

Knee Replacements in 2023 and the Role of Biologics to Improve Outcomes

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Disclosures

- Consulting: Enovis
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- Royalties: Innomed





Starting a New Joint Program in Colorado...



Starting a New Joint Program in Colorado...

Total Joint Replacement in 2023



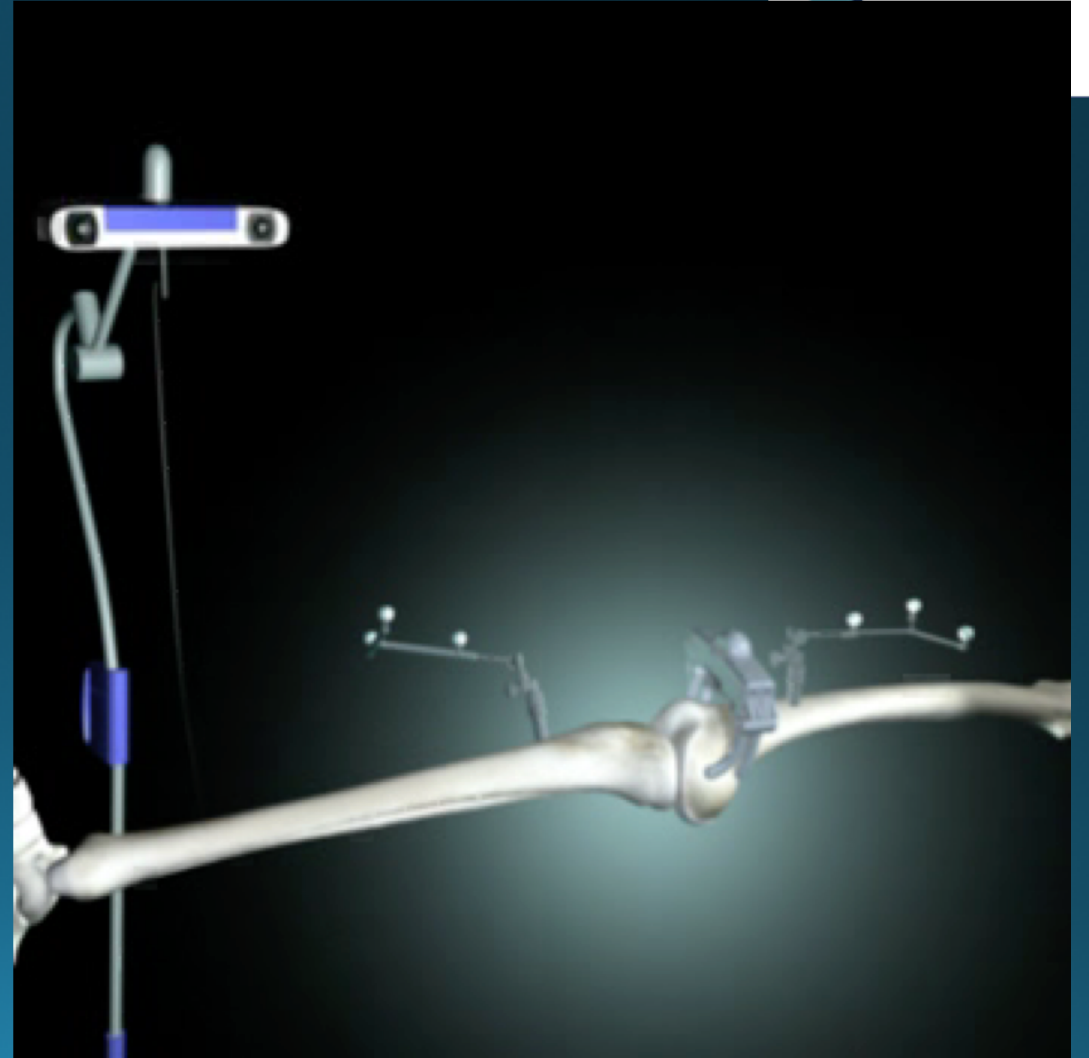
- Improved Designs and Bearings
- Improved Instruments
- Improved Anesthesia Techniques
- Enhanced Recovery



Total Joint Replacement in 2023



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Total Joint Replacement in 2023



