Hip & Knee
Osteoarthritis 2014

“Too Hip to Hop”

University of Vermont
Community Medical School
September 2, 2014
A roadmap for our journey ...

- Osteoarthritis of the Hip & Knee (OA)
- Medical Treatment Options for OA of the Hip & Knee
- Surgical Treatment Options for OA of the Hip & Knee
Synovial Joints

- Bone
- Fibrous capsule
- Joint space filled with Synovial Fluid
- Synovial membrane
- Articular cartilage
The Hip and Knee Joints
What is articular cartilage and what does it do?

This cartilage is the shiny, white surface that covers the ends of most bones.

Articular cartilage protects the ends of bones and allows the joints to glide smoothly with less friction.

It also helps to spread the loads applied to a joint.
Structure of Articular Cartilage

Cartilage is composed of collagen, proteoglycans and chondrocytes.

Glucosamine, chondroitin and hyaluronic acid are key structural components of matrix molecules.

Any abnormality in the structure of these proteins can lead to cartilage with poor function and thus to the development of osteoarthritis.
Biomechanics of Hyaline Cartilage

Simplistically, the resistance to water flow is provided by the intricate function of hydrophilic proteoglycans on a collagen netting.
Lifespan of Articular Cartilage

Hyaline articular cartilage acts as the joint “shock absorber”.

First two decades, damaged cartilage is constantly being repaired as old cartilage is degraded.

With time, the balance between degradation and repair is thrown off, cartilage breakdown occurs. As a result of cartilage breakdown, damage to bone occurs.
Arthritis: (Inflammation of Joints)

- Pain
- Loss Of Motion
- Avoidance Of Motion
- Increased Muscle Tightness

Pain → Loss Of Motion → Avoidance Of Motion → Increased Muscle Tightness → Pain
What is the inciting event?

Pain or damage often caused by:

- Injuries
  - Ligament
  - Meniscus
  - Articular cartilage
Knee Pain: Osteoarthritis

Cartilage

Healthy Knee

Osteoarthritic Knee
Hip Osteoarthritis (OA)

Normal Hip

Arthritic Hip
# Aging Joint vs. OA Joint

<table>
<thead>
<tr>
<th>Aging Joint</th>
<th>OA Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrillation- nonweightbearing</td>
<td>Weightbearing</td>
</tr>
<tr>
<td>No changes</td>
<td>Physical, chemical, synthetic, and degradative changes</td>
</tr>
<tr>
<td>No significant change in water content of cartilage</td>
<td>Water content of cartilage increases</td>
</tr>
<tr>
<td>No subchondral bone changes</td>
<td>Subchondral bone changes</td>
</tr>
</tbody>
</table>
Pathogenesis: “What goes wrong?”

What exactly controls the cytokine message to the chondrocyte is at this point an area of extensive research.

With advancing age, the chondrocyte cells appear to fail and seem to make more enzymes that destroy the cartilage resulting in osteoarthritis.

In addition, trauma, even small enough to cause microfractures in the cartilage, seems to result in inflammation and acceleration of osteoarthritis.
Supporting structures matter ...

Bone ends: bone bruise  fracture

Fibrocartilage: hip “labrum”  knee “meniscus”

Ligaments: anterior cruciate ligament

Synovium: the lining of the joint

Nerves that control function of the surrounding muscles, which facilitate joint movements.
Summary:
What is the real cause of OA?

Loss of the balance between cartilage breakdown and repair

- Loss of cartilage components
- Loss of sponge effect of cartilage
- Increased stress on entire joint!!
Osteoarthritis: 2030

As the U.S. population ages, these numbers are likely to increase dramatically.

People who have doctor-diagnosed arthritis is projected to increase to 67 million in 2030.
“Making the diagnosis of osteoarthritis?

