOINT ARTHROPLASTY

Sunday April 15th, 2018
Time: 9:00am-4:30pm

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Steve Caronia PT, DPT, OCS, COMT

DESCRIPTION:
This course will present a brief review of clinical anatomy and biomechanics of the hip, and knee. The main purpose will be to discuss the evidence-based features of the examination and management of individuals with hip and knee joint arthroplasty with emphasis on therapeutic exercises, and manual therapy interventions within a clinical reasoning framework. In addition, participants will gain insight into the potential complications following surgery, as well as the epidemiology of osteoarthritis and the indications and contra-indications to joint replacement.

TARGET AUDIENCE:
This course will be intended for physical therapists, physical therapist assistants, and students with varying years of clinical experience. The concepts and principles covered will benefit all participants and enable them to translate this information immediately into clinical practice.

INSTRUCTIONAL METHODS:
This course will use a combination of lecture, discussion, and lab activities of therapeutic exercises and manual therapy to facilitate learning and exchange of ideas, with an emphasis on clinical decision making in a variety of rehabilitation settings.

CONTACT HOURS:
All participants that attend the course will receive 8.4 contact hours towards their continuing education requirements in New York State.

OBJECTIVES:
Upon completion of this course participants will be able to:
1. Understand the relevant clinical anatomy of the hip and knee joints.
2. Understand the relevant biomechanics in open and closed kinetic chain of the hip, and knee joints.
3. Understand how abnormal anatomy and biomechanics can lead to clinical pathology.
4. Become independent in the examination of individuals following joint arthroplasty surgery
5. Become independent in recognizing complications following total joint arthroplasty and making appropriate referrals.
6. Incorporate appropriate therapeutic and manual therapy interventions with evidence-based guidelines where appropriate in the management of the patients with joint arthroplasties.
7. Be independent in understanding the rehabilitation guidelines for hip, and knee joint replacements based on tissue healing principles.
8. Understand outcomes related to joint replacements in the acute, subacute, and outpatient settings.

SCHEDULE:
Sunday April 15th, 2018 (9:00am-5:00pm)
9:00 – 10:00 Hip and Knee Anatomy and Biomechanics
10:00 – 10:45 Prevalence, Risks of Total Hip Arthroplasty, Surgical Techniques
10:45 – 11:00 Complications
11:00 – 12:00 Rehabilitation – Precautions, Pre-Operative, Post-Operative Care
12:00 – 1:00 Lunch
1:00 – 1:30 Prevalence, Risks of Total Knee Arthroplasty, Surgical Techniques
1:30 – 2:00 Complications
2:00 – 3:00 Rehabilitation – Acute Care, Subacute Care, Outpatient,
3:00 – 5:00 Lab Activities – manual therapy and motor control training

REFERENCES
**BONY ANATOMY** (Schuenke et al, 2016 Thieme Atlas of Anatomy)

- **Hip (Coxal) bone**
  - Ilium
  - Ischium
  - Pubis

- Ilium: ASIS, AIIS, PSIS, PIIS

- Ischium: ischial spine and tuberosity

- Pubis: inferior/superior pubic ramus, pubic tubercle

- Acetabulum
  - Cartilage, labrum

- **Femur**
  - Head, neck
    - Greater and lesser trochanters
    - Intertrochanteric line, crest
    - Linea aspera
    - Pectineal line
LIGAMENTOUS ANATOMY
- Iliofemoral ligament
  - AIIS to intertrochanteric line
  - Taught with hip extension and ER
- Ischiofemoral ligament
  - Ischium to greater trochanter
  - Taught with hip extension and IR
- Pubofemoral ligament
  - Acetabulum to pubic ramus
  - Taught with hip extension and AB

BLOOD SUPPLY
- Femoral artery
- Profunda femoral artery
- Medial and lateral circumflex femoral vessels

NERVE SUPPLY
- Femoral nerve
- Obturator nerve
- Superior gluteal nerve
TIBIOFEMORAL JOINT

- Stable
- Convex femoral condyles
- Concave tibial plateaus
- Stability
  - Passive
  - Active
- Condyloid joint

PASSIVE STABILITY

- Bony fit
- Capsule
- Menisci
- Ligaments
  - ACL
  - PCL
  - MCL
  - LCL
ACTIVE STABILITY

- **Anterior Thigh Muscles**
  - Iliopsoas
  - Rectus femoris
  - Vastus lateralis
  - Vastus medialis
  - Vastus intermedius
  - Sartorius
  - Tensor fascia latae
  - Pectineus

- **Medial Thigh Muscles**
  - Adductor longus
  - Adductor brevis
  - Adductor magnus
  - Gracilis
  - Obturator externus