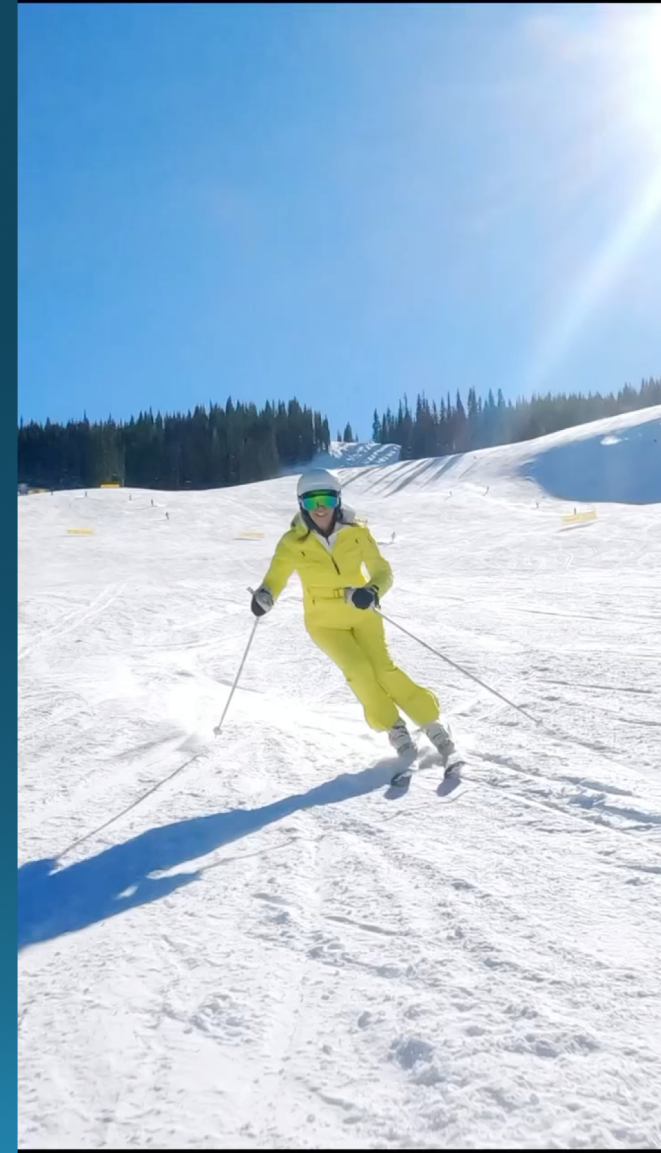
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Total Joint Replacement in 2023



- Improved Designs and Bearings
- Improved Instruments
- Improved Anesthesia Techniques
- **Enhanced Recovery**



Enhanced Recovery in TJA



- Reduced length of stay



- Outpatient Total Joints!



