STRIVING FOR PERFECTION IN TOTAL KNEE ARTHROPLASTY

CURRENT OPTIONS AND ALTERNATIVE THERAPIES FOR ARTHRITIS

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10/3/2019

DISCLOSURES

- Consultant
  - Conformis
- -Thank you for this opportunity!

OUTLINE

- Introduction to Arthritis and Total Joint Arthroplasty
- Traditional Total Knee Arthroplasty and outcomes
- Evolution and innovations (Custom instrumentation, implants)
- Comparison of options
- Alternative therapies (Stem Cell and PRP)

- Question and Answer

PROFESSIONAL BACKGROUND

- High School: Middleton
- College: UW Madison
- Medical School: UW Madison
- Residency (5 years): UCLA
- Fellowship: Mayo Clinic
  - Hip, Knee and Shoulder Replacement
- Prairie Ridge Health
  - Orthopedic Surgeon (August 2015)
    - Joint replacement specialist
    - General orthopedics
  - Chief of Staff (January 2019)
  - Associate professor MCOW (2018)
- IMEs with Crawford Evaluation Group
  - ~1.5 years


39
WATSO
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TEXANS
99

INTRODUCTION

- From 2013–2015, an estimated 54.4 million US adults (22.7%) have a form of arthritis: Osteoarthritis, rheumatoid arthritis, etc.
- The percentage of adults with arthritis varies by state, ranging from 17.2% in Hawaii to 33.6% in West Virginia in 2015.
  - Wisconsin ~ 22%

- <u>Projected Data:</u>
  - By 2040, an estimated 78 million (26%) US adults aged 18 years or older are projected to have doctor-diagnosed arthritis.

QUESTION 1

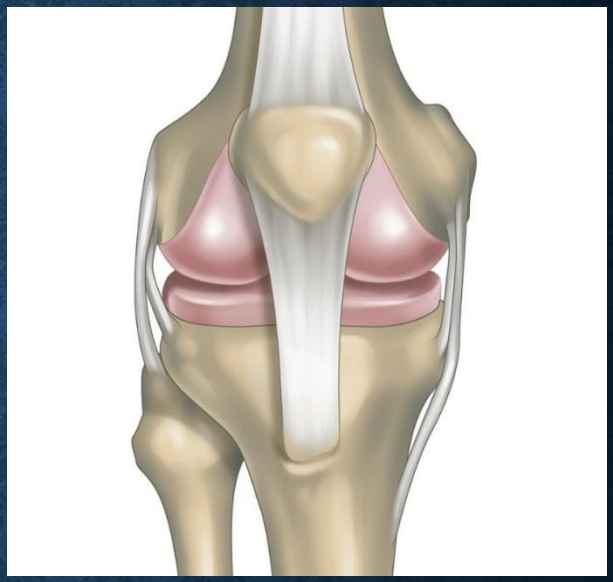
- True of False:
  - Arthritis is something that grows in and eventually destroys the joint?

WHAT IS ARTHRITIS?

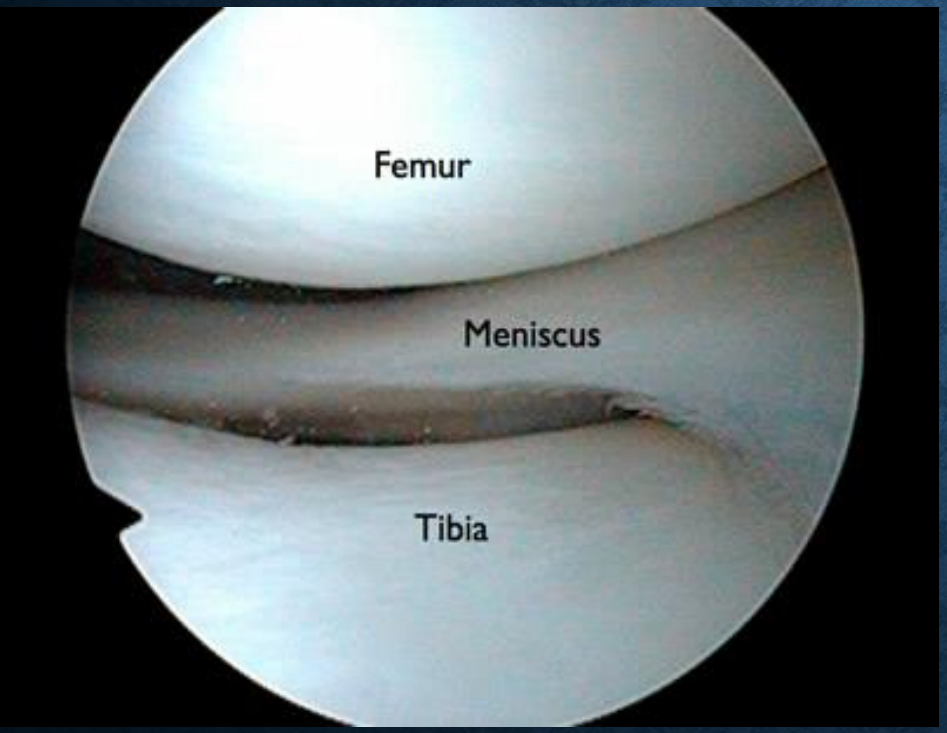
- False
- Literal Definition is “inflammation of the joint”
  - Misnomer
- In reality its simply a loss of articular cartilage
  - Nothing actually grows in the joint that needs to be removed
  - Progression of disease
    - “wearing tread on a tire”
  - Mild – Severe (End Stage)

ARTICULAR CARTILAGE

- Low friction surface on the ends of our bones
  - Hips, Knees, Shoulders, fingers, etc
- Lubricates and cushions movement
  - Slide and glide
- No nerve receptors (No pain)
- “Q-Ball”



NORMAL VS. ARTHRITIC



ARTHRITIC KNEE

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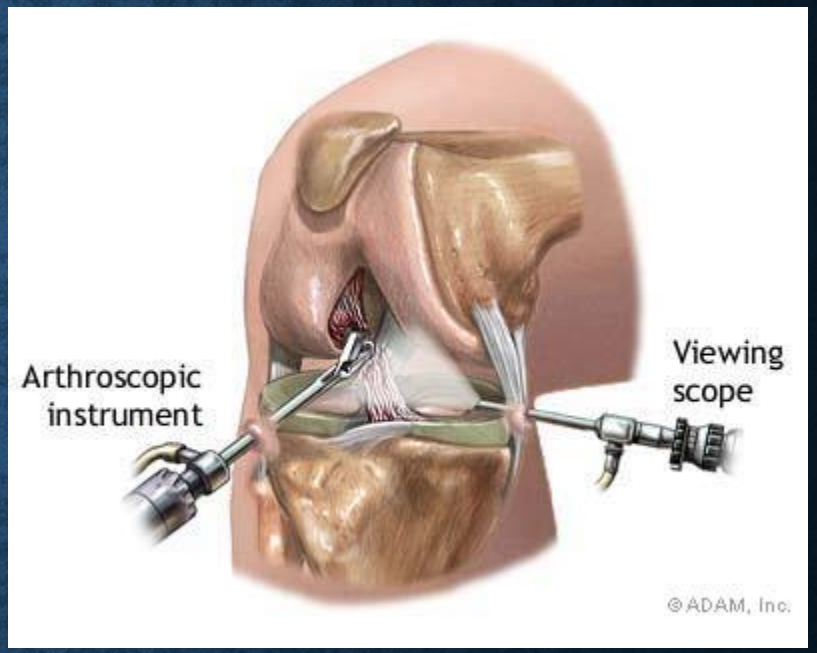
SURGICAL OPTIONS

- Arthroscopy – poor option for arthritis
  - Rare indications
    - Loose body, unstable meniscus ?
- Total joint replacement

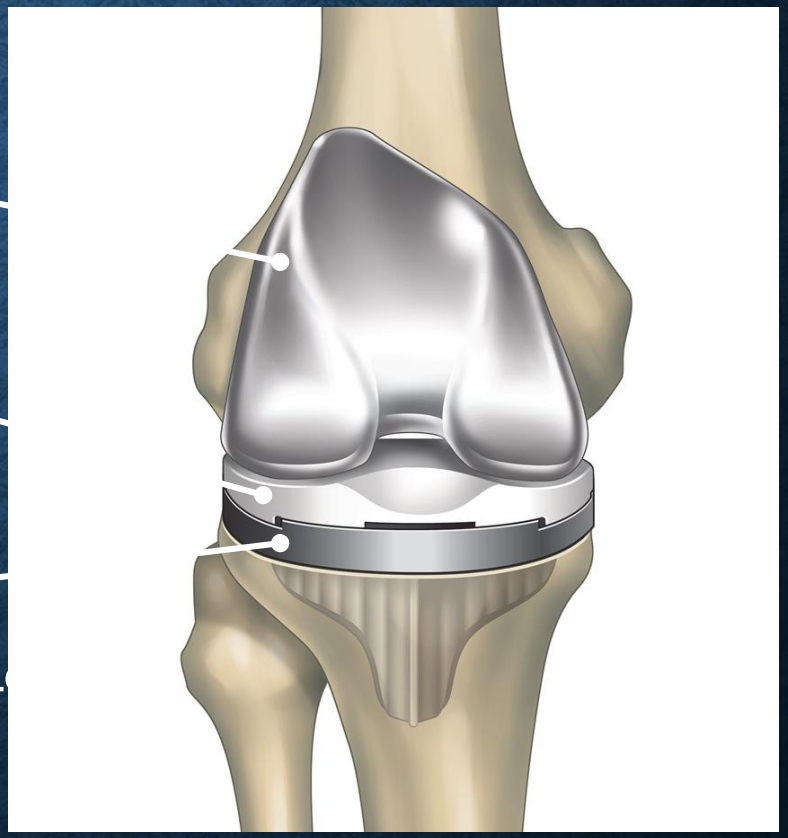


TOTAL KNEE REPLACEMENT

Femoral Component

Polyethylene Bearing
(acts as cartilage)

