

PF Joint-restoration, realignment, and replacement



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Overlapping Continuum of PF Treatment Options

- Distal lateral patellar chondrosis does well with AMZ alone
- Pan-patellar, bipolar and those with trochlear chondrosis: poorly with AMZ alone; good results when ACI added
- Bipolar uncontained PF chondrosis with bone erosion: consider PFA either endoprosthetic or OCA shells

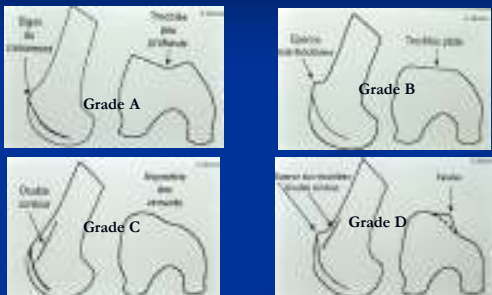
Step One

Define the Pathology

Classifications to aid in Treatment

- Morphology

Morphology : Dejour Dysplasia Grades



Classifications to aid in Treatment

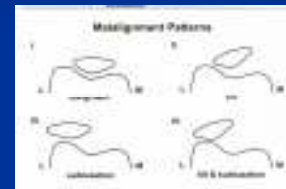
- Morphology
- Traumatic vs. Atraumatic (Primary DJD)

Classifications to aid in Treatment

- Morphology
- Traumatic vs. Atraumatic (Primary DJD)
- Fulkerson Alignment Classification

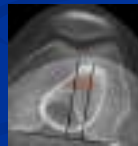
Fulkerson Alignment Classification

Neutral Patella
Tilt
Subluxation
Tilt and Subluxation



Fulkerson Alignment & TT-TG

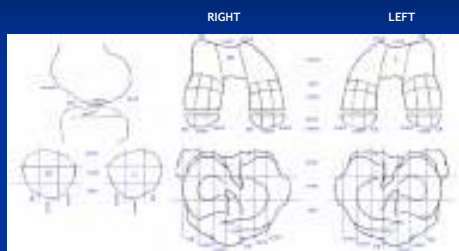
- Correlate Patellar position with contribution of TT-TG
- Mean of Asymptomatic patients: 13 mm
- Outlier symptomatic group: >20 mm



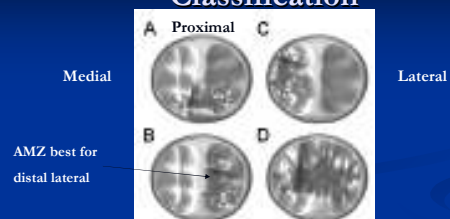
Classifications to aid in Treatment

- Morphology : Normal vs. "Dysplastic"
- Traumatic vs. Atraumatic (Primary DJD)
- Fulkerson Alignment Classification
- Regional Chondrosis Mapping

ICRS Regional Cartilage Map



Pidoriano & Fulkerson Classification



- A Type I is articular injury to the inferior pole
- B Type II is articular injury to the lateral facet
- C Type III is articular injury to the medial facet
- D Type IV is articular injury to the proximal pole (Type IVa) or a panpatellar injury (Type IVb).

Normalization of PF stress **without** Cartilage Restoration: AMZ

- Inferior Pole and Lateral Facet: 87% G/E
- Medial Facet: 55% G/E
- Proximal Pole and Diffuse: 20% GE
- Concomitant Central Trochlear Involvement: All Poor

Pidoriano and Fulkerson, 1997

Classifications to aid in Treatment

- Morphology : Normal vs. “Dysplastic”
- Traumatic vs. Atraumatic (Primary DJD)
- Fulkerson Alignment Classification
- Regional Chondrosis Mapping
- Soft Tissue Envelope

Soft Tissue Envelope

- Medial Patellofemoral Ligament Status
- Lateral Retinaculum Status



Step Two

Identify Why There Is Pain?