Practice Evolution



Practice Transition

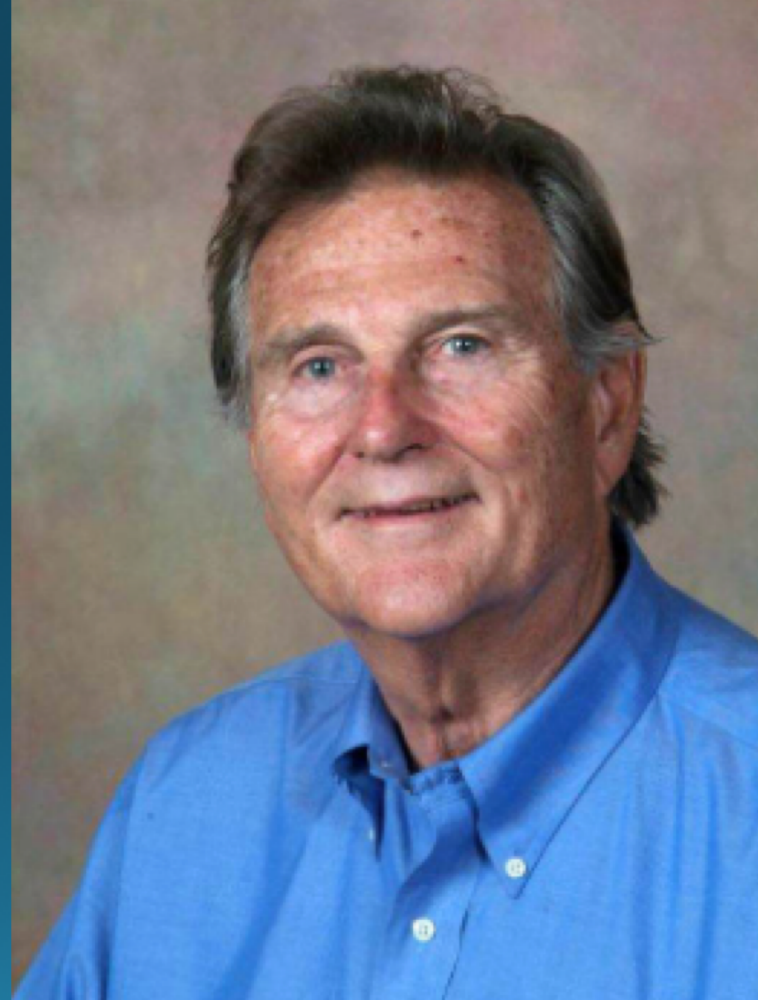


- Previous practice in Denver
 - 2006-2017
 - 2006 average length of stay **3.5 days**
 - 800 total joints in 2016
 - **ALL INPATIENT** total joint replacements
 - 2017 average length of stay **1.6 days**



The Steadman Clinic

- 1990 Dr. J. Richard Steadman
- 2005 Dr. Marc Philippon
- 2010 The Steadman Philippon Research Institute
- World renown for their care of professional and Olympic athletes
- Well-versed in **OUTPATIENT SURGERY**



Collaboration with The Steadman Clinic



- Outpatient surgery

+

- Total joint practice



Steadman Clinic Outpatient TJA



Our challenges:

- 2016 80 joint replacements in the Vail Valley (included shoulder arthroplasty)
- 54 bed hospital with 4 ORs
- Elevation: 8120 feet
- 30% of our patients from outside region/state/country



Steadman Clinic Outpatient TJA



- New practice at The Steadman Clinic since February 2017
- >5300 total joints
- Outpatient (97% since 2019)
 - >4700 outpatient total joints



Outpatient Total Joints



- Yes, it can be done!
- Essential program elements for outpatient TJA
 - Patient selection
 - Anesthesia
 - Surgical



Outpatient Total Joints

- Essential program elements for successful outpatient TJA
- **Patient selection**
 - Medical clearance
 - Pre-op education
- **Anesthesia**
 - Regional
 - Excellent pain control and nausea control
- **Surgical**
 - Well executed surgery
 - Efficient surgical team



Joint Replacements is a Team Sport



- PAs (4)
- Surgical assistant (1)
- Total joint team leader
 - Lead nurse
- Surgical techs (3)
- Circulating nurses (3)
- Implant rep
- Anesthesiologists (6)
- House keepers (3)
- SPD



Warren Buffett



- HIRE WELL!



WARREN BUFFETT'S 10 RULES FOR SUCCESS

1. FIND YOUR PASSION
2. HIRE WELL
3. DON'T CARE WHAT OTHERS THINK
4. READ, READ, READ
5. HAVE A MARGIN OF SAFETY
6. HAVE A COMPETITIVE ADVANTAGE
7. SCHEDULE FOR YOUR PERSONALITY
8. ALWAYS BE COMPETING
9. MODEL SUCCESS
10. GIVE UNCONDITIONAL LOVE



Just Because You're
Tom Brady...



Doesn't mean you'll win the
Superbowl!



Must have a winning TEAM!



Surgical Workflow

- 2 ORs, 3 teams
- 6:30 AM first cut time
- TKAs and THAs scheduled every 45 min
- 10 min room turnover
- 10 min from wheels in OR to incision
- 12 to 14 joints per day



Outcomes of our outpatient total joints utilizing The Steadman Clinic protocol

- Joshua Rozell M.D.



Study Design

Email survey to 915 patients



486 responses



429 phone call follow ups



Questions Asked

- Were you readmitted to the hospital?
- Did you have a blood clot?
- Did you have an infection?
- Did you have additional surgery on the knee/hip?



Key Findings: TKA and THA



Question	TKA	%	THA	%
Were you admitted hospital?	9	1.6	5	2.2
Did you have a blood clot?	3	0.5	3	0.5
Did you have an infection?	1	0.2	3	1.3
Did you have additional surgery?	2	0.4	2	0.9

Conclusions

- 90 day complications extremely low
- Infection rate 0.5%
- DVT rates are extremely low and comparable to prior studies of DVT rates at sea level
- Outpatient total joints perform well and are safe!



