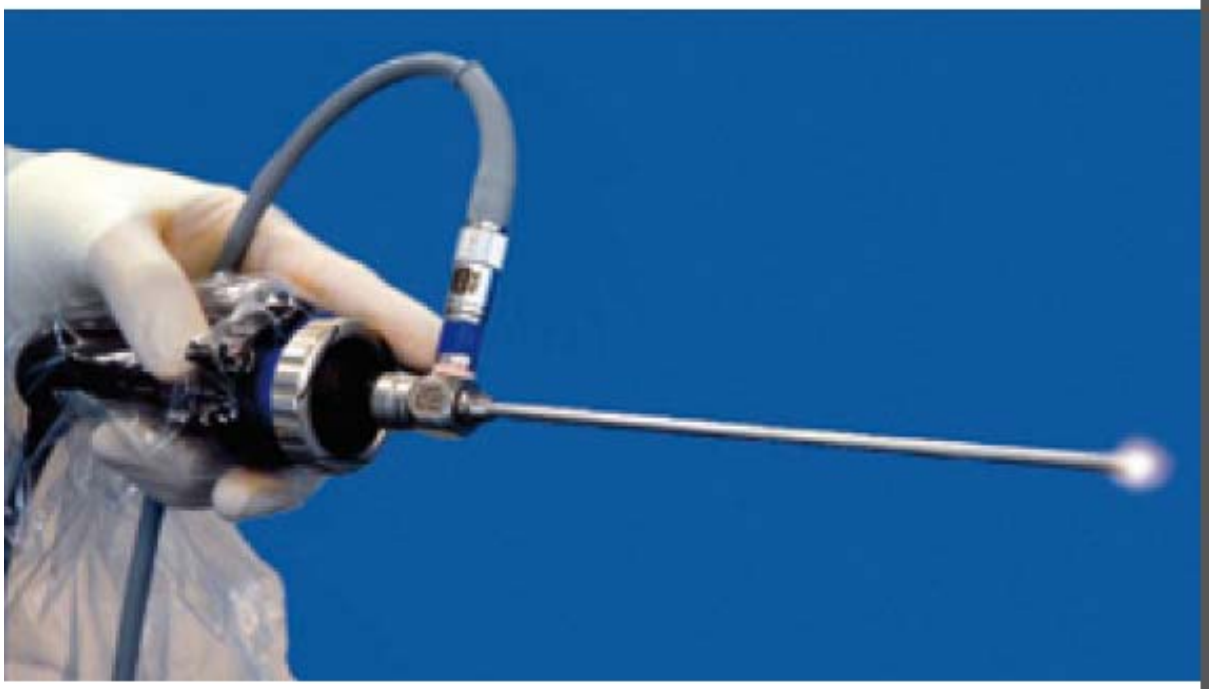
Knie Update 2013

AufSchalke

Handout K. Donald Shelbourne,

SHELBOURNE KNEE CENTER

Indianapolis, IN USA



1. Treatment of Meniscus Tears with ACL Reconstruction
2. Chondral Lesions of the Knee Joint
3. Multiple Knee Ligament Injuries: Algorithm for Treatment
4. Examination and Treatment Algorithm for Patellar Dislocation or Malalignment

Treatment of Meniscus Tears with ACL Reconstruction

Knee Update 2013 Congress
Dusseldorf, Germany
April 5, 2013

K. Donald Shelbourne, MD

History

- Been in practice since 1982
- Specialized orthopaedic practice – see only knee problems
- Dedicated staff for research to determine track patient outcomes
- All of the data presented today is from years of continual research follow-up of patients' outcomes (not opinion)

Factors to consider

- ACL intact or ACL deficient knee (today we will talk about ACL-deficient knee)
- From our research, most "repairable" meniscus tears are those that are asymptomatic
- Patients with symptomatic tears have flap or displaceable degenerative tears that are not amenable to repair
- "Save all menisci" is a good idea BUT
- Reality is most symptomatic tears that are repaired, even if they don't cause symptoms, may not function well

Factors to consider

- Medial versus Lateral
- Degenerative versus Nondegenerative
- Stable versus Unstable
- Treatment choices
  - Remove
  - Repair
  - Leave alone
- Postoperative Rehabilitation – does it matter?

History of treatment

- Before arthroscopy was available, most of the meniscus tears associated with ACL instability were not observed or treated
- In 1982-83 before using arthroscopy consistently with ACL reconstruction--35% had either a LMT or MMT
- When we started using arthroscopy, we found that 67% of patients had MTs with more being lateral
- Expected patients to return because of meniscal symptoms at some time after ACL reconstruction – didn't happen!

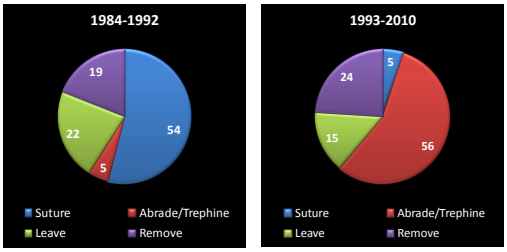
History of treatment

- When arthroscopy was used (from 1984 on), many more meniscus tears were observed
- Felt compelled to either repair or remove the tears even though the tears were not symptomatic
- Leaving the tear alone was not considered

Trends for Tears

- Acute vs. chronic instability
  - Medial tears
    - 44% of acute injuries had tears versus 54% of chronics
  - Lateral tears
    - 55% of acute injuries had tears versus 47% of chronics
- What does this mean?
  - Simply – Most lateral meniscus tears seen with acute injury heal

Overall Trend for Treatment of All Meniscus Tears



Why change treatment?

- The change in treatment occurred for several reasons
- All changes were made because of observation and analysis of follow-up results of patients

How to determine treatment

- Can we identify which meniscus tears are symptomatic?
- Other than the obvious degenerative stuck bucket-handle tears, it can be difficult
- Studied correlation of joint line tenderness and actual meniscus tears in acute and chronic injuries

Meniscus Tears with Acute ACL Injuries

- Prospective evaluation of joint line tenderness and meniscus tears
- 2-year period of time
- 173 patients seen for acute injury
- Evaluated for joint line tenderness at initial exam
- Recorded meniscus tears seen at time of surgery

Shelbourne et al., AJSM 1995

Meniscus Tears with Acute ACL Injuries

- Presence or absence of joint line tenderness has no correlation with meniscal tears in patients with acute ACL tears

Meniscus Tears with Acute ACL Injuries

- Now that we delay ACL surgery until the patient has a quiet knee with full ROM, what happens to joint line tenderness?
- On the day of surgery, few patients have pre-op joint line tenderness
- But >50% have meniscus tears

Meniscus Tears with Subacute and Chronic ACL Injuries

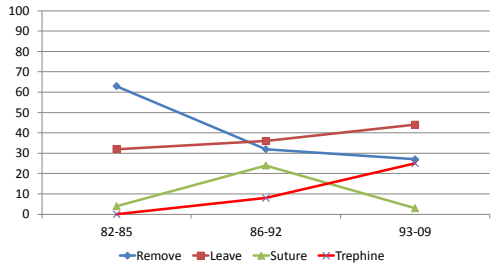
- Evaluated correlation of JLT to meniscus tears in patients with subacute or chronic ACL injuries
- Subacute = patient has delayed surgery after injury but did not have another ACL instability episode
- Chronic = Had another ACL instability episode after initial injury