- **Posterior Thigh Muscles**
  - Gluteus maximus
  - Gluteus medius
  - Gluteus minimus
  - Piriformis
  - Superior gemellus
  - Obturator internus
  - Inferior gemellus
  - Quadratus femoris
NEUROANATOMY

Lumbar Plexus
- L1-L4 ventral rami main nerve roots
- T12 inconsistent
- L5 inconsistent
- Iliohypogastric
- Ilioinguinal
- Genitofemoral
- Lateral femoral cutaneous
- Femoral
  - Saphenous
  - Obturator

Sacrococcygeal Plexus
- L4-S4
- Cluneal nerves
- Posterior femoral cutaneous
- Superior gluteal
- Inferior gluteal
- Nerve to obturator internus
- Nerve to quadratus femoris
- Sciatic
- Pudendal
INDICATIONS AND PREVALENCE OF HIP ARTHROPLASTY (CDC / AAOS, 2016)

- OA most common indication for THR
- Osteoarthritis is no longer considered a degenerative wear and tear disease, but rather complete joint failure with an inflammatory component (Ackerman et al, 2017, Berenbaum et al, 2013)
- More and more data are demonstrating OA affecting younger individuals, with hip OA prevalence increasing steadily with advancing age (Cross et al 2014)
- OA affects 13.9% adults 25yo or older
- OA affects 33.6% adults 65yo or older
- 26.9 million adults in the US with OA
- 2006 in the US
  - 231,000 primary THR
  - 251,000 hemi-THR
  - 38,000 revision THR
- 2030
  - 570,000 primary THR
  - 96,700 revision THR in the US
- Direct and indirect costs of OA are astronomical, and in a recent study in Australia, leaving the workforce early cost the system over 7 million dollars annually (Shofield at al, 2016)

PROGNOSTIC INDICATIONS FOR HIP ARTHROPLASTY

- Excellent outcomes: pain relief, improved joint mobility, function, patient satisfaction
- Pre-operative function dictates post-operative walking ability in primary and revision THR
- Older individuals > 70 have lower functional outcomes, longer acute care admission, and are more likely to be referred to an inpatient rehab facility
  

RISK ASSOCIATED HIP ARTHROPLASTY

- Mortality 0.15-2% THR; 2.4% hemi-THR; 0.87-2.6% revision surgery
- Greatest factors associated with adverse outcomes
  - Advanced age
  - Medical co-morbidities: CHF, CRF, DM
- Needing revision procedure (increase fracture)
  - 90% TKR last 10 years, many last 20 years
  - 97% hip resurfacing lasts 8-10 years
  - Rate of revision 3x higher younger males

SURGICAL TECHNIQUES

Total Hip Arthroplasty

- Most common hip surgery in adult population
- These patients will have most predictable post-op management
- Fixation
  - Cemented (acrylic)
    - Elderly
  - Noncemented (biologic fixation)
    - Younger, more active
- All femoral components metal stem inserted into medullary canal (longevity)
  - No single system better than others
  - Selection based on multitude of factors?
- Most cases cementless acetabular component is the device of choice
  - Cementless designs are porous over the entire surface that makes bony contact
  - Various methods of initial fixation, but all rely on ingrowth of bone for long-term stability
- Implant materials
  - Metal on polyethylene
    - Longest history of use because of minimal short-term complications
    - Prominent choice for less active individuals < 65yo
  - Ceramic on ceramic
    - Effectively resist wear
    - Used for younger, active patients
    - Higher incidence of squeaking and breaking
  - Metal on metal
    - Used for anterior approach and hip resurfacing
    - Younger, athletic population
    - Criticized for release of metal debris that can cause inflammation and osteolysis and lead to a revision procedure
    - Metal ions can be absorbed by a fetus and therefore are **NOT** an option for women of child-bearing age

Heislein, 2010; deSouza et al, 2012; Chen et al, 2013; Enseki et al, 2017
SURGICAL APPROACHES

Posterior approach
- Most common approach in US still
- Incision posterior aspect greater trochanter
- Detachment of short ER, incise posterior capsule
- Sparing of gluteus medius
- **Advantages:** technically easier, optimal intra-articular visualization
- **Major disadvantages:** higher rate hip dislocation, but meticulous repair of short ER and capsule has suggested decreased rates

Lateral approach
- Incision over the greater trochanter through gluteal fascia, ITB, insertion glut med to release glut min and gain capsular access
- **Advantages:** reduced risk of hip dislocation since no damage to short ER or post capsule, reduced injury to sciatic nerve
- **Major disadvantages:** abductor weakness, superior gluteal nerve