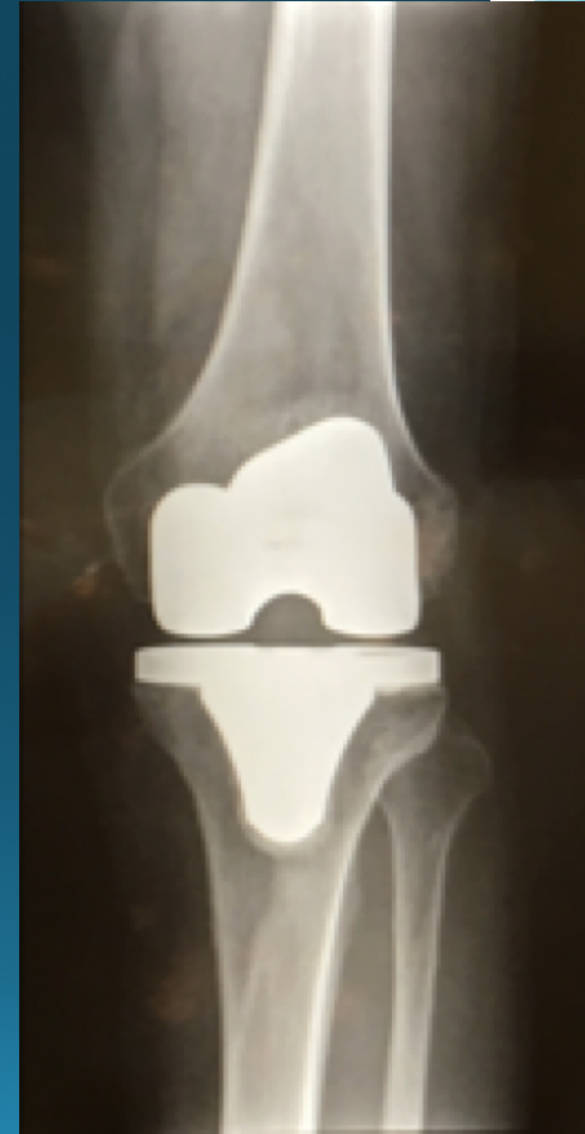
Total Knee Replacement



- Successful procedure
 - 93-97% survivorship at 11 years
 - 88-96% good/excellent HSS scores

Colizza, Insall, Scuderi, JBJS 1995

Ranawat, JBJS 1997



Stiffness in Knee Replacement



- Arthrofibrosis (stiffness) defined as limited range of motion
- Dramatically affect quality of life
- Poor functional outcomes
- Pain
- Limitations of daily activities



Stiffness in Knee Replacement



- Occurs in 8 to 60% of patients

Springer, Odum, Nagpal,
Lombardi, Berend, Kim,
Dennis, Orthop Clin N Am 2012

- Affects around 45,000 people in the US every year (800,000 TKA's performed annually)
- May require a second surgery to remove scar tissue, significantly delaying recovery and increasing costs



Stiffness in Knee Replacement



- Etiology
- Management
- Biologics



TKA Motion: Patient Factors



- Pre-op ROM closely correlates with post-op ROM

Ritter, JBJS 2002

Lizaur, JBJS 1997

Harvey, JBJS 1993

- Obesity
 - ↑ Lower extremity girth
 - soft tissue impingement

Shoji, Orthopedics 1990



Courtesy of Dr. Josh Baumfeld

Patient Factors

- Inadequate post-op rehabilitation
 - Pre-op education is critical
 - Goal setting is helpful
 - Pain inhibition - adequate analgesia



Is Socio-Economic Status a Risk Factor for Stiffness after TKA? A Multicenter Case Control Study



- **African-Americans** 2x risk for manipulation
- **Age < 45** 2x risk for manipulation compared with patients > 75
- Medicare patients less risk
- No correlation with gender, femoral component design

Springer, Odum, Nagpal, Lombardi, Berend, Kim, Dennis
Orthop Clin North Am, 2012

Technical Errors:



