ARTHROFIBROSIS: PREVENTION AND TREATMENT AFTER TKA

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TOTAL KNEE REPLACEMENT RELIEVES PAIN AND ALLOWS A HIGH LEVEL OF FUNCTION FOR MANY PATIENTS…
HOWEVER, THERE ARE STILL UNSOLVED PROBLEMS AND COMPLICATIONS THAT ARISE AFTER TKA...
Initially described in the early 1990s as abnormal scar response and stiffness after ACL reconstructions

Extended to define TKA patients with reduced range of motion

Characterized by dense fibrotic scar and tissue “metaplasia”

Pain and stiffness: a common cause of patient dissatisfaction in 5-10% of TKA patients
Why Are Total Knees Failing Today? Etiology of Total Knee Revision in 2010 and 2011

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**Table**

Mechanism of Failure Over Time.

<table>
<thead>
<tr>
<th>All Patients</th>
<th>&lt;2 Years</th>
<th>2–5 Years</th>
<th>5–15 Years</th>
<th>&gt;15 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>844</td>
<td>100.0%</td>
<td>298</td>
<td>35.3%</td>
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<tr>
<td>Aseptic Loosening</td>
<td>263</td>
<td>31.2%</td>
<td>56</td>
<td>18.8%</td>
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<tr>
<td>Instability</td>
<td>158</td>
<td>18.7%</td>
<td>75</td>
<td>25.2%</td>
</tr>
<tr>
<td>Infection</td>
<td>137</td>
<td>16.2%</td>
<td>68</td>
<td>22.8%</td>
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<tr>
<td>Poly Wear</td>
<td>84</td>
<td>10.0%</td>
<td>3</td>
<td>1.0%</td>
</tr>
<tr>
<td><strong>Arthrofibrosis</strong></td>
<td><strong>59</strong></td>
<td><strong>7.0%</strong></td>
<td><strong>38</strong></td>
<td><strong>12.8%</strong></td>
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<tr>
<td>Malalignment</td>
<td>56</td>
<td>6.6%</td>
<td>24</td>
<td>8.1%</td>
</tr>
<tr>
<td>Isolated Patella Revision</td>
<td>35</td>
<td>4.1%</td>
<td>15</td>
<td>5.0%</td>
</tr>
<tr>
<td>Periprosthetic Fracture</td>
<td>27</td>
<td>3.2%</td>
<td>7</td>
<td>2.3%</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>1.5%</td>
<td>7</td>
<td>2.3%</td>
</tr>
<tr>
<td>Extensor Mechanism</td>
<td>10</td>
<td>1.2%</td>
<td>5</td>
<td>1.7%</td>
</tr>
<tr>
<td>AVN patella</td>
<td>2</td>
<td>0.2%</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

*Revision rates
Why Are Total Knee Arthroplasties Failing Today—Has Anything Changed After 10 Years?

Peter F. Sharkey, MD, Paul M. Lichstein, MD, MS, Chao Shen, MD, Anthony T. Tokarski, BS, Javad Parvizi, MD, FRCS

The Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania


Fig. 5. Comparison of overall incidence of failure between 2002 and 2012 stratified by mechanism. *P < 0.05, **P < 0.01.

* Revision rates
- 67° for swing through phase of ambulation
- 83° to ascend or descend 8 inch stair riser
- 90-100° to descend stairs
- 93° rising from a standard chair
- 105° to rise from low chair
- 125° degrees for kneeling to pray or eat

Laubenthal et al. *Physical Therapy* 1972
MOTION MATTERS TO PATIENTS!