Anterior approach
- Between the TFL and sartorius
- **Advantages:** low rate of dislocation, less muscle disruption, no **FORMAL** hip precautions
- **Disadvantages:** technically difficult, MAY have hip extension limitations initially (neutral extension)

Anterior approach has been shown to have shorter LOS, and better outcomes at 3 and 6 month follow ups on the Hip Harris Score compared to a traditional posterior approach. (Sibia et al, 2016, Balasubramaniam et al, 2016.)
COMPLICATIONS

- Days/weeks
  - DVT or PE (Homan’s sign, Wells CPR)
  - Pulmonary/cardiac issues: atelectasis, pneumonia, orthostatic hypotension, anemia, arrhythmias, MI
  - Acute care PT: screening and prevention
    - Auscultation of the lungs, BP, HR
    - LE alignment checking for hip dislocation usually accompanied by increased pain
    - CPR for assessment of DVT

<table>
<thead>
<tr>
<th>Wells Criteria for Identifying DVT</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active cancer (within 6 months of diagnosis or palliative care)</td>
<td>1</td>
</tr>
<tr>
<td>Paralysis, paresis, or recent plaster immobilization of the LE</td>
<td>1</td>
</tr>
<tr>
<td>Recently bedridden &gt;3 days or major surgery within 4 weeks of application of CDR</td>
<td>1</td>
</tr>
<tr>
<td>Localized tenderness along distribution of deep venous system</td>
<td>1</td>
</tr>
<tr>
<td>Entire LE swelling</td>
<td>1</td>
</tr>
<tr>
<td>Calf swelling &gt;3cm compared with asymptomatic LE</td>
<td>1</td>
</tr>
<tr>
<td>Pitting edema (greater in the affected LE)</td>
<td>1</td>
</tr>
<tr>
<td>Collateral superficial veins (non-varicose)</td>
<td>1</td>
</tr>
<tr>
<td>Alternative diagnosis as likely or greater than that of DVT</td>
<td>-2</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
\leq 0 &= \text{ probability DVT } 3\% \ 	ext{95\%CI (1.7-5.9\%)} \\
1 \text{ or } 2 &= \text{ probability DVT } 17\% \ 	ext{95\%CI (12-23\%)} \\
\geq 3 &= \text{ probability DVT } 75\% \ 	ext{95\%CI (63-84\%)} 
\end{align*}
\]

Hip dislocation: related to surgical approach
- Hip precautions vary from surgeon to surgeon
- Consensus is 4-12 weeks
- Causes of dislocation with posterior approach
  - Bending forward while putting on shoes
  - Twisting the trunk sit/standing with feet planted
  - Rising from a low toilet with hip in ADD/IR position

Infection: staph aureus most common
COMPLICATIONS CONTINUED

- Most common long-term complication of THA is **implant failure** from instability and mechanical loosening
- **Aseptic loosening** accounts for 75% implant failures
  - Debris from polyethylene wear accumulates in the femoral-bone-cement interface causing an inflammatory process and ultimate osteolysis
  - **Ceramic** prevents this, brittle with high loads
  - **Hip resurfacing** can contribute to loosening
- **Weakness** can contribute to loosening
- **Younger age** and being **male** increase the risk for revision THA
  - Surgeons hesitant to recommend < 60yo

PREOPERATIVE REHABILITATION

- **Educational programs (1-2 weeks prior)**
  - Patients who fully understand post-operative expectations and clinical care protocols have demonstrated better coping strategies
- **Exercise programs**
  - Address impairments associated with OA
  - Exercise prior to surgery demonstrates improved strength and functional recovery more quickly
  - Overall evidence is inconclusive

ACUTE CARE REHABILITATION

- Average length of stay 2-3 days (Europe 1 day; at times same day)
- PT interventions begin either POD 0 or POD 1 (Masaracchio et al, 2017)
  - **Education**: THR precautions
  - **Functional training**: ambulation 100 feet; independent transfers, stair negotiation
  - **Therapeutic exercise** to improve motor control
- Important to document physiological status
  - Low hematocrit
  - Fever
  - Elevated anti-coagulation levels
  - Orthostatic hypotension

ACUTE CARE REHABILITATION CONTINUED

- **Therapeutic Exercise**
  - Quadriceps isometrics, heel slides
  - **SLR and gluteal isometrics should only be initiated if there are no WB restrictions since they create high contact pressures in the hip**
  - Progress to standing hip exercises when there is good postural control and FWB
**Quadriceps isometrics**
- Extremely important to initiate quad return
- Patients should be instructed to perform 100 reps a day
- Need to watch for substitution from the glutes
- Heel needs to be lifted off the table