Technical Errors: Educating Residents and Fellows





StiffTKA: Management

Stiffness in Knee Replacement

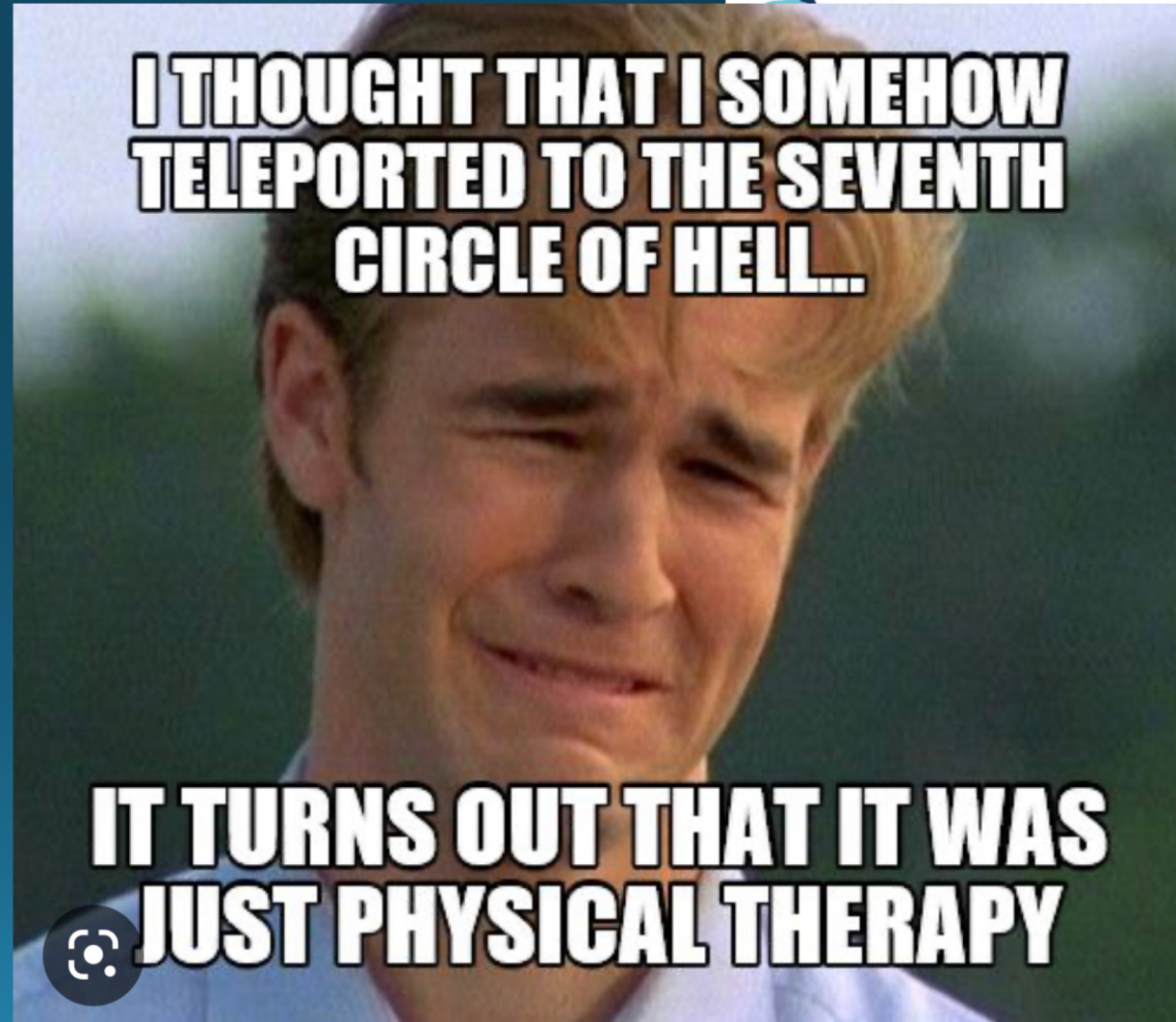


Your Orthopedic Surgeon

Stiff TKA: Management



- Early Postoperative
 - Aggressive physiotherapy
 - Adequate analgesics



Stiff TKA: Management

- Closed Manipulation
 - 4-8 weeks postoperatively
 - Consider regional blocks
 - Aggressive post-op PT
 - Consider dynamic splinting



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Closed Manipulation

- 24 yo F, s/p 10 previous surgeries for tibial plateau fracture (ex fix, ORIF, infection, open debridement, hardware removal, etc)
- 6 weeks s/p TKA, 0-95°
- Closed manipulation
- 0-125° 2 yrs post manipulation



Stiff TKA: Management

- Late (> 3 - 4 months postoperative)
 - Usually surgical (capsular contracture)
 - Soft tissue expansion (cutaneous contracture)
 - Arthroscopic arthrolysis
 - Open synovectomy
 - Revision



Revision TKA for Stiffness



- 7 stiff TKAs revised
 - Arthrolysis of adhesions
 - Thinner polyethylene liner
- Pre-op ROM arc = 38.6° ($15-60^{\circ}$)
- Post-op ROM arc = 58° ($40-70^{\circ}$)
- Minimal change in KS pain / function scores
- Knee stiffness poorly understood