- Detailed history
- Physical exam
- X-rays
- Blood tests?
Knee X-ray appearance

Healthy knee

Osteoarthritic knee
Hip X-ray appearance

Healthy hip

Osteoarthritic hip
Treatment of Osteoarthritis

- Health and behavior modifications
- Rehabilitation to avoid stiffness/weakness
- Oral medication/supplements
- Intra-articular medication
- Surgery
Symptom suppression: “Less pain”

- Activity Modification
- Weight Loss
- Cane/walker
- Medication
Medications for osteoarthritis

- NSAIDs are nonsteroidal anti-inflammatory drugs
  - Aspirin
  - Ibuprofen
  - Naproxen
  - Acetaminophen (Tylenol ®)

CAUTION
Vitamins & Nutritional Supplements

Glucosamine & Chondroitin Sulfate
- Some positive results reported (industry bias)
- No benefits seen in NIH G.A.I.T. study (best)
  - If benefits not seen within 8 weeks, not likely

No F.D.A. oversight … proceed with caution
Alternative Medicine

Complementary Approaches May:

Ease symptoms

Improve outlook and attitude
Alternative Medicine

Complementary Approaches Will Not:

- Cure acute illness
- Replace proven medical treatments for osteoarthritis
## Alternative Medicine

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Symptom</th>
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<tbody>
<tr>
<td></td>
<td>Pain</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>♦</td>
</tr>
<tr>
<td>Visualization</td>
<td>♦</td>
</tr>
<tr>
<td>Hypnosis</td>
<td>♦</td>
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<tr>
<td>Relaxation</td>
<td>♦</td>
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<tr>
<td>Yoga</td>
<td>♦</td>
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<tr>
<td>Tai Chi</td>
<td>♦</td>
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<tr>
<td>Acupuncture</td>
<td>♦</td>
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<tr>
<td>Magnets</td>
<td>♦</td>
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<tr>
<td>Vegetarian Diet</td>
<td>♦</td>
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<tr>
<td>Herbs &amp; Supplements</td>
<td>♦</td>
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</tbody>
</table>
Exercise Dos

- Include flexibility, strengthening, and aerobic exercises
- Exercise when pain and stiffness lowest
- Exercise when you are not tired
- Exercise when medication having greatest effect
Too Much Exercise

Consult your doctor if these symptoms are present:

- Unusual or persistent fatigue
- Increased weakness
- Decreased range of motion
- Increased joint swelling
- Continued pain 2 hour after exercising
Goals of Hip/Knee Osteoarthritis Surgery

- Relieve pain!!!
- Restore function
- Improve mobility
Asking Questions About Surgery

- Why is surgery recommended?
- Alternatives?
- Benefits and for how long?
Asking Questions About Surgery

- Duration of recovery?
- Assistance at home? How long?
- Disability after surgery?
- Physical therapy?
- Return to normal activity?
The $50,000 question is ...

If you have significant symptoms of osteoarthritis that limit your lifestyle

... and you have exhausted the full spectrum of non-operative treatments

What is the best option for you to relief pain and restore function?
Do you have to replace the entire knee joint?

What are your goals of surgery?

How far advanced is your knee osteoarthritis arthritis?

Have you lost range of motion?
Knee Osteoarthritis: disease of the entire joint

Complete coverage of knee joint surfaces

- All compartments (three)
  - “Tricompartmental”
  - “Total knee”
Total knee replacement

- **Advantages:**
  - Most effective treatment for long-term pain relief
  - Durability and flexibility (*future upgrade*)

- **Disadvantages:**
  - Greater investment in recovery time
Tricompartmental Knee Replacement (TKR)

Patellar component
TKR Bone Cuts
TKR Implant Insertion
TKR implants in place
Do you have to replace the entire knee joint?

What are your goals of surgery? Low demand

How far advanced is your knee osteoarthritis arthritis? Limited to one compartment only

Have you lost range of motion? Still have full motion and intact ligaments
Partial Joint Replacement

Coverage of currently degenerated surfaces

- One compartment
  - “uni” or “partial”
- Advantages
  - Intact ligaments
  - Faster recovery
Partial Joint Replacement

Coverage of currently degenerated surfaces

- 30 years of data
- 80% 10 yr survivorship
- Conversion to TKR
- First replacement for < 45 yo
- Only replacement for > 75 yo
Total knee vs. partial knee

For > 90% of patients in North America

TOTAL KNEE REPLACEMENT IS THE GOLD STANDARD

95% patient continue to experience good pain relief and maintained function @ 15 years
Do you have to replace the entire hip joint?

