Session 11: Dealing With Complications

Learning Objectives
Upon completion of this activity, participants should be able to:

1. Diagnose and manage the complications associated with total hip arthroplasty.

2. Learn techniques and skills to minimize the frequency of the complications associated with total hip arthroplasty, including dislocation, infection, leg length discrepancy, heterotopic ossification, and neurovascular injuries.

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Diagnosing and Managing Instability
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Introduction
- Dislocation after THA is a disturbing complication for the patient and the surgeon.
- It is underreported.
- Most studies deal with prevalence, but the risk continues throughout life.
- Prevalence ranges from 0.3% to 10% (Average 2%-3%). Higher after revision surgery.
- Recurrent dislocation is associated with poor function.
- Reoperation for instability carries a high failure rate.
- Frequent cause of apprehension, unhappiness, even litigation.

Management of Recurrent Instability

Evaluation of the Unstable THA
- History of the dislocations
- Physical examination: Stable ROM, abductor strength
- Review of films with hip out (direction)
- Review good post-reduction films (*including true lateral*)
- Consider CT exam
- Consider exam under anesthesia/x-ray (rarely)
- Assess cause(s) of instability

**Causes of Instability**
1) Component malposition
2) Inadequate soft tissue tension
3) Impingement
4) Patient factors (compliance …)
5) Unexplained

**Component Orientation**
- Most important factor
- Socket version
  - (often ↓ in posterior approach)
- Socket inclination
- Stem version
  - “Safe position” (Lewinnek): 15° ± 10° anteversion
  - 40° ± 10° lateral opening

**Soft Tissue Tension**
- Intraoperative testing important
  - Know state of patient relaxation
  - Do not produce pseudotension by soft tissue retractors

- Reconstruct soft tissue
  - In anterior approach: gluteus medius
  - In posterior approach: capsule and external rotators

- Restore limb length
  - Increase modular neck length if necessary
  - Warn patient preoperatively of possible issues of LLD post-op

- Restore off-set
  - Proper pre-op templating
  - Proper prosthetic design selection

- Advance greater trochanter if necessary

**Impingement**
- Bone
  - Pelvis, greater trochanter, ectopic bone
  - Rx: excise

- Soft tissue
  - Anterior capsule, scar
  - Rx: excise
— Prosthetic
  1) Low head-neck diameter ratio
     ↑ Femoral prosthetic head size
     Avoid skirts on femoral prosthetic head
  2) Elevated-hooded liners
     Can ↓ posterior instability, but produce neck –EHDP
     Impingement in extension → anterior instability

Do not leave operating room with suboptimal stability.
Things do not get better afterwards.

Patient Factors
— Sex: (female > male 2:1)
— Prior surgery (3:1)
— Neuromuscular conditions (Parkinson, CP)
— Compliance (old age, substance abuse … )

Surgical Treatment
  1) Correct component malposition
  2) Remove impingement
  3) Improve soft tissue tension (advance trochanter?)
  4) Postoperative protection: patient education, bracing, hip spica cast

Besides this, what do we do today?

a) Big heads
   Advantages:
   - Increase ROM prior to dislocation
   - Decrease chance of impingement
   - Greater resistance to dislocation once impingement occurs
   - May enhance capsular stability
   - If dislocation occurs, closed reduction is possible
   Disadvantages:
   - Larger heads-less HDP
   - Non-prosthetic impingement possible

b) Bipolar (useful with big socket–little non-modular head combination)
   Advantages:
   - Greater ROM before dislocation
   Disadvantages:
   - Highly crosslinked EHDP not available

c) Constrained socket
   Advantages:
   - Immediate stability
- Simple, but must know locking technique (study device before going to OR)
- Excellent results with long-term follow-up (low recurrence rate of dislocation)

Disadvantages:
- Constraint variable with designs
- Device will not overcome a malpositioned component
- ROM before impingement less; thus ↑ risk of EHDP wear
  ↑ risk of socket loosening
- Dislocation often (but not always) mandates open reduction
- Complex mechanical devices; chances of different types of mechanical failure

Indications:
- Gross abductor insufficiency
- Patients with reiterated surgical failures to stabilize THA
- Old patients with well positioned components, well ingrown socket and recurrent instability

d) Dual mobility sockets
- A new concept in the US
- Thin acetabular polished shell-inner EHDP bearing
- Started by Bousquet (Lyon) in the 1970s
- Large experience in France
- Recently available here

Conclusions
Avoiding dislocations in primary THA requires:
- patient education
- proper surgical technique
- postop precautions × 6 weeks

Treatment of dislocation requires:
- thorough assessment of etiology
- use of simplest means to achieve stability

It remains to be proven whether current methods of surgical management will improve on our historical results.