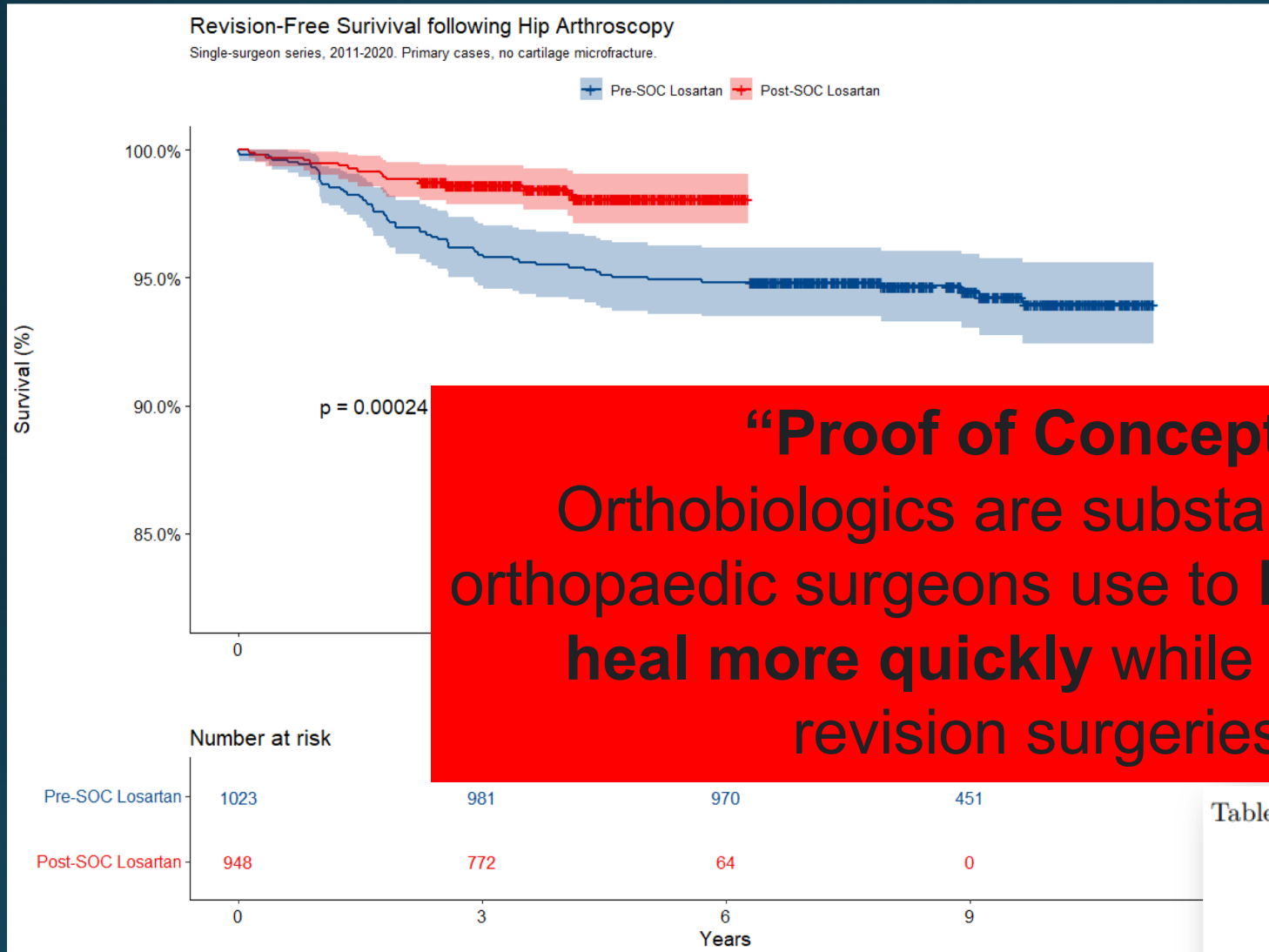
Babis, Trousdale et al, JBJS 2001

Stiff TKA Management

- Best management is **PREVENTION**
 - Preoperative education
 - Avoidance of technical errors
 - Biologics???



Losartan results in a 64% reduction in the need for revision hip surgery. Now a standard of care for Dr. Marc Philippon.