Shelbourne KD, Benner RW. J Knee Surg 2009

Meniscus Tears with Subacute and Chronic ACL Injuries

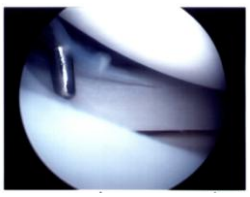
- Same study design as study of acute injuries
- 3531 patients
- Same finding – JLT was about 50% sensitive, specific, or accurate for detecting a medial or lateral meniscus tear

Lateral Meniscus Tears: Treatment Trend



Lateral Meniscus Tears with ACL Surgery

- Repairing posterior third LMT with an inside-out technique is difficult



Lateral Meniscus Tears with ACL Surgery

- It is rare to have a patient with an intact ACL have a symptomatic posterior third LMT
- We began repairing less LMTs by leaving the posterior third tears in situ
- Then we followed the patients' results

Lateral Meniscus Tears

- 1146 ACL reconstructions between 1982 and 1991
- 598 LMTs identified
  - 256 Partial excision
  - 135 Meniscus repairs
  - 207 left in situ
- Results – None of the patients had a subsequent removal of LMT

FitzGibbons and Shelbourne, AJSM 1995

Lateral Meniscus Tears: Leave Alone Tears

- Isolated LMT left alone, no MMT or CM
  - PHA LMT (70)
  - Radial flap tears (50)
  - Peripheral post tears (212)
- Mean 7 years f/u
- 96% had IKDC objective rating of normal or nearly normal
- Of 332 tears, only 8 required subsequent surgery (2.4%)

Shelbourne KD, Heinrich J. *Arthroscopy* 2004

Lateral Meniscus Tears: Treatment and Failure Rates

Treatment	82-85 (n=228)	86-92 (n=1197)	93-09 (n=3898)
Removal %	63	32	27
Leave (failure) %	32 (0)	36 (4)	44 (3)
Suture (failure) %	5 (0)	24 (10)	3 (12)
Trephine (failure) %	0	8 (4)	26 (4)

Lateral Meniscus Tears Left Alone: Conclusions

- Most LMTS seen at ACL reconstruction are asymptomatic and can remain left in situ
- Vertical tears posterior to the popliteus tendon do not become unstable bucket-handle tears if left in situ

Meniscus Tears with ACL Reconstruction

- When meniscus repair techniques were developed, I started performing more meniscus repairs
- Did not know what the success rate would be

Meniscus Tears with ACL Reconstruction

- Complication developed
- In chronic ACL injuries where patients had a locked bucket-handle tear with bad extension going into surgery, I had an increase in rate of arthrofibrosis with combined ACL reconstruction and repair

Meniscus Tears with ACL Reconstruction

- Began performing staged procedures –
  - Treat locked meniscus
  - Return later, if needed, for ACL reconstruction
- Rationale
  - Did not want to do anything to cause ROM problems
  - Patients with locked meniscus tears sought treatment for the tears; had been dealing with ACL deficiency for awhile

Meniscus Tears with ACL Reconstruction

- Did a scope and performed repair regardless of how bad the meniscus looked
- Knew that I would be back later for ACL reconstruction and could remove the tear at that time if needed
- Rehabilitation was not restricted
  - Full ROM and weightbearing was encouraged

Bucket-Handle Medial Meniscus Repair

- Used a rasp and multiple needle sticks to stimulate bleeding
- Left the posterior section in situ because we know these tears can heal

Bucket-Handle Medial Meniscus Repair

- Began using 4-6 sutures in the anterior half of the meniscus
- Basically converted an unstable tear to a stable tear

6 Weeks after Repair

- Follow-up at the time of ACL reconstruction

Meniscus Tears with ACL Reconstruction

- What I learned by doing 2-stage meniscus repair and ACL reconstruction
  - Could allow weightbearing as tolerated and the meniscus can heal
  - Found the more sutures placed fostered better healing; however, sutures would not be present at 2nd look arthroscopy
  - Determined that placing the needle through the meniscus stimulated healing
  - Believe trephination with many needle sticks is all that is necessary with most types of repairable meniscus tears

Bucket-Handle Meniscus Tears

- Have found that many BH tears, even in the white/white zone, can heal with repair
- Major question – But do they function?

Bucket-Handle Tears- Repair or Remove?

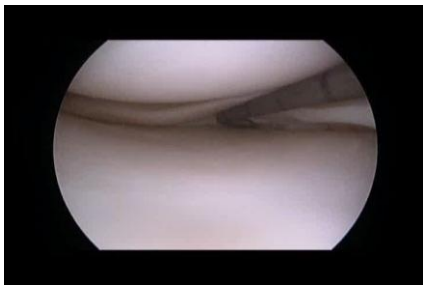
- Does the repaired BH meniscus tear function well enough to provide joint protection?
- Study* compared results of 155 BHMMT
  - 56 repair vs. 99 partial meniscectomy
  - Mean modified Noyes score = 90.8 points for both groups 8 years post-op
  - Repaired group:
    - Non-degenerative tears: 93.9 points
    - Degenerative tears: 87.1** points
  - No difference in radiographic grades between repair and removal groups at a mean of 7 years post-op

*Shelbourne/Carr AJSM 2003** statistically significantly lower

Bucket-Handle Tears- Repair or Remove?

- Concluded that repaired degenerative BHMMT may not function normally or provide advantage over partial meniscectomy
- Also, although healing was present at follow-up arthroscopy, many patients returned later because of subsequent meniscus tear
- Now, remove degenerative white/white tears

Bucket-Handle Tears- Repair or Remove?



Bucket-Handle Tears

- Remove degenerative BH tears that can be pulled into the notch

Medial Meniscus Tears

- Other types of medial meniscus tears seen with ACL reconstruction can be treated
  - Trephination
  - Left in situ
  - Suture repair

Peripheral Stable Medial Meniscus Tear

- Common meniscus tear seen with acute ACL injury
- Can easily be missed
- Once recognized, need a treatment plan that works

Study by Shelbourne/Rask (Arthroscopy 2001)

- To determine the long-term clinical sequelae of salvageable, non-degenerative, peripheral vertical MMTs seen at the time of ACL reconstruction
- Meniscus tears – Stable > 1 cm but < 2 cm in length treated with abrasion and trephination
- Meniscus tears – Unstable > 2 cm in length, treated with suture repair (> 50% of the circumference)

Subsequent arthroscopy

Group	N	Number Subsequent Scopes	(%)	Time post-op (years)
SITU	139	15	(10.8)	2.5
AT	233	14	(6)	2.3
Suture	176	24	(13.6)	4.3
No Tear	526	14	(2.9)	5.0

Results: Subsequent Arthroscopies

- Subsequent scopes performed at a mean of 3.7 years after ACL reconstruction
- Of patients who had subsequent arthroscopy, 45% of the AT and SITU groups and 75% of the SUTURE group had the procedure at > 2 years after ACL reconstruction
- Need much longer than 2 year follow-up to determine outcome

Peripheral MMTs

- Of unstable peripheral vertical MMTs treated with suture repair, 13.6% failed, with 75% re-tears occurring at greater than 2 years after repair
- Of stable peripheral vertical MMTs treated with abrasion and trephination alone and no direct fixation, most (94%) remain asymptomatic at a mean of 3.6 years after treatment

Treatment Decision

- Not doing “something” is difficult for a surgeon
- We are trained to do procedures when a tear is present because treatment has to be better than leaving it alone
- The treatment should make the patient better than leaving the tear alone

Rehabilitation

- Decisions made for rehabilitation are critical to outcome
- Many programs limit ROM and weight bearing because of fear that the repair will not heal
- Our data show that almost all tears can heal with allowing full ROM and weightbearing

Rehabilitation

- Limitations in ROM and weightbearing are detrimental
  - Limited WB makes the patient hold the knee in bent position
  - Causes ROM problems
- Why is ROM loss important?