- ROM correlates with SF-36 and Oxford knee scores
- Postop ROM and improvement of ROM correlate with KS score, WOMAC
- >125° Flexion not as important
  - Better stairs
  - No change in overall functional scores
FACTORS CONTRIBUTING TO A STIFF TKA

- Intraoperative
- Preoperative
- Postoperative
PREOPERATIVE FACTORS/CORRELATIONS:

- Preoperative ROM!
- Prior surgery
- Young age
- Non-white
- Smoker
- DM
- Obesity (not all studies show independent risk factor – goes back to preop motion/impingement)
- Inflammatory arthritis (get greater GAIN than OA patients)
- Patient psychology?
- Things that **DO NOT** predict ROM: bilateral TKA, keloid formers
“ONLY THING WE HAVE TO FEAR IS FEAR ITSELF” - FDR

Decreased Range of Motion After Total Knee Arthroplasty Is Predicted by the Tampa Scale of Kinesiophobia

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The Journal of Arthroplasty 31 (2016) 793–797

- TSK measure of fear of painful stimulus
- For every point on TSK, lose ½ deg of flexion post-op

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I’m afraid that I might injure myself if I exercise</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. If I were to try to overcome it, my pain would increase</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. My body is telling me I have something dangerously wrong</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. My pain would probably be relieved if I were to exercise</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. People aren’t taking my medical condition seriously enough</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. My condition has put my body at risk for the rest of my life</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Pain always means I have injured my body</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Just because something aggravates my pain does not mean it is serious</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I am afraid that I might injure myself accidentally</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I wouldn’t have this much pain if there weren’t something potentially dangerous going on in my body</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Although my condition is painful, I would be better off if I were physically active</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Pain lets me know when to stop exercising so that I don’t injure myself</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. It’s really not safe for a person with a condition like mine to be physically active</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I can’t do all the things normal people do because it’s too easy for me to get injured</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. Even though something is causing me a lot of pain, I don’t think it’s actually dangerous</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. No one should have to exercise when he/she is in pain</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Fig. 1. Modified Tampa Scale of Kinesiophobia questionnaire. The 17-item questionnaire uses a 4-point Likert scale and contains 4 negatively worded, reversed scored questions. Tampa Scale of Kinesiophobia scores range from 17 to 68 with scores >39 indicating a high fear of movement.
INTRAOPERATIVE – TECHNICAL FACTORS

- Poor gap balancing
- Poor ligament balance
- Component malposition
- Component oversizing
- Excessive joint line elevation
- Anterior tibial slope
- Unrecognized PCL tightness
- Residual posterior capsular tightness
- PS vs CR not shown consistently to make a difference
POSTOPERATIVE RISK FACTORS

- Infection

- Patient biology (fibroblast function)

- CRPS/Pain syndromes – historical as high as 1%

- HO (uncommon to be clinically relevant post TKA)

- Patient factors
  - Motivation
  - Pain tolerance
  - Psychological factors
Stiffness can be the common final outcome of many pathologic inputs:

- Poor sizing
- Unbalanced
- Residual osteophytes
- Infection
- Poor Rehab
- Pain syndrome
- Patient Biology
- Stiff Preop
- DM
- Obese
- "catastrophizer"
TIPS AND PEARLS

- Proper ligamentous balance
- Restore native joint line with equal gaps
- Clear the “posterior compartment” osteophytes
- Capsular closure in flexion
The flexion gap matches the extension gap.
STIFF TKA

ALGORITHM

Rule out Infection

Exam, Labs

Treat Infection if Positive

Component Evaluation

loosening/imbalance

malpositioning or oversized

Revision TKA

Neg Work Up Lacks Functional Flexion

<6 weeks

Aggressive PT

6 weeks – 3 mo

MUA

3-6 mo

Arthroscopic vs Open lysis of adhesions

>6 mo

Revision TKA
REHABILITATION

- **Stay ahead of pain**
  - Neuraxial, Regional vs Local, Multimodal Approach
- **WBAT, early PT**
- **Routine CPM use not indicated**
  - CPM for an unmotivated patient, or reoperation for stiffness
- **Older studies**
  - Early discharge correlates with higher rate of manipulation (Mauerhan 1998)
  - Organized PT for 1 month – better flexion at 2 and 9 yr f/u (Shoji 1990)
- **Newer studies**
  - Telemedicine equivalent to formal PT post-TKA (Bini 2016)
  - Outpatient and home based PT equivalent (Artz 2015)
  - Moving towards no PT? – Yes in hip! (Parvizi 2015 AAHKS)
Continuous passive motion following total knee arthroplasty in people with arthritis (Review)