“Proof of Concept”:
Orthobiologics are substances that orthopaedic surgeons use to **help injuries heal more quickly** while reducing revision surgeries

Table 1: Cox Proportional-Hazards Model for risk of revision hip scope at TSC

Characteristic	HR	95% CI	p-value
LOSARTAN			
Pre SOC Losartan	—	—	
Post SOC Losartan	0.36	0.21, 0.64	<0.001

¹ HR = Hazard Ratio, CI = Confidence Interval

The Beneficial Effect of an Intra-articular Injection of Losartan on Microfracture-Mediated Cartilage Repair Is Dose Dependent

Catherine A. Logan,* MD, Xueqin Gao,*[†] MD, PhD , Hajime Utsunomiya,* MD, PhD , Alex C. Scibetta,* BS, Mika Talwar,* BS, Sudheer K. Ravuri,* PhD, Joseph J. Ruzbarsky,* MD, Justin W. Arner,* MD, Dandan Zhu,[‡] PhD, Walter R. Lowe,[‡] MD, Marc J. Philippon,* MD, and Johnny Huard,*^{†§} PhD
Investigation performed at the University of Texas Health Science Center at Houston, Houston, Texas, USA

Background: A previous publication demonstrated that the oral intake of losartan promoted microfracture-mediated hyaline-like cartilage repair in osteochondral defects of a rabbit knee model. However, an intra-articular (IA) injection of losartan may have direct beneficial effects on cartilage repair and has not been studied.

Purpose: To determine the dosage and beneficial effects of an IA injection of losartan on microfracture-mediated cartilage repair and normal cartilage homeostasis.

Study Design: Controlled laboratory study.

Methods: Rabbits were divided into 5 groups (n = 6 each): a microfracture group (MFX group) and 4 different losartan treatment groups that received varying doses of IA losartan (0.1, 1, 10, and 100 mg per knee). An osteochondral defect (5 mm) was created in the trochlear groove cartilage of 1 limb in each rabbit, and 5 microfracture perforations were made in the osteochondral defect. Both the injured and the contralateral knee joints were injected with IA losartan immediately after microfracture and at 2 and 4 weeks after surgery. Rabbits were sacrificed at 6 weeks after surgery for analysis including gross observation, micro-computed tomography, histology, and reverse transcription quantitative polymerase chain reaction.

Results: Micro-computed tomography and gross observation demonstrated comparable subchondral bone healing and hyaline-like cartilage morphology in the 0.1-, 1-, and 10-mg losartan groups relative to the MFX group. Conversely, the 100-mg losartan group showed neither bony defect healing nor cartilage repair. Histology revealed higher O'Driscoll scores and hyaline-like cartilage regeneration in the 1-mg losartan group compared with the MFX group. In contrast, the 100-mg losartan group showed the lowest histology score and no cartilage repair. An IA injection of losartan at the doses of 0.1, 1, and 10 mg did not cause adverse effects on uninjured cartilage, while the 100-mg dose induced cartilage damage. Quantitative polymerase chain reaction results showed downregulation of the transforming growth factor β (TGF- β) signaling pathway after IA losartan injection.

Conclusion: An IA injection of losartan at the dose of 1 mg was most effective for the enhancement of microfracture-mediated cartilage repair without adversely affecting uninjured cartilage. Conversely, a high dose (100 mg) IA injection of losartan inhibited cartilage repair in the osteochondral defect and was chondrotoxic to normal articular cartilage.

Clinical Relevance: An IA injection of losartan at an optimal dosage represents a novel microfracture enhancement therapy and warrants a clinical trial for future clinical applications.

Keywords: microfracture; cartilage repair; losartan; TGF- β signaling; intra-articular injection



Additional Losartan Benefits?



- We have already tested the **knee** and the **hip** (Hajume Utsunomiya, Marc Philippon)
- Drs. Lucca Lacheta and Peter Millett are testing it in the **shoulder** (rotator cuff), AGA MEDI award (Germany)
- Drs. Ingrid Stake, Tom Clanton, Tommy Haytmanek are testing it in the **ankle**

Enhancement of Rotator Cuff Healing with Bone Marrow Stimulation combined with Losartan to inhibit Transforming Growth Factor-Beta (TGF- β) in a Rabbit Model

Research performed at the Steadman Philippon Research Institute, Vail, CO

Short-running title: Blocking Transforming Growth Factor-beta in Rabbit Rotator Cuff Healing



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Research Article

Frontiers in Orthobiologics for the Treatment of Osteochondral Lesions of the Ankle Joint