Rehabilitation

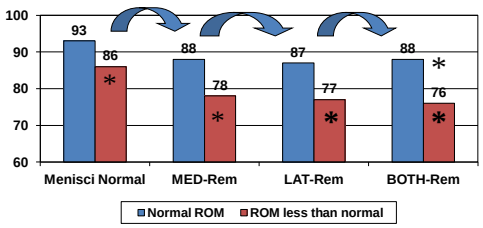
- Long-term outcome of ACL reconstruction shows that ROM loss causes more symptoms and increases rate of OA
- ROM is compared to the opposite normal to include hyperextension

Assessing ROM
Passive Extension

Importance of Symmetrical ROM

- Evaluated our long-term outcomes with ROM as one of the variables
- IKDC defines normal ROM to be:
  - Within 2° of extension – to include hyperextension
  - Within 5° of flexion
- ROM loss was most important factor affecting subjective and objective results
- Difference between patients with and without normal ROM was eye-opening!

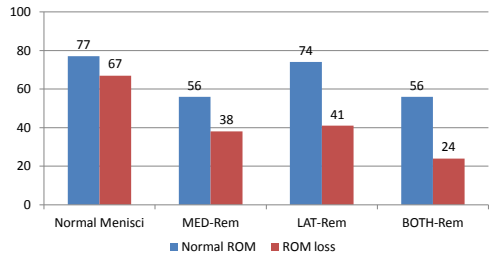
Subjective Scores at 10-20 yr f/u: ROM and Meniscal Status



*Statistically significant lower

Shelbourne KD, Gray T. AJSM 2009

ROM and Radiographs: % of patients with normal radiographs



Rehabilitation Matters!

- Regardless of whether you repair or remove meniscus-
  - You need to ensure patient regains full ROM, especially extension
  - Need to maintain full ROM for rest of their lives

Rehabilitation Matters!

- Widely established that meniscectomy and articular cartilage damage causes more OA in the long-term after ACL
- We found that ROM loss was equally as devastating to the long-term results
- WE have more control over ROM
- Whatever you do, obtain full extension (including hyperextension) and flexion

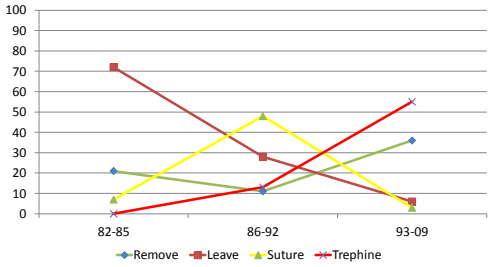
Rehabilitation Matters!

- Do not be concerned if the ACL-reconstructed knee has some increased AP laxity compared with the normal knee
- Rather have a knee that has some play in it with full ROM than a stiff knee
- Stiff knee will cause OA in the long-term

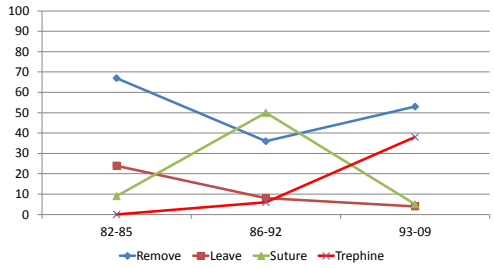
Rehabilitation Matters!

- Do not restrict ROM or WB
- WB promotes healing
- It pushes the meniscus toward the capsule
- It isn't the sutures that matter with repair
- It is the needle going through the meniscus into the capsule that creates the blood channel for healing
- Trephination with WB can be enough for healing

Acute Medial Meniscus Tears: Treatment Trend



Chronic Medial Meniscus Tears: Treatment Trend



Conclusions: LMTs

- LMTs and MMTs are different
- Most LMTs can be left in situ
- The only LMTs I repair now are displaceable vertical peripheral tears that extend anterior to the popliteus
- I repair only the middle third of the LMT
- If in doubt with a LMT – leave it alone

Conclusions: MMTs

- Although degenerative BH meniscus tears can heal with repair, re-tear rate is high and they do not function normally
- Posterior half nondisplaceable peripheral nondegenerative vertical MMTs can be left alone or trephinated
- The posterior portion of a non-degenerative bucket handle MMT can be trephinated and left in situ
- The middle third should be stabilized with sutures

Conclusions

- Rehabilitation
  - Allow full WB as tolerated
  - Emphasize full ROM
  - Patients that do not regain full ROM will have an increased chance of developing OA in the long-term
- Repair success rate will be just as good (if not better) with unrestricted rehabilitation

Chondral Lesions of the Knee Joint

Knee Update 2013 Congress
Dusseldorf, Germany

April 5, 2013

K. Donald Shelbourne, MD

Questions to Consider

- How are chondral lesions found?
- Are chondral lesions symptomatic?
- What is the ideal rehabilitation for chondral lesions with or without surgery?

How are chondral lesions found?

- Radiographs do not usually show chondral lesions (unless OCD is present)
- Arthroscopy – for meniscus tear, ligament reconstruction, PF realignments
  - Incidental findings found and not the reason for the surgery
- MRI
  - Used so frequently that surgery is many times based on MRI findings versus clinical symptoms

Are chondral lesions symptomatic?

- In general – No
- Chondral defects by themselves do not cause pain
- In general, pain comes from
  - elevated chondral flaps (OCD)
  - loose chondral pieces
- The defect may cause knee soreness or anterior knee pain with activities, but the defect itself doesn't cause the pain

Are chondral lesions symptomatic?

- Every patient with joint space narrowing on radiograph will have chondral lesions
- Yet, most will not have severe symptoms
  - Usually soreness with weight bearing (WB)
  - Anterior pain without localizing pain

What is the ideal rehab?

- WB vs. Non-WB
- How did non-WB become deemed "necessary" for healing?
  - Animal studies showing it takes 2 years for the new cartilage to adapt and mature
  - Not sure 6 weeks of non-WB makes a difference
  - In fact, I believe that appropriate WB can be beneficial for healing and maturation

What is the ideal rehab?

- Rehab lessons learned from following patients after treatment where chondral lesions were observed
- Several studies show that achieving full ROM is important to obtain optimal outcome

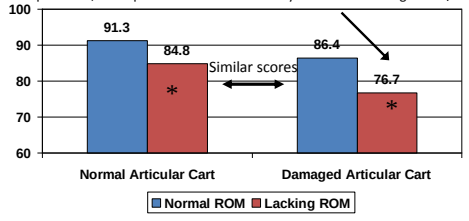
10-20 year results after ACL reconstruction

- Study* to look at the effect of ROM loss on results in the long-term
- Results were obtained for 1113 patients at a mean of 15.9 years after surgery

*Shelbourne KD, Gray T. AJSM 2009

Subjective Scores: ROM and Chondral Status

*Patients with ROM loss and articular cartilage damage – worse scores
* Keep in mind, these patients are around 30-35 years old at the long-term f/u



*Statistically significantly different

Deconditioned Knee Study*

- ACL data led us to evaluate how improving ROM might help patients with chronic knee pain and ROM loss
- 50 patients - mean age - 53.2 ± 9.9 years
- Underlying pathology – Osteoarthritis
- Rehabilitation program provided to improve ROM first and strength 2nd