Harvey LA, Brosseau L, Herbert RD

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Authors’ conclusions

CPM does not have clinically important effects on active knee flexion ROM, pain, function or quality of life to justify its routine use. It may reduce the risk of manipulation under anaesthesia and risk of developing adverse events although the quality of evidence supporting these findings are very low and low, respectively. The effects of CPM on other outcomes are unclear.
**MANIPULATION UNDER ANAESTHESIA**

- Best results when <3mo post-op
- Can expect ~35° improvement in total ROM immediately post-op
- Can reach equivalent functional outcomes and PRO scores – Issa J Arthroplasty 2014

- Our protocol
  - Outpatient, regional anaesthesia, immediately resume PT

- Complications (0.5-1%)
  - Fracture
  - Infrapatellar ligament/quad tendon rupture
  - Hematoma
  - Wound Dehiscence
### Summary of MUA literature (Ghani *The Knee* 2012):

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Age range of patients</th>
<th>Sample size of patients</th>
<th>Mean time elapsed between TKA and MUA (months)</th>
<th>Mean ROM before TKA</th>
<th>Mean improvement in ROM in degrees (°)</th>
<th>Mean improvement in flexion</th>
<th>Mean improvement in extension</th>
<th>p-value of mean improvement in ROM</th>
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<td>Yercan</td>
<td>54-88</td>
<td>46</td>
<td>1</td>
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<td>47</td>
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<td>---</td>
<td>p&lt;0.015</td>
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<tr>
<td>Esler</td>
<td>46-88</td>
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<td>3</td>
<td>102</td>
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<td>Scranton</td>
<td>---</td>
<td>19</td>
<td>1.5-7</td>
<td>---</td>
<td>42</td>
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<td>Keating</td>
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<td>90</td>
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<td>102</td>
<td>---</td>
<td>35</td>
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<td>Mohammed</td>
<td>56-80</td>
<td>21</td>
<td>3</td>
<td>---</td>
<td>30.2</td>
<td>20.7</td>
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<tr>
<td>Cates</td>
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<td>37</td>
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<td>115</td>
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<td>Rubinstein</td>
<td>51-85</td>
<td>37</td>
<td>---</td>
<td>109</td>
<td>38</td>
<td>33</td>
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<td>Fox</td>
<td>---</td>
<td>76</td>
<td>.5</td>
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<td>Maloney</td>
<td>---</td>
<td>24</td>
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<td>47</td>
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<td>---</td>
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<td>Ipach</td>
<td>42-82</td>
<td>39</td>
<td>2.6</td>
<td>104.9</td>
<td>---</td>
<td>26.5</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

--- = not mentioned in manuscript
LATE MANAGEMENT (>3MOS)

- RULE OUT INFECTION!!!
- Most authors feel that closed manipulation no longer successful (scar matured)
- surgical management of capsular contracture
  (Arthroscopic vs open)
- specific goals in mind for re-operation

Diagram:
- Neg Work Up Lacks Functional Flexion
  - <6 weeks: Aggressive PT
  - 6 weeks – 3 mo: MUA
  - 3-6 mo: Arthroscopic vs Open lysis of adhesions
  - >6 mo: Revision TKA
**ARTHROSCOPY AFTER TKA**

- rarely indicated (complications – Sisto)
- patella clunk
- intra-articular adhesions – not helpful
- isolated PCL tightness (Windsor)