Chondrosis \neq pain Diagnosis of Exclusion

Articular cartilage is **aneural**

Pain therefore originates from:

- Soft tissue (Synovium, Capsule, Tendons and Ligaments)
- Nerves (Local or Remote, e.g., saphenous, neuroma)
- Bone (Local or Remote, subchondral, referred hip)
- Need to identify those patients with pain on the basis of the mechanically identifiable factors and associated chondral defects; exclude CRPS and debilitation (exceeding Dye Envelope of Function)

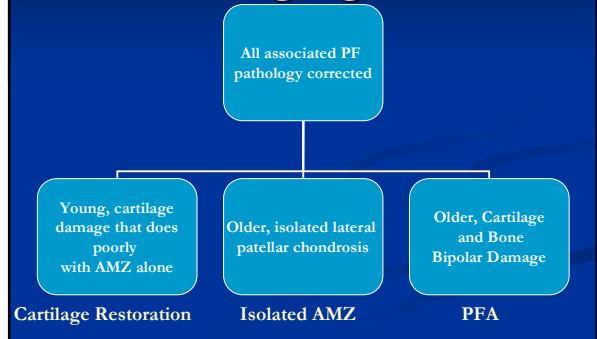
Step Three

**Right Surgery for the Right Patient:
Patient Specific Demand Matching
Treat both Mechanical and Chondral
Pathologies**

Example of Patient Specific Demand Matching

- “Isolated” AMZ for isolated lateral patellar lesions do well; documented to 12 years
- Improved 2007 PF ACI outcomes compared to 1994: Increased attention to alignment and force distribution
- Patellofemoral Arthroplasty’s most common failure mode with current implants: TF arthritis progress

Patient Specific Demand Matching Algorithm



Step Four

Applying the Specific Surgery

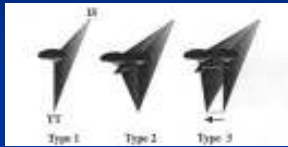
Tibial Tuberosity Medialization

- TT-TG distance > 20mm



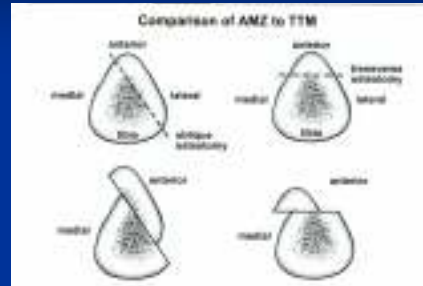
- If suspected Femoral/Tibial rotational abnormalities (e.g., Increased femoral anteversion): CT assess hip/knee/ankle rotation (Teitge)

Combining Proximal and Distal PF Surgery: Kobayashi 2003



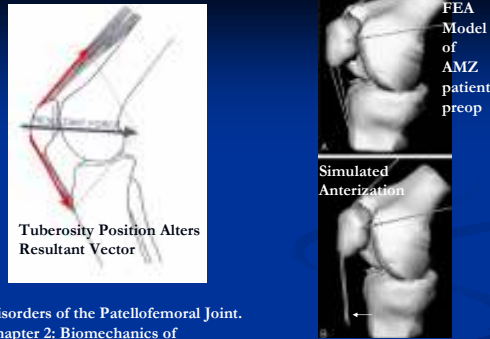
- Type 1 Neutral Patella in Trochlea; TT-TG < 20 MPFL
- Type 2 Excessive Lateral Patella to Trochlea; TT-TG < 20 MPFL
- Type 3 Excessive Lateral Patella to Trochlea; TT-TG > 20 MPFL + TTO

Tibial Tuberosity Osteotomy



Deciding on Tuberosity Transfer

- Degree of Anterization:
 - Ferrandez 10 mm Clin Ortho 1989
 - Ferguson 12.5 JBJS 1979
 - Fulkerson 15 mm AJSM 1990
- Medialization
 - Do NOT over-medialize—Andrish 2005
 - Goal to normalize in range of TT-TG 10-15 mm



