Idiopathic Anterior Knee Pain

Postgrad Lecture 2012

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Causes of anterior knee pain

- Post-traumatic subluxation/dislocation
- Patella or trochlea dysplasias
- Osteo-arthritis
- Apophysitis
- Tendonitis
- Plica syndrome
- Hoffa’s lipoma

Idiopathic anterior knee pain?

- Atraumatic
- No identifiable structural abnormality
- No identifiable histological pathology
- Misnamed “chondromalacia patellae”
- Psycho-somatic ?

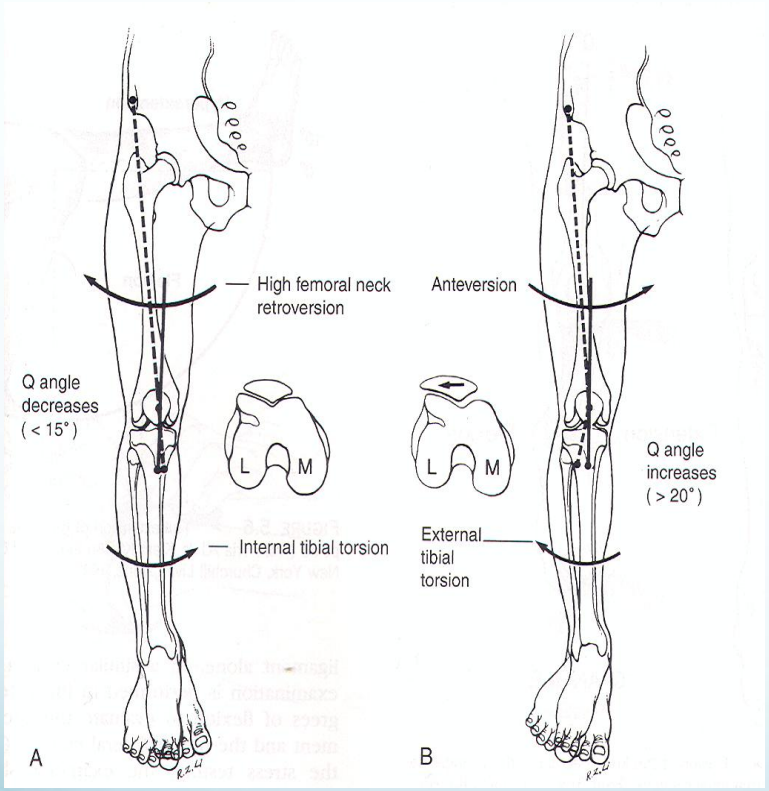
Characteristics of idiopathic anterior knee pain

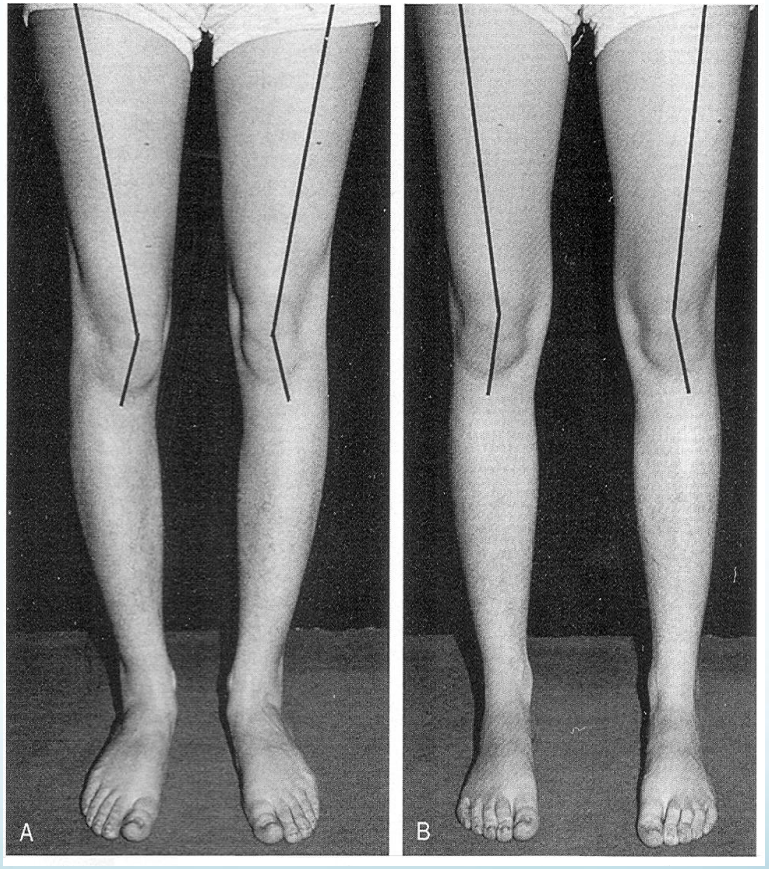
- Commonly affects adolescents F>M
- Episodic but may be constant
- No history of significant trauma
- Aggravated by sports
- ? Swelling

What causes the pain?

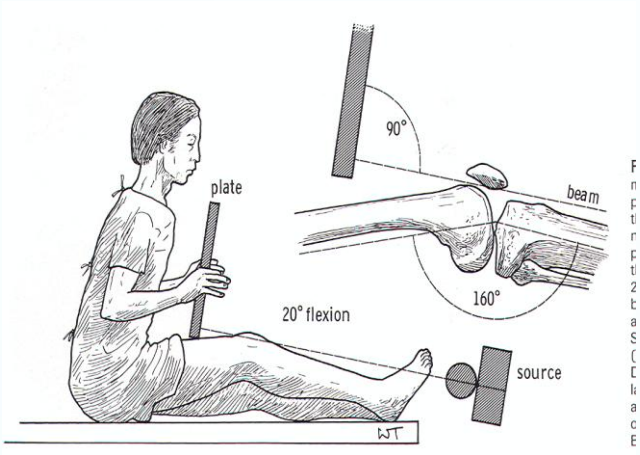
- Maltracking
  - Mal-alignment
  - Shape
  - Instability
- Excessive (lateral) pressure
  - ?Tight retinaculum
- Altered biomechanics
  - Muscle imbalance
  - Abnormal gait
- Hypermobility

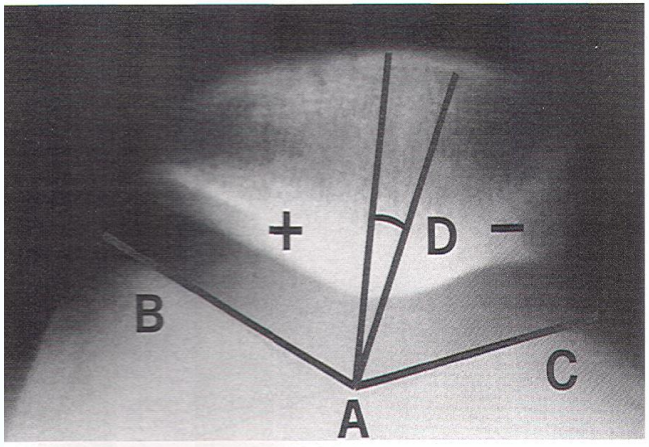
Quadriceps angle (Q)

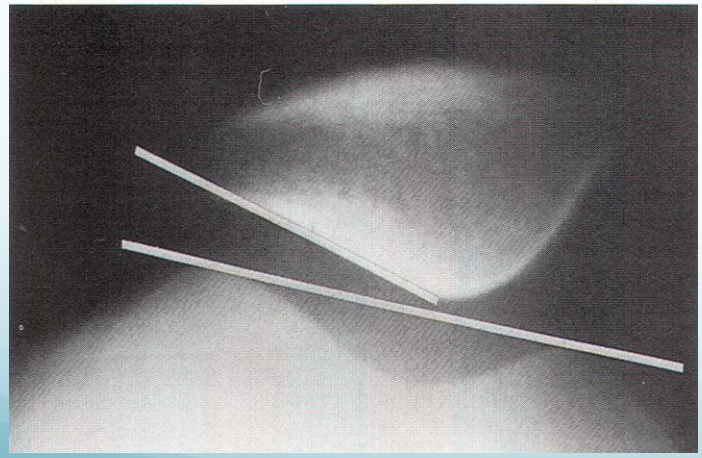


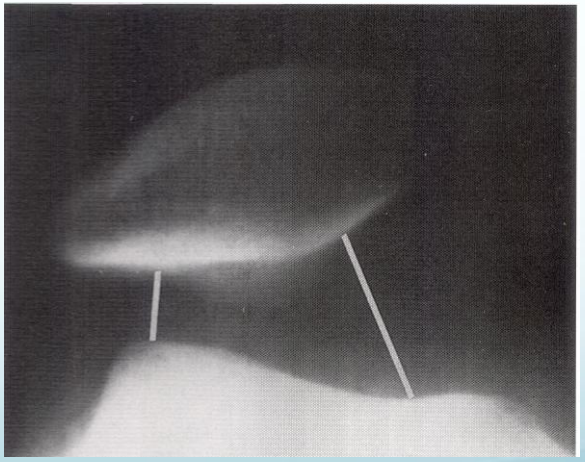


Anatomy - PFJ articulation









Normal radiological values

- Sulcus angle - < 145^{o}
- Laurin's lateral patello-femoral angle > 0^{o}
- Merchant's congruence angle <15^{o}

MRI

- Staubli HU.
- Anatomy and surface geometry of the patello femoral joint in the axial plane.
- J Bone Joint Surg Br 1999;81:452-8

Anterior Knee Pain: the use of computerised tomography to assess the results of tibial tubercle transfer

WM Harper*, AW McCaskie*, ML Harding**, DBL Finlay**

*The Glenfield Hospital
**The Leicester Royal Infirmary NHS Trust
Leicester , UK.