**Quadriceps Progression**
- SAQ, SLR
- Patients should be instructed to perform 50 reps a day
- Ensure quad set first before SLR or SAQ
- Do **NOT** perform if there is an extension lag

**WB exercises when FWB permitted and adequate control**
- Patients should be instructed to perform 30 reps a day
- Sit to stand concentric/eccentric glute activation
ACUTE CARE REHABILITATION CONTINUED

- D/C to either inpatient facility or home?
  - Independent transfers (bed, chair, toilet)
  - Independent ambulation of at least 100 feet with AD
  - Independence in stair climbing
  - Adherence to hip dislocation and WB precautions
- Comprehensive Care Joint Replacement (CCJR)
  - Medicare 2016
  - Short-term rehab

SUBACUTE REHABILITATION

- Length of stay inpatient facility 7-10 days with D/C home occurring at POD 14
- Exercises can be increased with weights and bands
- Aerobic exercises are important to overcome deconditioning

OUTPATIENT REHABILITATION (Sizer et al, 2016)

- Goal: return to previous level of function
  - Improve muscle weakness
  - Improve postural stability
  - Normalize gait deviations
- Persistent weakness and/or altered motor patterns contribute to decreased balance, altered gait patterns, and fear of falling
- Outcome measures: HHS, WOMAC
  - Harris Hip Score (HHS)
    - Functional change and status following THA
    - Combines pain, functional capacity, deformity correction, and hip ROM are assessed and combined for a total of 100.
    - MCID 15-18 points for minimal improvement; > 39 moderate improvement (Singh et al, 2016)
  - Western Ontario McMaster Universities Osteoarthritis Index (WOMAC)
    - Pain, stiffness, and functional disability in hip and knee OA patients
    - 96 points is the highest indicating maximum disability
    - MCID 12-22% change following intervention (Cibulka et al, 2009)

C&M ORTHOSPORTS OUTPATIENT HIGH PRIORITY CHECKLIST

1. Hip extension ROM
2. Neuromuscular control of gluteal muscles
3. Lumbopelvic control
4. Balance and proprioception
5. Gait considerations

How long should all of this take?
Should the order matter?
Clinical reasoning?
Progression and sequencing within and between sessions?
GAINING HIP EXTENSION
- Essential for terminal stance of the gait cycle (at least 10 degrees), increasing step length, cadence, and overall efficiency
- Allows proper function of gluteal group
- Elongates anterior soft tissues
- Unloads the lumbar spine (anterior pelvic tilt/lower cross syndrome)

PSOAS RELEASE
- Add hip ROM, pelvic rocking during soft tissue mobilization
- Can perform soft tissue mobilization during stretch

JOINT MOBILITY ASSESSMENT
- Therapist position
- Patient position
- Clinical reasoning?
  - Grade?
  - Dosage?
- Goal of the mobilization

Lateral Glide
Posterior Glide
Anterior Glide

Anterior Glide
GLUTEAL NEUROMUSCULAR CONTROL

- Must overcome deleterious effects of surgical approach, longstanding deficits (i.e., from OA)
- Expect autogenic inhibition early after surgery
- Begin with simple exercises
- Patience is important – don’t assume exercises are too easy; don’t progress too quickly
- Enhance muscle recruitment

GLUTEAL ACTIVATION DURING THE GAIT CYCLE (Neumann, 2016)

GLUTEAL ACTIVATION DURING THE GAIT CYCLE (Neumann, 2016)

GLUTEAL NEUROMUSCULAR CONTROL

- Therapeutic exercises (Sets? Reps? Weight?)
  - Glute sets, supine or standing abduction
  - Side lying AB, bridging, and clam shells
  - CKC exercise as strength improves, no WB restrictions
  - Step ups, lunges, mini-squats
- Research demonstrates significant improvement in strength and stability 12-24 months after THR
  Unlu et al, 2007; Galea et al, 2008
THERAPEUTIC EXERCISES GLUTEUS MAXIMUS AND MEDIUS (Boren et al, 2011)