Tuberosity Position Alters Resultant Vector

FEA Model of AMZ patient preop

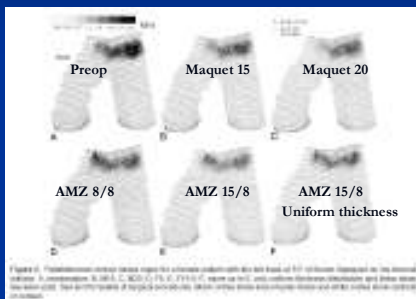
Simulated Anterization

Disorders of the Patellofemoral Joint. Chapter 2: Biomechanics of the Patellofemoral Joint, 4th Ed., Lippincott Williams & Wilkins, 2004

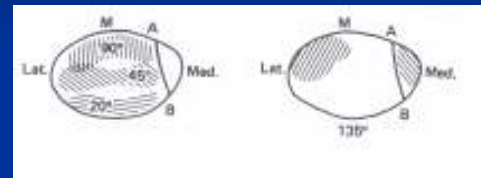
Cohen, Henry, McCarthy, Mow, Ateshian: 2003 Am J Sports Med

FEA Patient-Specific Models for Tuberosity Transfer:

AMZ mean 20% decrease in stress



AMZ will also change contact area with specific flexion angle

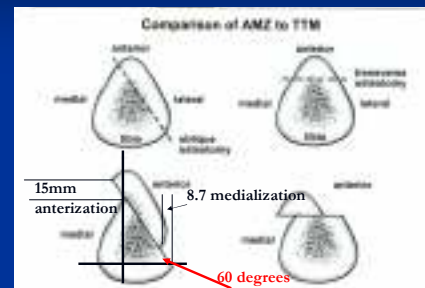


Hungerford DS, Barry M. Biomechanics of the Patellofemoral Joint. Clin Orthop

Planning Tuberosity Transfer

- Preop Planning: Knee Specific
 - Steepest slope approx. 60 degrees
 - Applying Trigonometry to a constant elevation of 15mm:
 - 60 degree slope & elevation 15 = 8.7 mm medialization
 - 50 degree slope & elevation 15 = 12.5 mm medialization
 - 45 degree slope & elevation 15 = 15 mm medialization
- Example of Typical Excessive TT-TG of 25 treated with:
- 60 degree slope or 8.7 = 16.3 post op TT-TG
 - 50 degree slope or 12.5 = 12.5 post op TT-TG

AMZ compared to TTM



AMZ example:
Chronic Patellar Subluxation



Brief AMZ:
See Demonstration in Video Section



Cutting Block Fixed in Position
with desired Slope



Proximal Osteotome Cuts



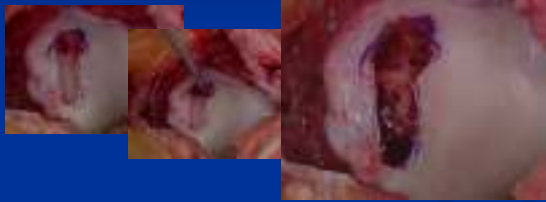
Post Op Radiographs



PF Cartilage Restoration:

1. Optimizing (Normalize) **Stress** (Force/Contact Area)
2. Optimize (Normalize) Tracking
3. Optimize (Normalize) **Stability** without over-constraint
4. Use optimal cartilage technique for specific stages of chondrosis (region, dimensions and grade, unipolar/ bipolar, containment)

Marrow Stimulation: Contained Smaller/ Irregular lesions



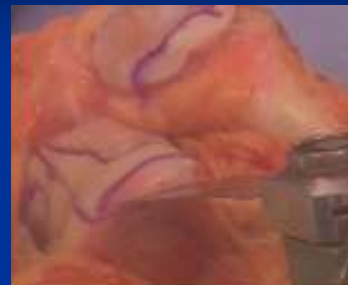
Autograft Osteochondral Plugs: Avoid Mismatch of Bone/Cartilage