Tibial Tray
(supports polyethylene bearin



TOTAL HIP REPLACEMENT

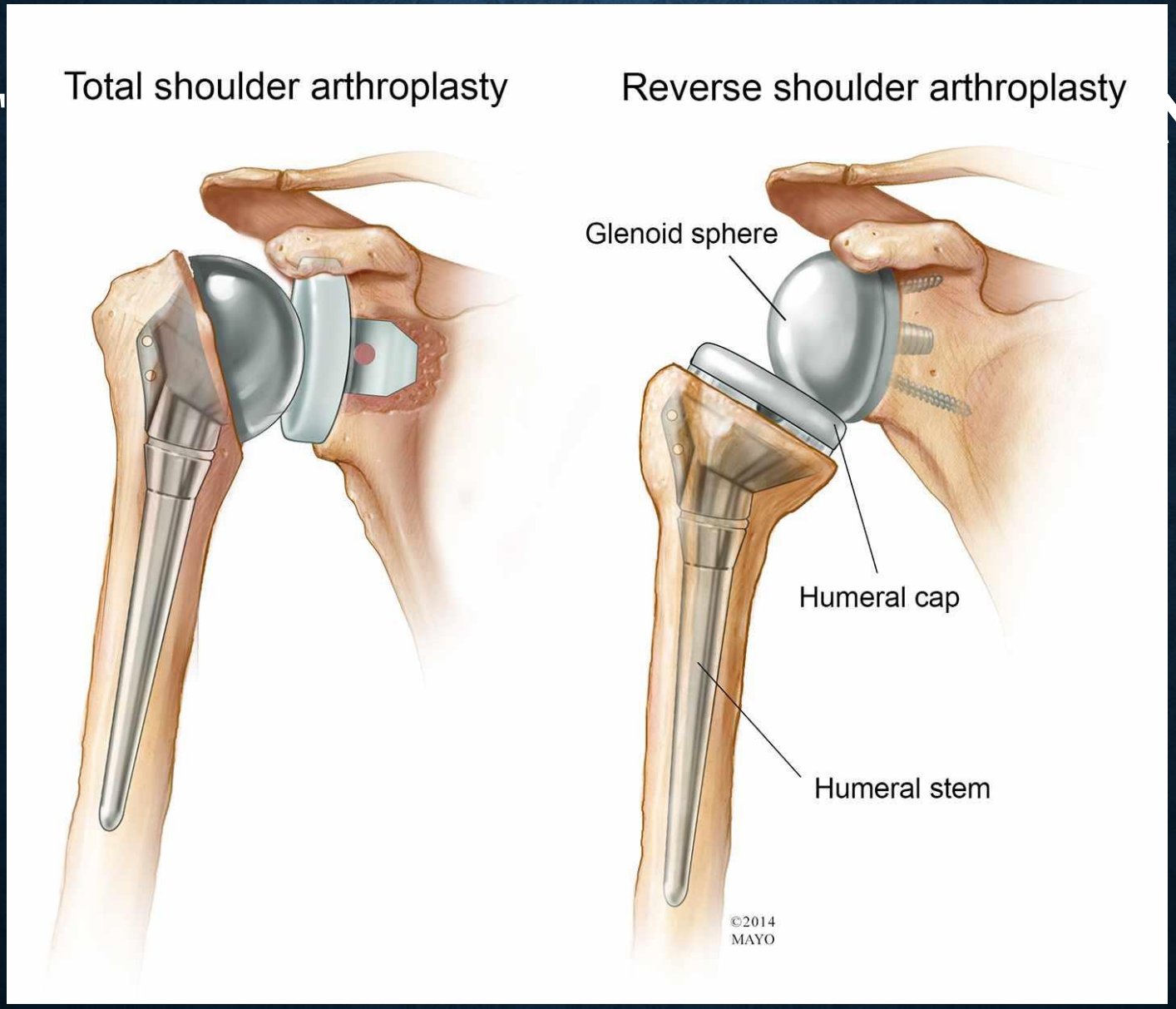
Shell

Liner

Stem

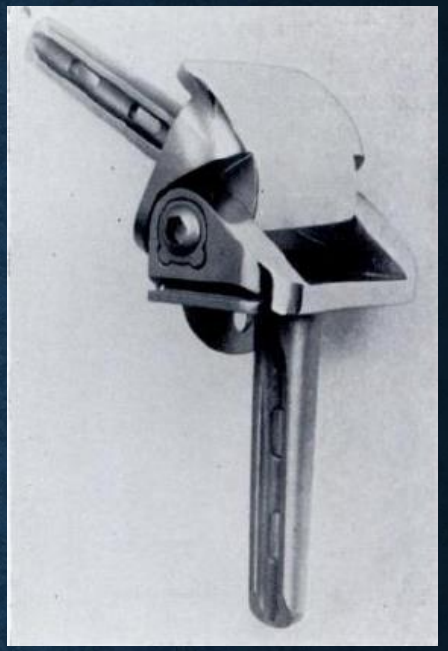
TOTAL HIP REPLACEMENT

T NT

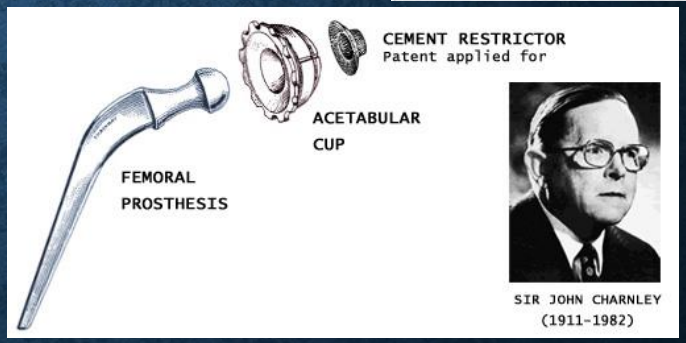

Total shoulder arthroplasty
Reverse shoulder arthroplasty
Glenoid sphere
Humeral cap
Humeral stem
©2014
MAYO