- EMG activity
  - Front plank hip extension: max: 106.22; med: 75.13
  - Side plank DL up: max: 72.87; med: 88.82
  - Side plank DL down: max: 70.96; med: 103.11
  - Single leg squat: max: 70.74; med: 82.86
LUMBOPELVIC CONTROL
- Improve lumbopelvic dissociation
- Improve lumbopelvic rhythm
- Start simple, progress accordingly
- Incorporate into functional activities
  - Supine/quadruped is a great way to teach abdominal hollowing/bracing and pelvic neutral, but it is not functional
  - Move to functional positions when the patient is independent in spinal neutral and maintaining transversus abdominus contraction without substitution
  - The addition of UE and LE movement patterns on a stable base will set the foundation for exercises sitting on a physioball, as well as standing with theraband
BALANCE / PROPRIOCEPTION
- Balance training is important to facilitate ambulation without AD
  - Begin bilateral activities
  - Progress to unilateral activities
  - Progress to unstable surfaces
  - Progress to multi-plane directions
- Gait training to increase symmetrical step length and stance time
- Leg length discrepancies? Maloney et al, 2004

GAIT CONSIDERATIONS
- Loss of gait speed
  - Normal 1.2-1.4m/s
  - < 1.0m/s require rehab
  - < 0.6m/s increase fall risk Beaulieu 2010, Ewen 2012
- Decreased stride length
- Decreased step length
- Hip abductor weakness
- Lateral trunk lean to involved side
- Decreased hip extension

SPORT PARTICIPATION RECOMMENDATIONS
- Permitted: golf, swimming, walking, stationary bike, dancing, elliptical, bowling, stationary skiing, treadmill, low-impact aerobics, speed walking, road bicycling, hiking, stair climber, doubles tennis, rowing, weight machines
- Permitted with experience: pilates, cross country skiing, weight-lifting, ice skating, roller blading, downhill skiing,
- Not permitted: baseball/softball, racquetball/handball, football, basketball, snowboarding, jogging, high impact aerobics, contact sports, singles tennis, martial arts Klein et al, 2007; Jacobs et al, 2009
OSTEOARTHRITIS KNEE

Prevalence
- Women > men
- > 50 years old
- 27 million Americans

Symptoms
- Pain with WB
- Morning stiffness < 30 minutes
- Diffuse tenderness

Systemic risk factors
- Age and sex
- Genetics
- Decreased estrogen levels
- Increased bone mineral density
- Obesity
- Acute injury
- Repetitive injury
- Joint deformity

Copstead, 2005; Arden et al, 2006; Lawerence et al, 2008; Murphy et al, 2008; Wong, 2010
PREVALENCE OF KNEE ARTHROPLASTY
- 516,000 TKAs 2006
- 3.48 million 2030
  - Increasing use of this surgery
  - Epidemic of obesity
  - Ageing population
- Knee OA and RA account for over 90% TKAs
  - OA 72.7%
  - RA 21.2%
- Revision rates < 1%/yr, at 10yrs 90% still functional

CRITERIA FOR CLASSIFICATION OF KNEE OSTEOARTHRITIS
- Age > 50 years old
- Knee crepitus
- Palpable bony enlargement
- Bony TTP
- Morning stiffness that improves in < 30min

TREATMENT
- Manual therapy and exercise combined
- Exercise
  - Hip, knee, OKC, CKC
- Gait training
  - Lack of TKE
- Hip mobilization
  - CPR for patients with knee OA likely to benefit from hip mobilization

OSTEOARTHRITIS TREATMENT
- Recommendations for nonsurgical OA Tx
  - Self-management education programs (B)
  - BMI > 25 encouraged lose weight (A)
  - Low impact aerobic fitness (A)
  - Quad strengthening (B)
  - Patellar taping (B)
  - Glucosamine not be Rx (A)
  - Meds (B)
  - Steroid injections (B)
  - Synvisc injections (B)
  - Against Arthroscopic lavage, debridement (A)
INDICATIONS/CONTRAINDICATIONS TKA
- Indications (no clear consensus)
  - Can no longer stand the pain (however higher levels of pain at time of surgery dictate poorer outcomes)
  - Radiographic severity not an indicator
- Contraindications (no clear consensus) Cross et al, 2006;
  - Major psychiatric disorder (dementia)
  - Poor soft tissue coverage
  - Infection
  - PVD
  - Poor motivation
  - Alcohol and drug abuse

PROGNOSTIC INDICATIONS/TIMING TKA
- Patients with more pain
- Lower self-reported function
- Lower scores on 6MWT, TUG, SCT Lavernia et al, 2009
- Other factors:
  - Female
  - Older age
  - Lower socioeconomic status
  - Co-morbidities
  - Depression
  - Poor pain coping strategies
  - Unrealistic expectations

TKA SURGERY OVERVIEW
- Techniques range from gold standard median parapatellar to the new minimally invasive computer-assisted TKA Froimson et al, 2007
- Goal of any TKA
  - Restore the mechanical axis of the TFJ through bony cuts, soft tissue mobilization, and ideal component implantation with proper patellar tracking
- All surgical approaches involve 3 steps
  - Skin incision
  - Arthrotomy
  - Mobilization of the extensor mechanism