The KNEE 1995

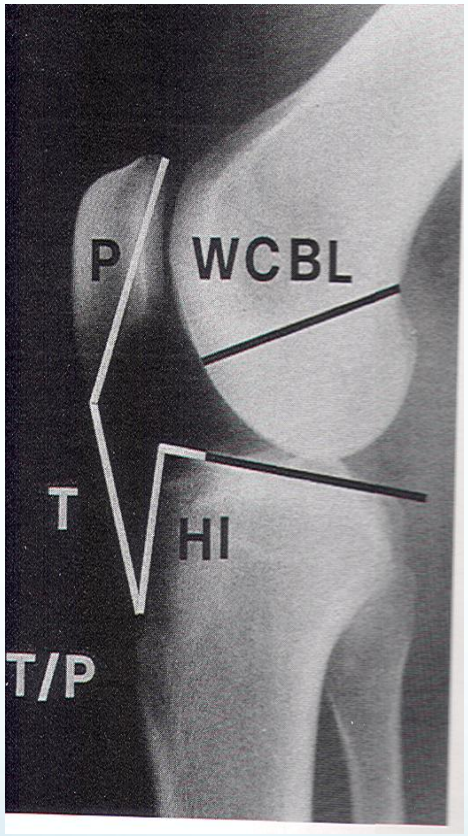
Aim of Study

3 populations of patients

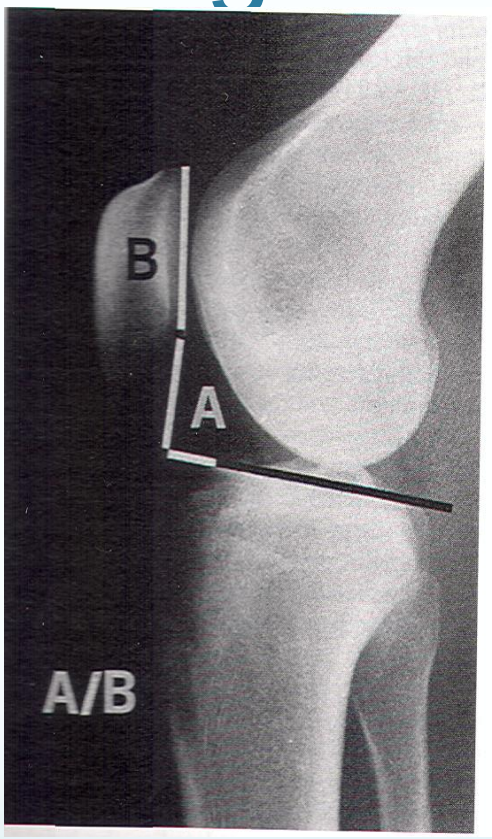
- Those with AKP (untreated) but awaiting surgery
- AKP treated surgically with Elmslie-Trillat type tibial tubercle transfer
- Control group

(Harper, 1995)