TOTAL SHOULDER REPLACEMENT

TOTAL KNEE ARTHROPLASTY



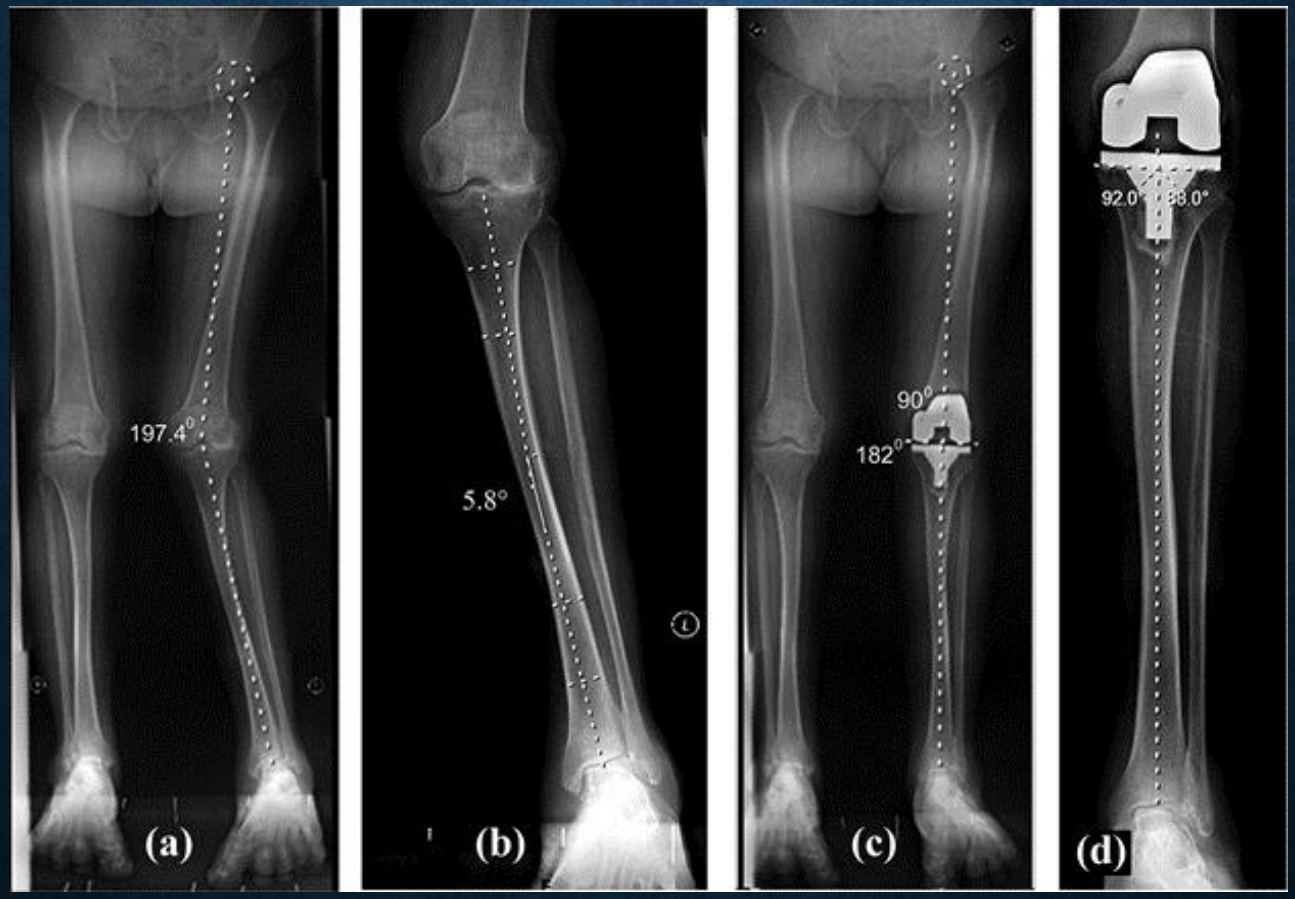
- 1860-German surgeon, Themistocles Gluck, surgically implanted the first primitive hinge joints made of ivory.
- 1951 - Introduction of the Walldius hinge joint. Initially this was manufactured from acrylic. – Early failure
- 1958 – Introduction of cobalt and chrome surfaces. –Still the gold standard
- Early 1960s, John Charnley's cemented metal-on-polyethylene THA inspired the development of the modern total knee replacement.



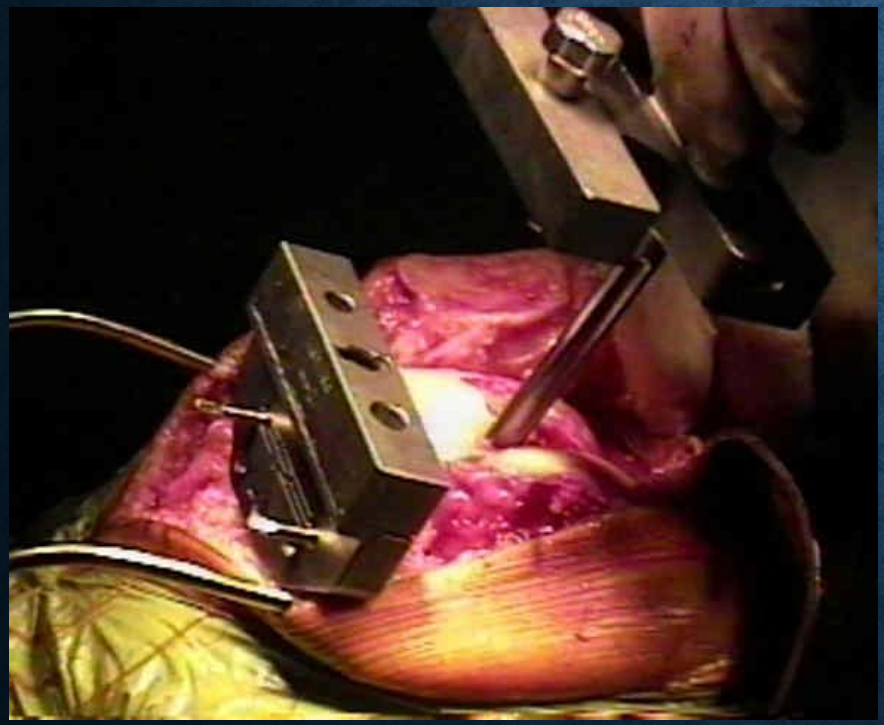
TOTAL KNEE ARTHROPLASTY

- Early 1970s - The metal-on-polyethylene condylar design which completely replaced the femoral and tibial articulating surfaces,
- Improvements in component materials, geometry and fixation have continued since the 1970s and 1980s.
- Advancements in component materials, geometry/shape, sizing, fixation, instrumentation since the 1970s:
- Too much to discuss! Just a few…
  - Total versus partial versus PF
  - Cemented versus press-fit
  - Gender knees-sizing
  - High flexion options
  - Polyethylene options
  - Crosslinked polyethylene
  - Navigation and robotics
  - Custom 3-D printed implants

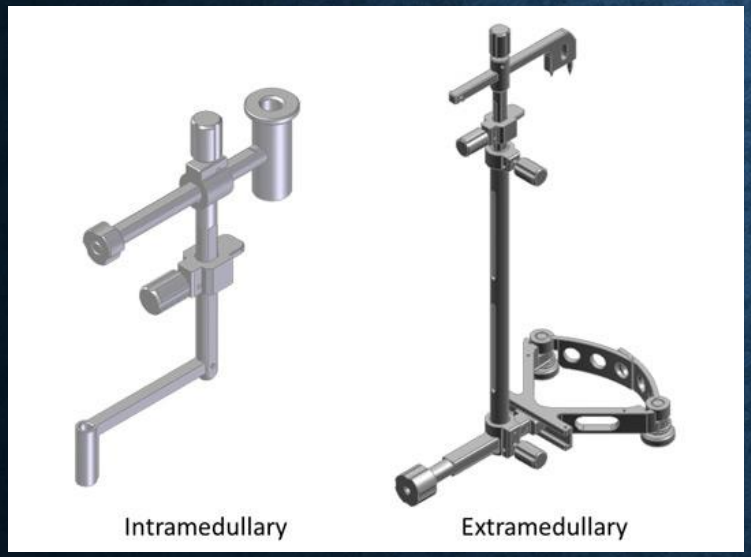
TRADITIONAL KNEE ARTHROPLASTY

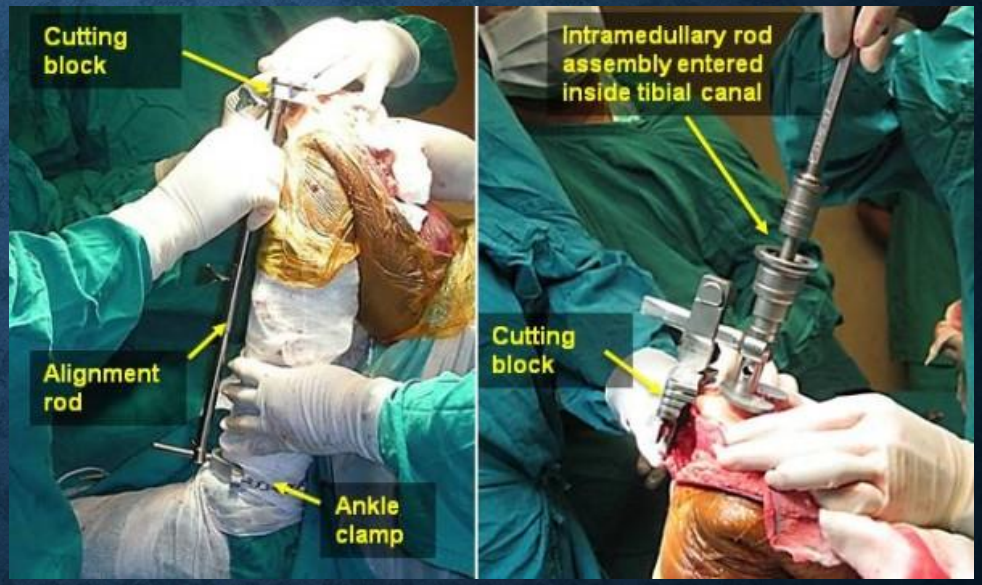


TRADITIONAL KNEE ARTHROPLASTY



TRADITIONAL CUTTING GUIDES IN TKA





TRADITIONAL CUTTING GUIDES

- Challenge of precision and reproduction of “ideal cut” and mechanically aligned knee
  - Loose knee- poorly balanced painful, wear/loosening
- Blood loss from IM rod
- Increased pain and swelling after surgery
- Risk of fracture – low risk
- Still considered gold standard
  - Insurance coverage of PSI, custom implants varies considerably