References:


Session 11
Diagnosing and Managing Infection

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Periprosthetic total hip arthroplasty (THA) infection is a devastating complication that occurs in 1%-2% of cases. Diagnosis requires a thorough history and examination combined with appropriate investigations. Differential diagnosis includes aseptic loosening, trochanteric bursitis, iliopsoas impingement, or pain from intrinsic sources such as the spine. Effective use of available testing modalities is critical to making the diagnosis. Investigations may include hematologic studies, imaging studies, intraoperative frozen-section, as well as synovial fluid white blood cell (WBC) count, culture, and Gram stain.

Infected THA usually presents with pain, often at night or at rest. Radiographs may demonstrate loosened components, progressive radiolucencies, focal lysis of bone, and periosteal new-bone formation. Erythrocyte sedimentation rate (ESR) and c-reactive protein (CRP) are nonspecific tests but can provide critical information. In a recent study, Schinsky et al found no THA patients with an ESR of < 30 mm/hr and a CRP level of < 10 mg/dL were infected. This corroborates earlier work indicating that a combination of a normal ESR and CRP is reliable for predicting the absence of infection. Synovial fluid cell count of > 3000 white blood cells/mL has been shown to be the most predictive perioperative testing modality in the diagnosis of THA infection when combined with an elevated ESR and CRP. Frozen section is considered positive in the presence of at least 10 polymorphonuclear cells per high-power field. Technetium-99 scans may be helpful in diagnosing chronic infection, however they are nonspecific. Indium-111 leukocyte scanning alone is more accurate, however the combination of these 2 tests improves the accuracy for detecting infection to up to 95%. Newer tests such as polymerase chain reaction have thus far shown large discrepancies in sensitivity and positive predictive values and are probably not yet ready for routine use.

Implant removal, thorough debridement, extended IV antibiotics with second stage reimplantation remains the gold standard treatment option for infected THA. While some studies have reported successful outcomes after single-stage revision, the best results continue to be obtained by a minimum of 6 weeks between excision and reimplantation, with over 90% infection eradication.

References:
2. Spangehl MJ, Masri BA, O'Connell JX, et al. Prospective analysis of preoperative and intraoperative investigations for the diagnosis of infection at the sites of two
Dealing With Heterotopic Ossification

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Introduction: Heterotopic ossification is the abnormal formation of lamellar bone in nonosseous soft tissues, and is histologically distinct from dystrophic calcification.

Clinical Presentation: Most commonly, heterotopic ossification occurs as a sequel to surgically induced trauma about the hip, especially in association with operative repair of acetabular fractures or total hip arthroplasty (THA). The radiographic prevalence of heterotopic ossification following THA is reported to be as high as 90%; up to 8% of patients experience a compromise in clinical function manifest as pain, decreased range of motion, or frank ankylosis. Known risk factors include male gender, prior heterotopic ossification, hypertrophic or posttraumatic arthritis, diffuse idiopathic skeletal hyperostosis, ankylosing spondylitis, and traumatic brain injury or other central nervous system condition.

Pathophysiology: Our understanding of the pathophysiology of heterotopic ossification is largely speculative. Pluripotent mesenchymal stem cells are induced to differentiate down
osteoprogenitor cell lines within 16 hours of the inciting event, with a peak in cellular activity at less than 36 hours. Efforts at preventing the formation of the osseous tissue are futile if initiated beyond 96 hours after the inciting event. Cells are thought to derive from the local tissues and pathologic formation of bone passes reliably through a pathway of endochondral ossification. The ectopic bone is metabolically hyperactive.

**Prophylaxis:** Effective prophylaxis must be initiated within 5 days of operation or injury. Bisphosphonates delay mineralization of osteoid matrix; following their discontinuation, radiographic appearance of ectopic bone proceeds unimpeded. Nonsteroidal anti-inflammatory agents effectively prevent the formation of heterotopic bone, but are poorly tolerated by arthroplasty aged patients and have systemic effects that delay ingrowth into prosthetic surfaces. Limited field external beam radiation is highly effective prophylaxis; it can be administered in a single pre- or post-operative treatment and its effects are precisely localized to the operative area. Wound complications are rare with a single treatment of 600 to 800 rad, and late sarcoma appearance has not been reported at these doses.

**Treatment:** Surgical removal of ankylosing ectopic bone about the hip is infrequently required. Postoperative prophylaxis is essential to avoid recurrence; full field radiation is highly effective and minimizes marginal field bone growth.

References:


**Avoiding Leg Length Inequality**

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Leg-length inequality is an undesirable complication of total hip arthroplasty (THA) with numerous adverse effects, including gait alterations, low-back pain, and patient dissatisfaction or even litigation. Leg-length discrepancy can result from poor preoperative patient evaluation as well as intraoperative technical errors in neck resection level, prosthetic neck length, and failure to restore offset.
Preoperatively, patients should be carefully assessed for true leg-length discrepancy due to hip disease, which should be distinguished from pelvic obliquity due to spine pathology. Evaluation should also assess for coxa vara, acetabular protrusion, and a marked preoperative hip flexion contracture which may place the patients at increased risk for postoperative leg-length inequality. Accurate preoperative planning and templating of radiographs is critical for component selection and positioning. Various methods have been described for radiographic templating with the use of the greater and lesser trochanters, the interischial and the interteardop lines, and the center of the femoral heads as references points.