Patella height

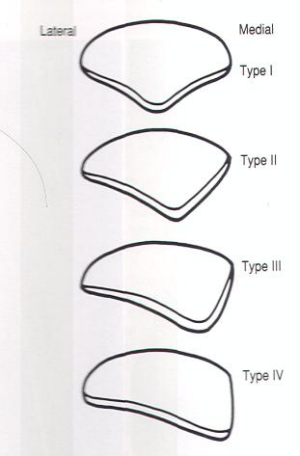


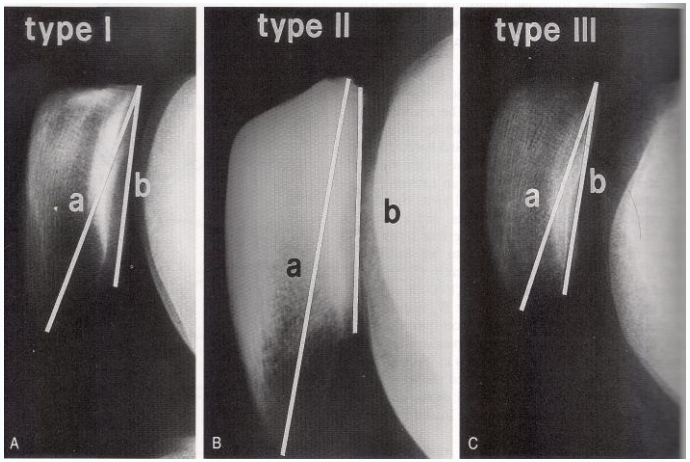
Insall-Salvati ratio < 1.2

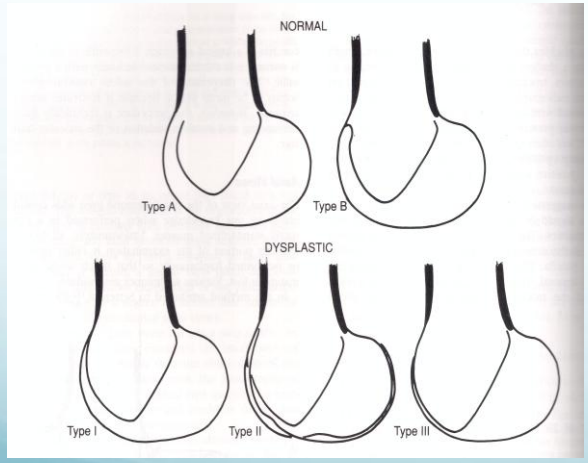


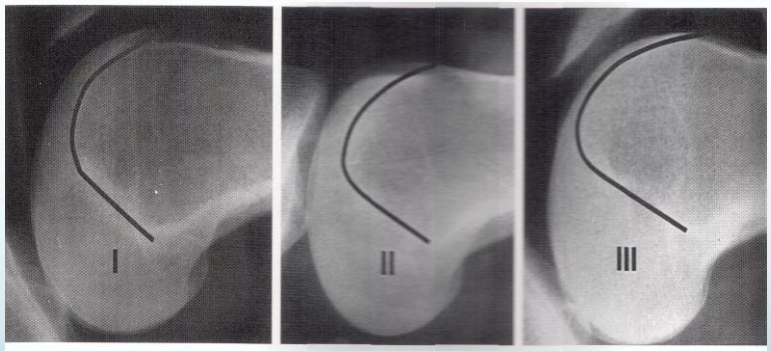
Blackburn-Peel ratio < 1.1

Patella and trochlear morphology

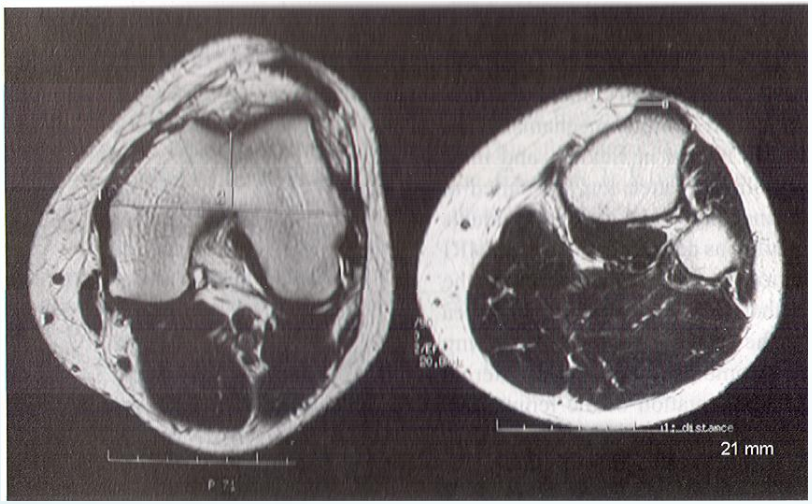


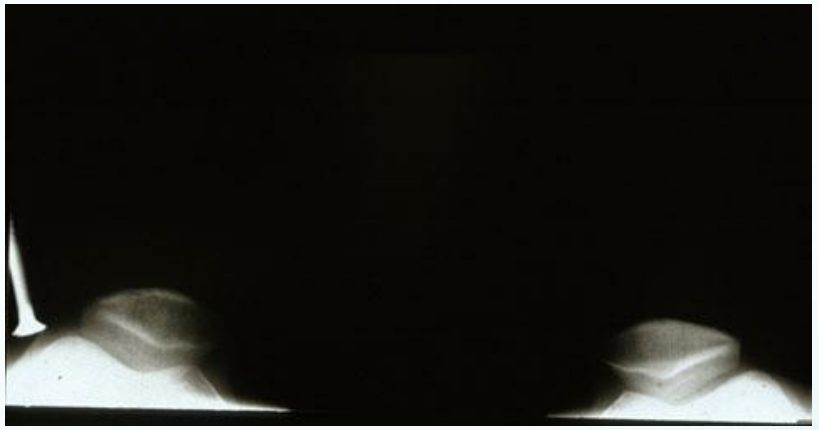






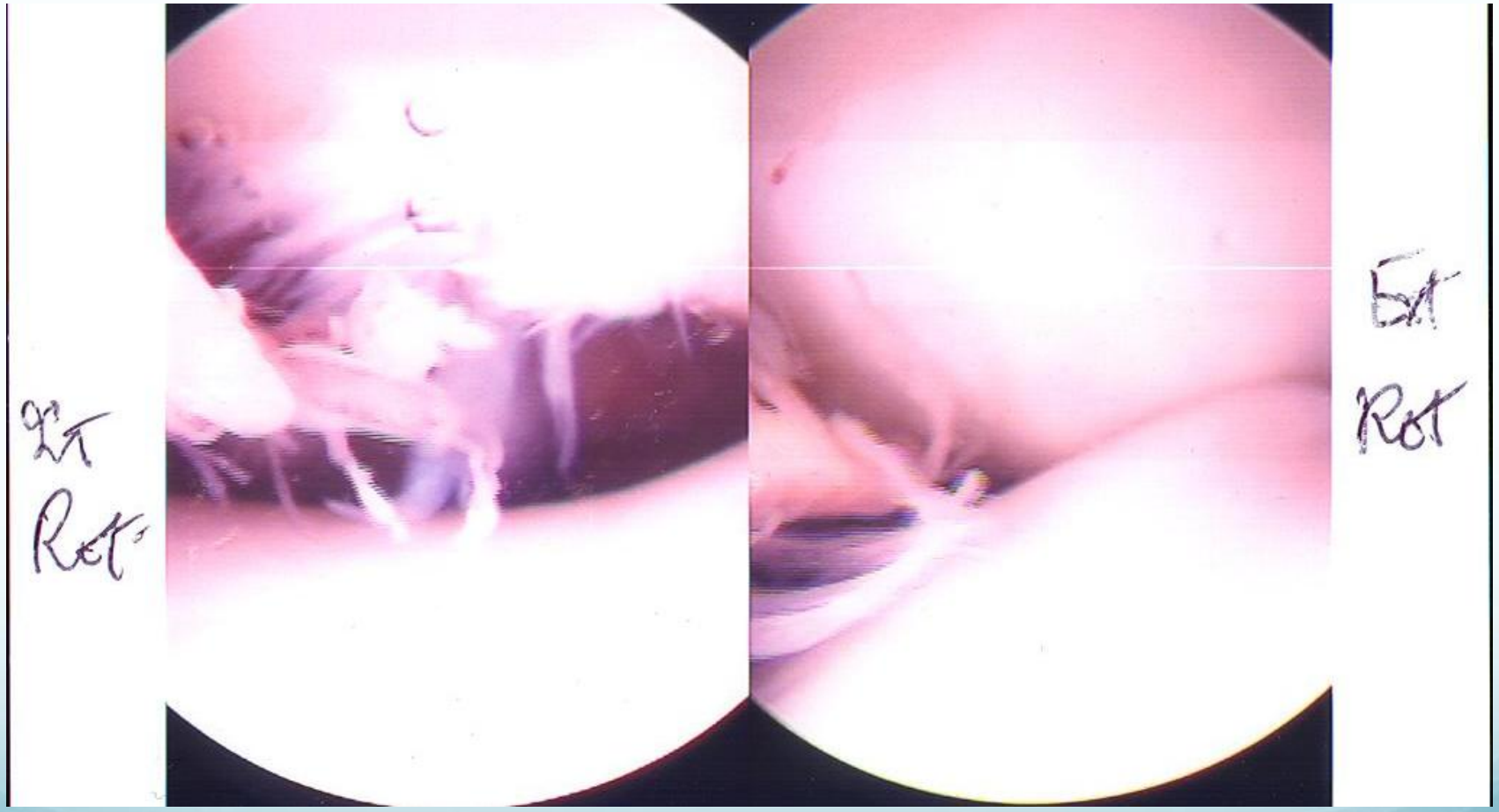
Rotational malalignment
TT – TG distance



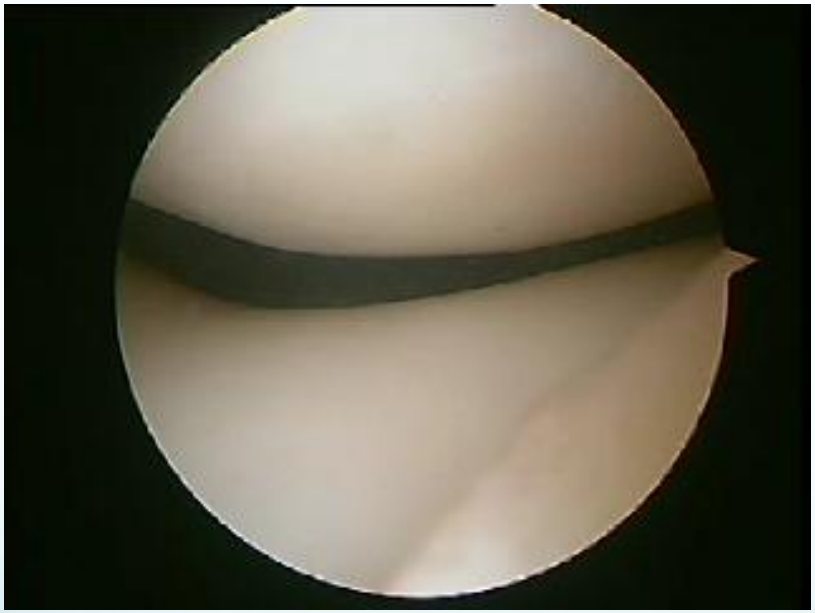


> 20mm = abnormal (Dejour)

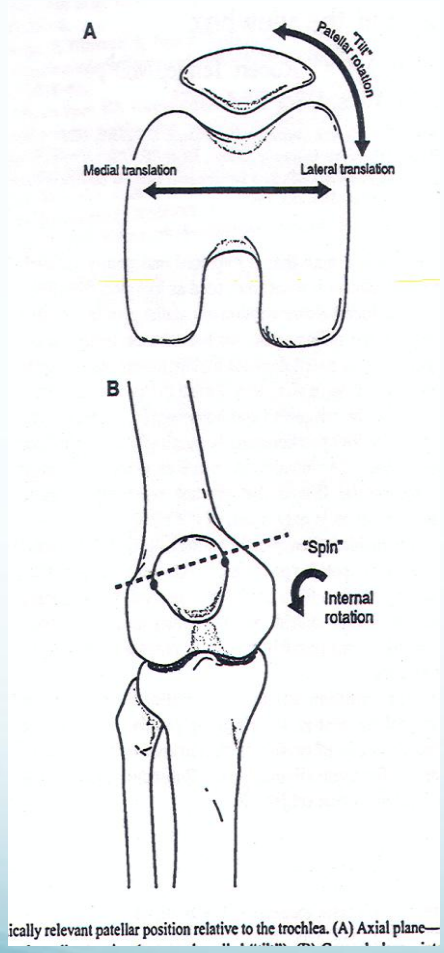
Arthroscopic assessment



Concept of instability



Kinematics



ically relevant patellar position relative to the trochlea. (A) Axial plane—

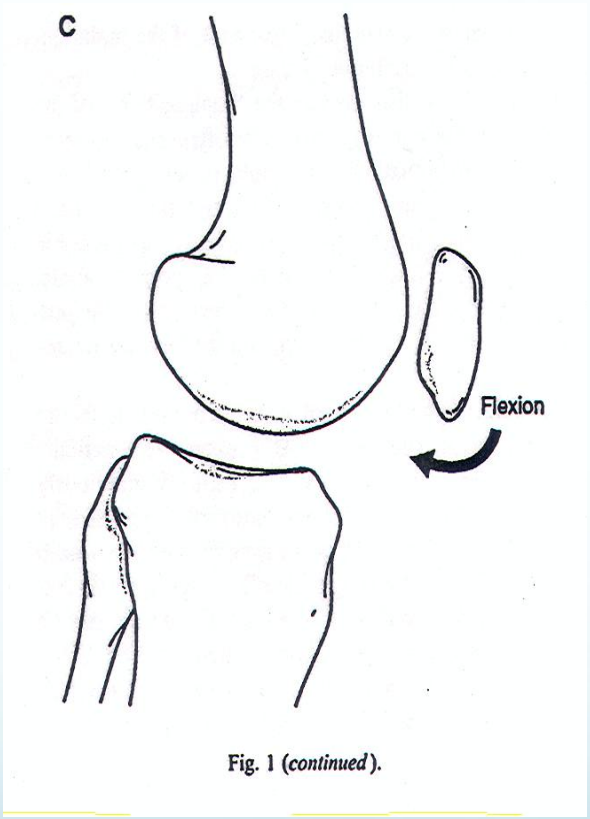
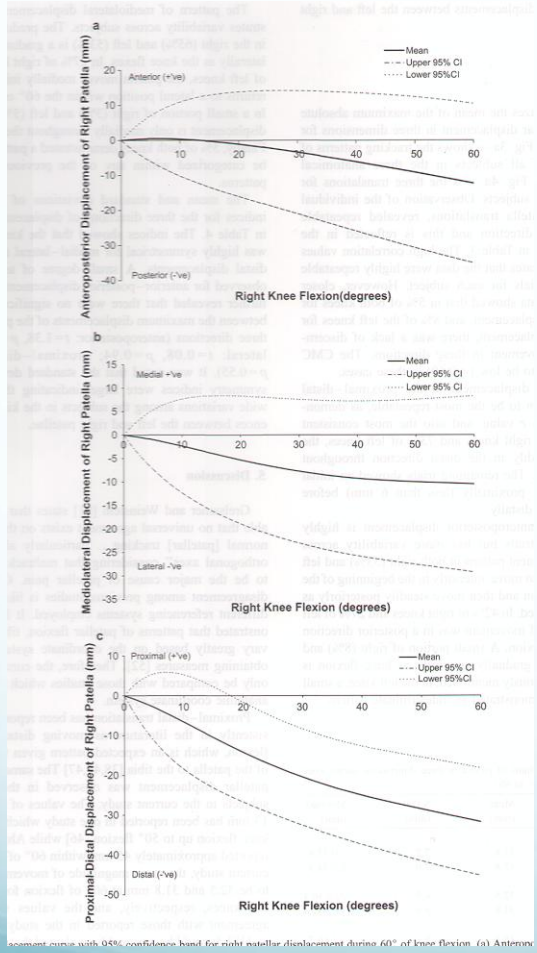