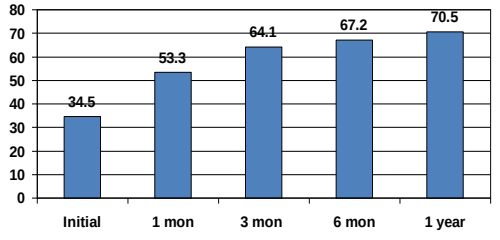
*Shelbourne et al. Am J Sport Phys Ther 2007

Range of Motion Deficits Compared to Opposite Normal Knee

	Initial Mean ± SD (Range)	Final Mean ± SD (Range)
Extension*	10° (5-34°)	3° (0-10°)
Flexion*	19° (1-70°)	9° (0-62°)

* $P < 0.001$

Results: IKDC Subjective Scores Through Time



ROM – Weight Bearing

- What does ROM have to do with WB?
- Believe that a non-WB restriction is the major factor causing ROM problems in the treatment of knee injuries
- Non-WB means people have to get around on crutches
- Hold leg in a bent-knee position
- Non-WB restrictions with articular cartilage restoration procedures last 6 weeks or more

ROM – Weight Bearing

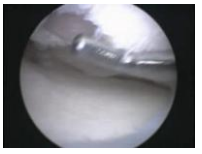
- Would you want to live with that restriction?
- An even better question is, how compliant do you think patients are with this restriction?
- ACL patients taught us long ago that they were non-compliant with WB restrictions – had better results
- I would propose that the patients who are non-compliant with WB restrictions with articular cartilage procedures have the best results
- Why? Because WB provides good stimulation for healing

Lesions left alone - Results

- Different study* of 125 patients with isolated articular cartilage defect of Outerbridge grade 3 or 4 at time of ACL reconstruction
- Medial – 60 patients
- Lateral – 65 patients
- All patients had both menisci intact
- Mean age – 26 years old
- Mean defect size 1.7 cm^2 (0.5 cm^2 to 6.5 cm^2)
- Compared to a control group with no lesions

*Shelbourne et al. JBJS Suppl 2, 2003

Chondral defect



Mean Subjective Scores: 101 pts at mean of 8 years post-op

Compartment	DEF group	Cont Group
Medial (N=48)	94.0 ± 7.1	95.2 ± 6.7
Lateral (N=53)	92.8 ± 8.4	95.9 ± 6.5

Results show the natural history of leaving the lesions alone

Rehabilitation

- Rehabilitation included obtaining full ROM as soon as possible and there was no restriction on WB
- This rehabilitation is also used in patients who have a chondral lesion with a loose piece and are treated with microfracture

Grade IV Chondral Fx: Loose piece causing locked knee

Follow-up Arthroscopy: 10 months later

Rehabilitation

- Need to recognize knee asymmetry problems associated with chondral defects
- Exhaust all rehabilitation efforts to restore full ROM and improve strength before resorting to surgical intervention
- Articular cartilage surgery that involves rehabilitation restricting WB and ROM will undoubtedly make any knee ROM or strength deficit worse

Rehabilitation

- So, how do you accomplish the goal of successful non-operative rehabilitation with physical therapy?
- Need to be able to work closely with physical therapist or athletic trainer who understands or can learn what you want to accomplish
- Ideally, this is done by having rehabilitation done in your office

Rehabilitation

- Advantage of rehab in your office
  - Rehab staff gets a complete understanding of the patient history
  - Can view x-rays and MRIs
  - If your practice has a high knee volume, they gain more expertise with treating knee problems

Rehabilitation

- If you do not have rehab in your office
  - Have the PT or ATC come to office and observe you and your patients
  - Take time to teach them how to evaluate
    - Knee ROM
    - Effusion
    - Knee asymmetry
  - Teach them what you want them to do with your patients

Rehabilitation

- Having good rehab staff will
  - Make your non-operative rehabilitation more effective
  - You will find you will won't need to do as much surgery
  - More importantly, results will be more successful and patients will be happy

Rehabilitation

- If your patient does not have the desire to undergo rehab to improve ROM, then do not do surgery on that patient – he/she won't get better

Rehabilitation with articular cartilage procedures

- I am not against research and ideas for how to "grow" articular cartilage
- I just hate seeing patients treated surgically with the assumption that we "need" to do something or that patients will be better because we did "all that we could do"

Conclusion

- Chondral defects are common – BUT why penalize patients with over-treatment?
- Most chondral defects do not require surgical treatment
- When and which ones to treat are unknown
- Proper non-operative rehabilitation can be effective

Osteochondritis Dissecans

- OCD defined as a fragment of articular cartilage, together with avascular subchondral bone that becomes separated partly or completely from the joint surface (Aicroth)
- Eitiology remains unclear

OCD Treatment Options

- Ideal technique remains controversial
- Nonoperative – activity modification avoiding high impact activities, short-term immobilization and protected weight bearing
  - Goal is to prevent further loosening and/or chondral collapse
  - Generally only used in children with a nondisplaced piece
  - Need to be careful about immobilization because of the complications of atrophy, stiffness, and cartilage degeneration

OCD Treatment Options

- Excision with stimulation
  - Abrasion
  - Drilling
  - Microfracture
- Fixation
- Restorative Techniques
  - ACI
  - Osteochondral Graft
  - Bone-Marrow Derived Cell Transplantation

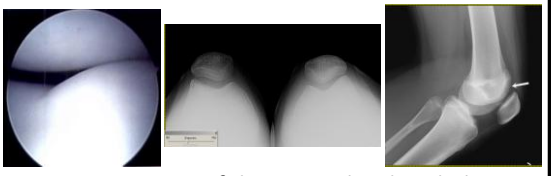
OCD Treatment Options

- To date, results are mixed
- There does not seem to be a clear advantage of one procedure over another, although use of restorative techniques is on the rise

My experience

- From 1983 to 2009, treated 102 patients with OCD
- Recently, obtained ≥ 2 yr follow-up on 33 patients who lived within 100 miles of our clinic

My Treatment Approach

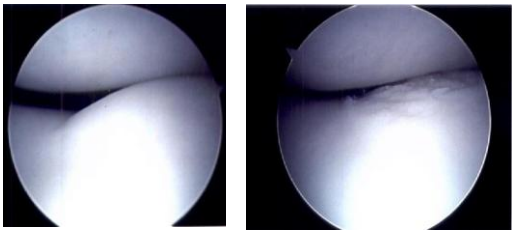


- Prior to separation of the piece, the chondral surface becomes elevated and symptomatic
- This is contrary to what you would think the appearance would be based on x-ray

My Treatment Approach

- For stable lesions, I simply debride the elevated portion with abrasion chondroplasty
- When the lesion is detached or unstable, this turns into an excision/loose body removal
  - With debridement/PICK arthroplasty of the lesion site

My Treatment Approach
Example of Stable Lesion



Pre- debridement **Post- debridement**

My Treatment Approach
Example of an Unstable Lesion

Post-op Rehabilitation

- No immobilization
- No weight bearing restrictions
- Control swelling and prevent hemarthrosis
  - Cold/compression 24/7 for the first 2-3 days post-op
  - Elevation of knee above heart
  - Anti-embolism stockings
- Work on immediate return of full, symmetric ROM