Patellar Allograft OATS



Bipolar PF Allograft Shell



Transplanted PF Articulation



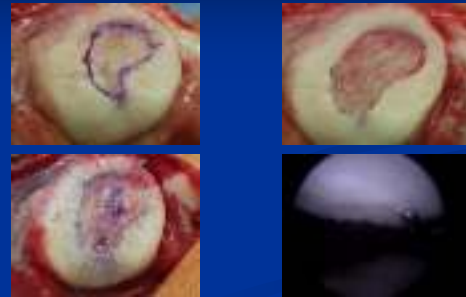
Patellofemoral Specific ACI Considerations

- Patella is “off label” in US—see package insert
- Match facet curvature
- Depth of cartilage walls

Match Facet Curvature



Deep Mid Waist Patellar Chondrosis



Transfer plus PF ACI

- Peterson 2002 79% G/E most with AMZ
- Bentley 2003 85% G/E
- Minas 2005 71% G/E 62% AMZ
- Henderson 2006 71% G/E
86% AMZ
55% No AMZ

Patellofemoral Arthroplasty 2007



Patellofemoral Arthroplasty: Background

- PFA date to the first arthroplasty experiments—McKeever: metal backed patella
- Importance of Alignment & Instability not recognized
- Early models often:
 - modified from TKA
 - designed to “fill the gap” of duocondylar

Prostheses

- Journey Competitor (Smith & Newpew; previously Richards I-III)
- Lubinus (Link)
- Avon (Stryker)
- Natural Knee Based (Zimmer/ Sulzer)
- Vanguard (Biomet)
- LCS Based (Depuy-J&J); New GCK option
(Disclosure: Farr is a design surgeon for GCK)

Overview of Historical Results

- Less than 1000 procedures reported
- Outcomes from 44% to 88% G/E
- Survivorship for 65% @ 8y to 78% @ 16y
- Current PFA example: Avon F/U >90% survival @ 6 years

Review: Indications for PFA

- Salvage procedure
- Isolated PF arthrosis
- Disabling isolated PF pain
- Other indicated Rx options exhausted
- Amount of medial/lateral compartment disease? (consider age, alignment and etiology of chondrosis)

Avoid “PF area pain” from Other sources

- Tendonitis (patellar, ITB)
- Neuroma from prior surgery
- Complex Regional Pain Syndrome/ RSD
- Patella infera
- Hip OA
- Inflammatory arthropathy

Pre-op Radiographs: Isolated PF DJD

- Shallow Flexion Axial (Merchants): decreased PF joint space correlates poorly with Sx and chondrosis; assess boney loss/ osteophytes
- Lateral: Assess Alta/ Infera (Baja)
- Standing AP and PA notch (skier) view
- Alignment: evaluate risk of TF DJD progression

Avoid Historical Failure Modes

1. Patellar Instability
2. Patellar Infera/ Baja
3. Loosening
4. Tibiofemoral compartment DJD progression
5. Clunking
6. Effusions
7. Persistent Patellofemoral and Soft Tissue Pain

All PF DJD is not the same;

therefore,

all PFA surgeries are not the same

Classifying PF DJD

Fulkerson Class + Morphology + Trauma

1. Fulkerson
 - Tilt
 - Tilt and Subluxation
 - Subluxation
 - Neutral Patella
2. Morphology : Normal vs. “Dysplastic”
3. Traumatic vs. Atraumatic (Primary DJD)

Assigning PFA subsets: Regarding Outcomes

- **Normal morphology PF:** “isolated” PF arthritis at risk of TF arthritis progression, especially if there is associate TF malalignment
- **Post traumatic PF:** Have potential to do well if not involved with other knee pathology, excessive scarring or patellar infera
- **Dysplastic PF:** Often achieve good PFA results as the primary pathology is the pathoanatomy rather than genetic cartilage pathology

Developing a Systematic Approach

- Assess prior scars and probability of future surgery
- Assess retinacular tightness/ tilt—consider lateral approach with lengthening of retinaculum