Fig. 1 (*continued*).

Kinematics



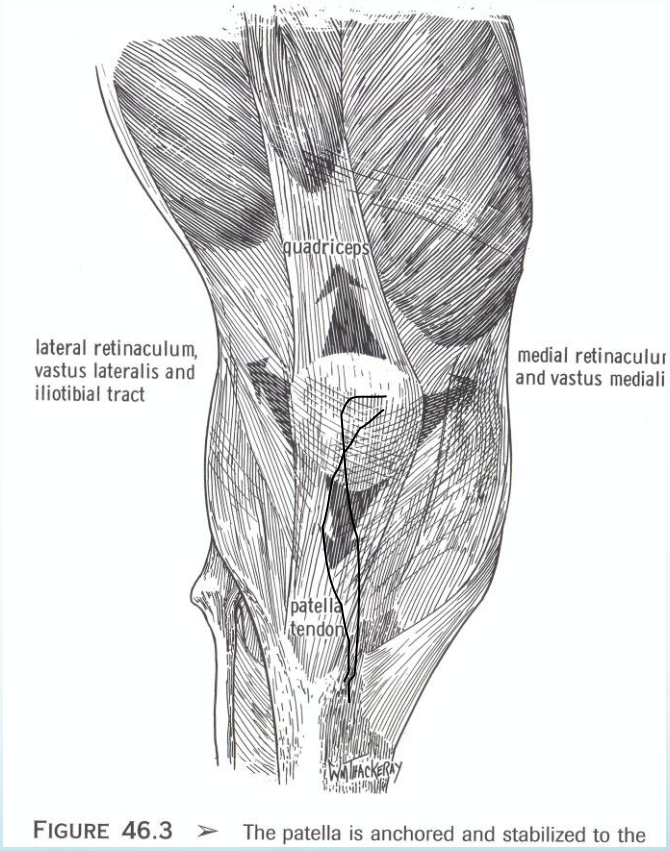
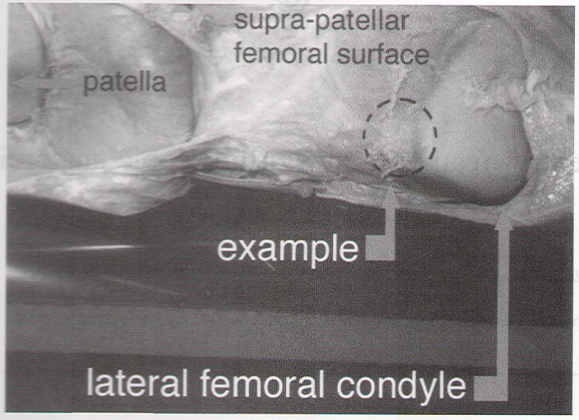
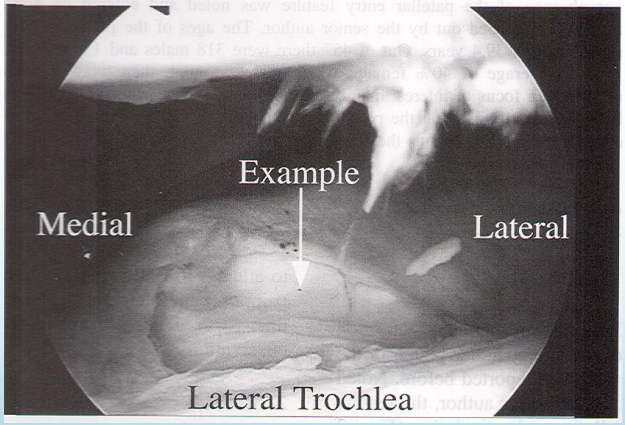


FIGURE 46.3 ➢ The patella is anchored and stabilized to the

Anatomy – entry facet



issection showing the anatomical feature on the soft synovial floor of the suprapatellar



Anatomy of MPFL

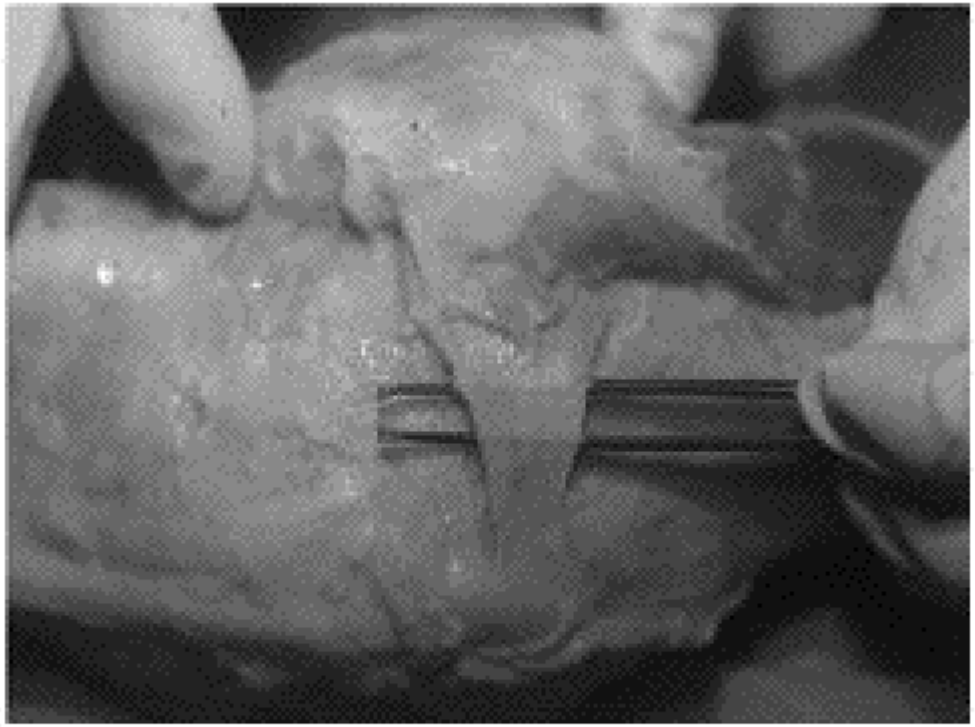


Fig. 1 Photograph of the medial aspect of the right knee with the patella at the top. The MPFL, passing over the forceps, links the proximal half of the medial border of the patella to the medial femoral condyle. The superficial fascia and distal part of vastus medialis obliquus have been removed.