Review of arthroscopy for TKA stiffness from Fitzsimmons CORR 2010

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of knees/number of patients</th>
<th>Final increase in ROM (mean)</th>
<th>Final increase in flexion (mean)</th>
<th>Final increase in extension (mean)</th>
<th>Timing of procedure (mean in months)</th>
<th>Followup (mean in months)</th>
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<tbody>
<tr>
<td>Arthroscopy group</td>
<td></td>
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<td>Bae et al. [2]</td>
<td>13 (11)</td>
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<td>45°</td>
<td>-3°</td>
<td>20</td>
<td>12</td>
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<td>Campbell [4]</td>
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<td>-</td>
<td>-</td>
<td>11.6</td>
<td>≥12</td>
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<tr>
<td>Diduch et al. [8]</td>
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<td>26.3°</td>
<td>-</td>
<td>-</td>
<td>7.4</td>
<td>-</td>
</tr>
<tr>
<td>Johnson et al. [13]</td>
<td>2 (2)</td>
<td>-</td>
<td>30°</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parisien [21]</td>
<td>1 (1)</td>
<td>50°</td>
<td>45°</td>
<td>5°</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Scraffon [24]</td>
<td>7 (7)</td>
<td>31°</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Sprague et al. [26]</td>
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<td>23°</td>
<td>5°</td>
<td>18°</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Teng et al. [28]</td>
<td>11 (11)</td>
<td>30.8°</td>
<td>29°</td>
<td>1.8°</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Wasilewski and Frankl [29]</td>
<td>6 (6)</td>
<td>34°</td>
<td>26°</td>
<td>8°</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Williams et al. [30]</td>
<td>10 (9)</td>
<td>33°</td>
<td>30.5°</td>
<td>2.5°</td>
<td>29</td>
<td>20</td>
</tr>
<tr>
<td>Yercan et al. [33]</td>
<td>3 (3)</td>
<td>60°</td>
<td>58.4°</td>
<td>1.6°</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Deep MCL fibers along medial plateau to semimembranosis bursa
lateral fibers to Gerdy’s tubercle
chondro-osseous border of the patella
lateral patello-femoral ligament
flexion and external rotation of the tibia is key

More likely to return to functional range of motion after open release (systematic review mean 43° increase ROM) – Ghani Knee 2012.
Thorough pre-revision evaluation

Want to know the etiology of a patient's pain and stiffness so you can address it!
  - Imbalance
  - Loosening
  - Joint line elevation
  - Malalignment
  - Poor sizing

Outcomes will be unpredictable if operating solely for stiffness without a cause
EVALUATION OF IMPLANT FACTORS IN STIFF TKA:

- 3D component sizing (AP and ML dimension)
- Anterior and posterior offset
- Kinematic conflict (tissue vs implant, implant vs implant)
Overhang and oversizing – a potential contributor to stiffness and pain
HIGH CONFORMITY OR CONSTRAINT OF A MOBILE BEARING CAN CREATE STIFFNESS
ACCURATE RESTORATION OF ANTERIOR AND POSTERIOR OFFSET…

- Measure preop films!!
Revision TKA for stiffness (<70 flexion preop)
- 8/11 had some preop identifiable reason for stiffness (loosening, malalignment, HO, instability)
- ROM improved from $39\pm20^\circ$ preop to $83\pm23^\circ$ postop (p<0.01)
- Flexion contracture improved from $11\pm11^\circ$ to $3.5\pm4^\circ$ (P<0.02)
- KSS improved, functional scores improved, 11/11 satisfied
- 4/11 required MUA at an average 1 month post-op

Revision of both components can be successful
- Key is ligamentous balance, joint line restoration, proper component sizing

Revision of the Stiff Total Knee Arthroplasty

LCDR Christian P. Christensen, MC, USNR,* John J. Crawford, MD,† Matthew D. Olin, MD,‡ and Thomas Parker Vail, MD†

The Journal of Arthroplasty Vol. 17 No. 4 2002
IS IT THE PATIENT’S BIOLOGY?
15 primary TKA patients with history of MUA or revision for stiffness on contralateral

Higher rates of MUA (26.7%) vs historical control at same institution (2.8%)

Though early stiffness more common by 2 years able to reach equivalent ROM and functional outcomes scores vs controls with close follow-up and early intervention
EMERGING THERAPEUTIC DRUGS.

- Anakinra – IL-1 receptor antagonist
  - Small pilot trials demonstrated some efficacy with intra-articular injection in improving ROM and pain in patients with refractory arthrofibrosis (not limited to TKA patients) – Brown Orthopedics 2010
  - Fibroblasts of synovium and fat pad in TKA patient exhibit proinflammatory response to IL-1 (Dixon Scientific Reports 2015)
- Rosiglitazone – PPAR-gamma agonist (common DM drug)
  - PPAR-gamma agonists can block TGF-beta – known fibrosis inducing pathway
  - In rabbits demonstrated decreased flexion contractures after surgical capsular release with this treatment