Developing a Systematic Approach

- Assess if more metal and plastic thickness will occur: not classic overstuffing, but putting “normal” thicknesses in a compartment that has NEVER been a normal thickness
- Increased thickness predictably over tightens lateral more than medial through flexion (lateral normally tightens in flexion; medial loosens in flexion)

Developing a Systematic Approach

- Address medial (MPFL): note that patholaxity may be only apparent after friction of DJD removed
- Contribution of abnormally lateral tibial tuberosity (TT-TG distance) to subluxation; Plan medialization as needed
- Plan distalization if patella does not engage the trochlea in full extension/ hyperextension

Developing a Systematic Approach

- External rotation cannot always compensate for maltracking to the same extent as in TKA
- Normal trochlear anatomy—may consider “anatomic” in-lay benefits
- Severely dysplastic anatomy—may consider on-lay benefits

Generic Description of Prosthesis Types

- Trochlea
On-lay vs. In-lay
- Patella
On-lay vs. Inset

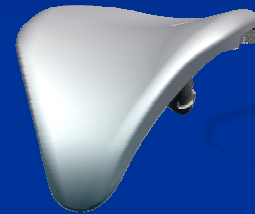
On-lay Trochlea (AVON)



In-lay Trochlea (Merchant LCS based)

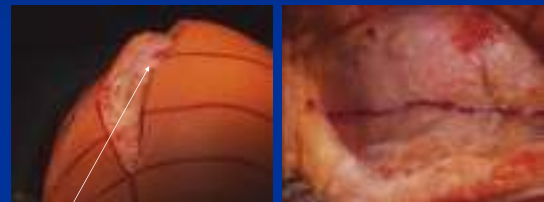


Inlay or On-lay (GCK)