Significance of MPFL in extension

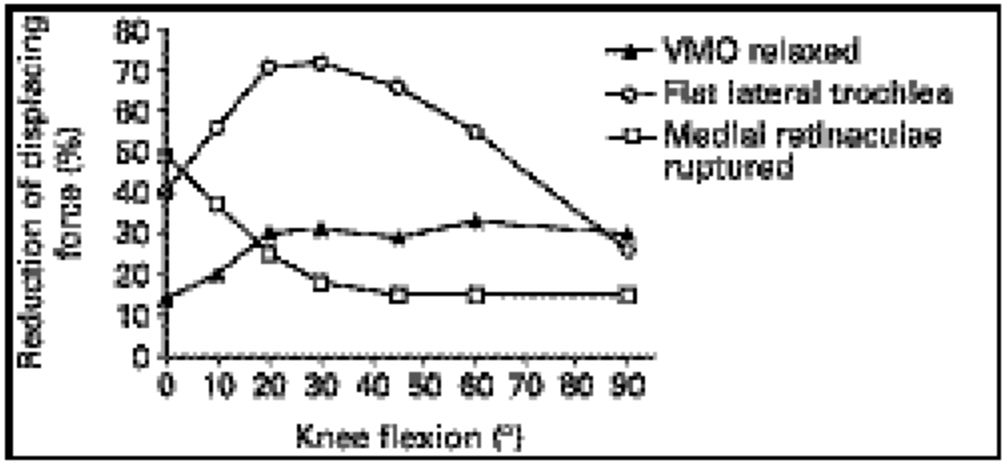
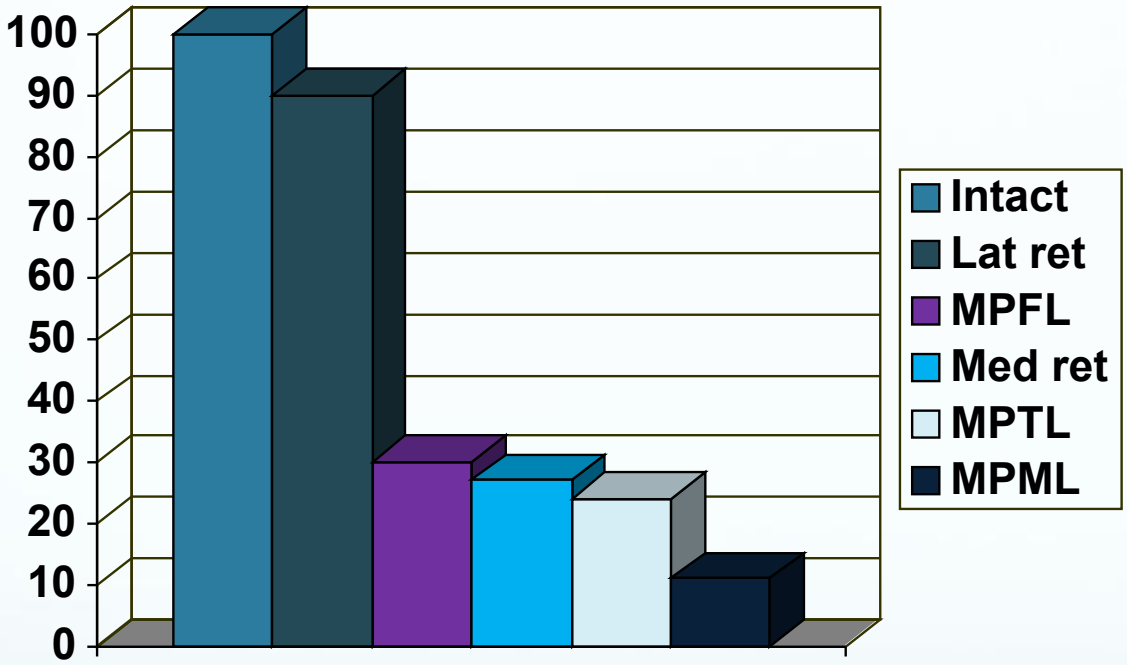


Fig. 6. Percentage loss of resistance to 10 mm lateral patellar displacement caused by each of the three simulated pathologies in isolation.

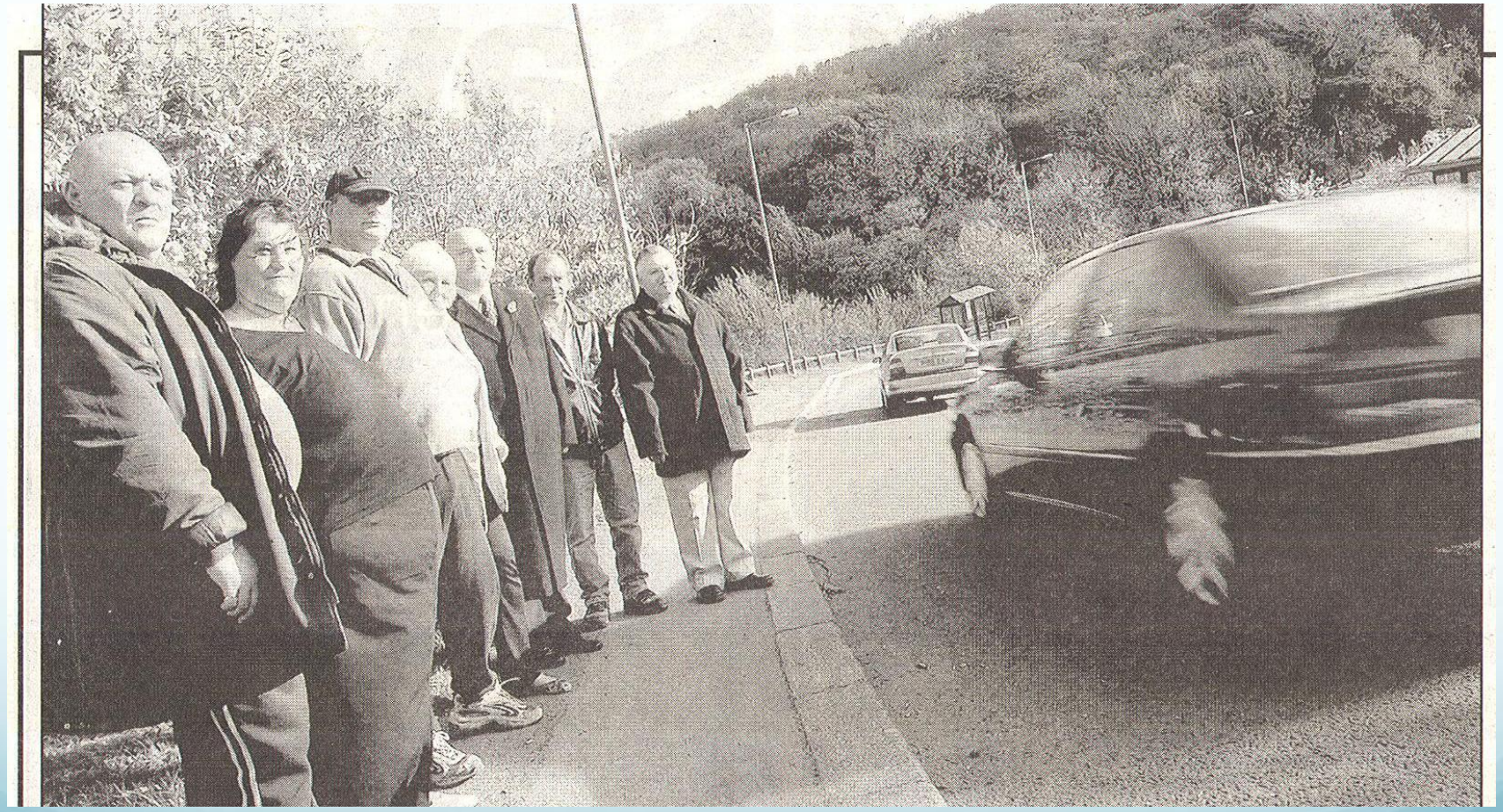
J Bone Joint Surg [Br] 2005; 87-B; 577-82

Significance of lateral retinacular ligaments



Desio SM,Burks RT, Bachus KN. “Soft tissue restraints to lateral patellar translation in the human knee” *Am J Sports Med* Vol 26(1);59-65