COMMON SURGICAL APPROACHES
- Medial parapatellar
- Subvastus
- Midvastus
- Lateral
MEDIAL PARAPATELLAR  

**Advantages**
- Gold standard
- Familiar among surgeons
- Allows for adequate exposure and clear visualization of the joint
- Can be adapted for extensor mechanism mobilization by adding secondary incisions
- Protects neurovascular structures

**Disadvantages**
- Extensive incision through the quadriceps tendon
- Usually results in post-op quadriceps inhibition
- When combined with a lateral release (not common) has been associated with reports of patella AVN
- This approach detaches the vastus medialis from the remainder of the extensor mechanism, reducing blood flow to the patella

SURGICAL DETAILS
- Incision splits the quadriceps tendon
- A release of the rectus and vastus medialis from the patella
- Patella eversion (flipping)
- Correction of varus/valgus deformity
- Removal of menisci, ACL and any remaining osteophytes taken out
- PCL may or may not be spared
  - Very controversial (no long-term difference)
  - Based on surgeon’s comfort level currently
  - Posterior stabilized design, PCL is sacrificed and the function is replaced by a cam and post mechanism
  - **Better arthrokinematics, better ROM?** Verra et al, 2013; Nikolaou et al, 2014
- Place prosthesis and assess patella tracking

COMMON SURGICAL ELEMENTS  Bade et al, 2010
- Prepare the tibial and femoral surfaces
- Remove the menisci and ACL
- PCL may or may not be removed
- MCL/LCL are preserved
- Femoral component is metal
- Tibial component is metal
- Spacer on top of tibia is plastic
- Patella spacer
- Fixated with or without cement
  - WB restrictions
REVISION TOTAL KNEE ARTHROPLASTY

- Longevity TKA prosthesis depends on
  - Age
  - Gender
  - Type of implant
  - Type of fixation
  - Design of the patellar component

- 90% TKA 10 years; 78% 20 years

- Two primary reasons leading to revisions
  - Aseptic failure (82%)
    - Instability 28.9%
    - Tibial bone lysis 27.5%
    - Polyethylene wear 24.5%
    - Femoral bone lysis 22.5%
    - Tibial loosening 22.5%
  - Septic failure (18%)
    - Infection

- Symptoms: pain, decreased ROM, instability, swelling, paresthesias
- Biggest challenge bone loss

COMPLICATIONS

- DVT/PE
  - Most common reason readmission after TKA
  - Greatest week 1st week after surgery
  - Estimated annual incidence 67/100,00 in the general population
  - TKA population estimated incidence 36%
  - Incidence DVT in TKA 35.92%
  - Incidence of DVT in THA 23.23%
  - Symptomatic DVT THA 2.81%
  - Symptomatic DVT TKA 1.31%

- Symptoms
  - Pain, swelling, redness of the leg, dilation of the surface veins
  - Post-op DVT higher in women, all patients of increased age and BMI
  - 15% higher risk DVT every decade after 50; twice as likely for someone in their 80s versus the 60s
  - Common test clinically Homan’s test
  - Patients with a DVT have a positive test 8%-56%
  - Proximal DVT superficial femoral or popliteal vein more serious potential fatal PE
  - Signs and symptoms PE
  - Chest pain
  - Respiratory symptoms w/wo hemoptysis
  - Tachycardia
STIFF KNEE

- Definition? Varies widely
- Yercan et al
  - Flexion contracture equal to or > 10 degrees
  - Total arc of motion < 95 degrees
- Arthrofibrosis is used when both flexion and extension are limited secondary diffuse scar tissue
  - Incidence between 1-15%

- Pre-op predictors of knee stiffness
  - Soft tissue restrictions i.e., DM, lung disease, RA, smoking, pre-op ROM, h/o multiple surgeries
  - Mechanical contributions i.e., post-traumatic OA, previous high tibial osteotomy
  - Intra-operative i.e., errors in soft tissue balancing, wrong size implants, PCL mismanagement
  - Post-operative i.e. arthrofibrosis, infection, patient motivational issues, rehab, pain control

- Interventions for stiff knee
  - Intensive PT
  - Splinting
  - Injections
  - Closed manipulation (MUA)
  - Arthroscopic debridement (only after MUA fails)
  - Revision surgery (components fail)