**Trochlear Onlay:
GCK PFA Lateral
Approach: Previous
AMZ**

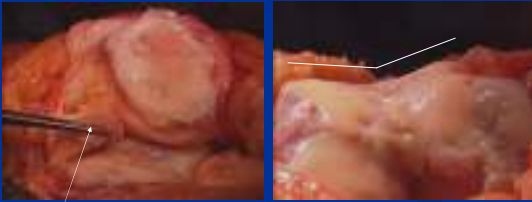
Incorporate Prior Skin Incision



Prior AMZ
Scar extent

Lateral Retinacular
Incision: Optional Step Cut
Lengthening

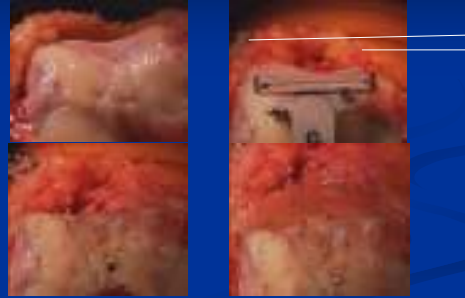
Lateral Exposure



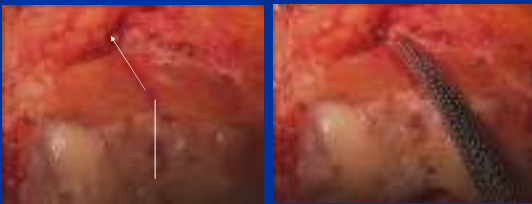
Synovial Impingement

Dyplastic Trochlea

Anterior Cut based on Local Anatomy



Contouring Central Concavity



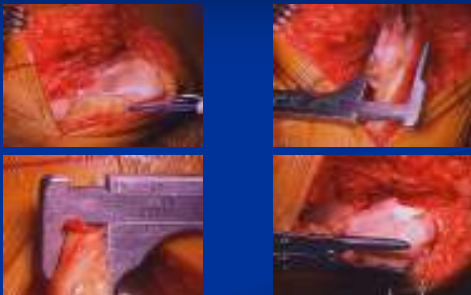
Angled Capture Meets Whiteside's Line

Distal Fit

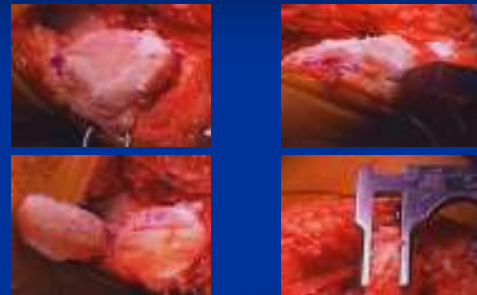


Fine Tune Distal Flush Fit

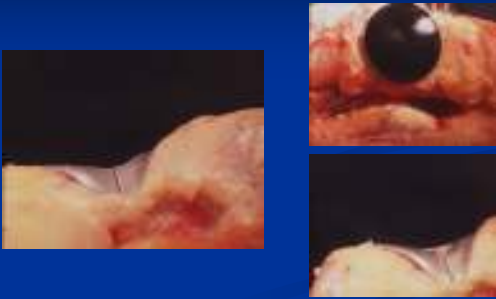
Patellar Preparation



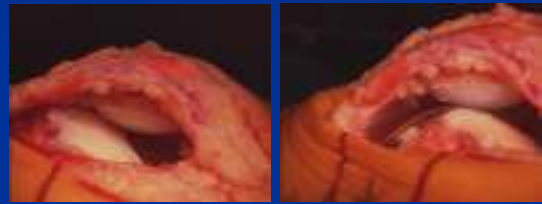
Patellar Preparation



Trials in Place



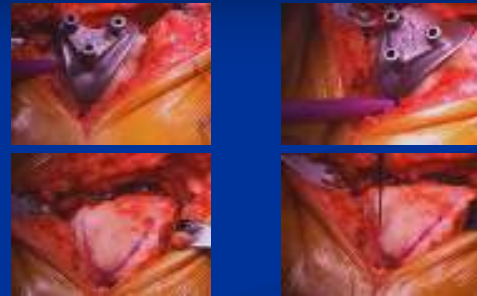
Components Implanted



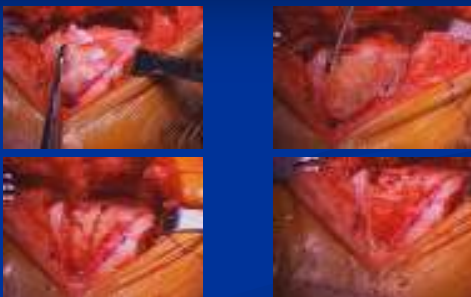
Patellar Tracking Video



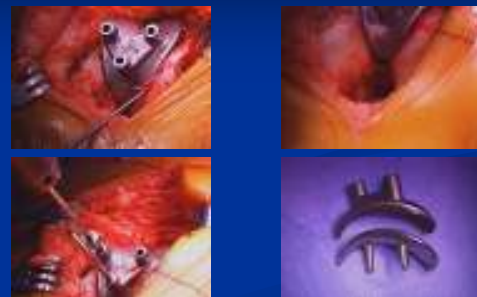
Trochlear Preparation: Merchant LCS based In-Lay



Trochlear Preparation: In-Lay



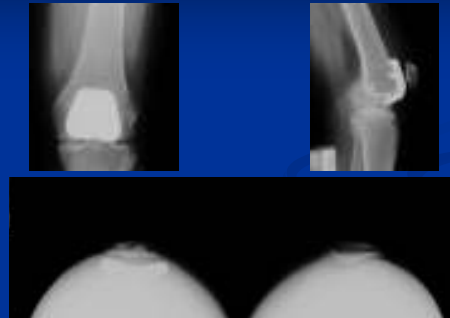
Trochlear Preparation: In-Lay



Trochlear Preparation: In-Lay



Avon On-lay Trochlea; On-lay Patella



Conclusions:

- PFA can be effective and durable
- PFA highly sensitive to patient and knee selection
- PFA highly sensitive to surgical technique
- Promising new designs
- PFA has an evolving role in patients with isolated end-stage PF arthritis who have disabling symptoms

Thank you

Jack Farr, M.D.