Post-op Rehabilitation

- Low impact exercise (bike, elliptical) ~2 weeks post-op
- Progress into strengthening phase once ROM is symmetric to the opposite knee and swelling is well-controlled
  - Single leg press, single leg extensions, step downs
  - Progress to bilateral strengthening once quad strength is within 10% (side-to-side) on isokinetic testing

Patient population

- Mean age at time of surgery: 23.3 yrs (range 14-48)
- Mean objective follow-up: 7.7 yrs (range 2-15)
- Mean subjective follow-up: 10.5 yrs (range 2-23)

Lesion Characteristics

Location of the Lesion	n
Medial Femoral Condyle	17
Lateral Femoral Condyle	5
Patella	5
Trochea	6

- Size of lesion: Mean 2.7 cm^2 (range 0.5 – 8.0)

Results
ROM

	1 mo	Latest Follow-up
Involved knee ROM	4-0-137	3-0-139
Non-Involved knee ROM	5-0-141	3-0-141

Results
Strength

	Latest Follow-up
Single Leg Hop Test	99%
Cybex 180 deg/sec	94%

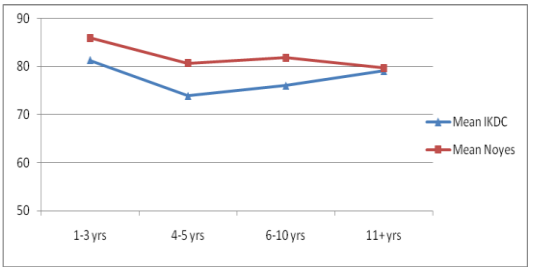
Subjective scores at Latest Follow-up

- Latest follow-up: 10.5 years (range 2-23)
- Modified Noyes: Mean 80.3 points (range 33 to 100)
- IKDC subjective score: Mean 79.9 (range 43 to 100)
- 19/33 (58%) had IKDC scores ≥ published normal scores for their age and sex
  - 24/33 (73%) were within 1 SD

Survey Scores Through Time

Years Post-op	IKDC		Modified Noyes	
	n	Mean ± SD	n	Mean ± SD
1-3	14	81.3 ± 16.2	18	85.9 ± 14.1
4-5	10	73.9 ± 18.0	13	80.7 ± 17.2
6-10	17	76.0 ± 18.4	16	81.8 ± 14.9
≥ 11	16	79.1 ± 19.9	15	79.7 ± 19.3
Most Recent	33	79.6 ± 18.9	32	80.3 ± 18.6

Survey Scores Through Time



Activity Level

- Pre-op mean: 7.7 (range 3-9)
- Post-op mean: 7.4 (range 3-10)

Results
Radiographs at Latest Follow-up

- Mean 7.7 years post-op
- No joint space narrowing : 76% (25/33)
- No osteophyte formation: 67% (22/33)
- No sclerosis: 82% (27/33)

Results
Radiographs at Latest Follow-up

- Data were then analyzed in two groups: normal joint space group and joint space narrowing group

	Normal Joint Space (n = 25)	Joint Space Narrowing (n = 8)	P Value
Follow-up Time	7.3 yrs	8.8 yrs	.51
Age at Follow-up	**29.2 yrs**	**37.9 yrs**	**.04***
Lesion Size (cm^2)	2.52	2.83	.72

*Statistically Significant Difference

Discussion

- The mean IKDC score reported in our study was 79.9 at a mean of 10.5 years post-op
- Comparable or higher than most studies of restorative procedures with shorter-term follow-up

Discussion

- Typical rehabilitation program after restorative procedures involves restricted weight bearing for 4-12 weeks
  - Usually non-weight bearing for the first 4 weeks
- Some programs do not restrict ROM, but others limit ROM or utilize braces
- These postoperative rehabilitation programs impose significant limitations on a patient's lifestyle during recovery
- We are also aware of the detrimental effects of prolonged weight bearing and/or ROM restrictions

Conclusions

- Results of this study show overall good results and a return to high level of function
- The results show 1/4 of patients develop degenerative changes
- One advantage of this treatment approach is that there is no restriction of weight bearing or a prolonged rehabilitation process

Conclusions

- Other procedures intended to restore the articular cartilage have yet to show superior results, yet employ rehabilitation restrictions that significantly impact the patient's lifestyle and could lead to permanent ROM deficits
- Is the additional cost and risk associated with these procedures justified?

Multiple Knee Ligament Injuries: Algorithm for Treatment

Knee Update 2013 Congress
Dusseldorf, Germany
April 6, 2013

K. Donald Shelbourne, MD

Current Trends

- Orthopaedic surgeons are trained to do surgery
- Current trend for knee dislocations is to repair or reconstruct all torn structures
- This approach is overtreament and leads to complications!

Introduction

- Knee dislocations worry most orthopedists because:
  - Severity
  - Lack of comfort with treatment
  - Poor outcomes
  - Possible complications

Introduction

- Unrecognized injuries can have a bad disabling result (most of these are lateral side injuries)
- Acute surgery gives good stability but causes many motion problems and less than normal knees (90% medial)
- Medial and lateral side injuries are different as are ACL/PCL injuries
- Need to separate the individual parts

Most Important Determination

- Determine if the knee dislocation is medial or lateral disruption
- Different approaches to treatment based on type of injury
  - Medial – acute surgery is not advised because stiffness is frequent
  - Lateral – acute surgery is needed to reattach the distally torn lateral capsule and stiffness is rare

Initial Evaluation

- History
  - Mechanism of injury?
  - How painful was the injury?
- Observe
  - Active ROM and leg control
  - Observe swelling
    - Is there a large hemarthrosis and is it contained within the capsule?
    - If so, the capsule is still intact and the injury is not as severe

Initial Evaluation

- Is there diffuse swelling in which the capsule is disrupted, causing swelling and/or discoloration into the calf?
- If so, the injury is more severe, although the knee may look less bad

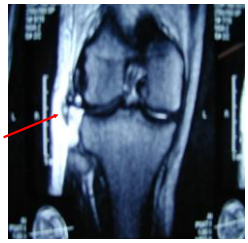
Medial Side Knee Dislocation

MCL injury

- Proximal injury

Lateral Side Knee Dislocation

Lateral Side Injury



Initial Evaluation

- Observe the knee
  - Is there gross posterior sagging of the tibia?
  - Does the knee go into recurvatum?
  - Evaluate peroneal nerve in lateral side injuries
  - By the time the patient is seen in the office, the vascular status has been confirmed, but make sure to check this if seeing the injury at an athletic event

Knee Dislocation
Approach to Treatment

- Approach to treatment regardless of whether it is a medial or lateral side dislocation is based on the healing potential of the ligaments
- What ligaments can heal?
  - MCL
  - PCL
- What ligaments usually do NOT heal?
  - ACL
  - Lateral side structures

Knee Dislocation
Approach to Treatment

- Major goal is to do the least amount of surgery needed to allow for the best long-term outcome
- Do not want to do a surgery that causes long-term ROM problems
- We want to allow ligaments to heal if possible

Ligament healing

- Well accepted that the MCL heal
- Some believe that the MCL may not heal well when other structures are torn
- If proper stabilization is provided that prevents stress on the MCL, it can heal regardless of other structures injured

PCL healing

- PCL can heal either as an isolated injury or with knee dislocation
  - Tewes et al. (CORR 1997)
  - Isolated injuries in 13 patients
  - Performed MRI at acute injury and at follow-up
  - Return of continuity in 10 of 13 complete PCL injuries
  - The 3 patients who had discontinuous PCLs had 2+ posterior drawer on exam