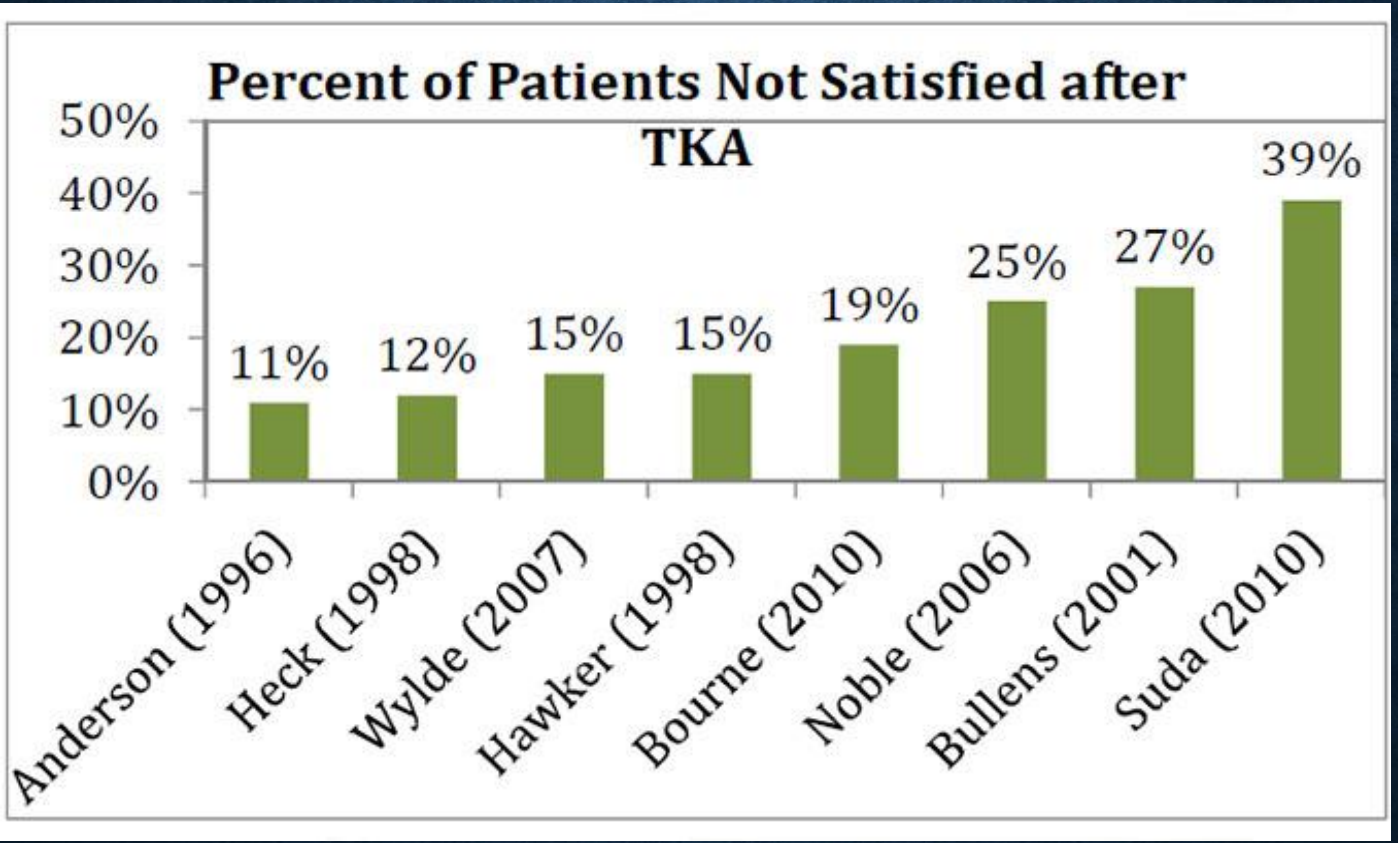
QUESTION 2

- What percentage of patients are satisfied after total knee arthroplasty?
- 1. 100%
- 2. 90-99%
- 3. 70-89%
- 4. 60-69%
- 5. Less than 60%

OUTCOMES AFTER JOINT REPLACEMENT

- Improved quality of life, pain, function, range of motion.
  - Complications do occur
    - 5-10% depending on procedure
- ~80% satisfaction with THA, TKA, TSA
- Longevity: ~1% failure per year for joint replacement
  - General rule for TSA, THA, TKA

OUTCOME OF TRADITIONAL TOTAL KNEE ARTHROPLASTY



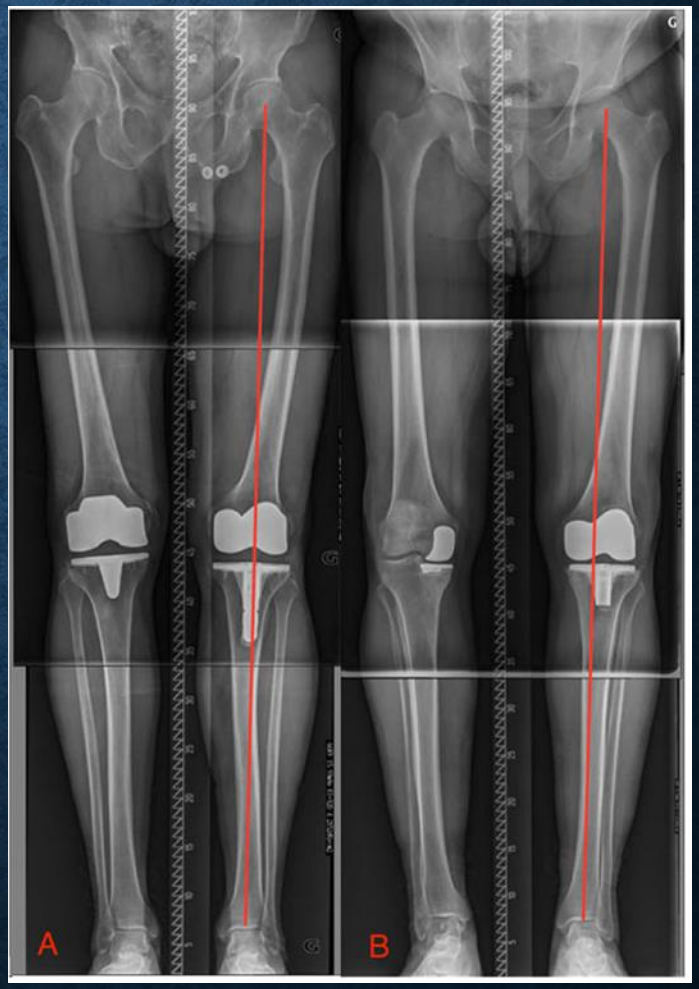
- Typical range 15-20% of patients are unsatisfied
  - 1 in 5!

STRIVING FOR PERFECTION

- This dis-satisfaction has lead to continued evolution in implants
  - Necessity breeds innovation
  - Optimized size, rotation, alignment, fixation, etc
  - Improve every variable in the equation

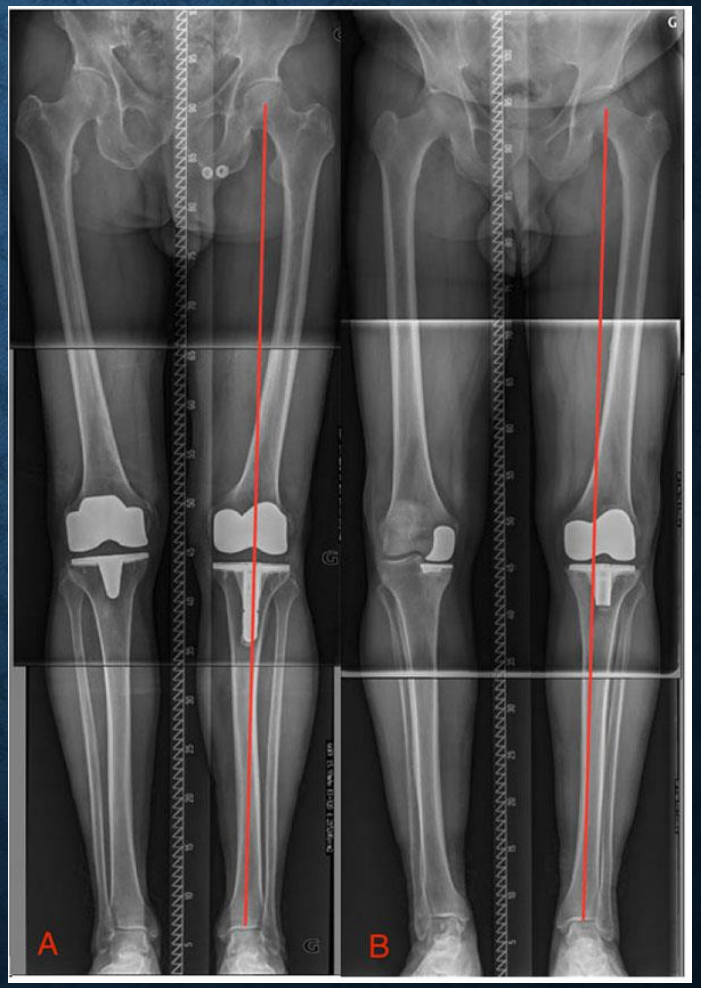
IMPROVED ALIGNMENT WITH NAVIGATION/ROBOTICS/PSI