What are your goals of surgery?

How far advanced is your hip osteoarthritis arthritis?

Have you lost leg length?
Total Hip Replacement

Arthritic Femoral Head

Femoral Head Removed

Femoral Shaft

Copyright MMG, Inc. 1996
Technique: Total Hip Replacement

Acetabulum (Hip Socket)

Inserting Acetabular Component

Reaming Tool

Reaming

Reamed

Acetabular Component (in place)
Technique: Total Hip Replacement

Preparing Femoral Canal

Femoral Rasp

Porous Coating

Femoral Stem

Femur

Copyright MMG, Inc. 1996
Technique: Total Hip Replacement

- Femoral Stem (inserted into femoral canal)
- Artificial Hip (in place)
Outcomes @ one year

Relieved pain and restored function to the patient’s satisfaction.

95% men VG/Excellent results

85% women VG/Excellent results
Outcomes @ 15 years

95% patient continue to experience good pain relief and maintained function

5% patients elect revision surgery for implant new components *(upgrade)*

80% of revised patients have their goal met or exceeded for other 10 years
Hip Surface Replacement

Only in very special situations
Minimally Invasive Joint Replacement

- Hip
  - Mini-Posterior
  - Direct Anterior
  - Lateral

- Knee
  - Quad split
  - Mid-vastus
  - Quad-sparing
Minimally invasive surgery

- Less pain & less blood loss
- Less adhesions/scar formation
- More rapid recovery (6 weeks)
“Am I a candidate for minimal incision surgery?”

- Weight proportional to height
- Muscle mass
- Health of the soft tissues
- Pre-operative range of motion
Strategies to improve long term survivorship

- New bearing surfaces
- Patient specific instruments
- Patient specific implants
Advanced material designs

- Advanced bearings wear 25 to 100 times less than standard implants.
Technology continues to improve

- Improved polyethylene resistance to wear
  - “Cross-linking”
- Improved metal surface resistance to damage
  - “Cementless fixation”
Strategies to improve long term survivorship

- New bearing couples
- Patient specific instruments
- Patient specific implants
**Patient specific instruments**

“Pre-navigation”

- X-ray & MRI
- Less invasive
- Less blood loss
“Promise of Custom Instrumentation “

- Accurate assessment of joint laxity.
- Elimination of IM rod reduces risk of DVT.
- Less invasive: Faster rehab, shorter scar.
- More accurate implant placement may extend implant’s life. (longitudinal studies)
**Take home message**

- **Conventional**
  - Significant Outliers

- **PSI**
  - Reduced Outliers

Alignment Deviation, °
Strategies to improve long term survivorship

- New bearing couples
- Patient specific instruments
- Patient specific implants
Patient specific implants

- X-ray & CT scan
- Custom made jigs for bone cuts
- Custom made implants
- Added $$ … value ??
Patient specific implants

- Less invasive technique
- More expensive to manufacture
- No flexibility at time of surgery
- No demonstrated long-term benefit
Joint Replacement: Strategies for improved outcomes

- Infection prevention
- Blood clot prevention
- Standardized rehabilitation plan
Emerging Knowledge & Future Research

What are the important risk factors that are associated with and precede the development of OA Knee?
Can we further develop ways to facilitate the regeneration of a new articular surface...

...and prevent the late changes of OA that lead to the need for joint replacement??
Gene therapy

A Gene-Modified, Cell-Based Approach to Cartilage Repair

1. Collect chondrocytes

2. Gene Therapy induces cells to express therapeutic gene product

3. Treat cartilage defects by transplanting transfected chondrocytes
Resources

American Academy of Orthopaedic Surgeons
6300 North River Road Road
Rosemont, IL 60018
www.orthoinfo.org

Arthritis Foundation
800-283-7800
www.arthritis.org