PCL Healing

- Shelbourne et al. (Am J Knee Surg 1999)
  - MRI at acute injury and at a mean of 3.2 years after injury
  - 23 isolated PCLs
  - 12 PCL/MCL
  - 5 PCL/ACL and lateral or medial side

PCL Healing

- 21 of 23 isolated injuries healed
- All PCLs with PCL/MCL injuries healed
- PCL/ACL injury – PCL healed, ACL did not
- 2 PCL/MCL/ACL injury – PCL and MCL healed; ACL did not
- PCL/MCL/lateral side – PCL and MCL healed; lateral side did not

PCL healing

- Degree of PCL laxity doesn't determine outcome
- No difference in subjective scores between patients with 1+ or 2+ PCL laxity (Shelbourne et al. AJSM 1999)

Medial side/ACL/PCL

- High incidence of knee stiffness and arthrofibrosis is acute ACL surgery
- Worse in ACL/MCL surgery
- It is not surprising that stiffness is even worse with acute surgery for medial side knee dislocations

ACL/PCL/MCL

- Confirm the ACL tear
- Need to determine location of MCL injury and degree of laxity
- Check for PCL injury
- At initial evaluation, if the knee is too swollen or the patient is not comfortable enough to allow for posterior drawer exam
  - Use TED hose, cold/compression, and elevation for a few days and then re-examine the knee
- MRI may be helpful but even severe grade 3 PCL injuries on MRI have been shown to heal with continuity

Medial Injury - Proximal

- Determine if the injury is proximal or distal
  - Proximal injuries
    - **Usually more painful**
    - **Large amount of swelling**
    - **Knee in a bent position**
    - **These injuries cause the knee to get stiff quickly**
  - Distal injuries
    - **Less swelling**
    - **Knee is comfortable in extension**

Cast vs. Immobilizer

- Immobilizer not secure enough to provide good stability
- Cast is more comfortable and allows weight bearing
- Remove the cast at least weekly to evaluate MCL healing
- Can reapply another cast if needed

Casting

- Proximal injury
  - Gets stiff quickly
  - MCL "healing" usually occurs in 1-2 weeks
- Distal injury
  - Less swelling and the knee does not get as stiff
  - May take longer period of casting to obtain MCL healing

ACL/PCL/MCL

- Once MCL healing occurs, re-evaluate PCL and ACL stability
- PCL most likely has healed to where you have a 1+ or 2+ posterior drawer with a good endpoint
- ACL reconstruction can be performed electively based on the patient's lifestyle, demands, and knee ROM

Medial side knee dislocations

- Key to successful results is to make sure the MCL heals well
- That is why we prefer a cast over a brace
- The MCL heals and the patient is more comfortable during the process
- If some residual laxity persists, the MCL laxity can be addressed during ACL surgery

Knee Dislocation with Lateral side injury

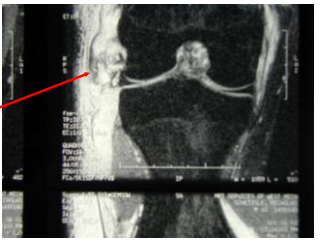
- Not a common injury – only 10% of knee dislocations and 1% of all knee ligament injuries
- When the injury is unrecognized, patients usually have disabling symptoms
- Lateral side injuries can involve the IT band, lateral capsule, popliteus, LCL, biceps tendon and lateral gastroc
- With marked lateral laxity, multiple structures are involved

Knee Dislocation with Lateral side injury

- Clinically, the most important structure providing stability is the lateral capsule
- The lateral capsule and biceps tear distally and retract proximally and will not heal as is
- Usually, the IT band and lateral gastroc are not injured
- Body quickly begins healing the tissue "en masse"
- Needs acute repair if > 1+ laxity
- Check for peroneal nerve injury

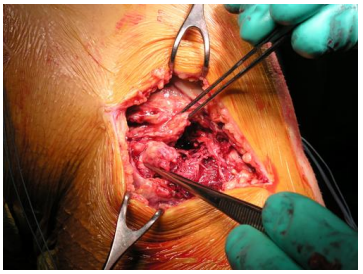
Lateral side knee dislocation

Structures tore distally and retracted proximally; will not heal as is



Lateral side knee dislocation

Lateral structures torn off distally



Treatment

- Lateral side injuries require immediate attention
- Surgical repair within 2 weeks after the injury is desired
  - Lateral stability usually can be established
  - Balance obtaining ROM and decreased swelling with the ability to repair the lateral structures

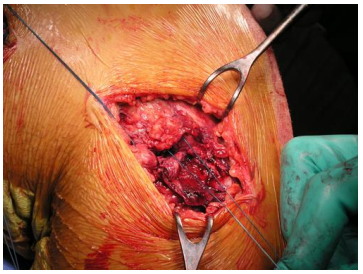
Treatment

- Can perform an ACL reconstruction along with lateral repair acutely
- Must be done as an open procedure
- If you want to do the ACL with arthroscopy, you will need to do staged procedures after the open lateral repair
- Repairing lateral side acutely is most important

Treatment

- Do ACL at the time of lateral side repair for patients who are higher risk – to protect the lateral side repair
- Allow the PCL to heal when lateral side repair is done

Reattach the joint capsule to tibia



Reattach lateral structures en masse to tibia with a staple

Follow-up Study

- 17 patients returned for follow-up examination and MRI
- Average time from surgery at follow up- 4.6 years

Subjective Results

Questionnaire	Mean	Range	SD
Modified Noyes Score	93.5	71-100	7.4
IKDC Subjective Scores	92.3	71-100	9.3
Activity Level-	8.2	6-10	1.3

Objective Results

- Ligamentous Testing
  - Two with 1+ lateral laxity
  - Two with 1+ posterior laxity
  - One with 1+ anterior laxity
- IKDC Knee Exam Results
  - 11 rated as normal, 6 as nearly normal
- All but 1 patient had full range of motion

Radiographic Results

- No knees demonstrated medial or lateral joint compartment narrowing
- One individual had patellofemoral joint space narrowing
- Varus Stress Radiographs
  - Mean difference between surgical and non-surgical legs- 1.1 mm (range, -1.2 mm to 4.7 mm)

MRI Results

- Lateral Side Repair
  - All presented intact/healed and appeared thickened
- All PCL injuries healed
  - Usually seen as elongated, buckled, or attenuated
  - All were intact and demonstrated bridging fibers

MRI of lateral side repair

MRI of healed PCL injury

Simple Treatment Approach

- #1 Goal – obtain functional stability without loss of knee motion, as loss of ROM leads to OA
- PCL laxity combined with collateral laxity is a problem
  - Have to get the MCL to heal (can be achieved nonopreatively)
  - Have to do surgery for lateral side injuries

Simple Treatment Approach

- PCL will heal with conservative treatment even with other structures torn
- Lateral side repair should be performed within two weeks of the injury for best results
- Perform ACL reconstruction IF NEEDED
- Better off waiting to do ACL reconstruction if in doubt
- This approach will NOT lead to ROM problems and will provide good stability and function

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Examination and Treatment Algorithm for Patellar Dislocation or Malalignment

K. Donald Shelbourne, MD

SHELBOURNE KNEE CENTER

Overview

- Discuss differences between acute and chronic dislocators
- Evaluation of the patellofemoral joint
- Our approach to treatment
  - Surgical
  - Non-surgical
- Rehabilitation

Introduction

- Many different treatment approaches to patellar dislocation, including non-operative rehabilitation
- Surgical options:
  - Proximal, soft tissue
  - Distal, bony realignment
  - Proximal and distal
- For PF instability, we need to customize our treatment based on the underlying problem