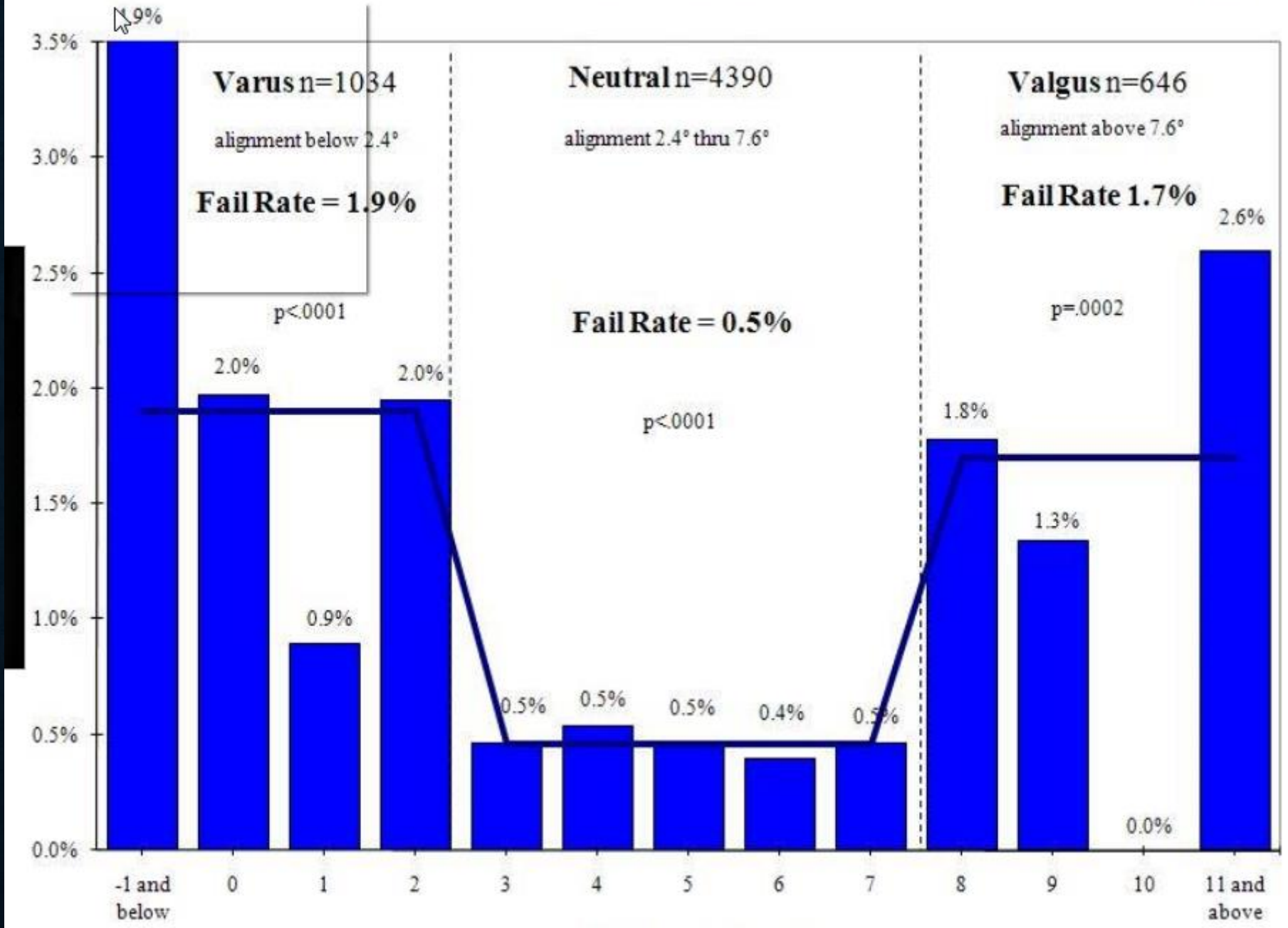
- Rand and Coventry 1988:
  - 10 yr survival if V/V < 4 deg: 90%
  - 10 yr survival if V/V > 4 deg: 73%
- Ritter 1994:
  - Highest rate of aseptic loosening in knees with > 4 deg varus
- Jeffery 1991:
  - 24% loosening if mechanical axis > 3 deg V/V
  - 3% if < 3 deg



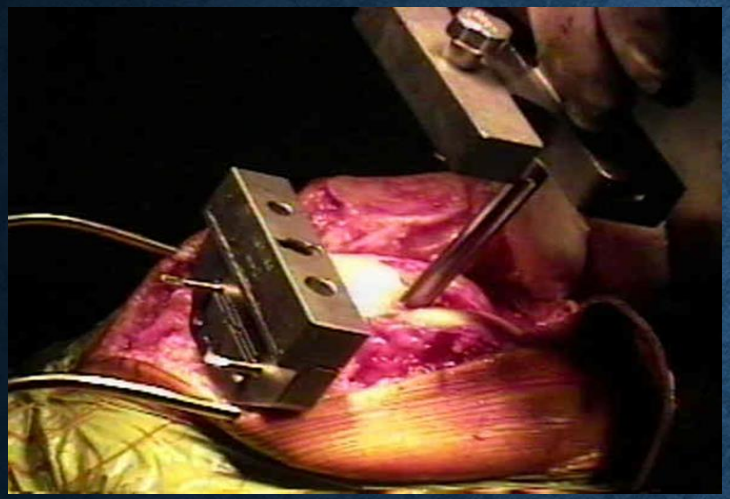
IMPROVED ALIGNMENT WITH NAVIGATION/ROBOTICS/PSI

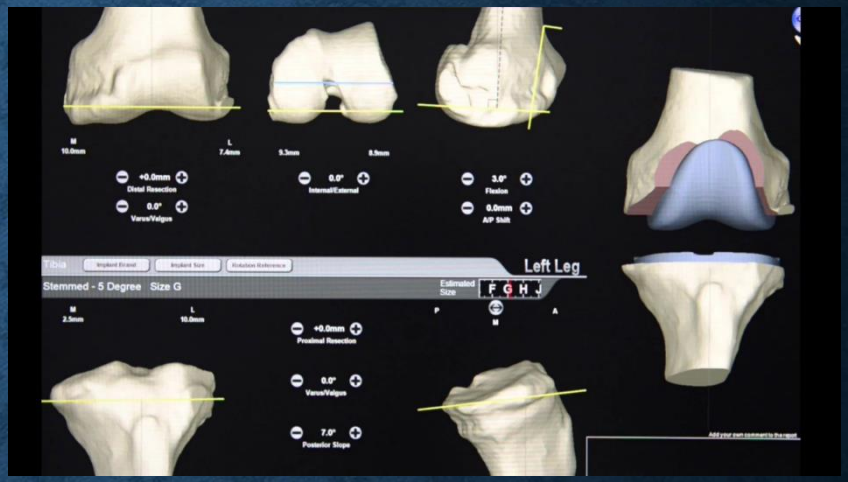
- Promote the durability of TKA by sharing load medially and laterally
- Alignment errors >3 degrees varus/ valgus (outliers)
  - Correlation to poorer results/increased rate of aseptic loosening