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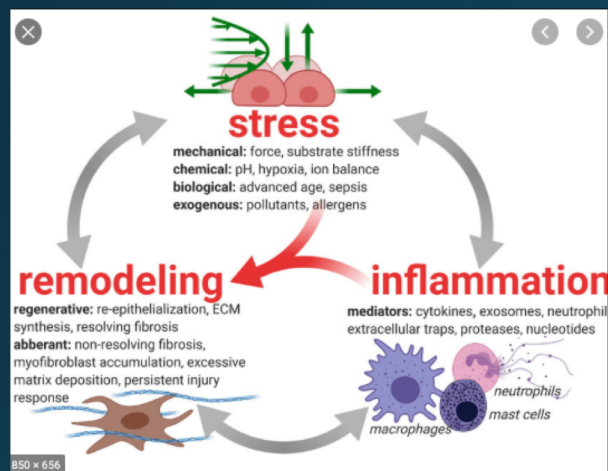
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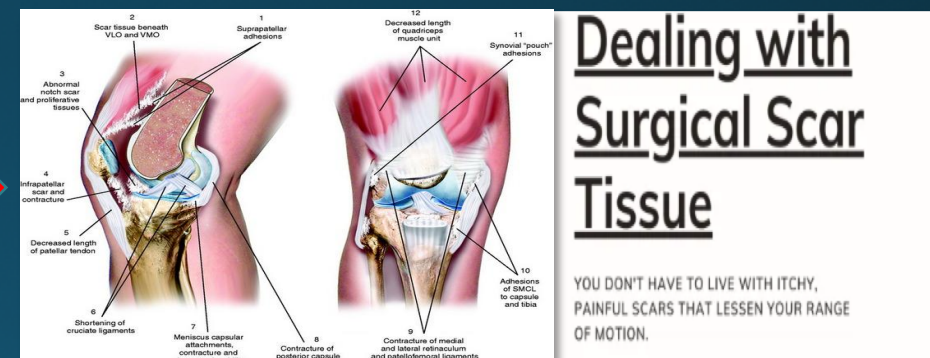
Combination of biological approaches to reduce fibrosis & chronic inflammation

THE USE OF SENOLYTIC AND ANTI-FIBROTIC AGENTS TO IMPROVE THE BENEFICIAL EFFECT OF BONE MARROW STEM CELL (BMSC) FOR OSTEOARTHRITIS

Reducing inflammation prior to surgery



Reducing scar tissue after surgery



Can reducing inflammation and scar tissue improve clinical outcome after knee replacement?

Mitigation of Arthrofibrosis after Total Knee Replacement using Losartan



- Principal Investigators
- Raymond Kim MD
- Johnny Huard PhD





Thank You
Crown Family Foundation

The Science Behind Losartan...



Losartan for Preventing Arthrofibrosis



MITIGATION OF ARTHROFIBROSIS AFTER TOTAL KNEE ARTHROPLASTY USING LOSARTAN

Principal Investigator: Raymond Kim, MD

Key SPRI Collaborators: Johnny Huard, PhD

Background & Significance: Arthrofibrosis occurs in 4 to 7% of patients after total knee arthroplasty (TKA), leading to joint stiffness and limited range of motion that may require secondary surgery to remove scar tissue. Fibrotic changes in muscle are also common in osteoarthritis patients; these changes are difficult to reverse through conventional therapy and are one of the greatest predictors of poor outcomes after TKA. Thus, there is a significant need to develop therapies for reversing existing fibrosis and preventing scar tissue development after TKA. Losartan is an angiotensin receptor blocker with inhibitory effects on transforming growth factor beta (TGF- β), which has been largely implicated in the development of fibrosis. Preclinical research at the Steadman Philippon Research Institute (SPRI) has shown that Losartan can block fibrosis development and clinical studies at The Steadman Clinic (TSC) have demonstrated that postoperative Losartan improves clinical outcomes and reduces the need for revision surgery after hip arthroscopy. Thus, there is substantial evidence to suggest that the use of Losartan pre- and postoperatively may reduce both joint and muscle fibrosis after TKA, reducing the need for corrective surgery and significantly improving clinical outcomes. SPRI & TSC are the ideal partners for conducting this study due to Dr. Kim's surgical expertise and high volume of TKA procedures and SPRI's research experience with Losartan combined with imaging capabilities for quantification of synovial thickening (a measure of fibrotic changes in the joint leading to stiffness).

Summary

- Make Arthroplasty Great Again!
- Knee Replacements in 2023
 - Excellent outcomes
 - Outpatient
- Role of Biologics
 - Reduce inflammation and scarring
 - Improve range of motion and function
 - Reduce risk of re-operation



Hiking with Total Joints



Skiing with Total Joints



Thanks for your attention



The Steadman Clinic
Vail, Colorado