Introduction

- In young competitive athletes, surgical treatment for patellar dislocation is not as common as ACL tears
- In 30 years of practice devoted to treatment of knee injuries
  - – 6000 ACL reconstructions and only 500 patellar realignment procedures

Introduction

- General orthopaedic surgeon who may treat 50 patients for ACL injuries per year may see only 10 patellar dislocations in the same period
  - Trend is the same for PTs and Athletic Trainers
- Without a high number of patients with patellar dislocation, it is difficult to arrive at a treatment algorithm

Introduction

- In the 1980's, we performed a Trillat procedure for all patellar dislocations showing significant lateral alignment of the patella
  - Medialize tibial tubercle
- As we have systematically researched our patients with long-term follow-up, we began to sort out the anatomical differences in patients with patellar dislocation
- Treatment approach has been refined based on the research results

Introduction

- Not all patellar dislocations are the same
  - Traumatic vs. atraumatic
  - Unilateral vs. bilateral malalignment or injury
  - Normal patella height vs. patella alta
  - Many factors to consider

Patellofemoral Instability 2 Main Categories

- Acute, traumatic dislocations
  - Patient without any previous PF instability in either knee
- Chronic/Recurrent Instability
  - Often non-traumatic mechanism of injury
  - Bilateral instability common

Patellofemoral Instability

- Most often, patients with recurrent or bilateral instability have congenital alignment problems that predispose them to dislocations
  - Lateral patella
  - Proximal patella (alta with J-sign)
  - Combined lateral and proximal alignment

Evaluation

- We evaluate the following factors:
  - Height of the patella on physical exam
  - Integrity of medial retinaculum
  - Position of the patella in relationship to the trochlea (radiograph)
  - Height of patella and length of the patella tendon on radiographs

Evaluation

- Comparison to the opposite patella is critical
  - Observe for asymmetries between the patellae
  - In patients with unilateral instability, you have a guide as to what the alignment of the involved patella should be
  - When the patient has congenital malalignment or bilateral instability, the alignment of the opposite patella may not be normal

Clinical Examination

- J-sign
  - Patient sits on the side of an examination table with knees bent
  - Observe the movement of the patella during active knee extension
  - Positive J-sign occurs when the patella moves out of the trochlea laterally
  - Indicates patella alta

J-Sign

Clinical Examination
Patella Hei

Patella Height and VMO Size

- It has been our experience that patients with long patella tendons have smaller VMO muscle mass
- Patients with short patella tendons have larger VMO muscle mass
- We don't believe that the smaller size of the VMO leads to PF instability
- BUT, patients with instability often have patella alta and hence, small VMOs

Clinical Examination: Patella Tilt

- Patella Tilt
  - Move the patella medially and gently lift the medial aspect of the patella with your finger tips
  - Observe for increased laxity of medial retinaculum compared to opposite side

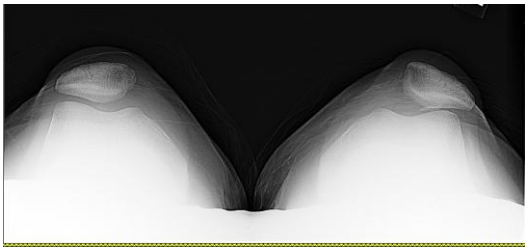
Radiographic Examination

- Merchant view
- Lateral view (60 degrees)
- Lateral view with knee extended and quadriceps contracted
- Bilateral films

Merchant View

- Assesses the relationship of the patella to the trochlear groove
- Provides a direct comparison to the opposite knee
- Observe for presence of an avulsion fracture

Merchant View



Lateral View

- Patella Tendon Length
  - Inferior pole of patella to tibial tubercle
- Normal Values
  - 45 mm for females
  - 50 mm for males

Lateral View

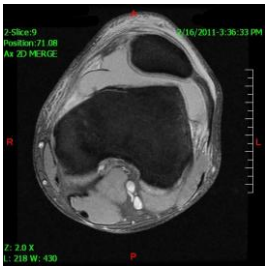
- Patella Height
  - Inferior tip of patella chondral surface to Blumensaat's line

Quad Contraction Lateral view

- Evaluate the height of the patella in relationship to the trochlear groove
- Inferior tip of patella chondral surface to superior edge of trochlea

MRI

- Used primarily to assess
  - integrity of the medial retinaculum
  - status of the articular cartilage



Surgical Treatment

- In general, proximal procedures are for traumatic problems in previously normal knees
  - Soft tissue corrections
- Distal procedures are done to correct underlying congenital problems
  - Procedures involving tibial tubercle

Treatment Algorithm

- Use the subjective history and evaluation of the patient to categorize patients
  - Dislocations without preexisting congenital malalignment
  - Dislocations in patients with preexisting congenital malalignment
    - Lateral patellae, normal patella height
    - Lateral and proximal patellae
    - Centered, but proximal patellae

Acute patellar dislocations

- Treatment is straightforward when knee was normal prior to dislocation

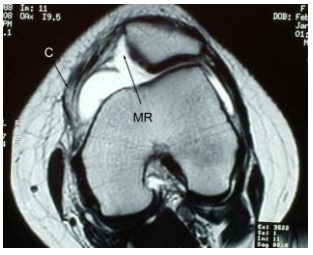
Acute patellar dislocations
Nonoperative treatment

- Symmetric Merchant view with both patellae centered in trochlea
- Focus on reducing effusion and regaining symmetric ROM and strength prior to functional progression back to sport
  - Patients tend to have large effusion and problems with quad control initially
  - Flexion loss due to effusion
  - Usually don't have extension ROM loss (if so, it is easily regained)

Acute patellar dislocations

- Exception is competitive athlete with MRI showing medial retinaculum tear despite the patella being centered
- Often require surgery to be able to return to sports without instability because the medial retinaculum cannot heal if it is badly torn

MRI: Torn Medial Retinaculum



Acute patellar dislocations
Operative Treatment

- Surgery done subacutely- ↓ swelling and ↑ ROM 1st
- Medial retinaculum imbrication and open lateral release (MI/LR)
  - Clear asymmetry between the two patellae on Merchant view x-ray
  - Contralateral patella centered within trochlea
- Elmslie-Trillat procedure (with MI/LR)
  - Clear asymmetry between two patellae
  - Contralateral patella is not centered within the trochlea

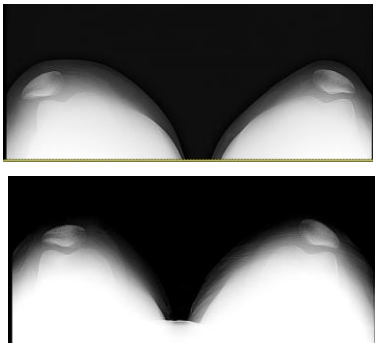
Acute patellar dislocations Operative Treatment

- Surgery is not done until swelling resolves and symmetric ROM is restored
- Pre-op rehab and patient education is very important
- Focus on
  - ROM, swelling control, quadriceps control, normal gait pattern

Medial Imbrication and Lateral Release

- Arthroscopy performed to evaluate articular cartilage status
- Open lateral release performed through a small incision on the lateral side of the patella leaving synovium intact
- Parallel incision made on medial side
- "Pants over vest" technique to imbricate the medial retinaculum