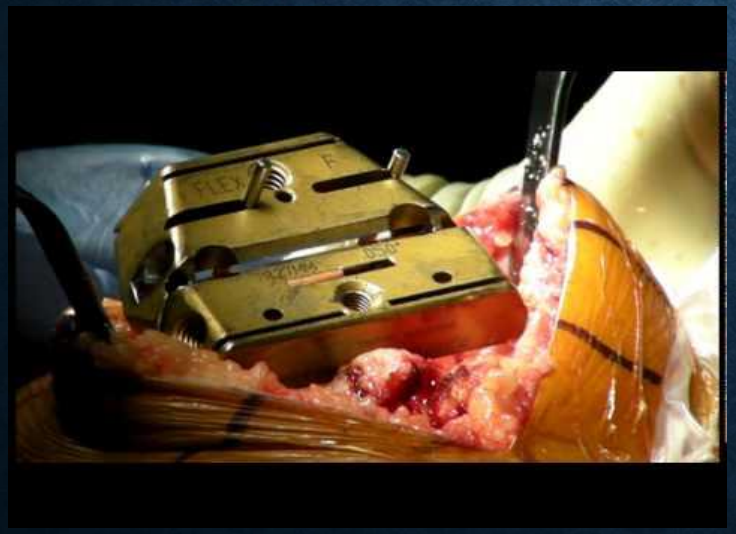


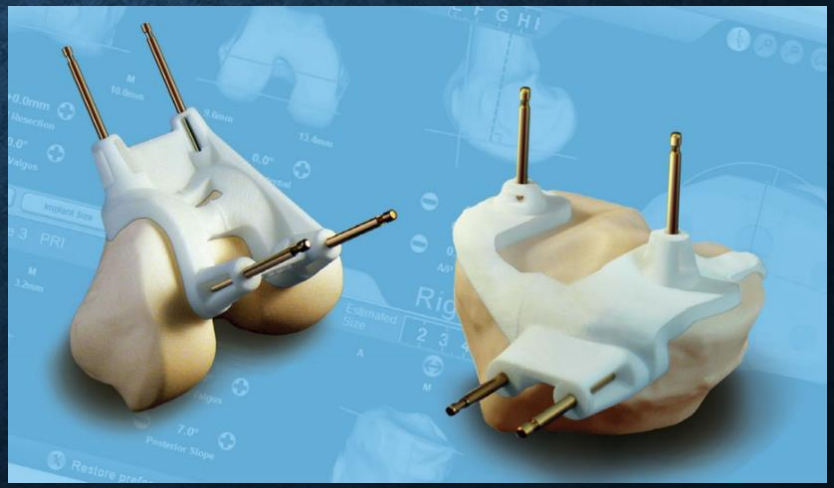

Cemented AGCs (n=6070) Failure Rate by Overall Alignment in Degree
Varus n=1034
alignment below 2.4°
Fail Rate = 1.9%
Neutral n=4390
alignment 2.4° thru 7.6°
Fail Rate = 0.5%
Valgus n=646
alignment above 7.6°
Fail Rate 1.7%
p<.0001
p<.0001
p=.0002
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
2.0%
2.0%
0.9%
0.5%
0.5%
0.5%
0.4%
1.8%
1.3%
0.0%
2.6%
-1 and below
0
1
2
3
4
5
6
7
8
9
10
11 and above
Post Operative Alignment

STRIVING FOR PERFECTION









STRIVING FOR PERFECTION


Degenerative Knee
Cuts

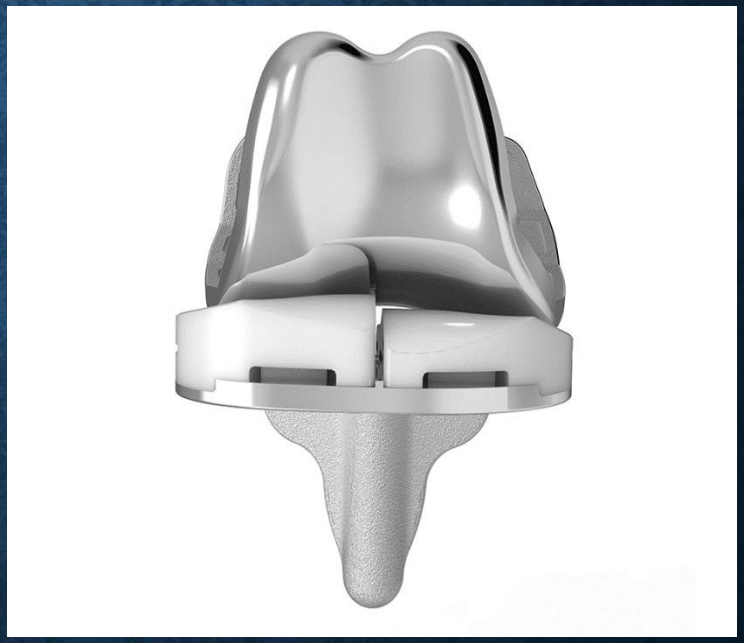
STRIVING FOR PERFECTION

- Improved/decreased rate of outliers with all of this technology
  - 3 degree goal
  - Ultimately (in my opinion) the surgeon's skill, attention to detail, etc. is a key factor
- Arbab 2018 – The Knee
  - ~15% outliers with PSI versus ~23% conventional
  - MRI based PSI
- Jeon 2019 – Journal of arthroplasty
  - ~11% for robot-assisted group versus ~17% in the conventional group
- Levengood 2018 –
  - 100% within 3 degrees
  - 84% at 0%
  - Remaining 16% within +/-2° of neutral.
  - CT based patient cutting jigs

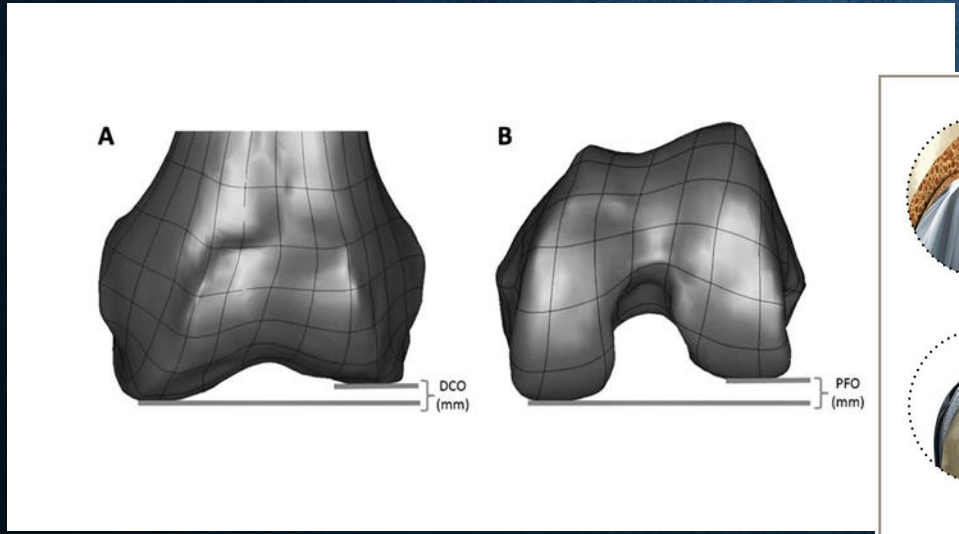
STRIVING FOR PERFECTION

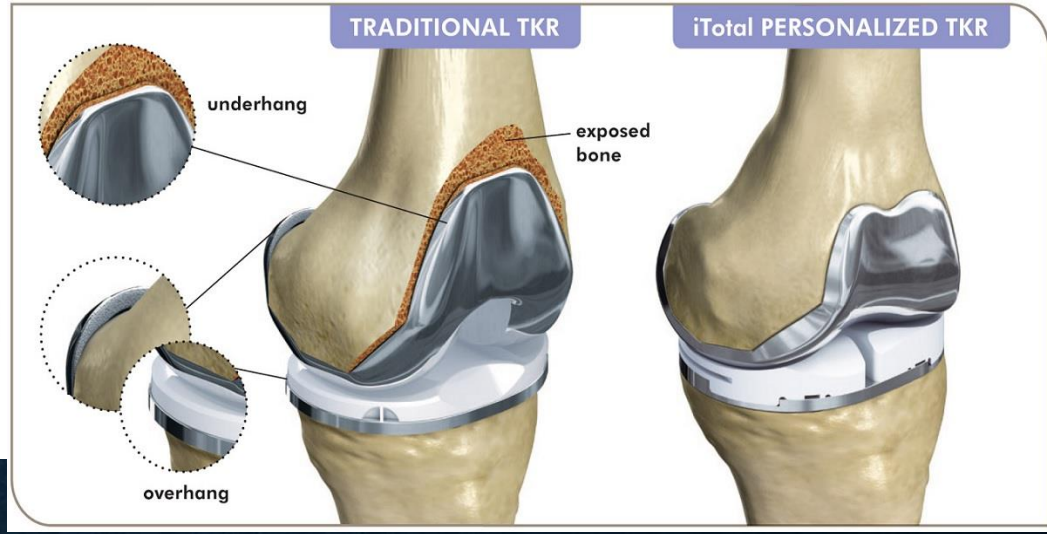
- “When it comes to fit, close isn’t good enough”
- If the implant extends over the bone by as few as 3mm, that can be a significant cause of pain after surgery.
  - **Overhang ≥3mm affects 40% of men and 68% of women with traditional knee replacement implants**
- Custom implants are now being used to provide a customized fit and perfect rotation specific to patient’s knee.
  - Improved alignment, rotation, offset, size, coverage of bone