- Pre-op ROM most important predictor post-op stiff knee
- Studies suggest favorable outcomes with pre-op PT before undergoing TKA
- Post-op PT plays crucial role in assessing a stiff knee early on (alert surgeon early 4 weeks)
- Conservative versus manipulation
  - Manipulation works best within 3mo surgery (first time most useful)
  - Late manipulation can be riskier with complications as quad and patella tendon rupture, femur fracture, and hematoma formation
  - More successful for flexion gains then extension gains
- Patients receiving intra-articular steroid injections showed better results
- Timing of MUA is variable in the literature
  - Does not gain 75° w/in 10 days
  - Or fails to progress with ROM w/in 2-3 months
  - < 90° knee flexion; > 15° flexion contracture; an arc < 70-80° w/in 6 weeks
- Previous research suggests patients manipulated w/in 3 weeks had an average ROM of 121° 1 yr post-op; compared to 112° for individuals manipulated 3 weeks-3 months

Yercan et al, 2006


INFECTION  
Moyad et al, 2008; Bozic et al, 2010; Kurtz et al, 2010
- Higher in TKA compared to THA due to decreased blood supply to the knee versus hip during surgery
- Most frequent reported reason for revision
- Revision surgery highest risk factor for infection
- Other factors
  - RA
  - DM
  - Obesity
  - Poor nutrition
  - Immunosuppressive medication
- Incidence deep infection 1-2% primary TKA
- Two-three times risk for revision surgery
- Infection in the Medicare population 1.55% incidence w/in 2 years and 0.46% incidence 2-10yrs post TKA
- Signs and symptoms infection:
  - Low grade fever
  - Night sweats
  - High skin temperature of the knee
  - Redness or drainage from incision with/without red streaks
  - Severe pain, swelling, malaise
- Delayed healing, hardening of the incision
- Infection diagnosed by combination
  - Symptom history
  - Objective examination
  - Blood analysis (ESR, C-reactive protein)
  - Radiographs
- Additional information may be gotten through joint aspiration and culture

PERIPHERAL NERVE INJURIES  
Yacub et al, 2009
- Rare after TKA
- Yacub et al studied the incidence of lower limb neuropathy w/in 90 days TKA in patients < 65 years old and established a 0.01% rate
- Nerve injury rates 10X higher in diabetics (0.11% versus 0.01%)
  - Most common nerve injury deep fibular nerve
EXTENSOR MECHANISM RUPTURE
- Quad tendon rupture after TKA rare 0.1%
  o Location usually patella tendon-tibial tubercle avulsion
- MOI: trauma or high loading end-range flexion
- Poor outcomes following repair in patients with TKA
- Serious complications and delays to rehabilitation

OUTCOME MEASURES
- WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index
- KOOS: Knee Injury and Osteoarthritis Outcome Score BEST for TKR
  o Pain subscale MDC 22.39
  o Stiffness subscale MDC 29.12
  o Physical function subscale MDC 13.11

FUNCTIONAL OUTCOMES

<table>
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<tr>
<th>AGE</th>
<th>SEX</th>
<th>MEAN 6MWT (m)</th>
<th>MEAN TUG (s)</th>
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<tr>
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</table>

REHABILITATION
- Purpose TKA surgery:
  o Pain relief and return of function
  o Rehabilitation should focus on these goals
  o Must restore ROM, muscle strength, gait, and functional activities
- Kennedy et al
  o Greatest improvement LEFS and 6MWT occurs in the first 12 weeks
  o Slower improvements weeks 12-26
  o No further improvement past 26 weeks
- Perioperative
  o 2000 inpatient stay average length 4 days
  o 1990 inpatient stay average length 9 days
- Primary pre-operative goals
  o Pain control
  o Education on restrictions
  o Safety with walking and stairs
  o Self-care and incision management
  o Understand home exercises
  o Meeting appropriate knee flexion milestones
OUTPATIENT REHABILITATION  
- Continuous passive motion (CPM): 2003 Cochrane Review stated short-term benefits from CPM and PT, but no long-term benefits
  - Denis et al newer study found no benefit with 2 hours CPM with PT on length of stay, active knee ROM in flexion or extension, TUG, or WOMAC scores
  - Lenssen et al, found no long-term differences again with the use of CPM in a group of patients who demonstrated decreased knee flexion <80° when being DC from hospital

C&M ORTHOSPORTS HIGH PRIORITY CHECKLIST
1. Edema
2. Knee extension ROM
3. Quad control
4. Knee flexion
5. Hip neuromuscular control
6. Balance and proprioception

EDEMA CONTROL
- Elevation is key, knee above the heart
- Ice early and often to decrease the effects of joint effusion and subsequent muscle inhibition
- Consider using a compression stocking (18-22mm/hg)
- Retrograde massage
- Kinesiology tape