Excessive (lateral) pressure



PF pain

ELPS

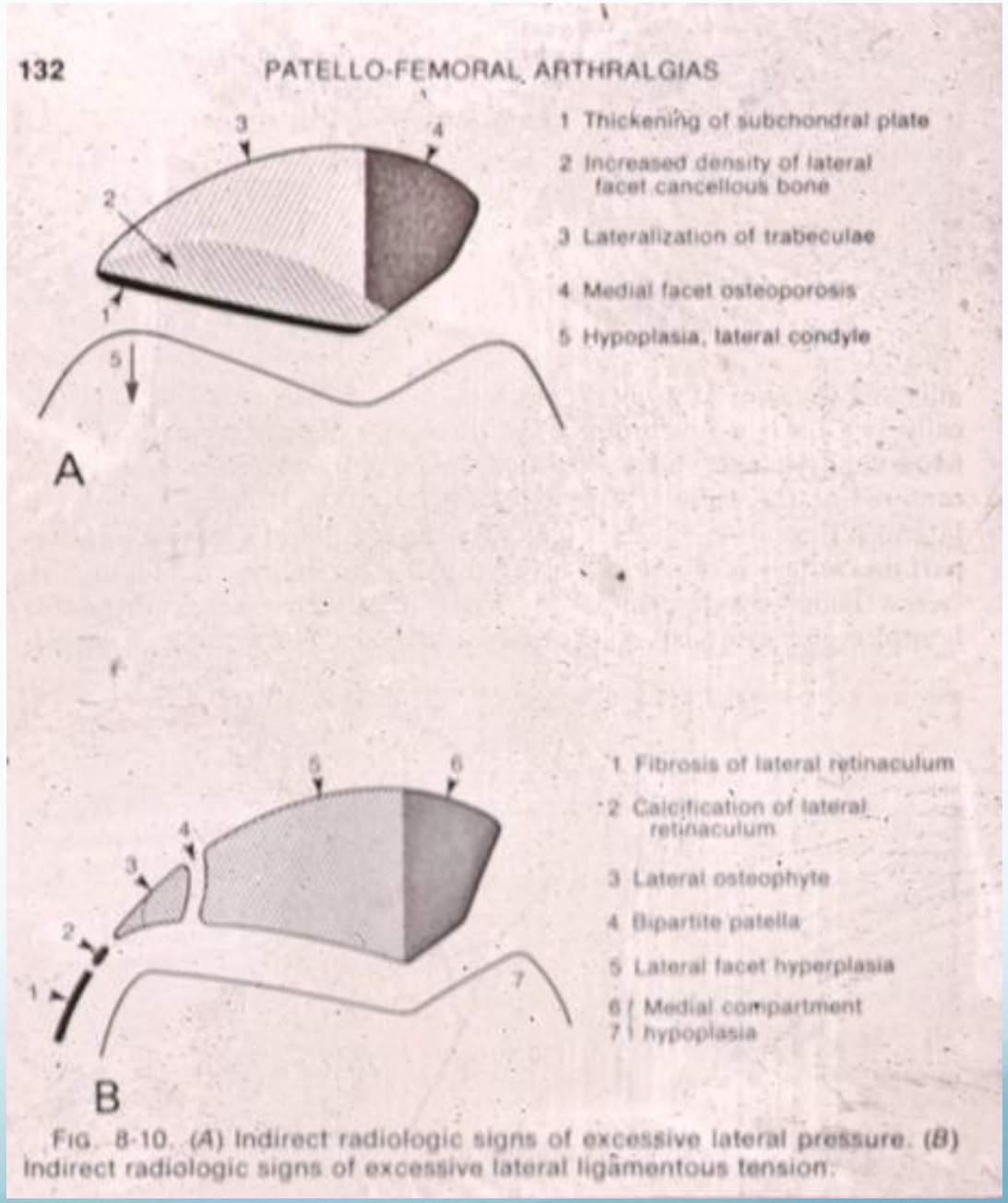


FIG. 8-10. (A) Indirect radiologic signs of excessive lateral pressure. (B) Indirect radiologic signs of excessive lateral ligamentous tension.

Patella “mapping”

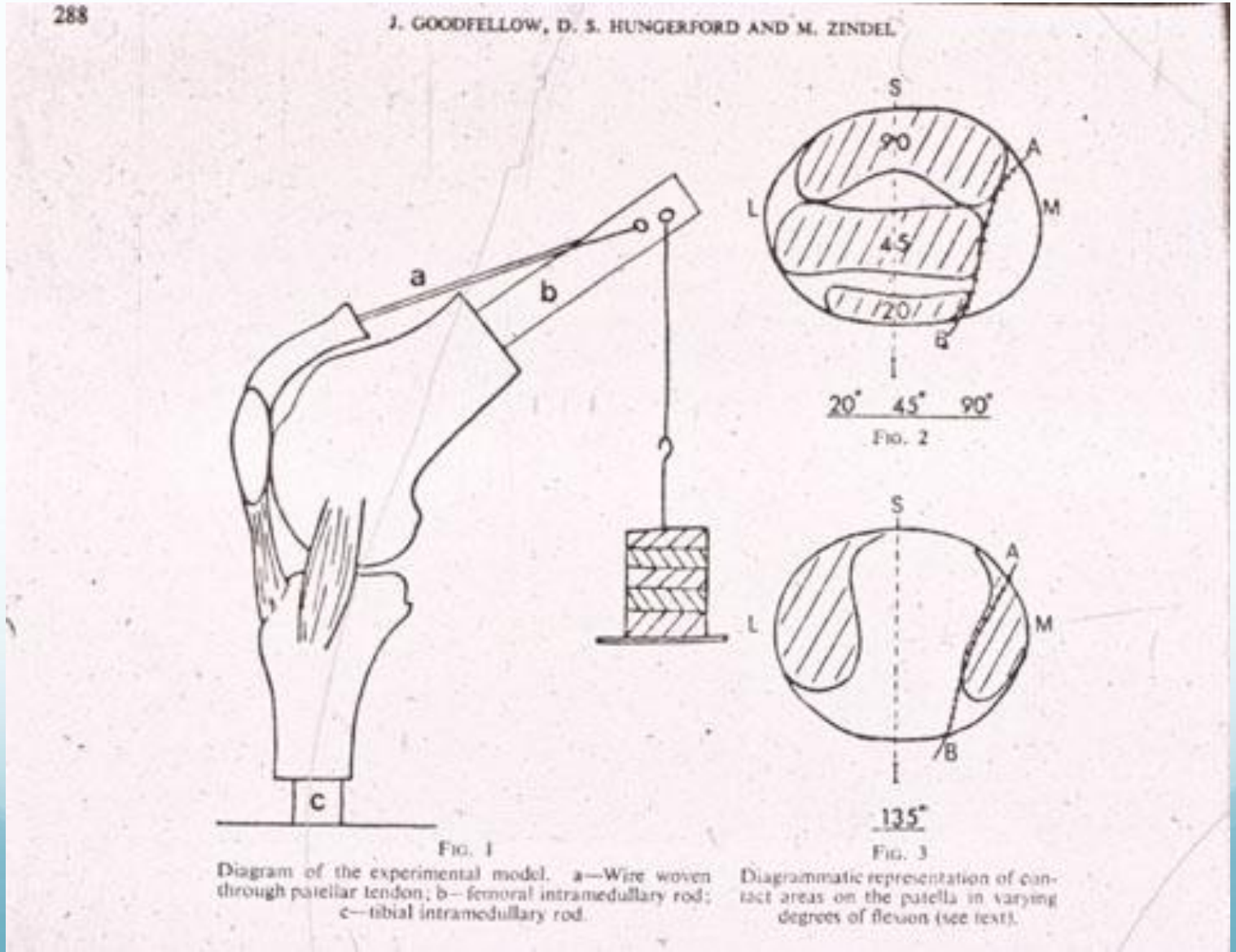
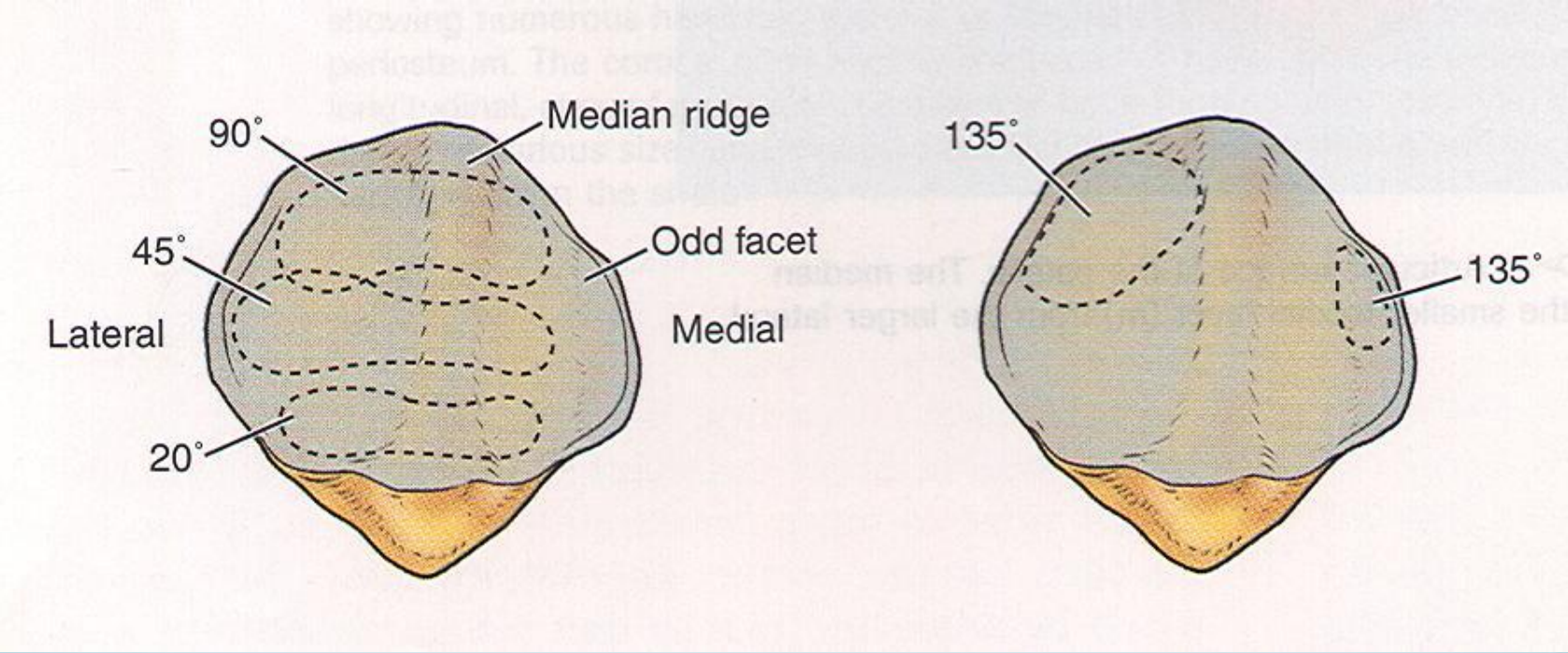


FIG. 1
Diagram of the experimental model. a—Wire woven through patellar tendon; b—femoral intramedullary rod; c—tibial intramedullary rod.