STRIVING FOR PERFECTION



STRIVING FOR PERFECTION





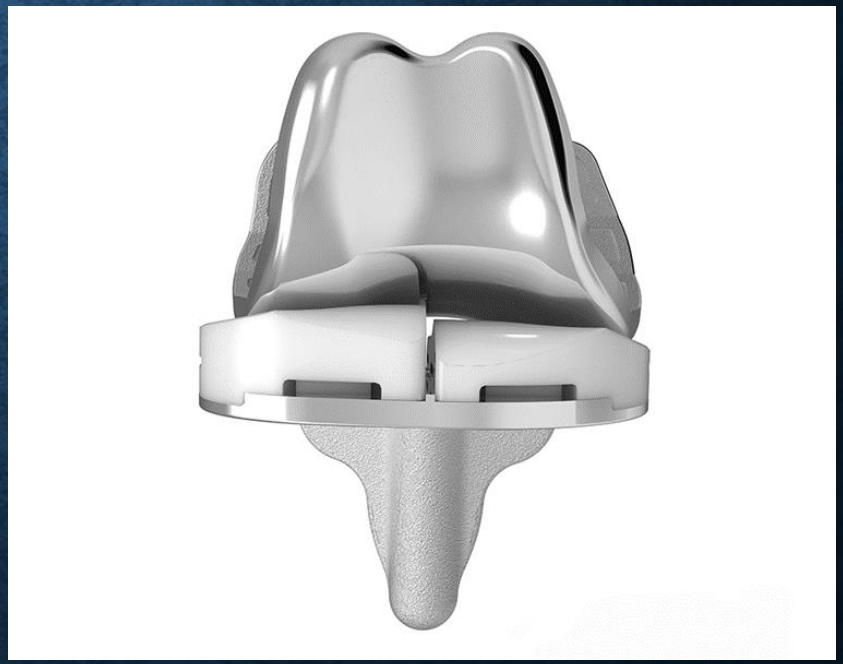
STRIVING FOR PERFECTION

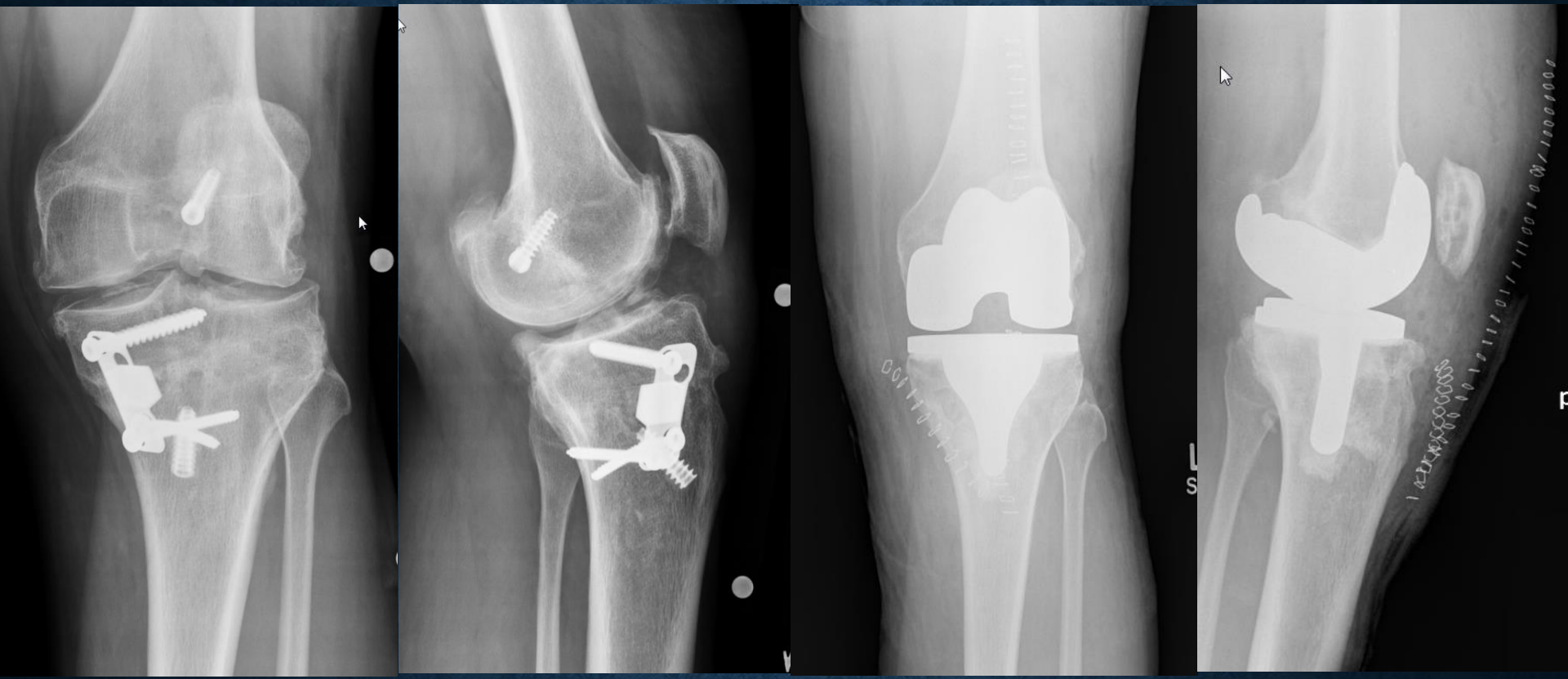
- **Martin 2016**

  Higher satisfaction rates with the custom knees in comparison to traditional, "off-the-shelf" knees.

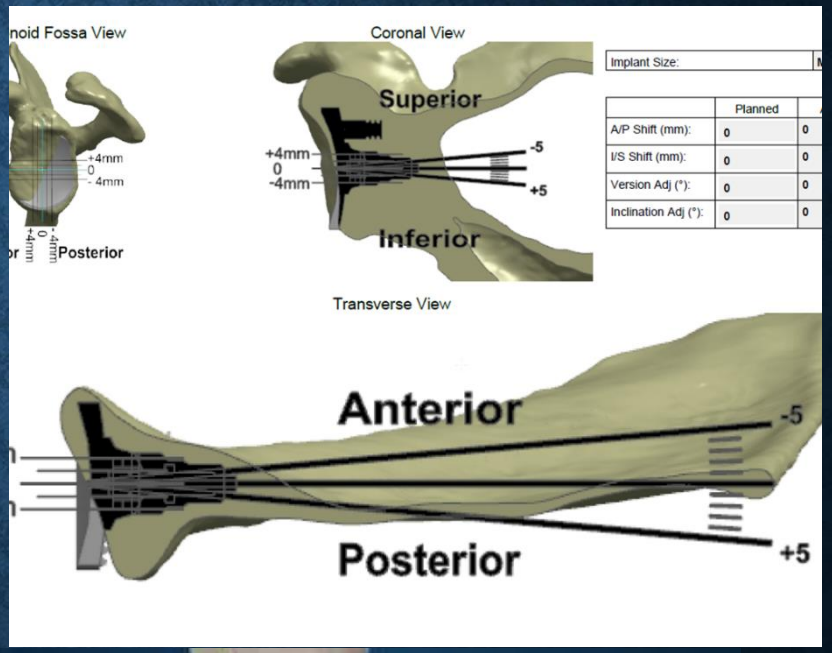
  - At one-year follow-up:
    - **94% of custom knees satisfied (Still not 100%)**
    - **74% of off-the-shelf satisfied.**

- Also reported custom knees had significant increase in patient reported outcome score and were able to return to activities of daily living faster when compared to off-the-shelf patients.





EVOLUTION IS HAPPENING WITH ALL JOINT REPLACEMENT



QUESTION 3

- If I needed a knee replacement I would get:
- 1. Whatever my surgeon recommended
- 2. An off the shelf knee with traditional instrumentation
- 3. An off the shelf knee with PSI, robot assisted, navigation
- 4. A Custom knee and Custom implant

ALTERNATIVE THERAPIES

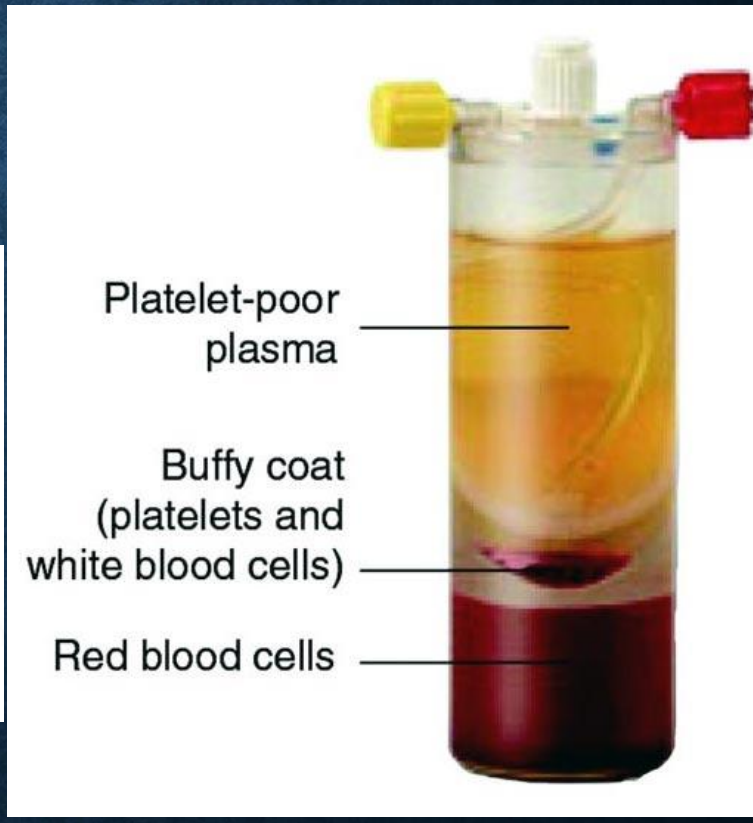
- Traditional options
  - NSAIDs, weight loss/exercise, bracing
  - CSI, Viscosupplementation

- Orthobiologics
  - Stem Cell, PRP, HA
  - Huge growth in orthopedics over past 5-10+ years

PRP AND STEM CELL

- “Regenerative Medicine”
  - Uses idea that your body has ability to heal injury
    - Paper cut
- PRP and Stem cell/BMAC
  - Tendonitis, fasciitis– anti-inflammatory
    - Tennis elbow/lateral epicondylitis
  - Enhance repairs in orthopedic procedures
    - ACL and meniscus repairs
    - Rotator cuff repairs, Quadriceps tendon repairs, Achilles repairs
  - Treatment for arthritis has been growing as well

PRP AND "STEM CELL"



PRP

- Works via biologically active proteins: PDGF, TGF, IGF, FGF, VEGF. These are expressed by platelets are possibly change gene expression in target cells
  - PDGF- stimulator of cell proliferation
  - TGF- abundant in bone and platelets and promotes healing

  End result – these growth hormones effect cellular recruitment to the environment and decrease inflammation.