CLINICAL PEARLS
- Constantly re-assess gains w/in session and between session; ask lots of questions (i.e. – where do you feel pain/stiffness?)
- Determine where limitation is coming from
- Hamstring length/hypertonicity
- Patella hypomobility (superior mobilization)
- Incision mobility as soon as it is healed
- If one mode of stretching is not working, try another; stress importance of the HEP for stretching
- As range progresses, must strengthen in new range
- TENS has shown some effect in two studies
- If full extension is not achieved in the OR, it is unlikely it will be achieved in PT

QUADRICEPS CONTROL
- Deficits 20-65% seen long after discharge
- Many patients get categorized as having good outcomes because of the focus on pain and ROM
- Normally see improvements 25-70%
- Pre-op strength one of the greatest predictors
• Post-op strength is more predictive of functional compared to pain or ROM
• Deficits are multimodal in nature consisting of atrophy, activation failure, and effusion

CLINICAL PEARLS
• Constantly re-assess gains w/in session and between session using HHD
• If one mode of strengthening is not working try another (OKC, CKC, eccentrics)
• Vary reps, sets, and intensity of strengthening
• Begin with quad sets, then SLR (when no lag)
• Step downs, leg press, and functional training
• NMES demonstrated good results with increased quad strength 6 months after use

KNEE FLEXION ROM
• Stairs require 85 - 110° knee flexion
• Rising from a chair requires 95° knee flexion
• Kneeling and squatting require 125-135° knee flexion
• Surgeons predict knee flexion to be w/in 5-10° of intra-operative measures or w/in 10-15° of pre-operative knee flexion

OUTPATIENT REHABILITATION Bade et al, 2010
• Joint mobility
  o High risk of PF joint disruption following TKA
  o Mobilization can be added both in clinic and at home prior to stretching
  o Role of TF joint mobilization is unclear
    ▪ Anterior to posterior mobilizations not indicated in PCL-sacrificing techniques at 90 degrees of knee flexion, OK in 0 degrees of extension

• Joint mobilization to increase extension
  o This can also be done with a valgus force or a varus force to maximize results
  o 5 x 30 second bouts

• Joint mobilization to increase flexion
  o This can also be done with a valgus force or a varus force to maximize results
  5 x 30 second bouts
JOINT MOBILIZATION TO INCREASE TIBIAL IR

Patient: supine with the treating LE in 90 degrees of knee flexion, with the hip flexed to 90 degrees
Clinician: standing on the side being treated
Instructions
- Clinician places one hand on the bottom of the heel and locks the ankle into DF
- The other hand has the thumb on the lateral aspect of the tibial tubercle
- The clinician exerts a force into tibial IR
- Dosage?

NOTE: patients with limited tibial IR also commonly have limited calcaneal EV

JOINT MOBILIZATION TO INCREASE TIB-FIB MOBILITY

Patient: supine with the treating LE in 90 degrees of knee flexion, with the foot on the table
Clinician: standing on the side being treated
Instructions
- Clinician places one hand on the medial aspect of the knee of the stabile
- The other hand takes up the soft tissue slack and using the thenar eminence the clinician exerts an AP force
- Dosage?

NOTE: be careful for the common fibula nerve
JOINT MOBILIZATION TO INCREASE MOBILITY OF THE PATELLA

Patient: supine with the treating LE in 20 degrees of knee flexion, with the heel on the table
Clinician: standing on the side being treated placing the knee under the patient’s knee, or use a half foam roll

Instructions
- The clinical places both thumbs on the lateral aspect of the patella
- Fine tuning his/her hands the clinician makes sure the patella is NOT tilted
- The clinician delivers a pure medial glide of the patella
- This can also be done in different degrees flexion to maximize results
- Dosage?

MEDIAL GLIDE

SUPERIOR GLIDE

INFERIOR GLIDE
EXERCISES

- Three different exercises to increase ROM
- Seated knee flexion good for HEP every single hour awake
- Self-extension with weight or bag must maintain PF of ankle to keep gastroc on slack
- Low load prolonged stretching better than shorter more aggressive bouts
- Need to figure out shortest to get increases in ROM

SPORTS PARTICIPATION RECOMMENDATIONS

- **Allowed**: bowling, stationary cycling, ballroom dancing, golf, horseback riding, shuffleboard swimming, normal walking, canoeing, road cycling, square dancing, hiking, speed walking

- **Allowed with experience**: rowing, ice skating, cross-country skiing, stationary skiing, doubles tennis, downhill skiing

- **Not allowed**: basketball, football, jogging, soccer, volleyball

- **No consensus**: fencing, roller skating, weight lifting, baseball, gymnastics, handball, hockey, rock climbing, racquetball/squash, singles tennis, weight machine