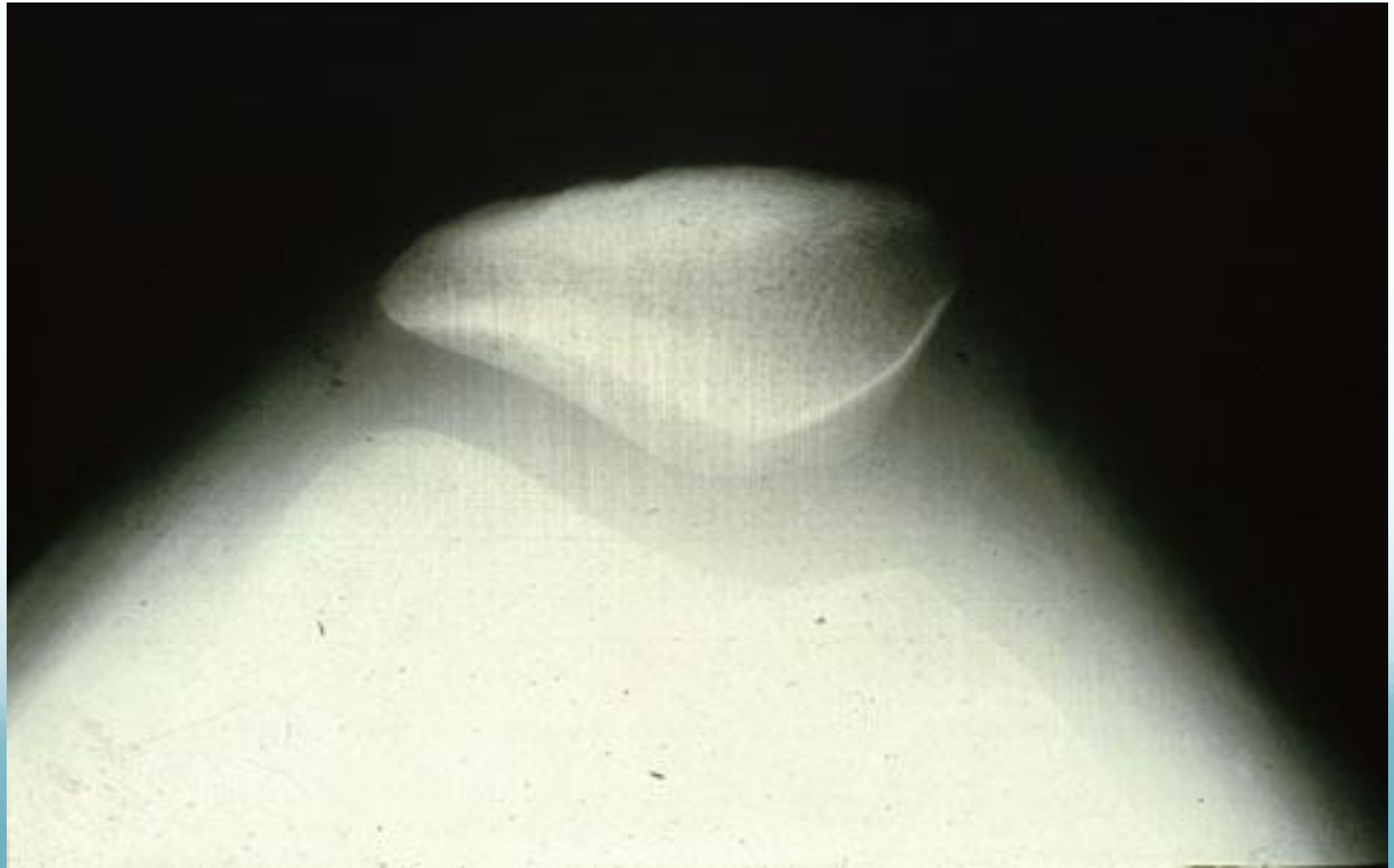
FIG. 2

FIG. 3
Diagrammatic representation of contact areas on the patella in varying degrees of flexion (see text).