PRP

- Autologous product
  - Variability in patients- platelet levels/amount of growth factors
  - Variability in how sample is obtained/prepared
  - No consensous if leukocytes are good or bad
    - Leukocyte poor versus leukocyte rich – Leukocytes can enhance concentration of growth factors, however can increase local inflammation.
    - Shorter centrifuge time and filtration time => Leukocyte poor
    - Literature is split on which is superior

PRP

- PRP in arthritis-
  - PRP increases chondrocyte growth and production of components of cartilage – PGs and type 2 collagen in lab settings
  - PRP has anti-inflammatory effect
  - Hope would be PRP enhances cartilage repair and slows degradation in arthritis.

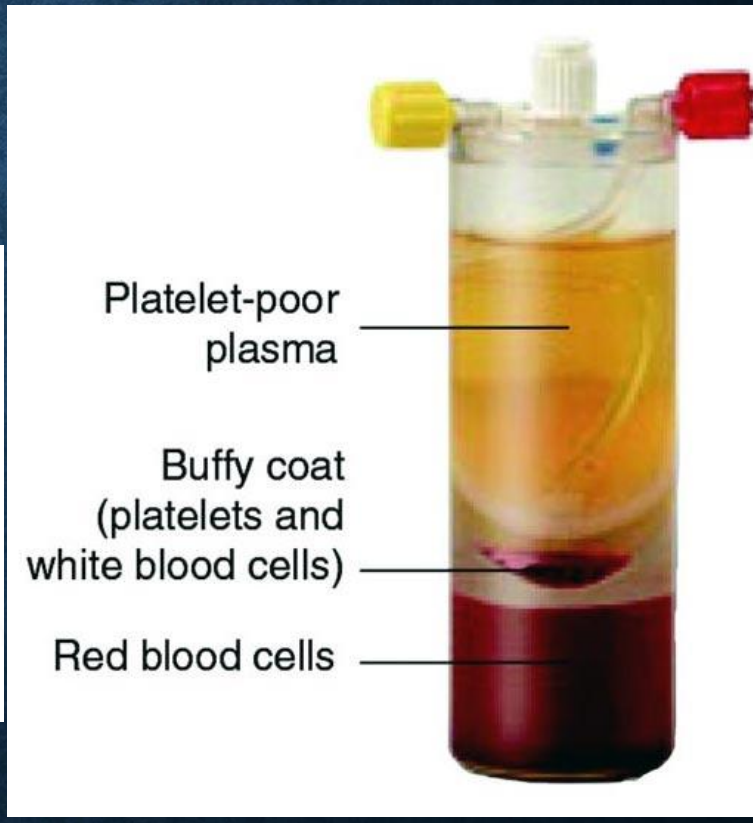
PRP LITERATURE

- 7 reviews/meta-analyses looking at PRP in OA treatment
  - Chang 2014 – Meta-analysis of 8 studies, 1,543 patients.
    - PRP showed benefit for 12 months. Benefit greater then seen with HA in patients with mild to moderate arthritis.
  - Laudy 2014 – PRP vs. HA vs. Placebo
    - 6 RCTs, 4 non RCT-s. Found improved function, WOMAC scores pain scores, after PRP in comparison to HA and placebo
  - Riboh 2015 – 9 studies. LRPRP vs LPRPP vs HA
    - LPPRP improved pain and function. LRPRP same effect as HA
    - Both PRP injections increased swelling and pain in comparison to HA
- Overall – Huebner 2019
  - “Literature suggests PRP is a promising therapy for symptom relief and improved functional outcomes in patients with OA for at least 12 months.”

STEM CELL/BMAC

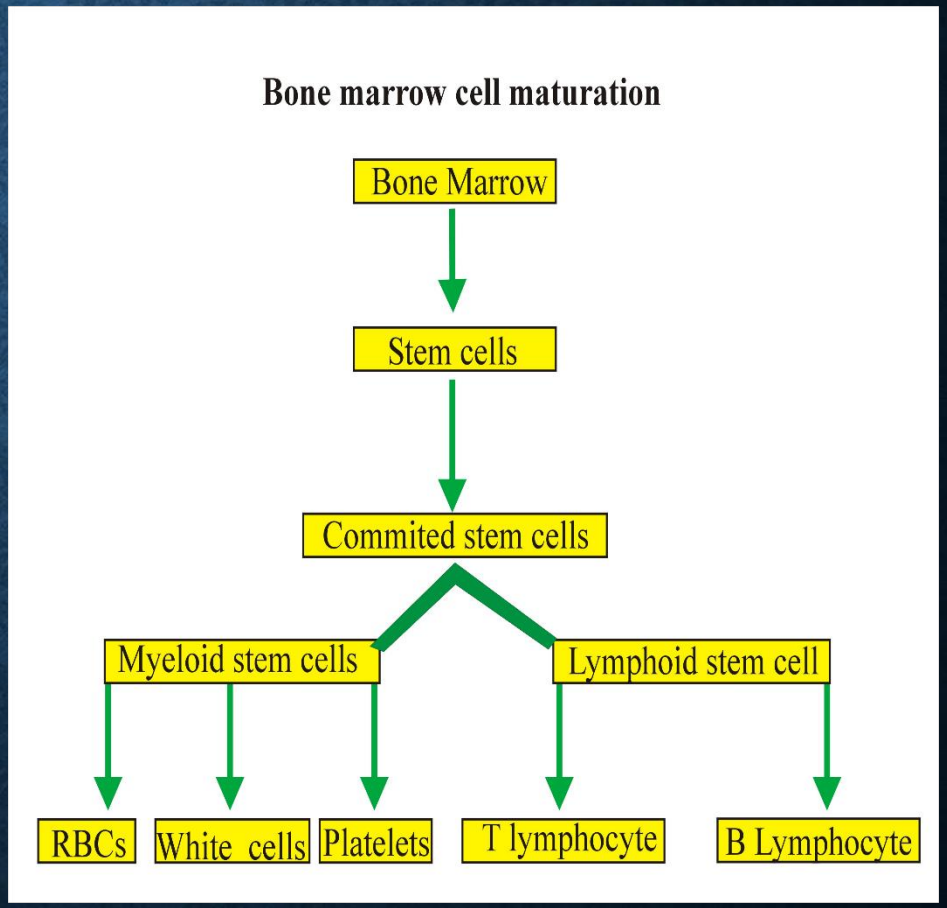
- Cell therapy
- BMAC – collect from bone via percutaneous fashion
  - Fast, safe, low donor site morbidity
  - Immediately processed and without manipulation
  - Classified through FDA as 361 product- are not subject to premarket review and approval

PRP AND "STEM CELL"



STEM CELL/BMAC

- BMAC is rich in mesenchymal stem cells (MSCs)
  - Potential for self renewal of tissue, healing
- BMAC is rich in IL-1Ra protein
  - Anti-inflammatory affect
- BMAC contains platelets



BMAC LITERATURE

- Wakitani 2002- BMAC with HTO
  - Did arthroscopic evaluation 42 weeks after treatment
  - All regions of cartilage defects were covered in white tissue
  - Improved arthroscopic cartilage grades, however no change in clinical outcomes
- Multiple studies have shown improved clinical outcomes after BMAC 6-12 months
  - Improved pain, increased walking distance, improved WOMAC scores, Potential increase in cartilage thickness on MRI
  - Orozco 2013, Kim 2014, Shapiro 2017, Sampson 2016
- Overall – Huebner 2019
  - “Further and more methodologically stringent studies need to be done in order to evaluate the benefit of BMAC for treatment of OA.”

SUMMARY OF ORTHOBIOLOGICS

- Treatments have shown promise in literature
  - Safe options/alternatives
  - Work by targeting inflammation, slow/repair cartilage damage
  - Up to 24 months of improvement
  - Cannot turn back the clock/regrow normal cartilage
- Still substantial gaps in our knowledge – indications, preparations, treatment methods/frequency
- No manipulation of therapies allows treatments to be used without FDA regulation
- Not covered by insurance as considered experimental
  - Out of pocket cost can be high

THANK YOU