Medial Imbrication/Lateral Release: Merchant View



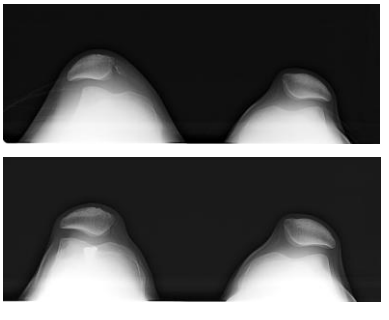
Elmslie-Trillat Procedure

- Lateral release
- Medialize tibial tubercle
- Medial retinaculum imbrication

Elmslie-Trillat Procedure

- Medial imbrication and lateral release is done to repair the acute injury
- Medialization of the tibial tubercle corrects the preexisting congenital abnormality: lateral patella alignment

Trillat/ Medial Imbrication/ Lateral Release



Trillat/ Medial Imbrication/
Lateral Release

Chronic Patellar Dislocation

- Patients grouped into the following categories:
  1. Normal patella height, patellae centered on Merchant view
  2. Normal patella height, patellae not centered on Merchant view
  3. Patella alta

Chronic Patellar Dislocation

- Category 1
- Despite normal Merchant view x-rays and normal patella height, some patients will experience chronic instability
- Indicates laxity of medial retinaculum
  - Detected by comparing medial patellar tilt to opposite knee or by MRI
- Treated with medial imbrication and lateral release

Chronic Patellar Dislocation

- Category 2
- Patients with lateral patellae on Merchant view and normal patellar height
- Treated with an Elmslie-Trillat procedure combined with medial imbrication and lateral release

Chronic Patellar Dislocation

- Category 3
- Patella Alta
  - Positive J-sign
  - Observable patella alta
  - Patella tendon length longer than normal
  - Increased patella height
  - Increased knee flexion allows patients to “W sit” between their heels

W Sitting

Normal vs. Long Patellar Tendon Length

Patella Alta

Chronic Patellar Dislocation Patella Alta

- Our previous treatment theory
  - All chronic instabilities were treated with Elmslie-Trillat procedure between 1982-1998
  - Research follow-up revealed that a small percentage of those patients experienced recurrent instability after surgery
  - This group of patients with recurrent instability had significantly longer patellar tendons
  - Theorized that medialization procedure only corrected part of their anatomic problem

Chronic Patellar Dislocation Patella Alta

- Distalization procedures have been used in the past, but became unpopular due to a high incidence of patellofemoral OA (Hauser)
- Historically, these were done indiscriminately for all instability problems without looking at patella tendon length or patella height
- When done as a correction for longer-than-normal patella tendons this procedure restores the normal anatomy, correcting the patella alta and positive J-sign abnormalities

Chronic Patellar Dislocation Patella Alta

Treatment for recurrent dislocations w/ patella alta

	Distalize Tubercle	Elmslie-Trillat	MI/LR
Centered patellae Medial retinaculum intact	X		
Lateral patellae Medial retinaculum intact	X	X	
Lateral patellae Medial retinaculum torn	X	X	X

Chronic Patellar Dislocation Patella Alta

- Our current treatment
  - Our experience has shown that patients perceive an asymmetry between their knees when only one patella is distalized
  - We now recommend bilateral tubercle distalization in this patient population to restore stability while maintaining symmetry

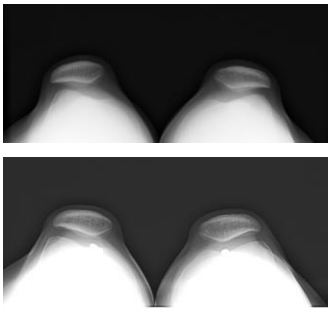
Distalization Procedure

- Amount of distalization is determined pre-operatively based on radiographic measurements
  - Height of patella above Blumensaat's line
  - Height of patella above the trochlear groove
  - Patella tendon length

Distalization Procedure

- Similar surgical approach to the Elmslie-Trillat procedure
- Tubercle is transferred to a distal, or distal and medial, position

Pre-op and Post-op Trillat with Distalization



Pre-op and Post-op Trillat with Distalization

Rehabilitation 1st Week Post-op

- Prevent hemarthrosis
  - Continuous use of a cold/compression device
  - Anti-embolism stockings
  - CPM machine to keep knee elevated above the heart
  - Patients remain on bed rest, except for bathroom privileges, for 5-7 days

Case TE

- 15 y/o male
- Freshman football / wrestling athlete
- History of bilateral knee pain for many years
- Some feeling of patella slipping in both knees through the years
- Previous physicians suggested he reduce sporting activity

Case TE

- Had injury to left knee with wrestling; patella slipped out of place and back in
- Had mild swelling but was able to continue sports
- Had another injury August 2008 doing a blocking drill in football
- Patella dislocated; had significant pain and swelling

Case TE

- Saw another physician
  - Used an immobilizer to wear briefly
  - 3 weeks of rehab
  - Went back to playing football

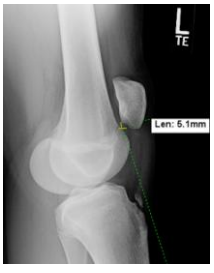
Case TE

- First evaluation by me Feb 2009
- Patient continued to have problems with PF pain of both knees and unstable left patella
- Physical exam
  - + J-sign
  - + patella tilt
  - + patella alta

Patella Alta: Radiographs

Patella Alta: Radiographs

Hyperextension quad contraction lateral view



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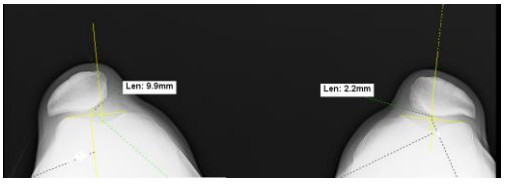

Case TE

- Treatment provided
  - Pre-op physical therapy for evaluation and testing
    - 90% strength (Cybex/leg press evals) pre-op
  - Bilateral scopes, medial imbrication, medial and distal tibial tubercle transfer (March 2009)

Case TE

- Surgery rationale
  - Patient wanted to be active with high school competitive sports
  - Had a long-term problem with both patellae
  - Recent dislocation of left patella making patella more unstable and patella aligned more lateral than opposite knee – needed medial imbrication for correction
  - Because of patella alta, distalization of tibial tubercle needed to provide stability

Case TE

- Surgery rationale
  - Prior experience has shown us that distalizing one side and not the other makes it difficult to make the knees feel equal with rehabilitation

Case TE

Case TE

Case TE

Case TE

- Post-op rehab provided as described above
- Outcome
  - 3 months post-op
    - ROM: 4-0-152 bilaterally
    - Quad strength: 95% on Cybex
    - Beginning to do some football drills

Case TE

- Outcome
  - 4 months post-op
    - Playing football some
    - Has soreness with intense practice
    - Quad strength increased on both legs to greater than pre-op strength, but strength now higher in left than right; 84% side-to-side
    - Instructed to concentrate on right leg strengthening to equalize strength

Case TE

- Outcome
  - 6 months post-op - Playing football without restrictions

Conclusions

- Our treatment algorithm has been developed after years of consistent observation and long-term research follow-up
- The treatment needs to be directed to resolving the underlying pathology
- Primary goal is to obtain symmetry between knees

Conclusions

- Rehabilitation should focus on early ROM
  - Knee flexion works as a "centering device" for the patella
  - As swelling resolves, knee flexion will continue to improve
- Promote quadriceps muscle control
  - Regain protective control as soon as possible
- Once these goals are achieved, begin functional progression for return to sports