Intraoperatively, several techniques have been described for assessing leg lengths including palpation of the heels and patellae, use of fixed pins into the ilium and greater trochanter, measuring from the lesser trochanter to the femoral head center, and referencing the infracotyloid groove to a mark on the greater trochanter.

Postoperatively, patients with leg-length inequality can be treated nonoperatively with observation or shoe lifts. Operative treatment may require component exchange with care not to compromise hip stability.

Leg-length inequality can best be avoided by pre-operative patient assessment, pre-operative radiographic templating, and intraoperative measurement.

References:
Avoiding Neurovascular Complications

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Neurologic complications following hip arthroplasty are usually due to peripheral nerve injuries, which vary in severity from neuropraxia (nerve intact but not functioning) to axonotmesis (endoneurial tube intact but the myelin disrupted) to neurotmesis (nerve completely disrupted).1

Most nerve injuries are in the operated leg, but pressure or traction can cause nerve injury in the opposite leg or arms, especially in rheumatoid patients and others where other joint problems can make positioning difficult.2

Deficits are usually present immediately post-surgery, but delayed onset is possible even if due to intraoperative events. Nerve injury can also occur in the days post-surgery due to direct pressure or hematoma formation. Deficits seen several weeks or longer after surgery can be due to changes in implant position or that of adjunctive hardware. It is very important that neurologic status be documented meticulously immediately post-surgery so that information regarding the onset of any nerve deficit is clear.

Postoperative nerve deficits are clinically evident in 0.6% to 1.3% of primary total hips.3-5 However, subclinical nerve injury as evidenced by electromyography (EMG) is much more common and can be detected in up to 70% of primary hip arthroplasty patients.3 Over 90% of clinically evident ipsilateral nerve palsies involve the sciatic nerve, with the femoral and obturator nerves much less commonly noted. Superior gluteal nerve injury is possible during surgical approaches that split the gluteus medius, particularly if the split extends more than 5 cm proximal to the trochanter tip.5,6 When sciatic nerve palsy occurs, approximately 50% involve the peroneal division alone with the other 50% involving both the peroneal and tibial divisions.7 A 2-fold or higher incidence of nerve palsy has been reported in female patients.3,8

To avoid nerve injury, careful surgical technique is important and includes meticulous attention to retractor placement. Limb lengthening should not exceed 4 cm or 6% of the calculated nerve length. Use of intraoperative nerve monitoring is controversial as it has not been documented to reduce the risk of nerve palsy when monitored and nonmonitored patients are compared in prospective fashion.9

Nerve recovery is variable and relates to the severity of the injury. Surgical exploration of the nerve is only reasonable if there is strong suspicion of major direct nerve injury, such as transection or impingement by cement, screws, or suture. Isolated peroneal palsy has a better prognosis than complete sciatic palsy.10 Still, up to 79% have been shown to have
incomplete recovery, with 15 of 28 in one study with both motor and sensory function deficits. In a multiyear longitudinal review of nerve palsies after total hip arthroplasty (THA) at the Mayo Clinic, most patients did not achieve full recovery, and when this occurred, it often took up until 18 to 24 months. If motor function is retained or begins to return within the initial few days of surgery, this does correlate with a higher rate of good final recovery and outcome.

Vascular complications as a result of THA are very rare, but can be catastrophic, and may be either arterial, venous or both. Structures at risk include the femoral artery and vein, obturator artery and vein, common and external iliac artery and vein, and the profunda femoris branches. Manifestations include hemorrhage, thrombosis, AV fistula formation, and false aneurysm formation. The incidence of significant vascular injury has been estimated at 0.2% to 0.3% of arthroplasties. Etiology includes direct injury from sharp instruments such as pointed retractors, knives or osteotomes, drills, and screws. All surgeons doing THA should familiarize themselves with the 4-quadrant system of dividing the acetabular cavity and the safe zone for screw placement (posterior-superior and posterior-inferior quadrants). Vessel laceration or tearing has also been described during extraction of intrapelvic cement and medially migrated acetabular components. Prior to such revisions preoperative studies including arteriography can be of help in identifying the proximity of vascular structures to the implant to be removed. In some cases intrapelvic control of the vessels by a vascular surgeon prior to component removal is indicated.

Knowledge of vascular anatomy before these events occur can be extremely helpful, and familiarity with adjunctive surgical approaches such as the ilioinguinal approach for emergent control of catastrophic vascular injury can be life-saving. Prompt recognition is important and a high index of suspicion is helpful in complex cases where vascular structures are adjacent to the operative field. Availability of a vascular surgeon is important as vascular surgical repair or ligation may be necessary depending on the structure injured.

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**Case Presentation & Discussion Panel**
Miguel E. Cabanela, MD, David Backstein, MD, Vincent D. Pellegrini, Jr, MD, Raymond Kim, MD, David G. Lewallen, MD