**Stiff Knee**
**Definition, pathoanatomy and classification**

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Disclosures: Nothing to declare

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**Arthrofibrosis**

How to prevent and fight...

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**Arthrofibrosis...**

...a “silent” enemy without a recognizable face??!!

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**Early Diagnosis and STRATEGY**

- talk, examine and LISTEN to your patient
  - Early consultation after surgery

- “what to look for”
  - we must think this problem is REAL
  - Potential causes

- Tools for diagnosis
  - some new trends and possibilities

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- Expect the unexpected!
  - Surgical error is sometimes the answer
Arthrofibrosis

- Arthrofibrosis represents a wide spectrum of disease, ranging from localized to diffuse involvement of all compartments of the knee and of the extra-articular soft tissues.
- Multifactorial - mechanical and biologic factors.

Major risk factors:
- Technical errors in intra-articular ligament reconstruction and extra-articular procedures.
- Injury severity, timing of surgery.
- Delayed postoperative physical rehabilitation.
- Hematoma formation.
- Prolonged immobilization.
- Infection.
- Complex regional pain syndrome.
- Genetic differences among patients with arthrofibrosis.

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Timing of surgery

...“multiple techniques used for reconstruction, variable definitions of timing and classification, and lack of prospective studies, firm conclusions regarding this ongoing debate remain elusive.”

“Key factor remains understanding the mechanism and severity of injury as they relate to the preoperative level of inflammation.”

Classification of Motion Loss of the Knee Based on Deviation From Full Flexion and Extension

<table>
<thead>
<tr>
<th>Group</th>
<th>Extension</th>
<th>Flexion</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$&lt;7^\circ$</td>
<td>$&gt;10^\circ$</td>
<td>Mild</td>
</tr>
<tr>
<td>2</td>
<td>$5^\circ$ - $10^\circ$</td>
<td>$90^\circ$ - $120^\circ$</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>$&gt;10^\circ$</td>
<td>$&lt;90^\circ$</td>
<td>Severe</td>
</tr>
</tbody>
</table>

Trauma severity/Energy

- Motion Loss - more common with multiligamentous high-energy injury than with single-ligament low-energy injury.
- Concomitant ACL and MCL repair
  - Noyes et al - 23% incidence of motion loss
  - Traumatic knee dislocation incidence of motion loss
    - Sisto and Warren 30%
    - Shapiro and Freedman 57%

Sprague Pathoanatomic Classification of Motion Loss

<table>
<thead>
<tr>
<th>Group</th>
<th>Pathoanatomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dense sheet of adhesions traversing the suprapatellar pouch</td>
</tr>
<tr>
<td>2</td>
<td>Complete obliteration of the suprapatellar pouch and periarticular gutter with presence of adhesions</td>
</tr>
<tr>
<td>3</td>
<td>Multiple bands of adhesions or complete obliteration of the suprapatellar pouch with extrapatellar involvement with bands of tissue from proximal fibula to anterior femur</td>
</tr>
</tbody>
</table>


Injury/surgery activates inflammatory cascade

Possible abnormal expression of TGF-β, PDGF, FGF, IGF, ... Collagen, I, III and VI

Abnormal fibrous tissue formation

Excessive periarticular scarring

Gene delivery of TGF-β/1 induces arthrofibrosis and chondrometaplasia of synovium in vivo

New Treatment Options in future?

- Active biomolecules delivery
- Cells control

NANOTECHNOLOGY: Opportunity

Definition: Branch of technology that applies the nanoscale principles and work at the atomic, molecular and supramolecular levels (1-100 nm).

Arthrofibrosis after TKA - Influence factors on the absolute flexion and gain in flexion after manipulation under anaesthesia
Prevention of motion loss remains essential to successful outcome.

In the patient who experiences motion loss despite preventive measures, treatment options include static or dynamic bracing, manipulation under anesthesia and arthroscopic or open debridement.

In recalcitrant cases, arthrodesis in the older patient or total knee arthroplasty may be required.

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"as little as 5º to 10º loss of extension"

- abnormal gait pattern
- quadriiceps weakness
- Anterior knee pain

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The better surgeons repair... better is the outcome!

Early stage (80’s):

as many as 35% of patients with acute ACL repair developed loss of knee motion


Advances in surgical technique and accelerated rehabilitation protocols:

incidence has markedly decreased, to as low as 0% to 4%


M. SKUTEK ET AL.

The better surgeons repair... better is the outcome!

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Surgical technical errors

- Nonanatomic graft placement
- Inadequate graft fixation
- notchplasty
- Incorrect graft tension

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Localized presentation - CYCLOPS

- Proliferative scar nodule in femoral notch
- Painful mechanical block to knee extension
- Crepitus and physical sensation of grinding with knee extension
- Dx clinical, MRI, arthroscopy

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12% early incidence of knee stiffness after primary ACL reconstruction

- Strongest predictors:
  - Previous surgery
  - poor compliance with rehab
- Conservative treatment results
  - Rate of stiffness fell to 5% at 12 months

Infrapatellar contracture syndrome (IPCS)

- Pathologic fibrous hyperplasia of the anterior knee following surgery or injury to the knee.
- IPCS is a subcategory of severe arthrofibrosis with extension loss, flexion loss, and patellar entrapment. Hypertrophic scar tissue invades the infrapatellar recess and lowers the patella, resulting in patella infera.
- Trauma to the knee produces bleeding, which initiates the clotting cascade. Inflammatory cells, fibroblasts, and growth factors, including the disordered regulation of collagen 6, contribute to arthrofibrosis synthesis.


**Localized presentation – INS**

Intercondylar notch scarring

Bone notch impingement – Often an illusion and misdiagnosis

**Infrapatellar contracture syndrome (IPCS)**

- Phase I – normal phase of healing 2-8 weeks after surgery
  - Treatment – Rehab protocol early full extension (hyperextension when applies)
- Phase II (active) – diminished patellar mobility; patellar tendon rigidity; quadriceps atrophy
- Phase III – Patellofemoral arthritis
  - Poor prognosis

**Foreign body reactions 99mTc-HDP-SPECT/CT**

- Painful knee joint after ACL reconstruction using biodegradable interference screws: SPECT/CT a valuable diagnostic tool? A case report
- Metabolic information (tracer uptake in SPECT/CT)
- Precise anatomical detail available with high spatial resolution CT
- Foreign body reaction, confirmed by histology

**Complex Regional Pain Syndrome**

- Metabolic information (tracer uptake in SPECT/CT)
- Precise anatomical detail available with high spatial resolution CT
- Foreign body reaction, confirmed by histology

**Phase I**

- Normal phase of healing
  - 2-8 weeks after surgery
  - Treatment – Rehab protocol early full extension (hyperextension when applies)

**Phase II**

- Diminished patellar mobility
- Patellar tendon rigidity
- Quadriceps atrophy

**Phase III**

- Patellofemoral arthritis
- Poor prognosis

**Treatment algorithm for arthrofibrosis**

- CPM = continuous passive motion
- CRPS = complex regional pain syndrome
- POD = postoperative day
- ROM = range of motion
- WBAT = weight bearing as tolerated

**Foreign body reactions**

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**References**


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*Note: The text is a representation of the content in the image and may not be an exact transcription.*
Take Home Message

- Multifactorial combination of Biologic and Mechanic factors...
  Enemy with many faces
- Surgical technique and less aggression decrease the risk
- Early rehabilitation
- Patient related risk factors (HLA, protein expression; biomarkers) might provide future perspectives in prognosis and treatment
- Early diagnosis... Have a strategy!!