Patella anatomy

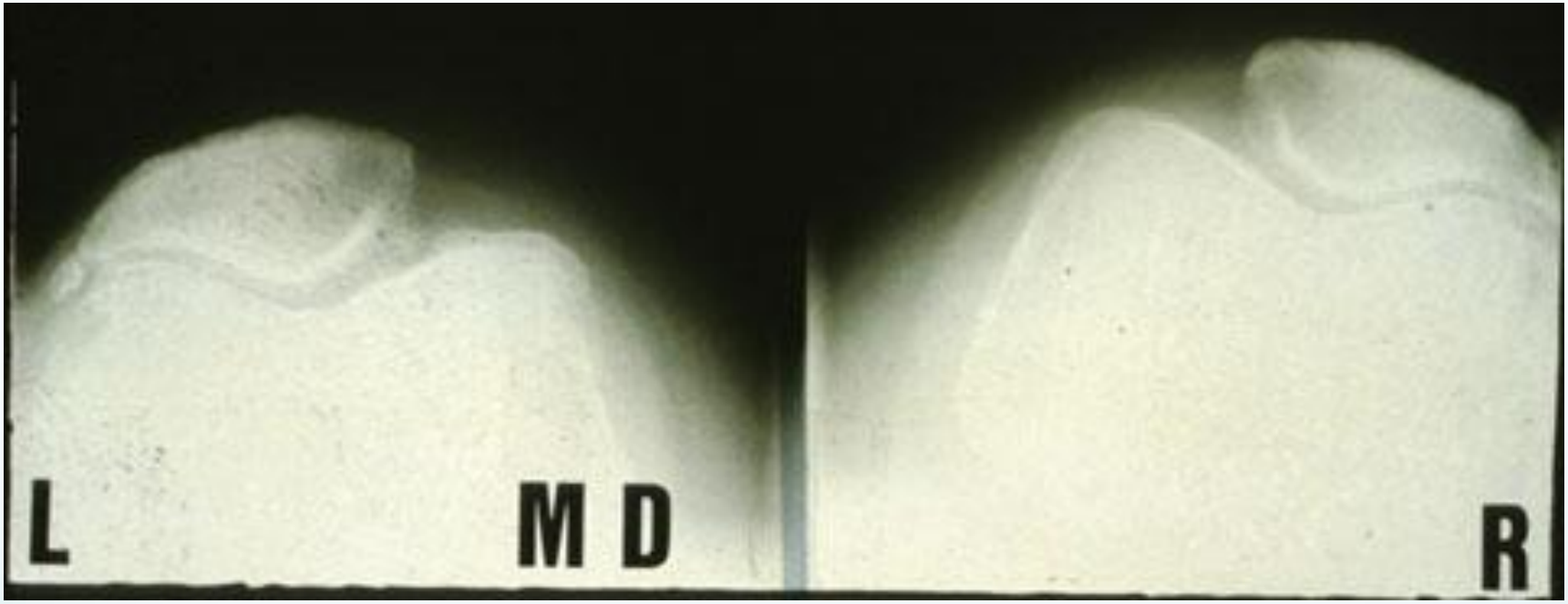


Recurrent dislocation - lateral tilt, early ELPS, regional BMD variation



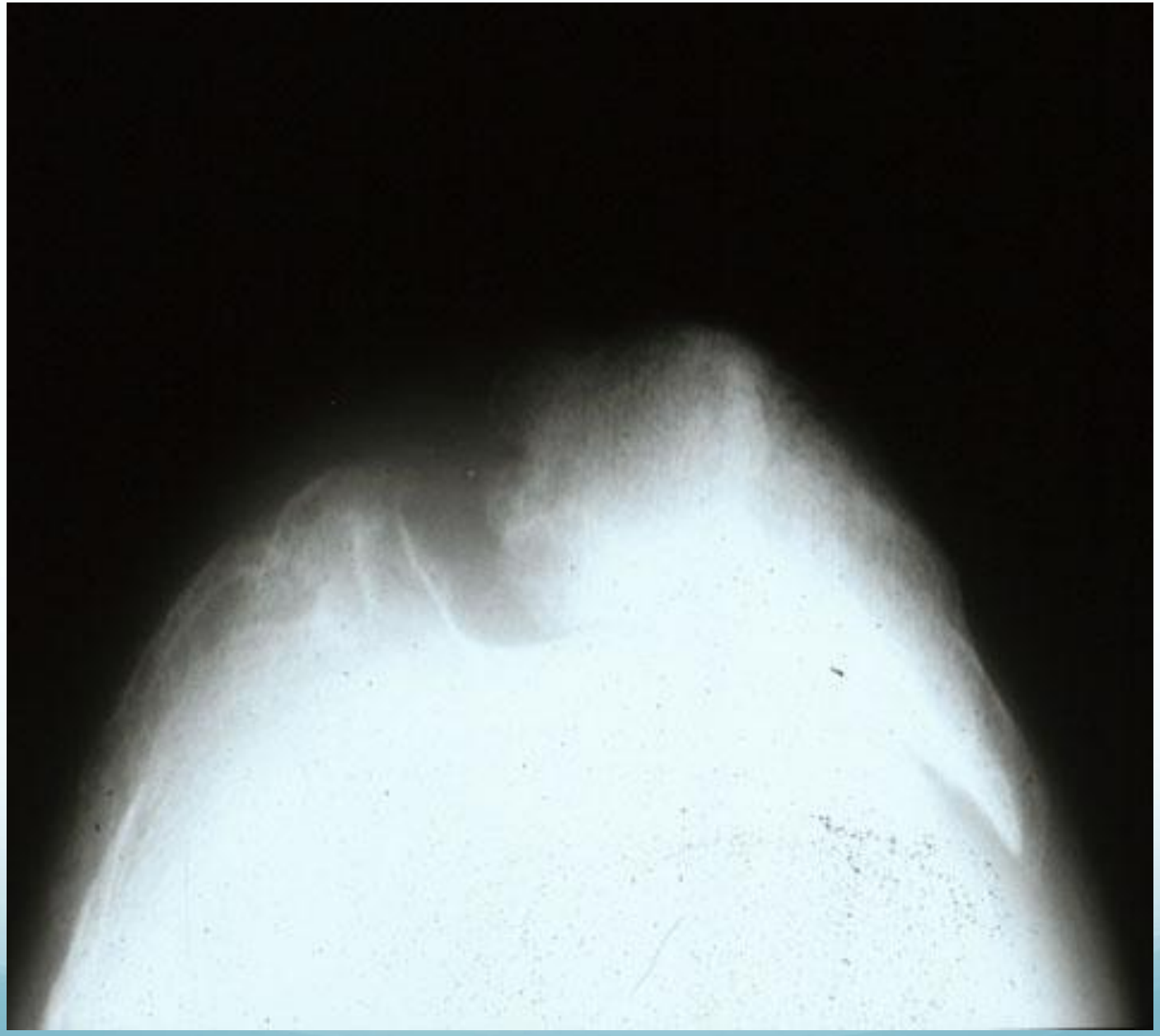
Excessive Lateral Pressure

End result?


L
M D
R

Extreme End Result

Patello-femoral osteo-arthritis



Thomas *et al. BMC Musculoskeletal Disorders* 2010, **11**:201
http://www.biomedcentral.com/1471-2474/11/201

BMC
Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

Anterior knee pain in younger adults as a precursor to subsequent patellofemoral osteoarthritis: a systematic review

Martin J Thomas[1*], Laurence Wood[1], James Selfe[2], George Peat[1]

Conclusion: no evidence to support AKP leads to OA

Lateral release

THE JOURNAL OF BONE & JOINT SURGERY (BJ)

■ REVIEW ARTICLE

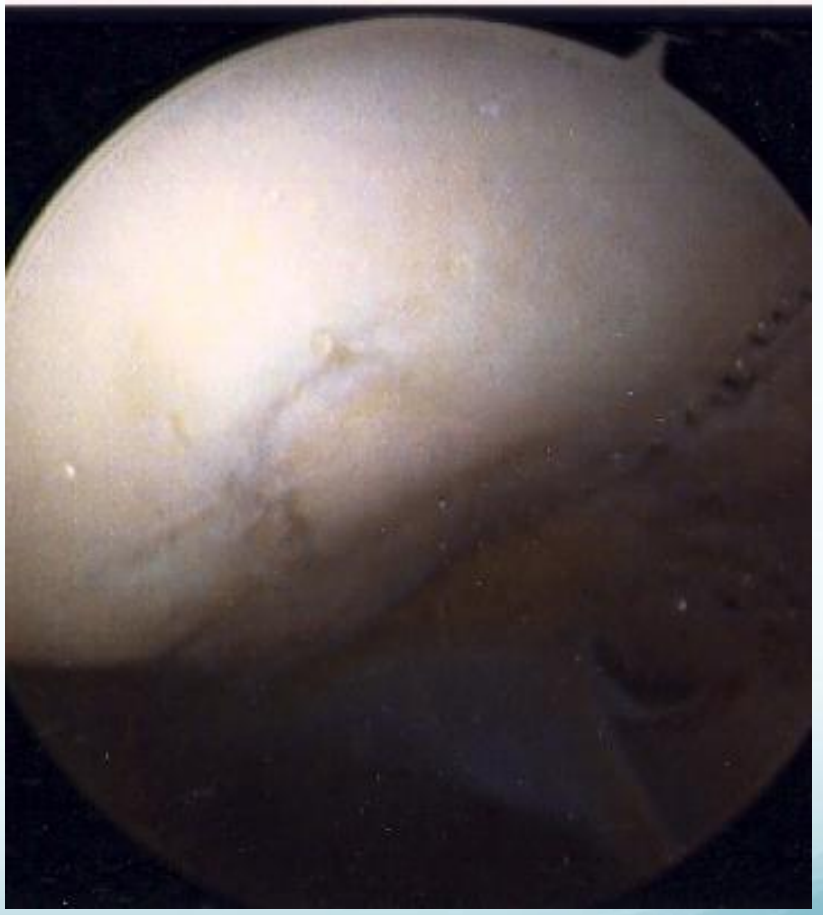
What is the role of lateral retinacular release?

R. Clifton,
C. Y. Ng,
R. W. Nutton

We have reviewed the literature to establish the role of lateral retinacular release in the management of disorders of the extensor apparatus of the knee. The scientific evidence for intervention is explored and reports on outcome are discussed.

Lateral release – my view?

Don’t



Distal re-alignment

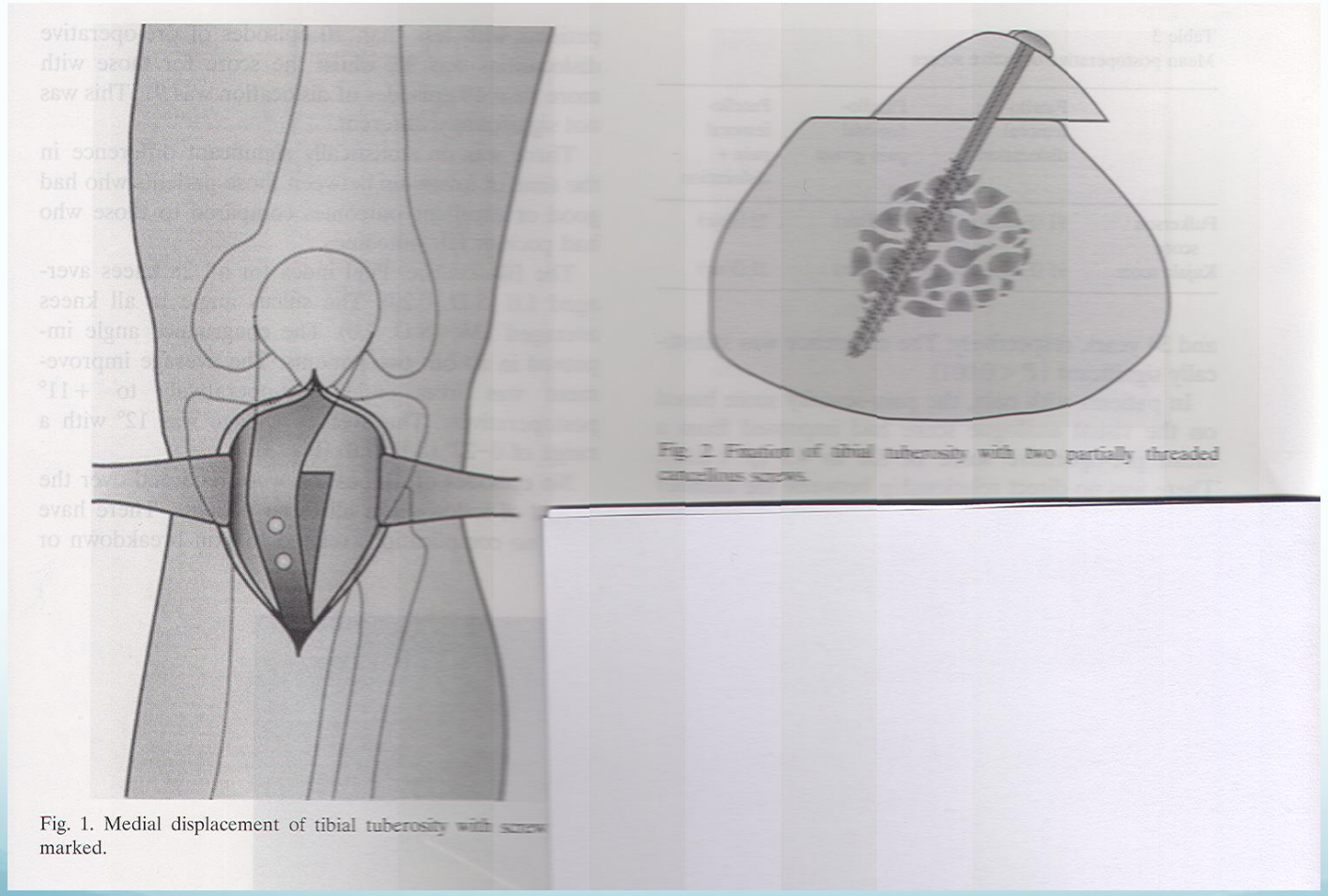


Fig. 2. Fixation of tibial tuberosity with two partially threaded cancellous screws.

Fig. 1. Medial displacement of tibial tuberosity with screw marked.

Why idiopathic AKP?

1. What is normal?

2. Are there any biometric or physiological abnormalities?

Study

- Prospective comparative study
- Approved by South Tees Local Research Ethics Committee
- Patients were recruited from a dedicated anterior knee pain research clinic at JCUH

Methods

- Inclusion criteria:
  - Age 11-25
  - Normal X-rays
  - No other identifiable cause

- Age and sex matched controls from two local schools and colleges

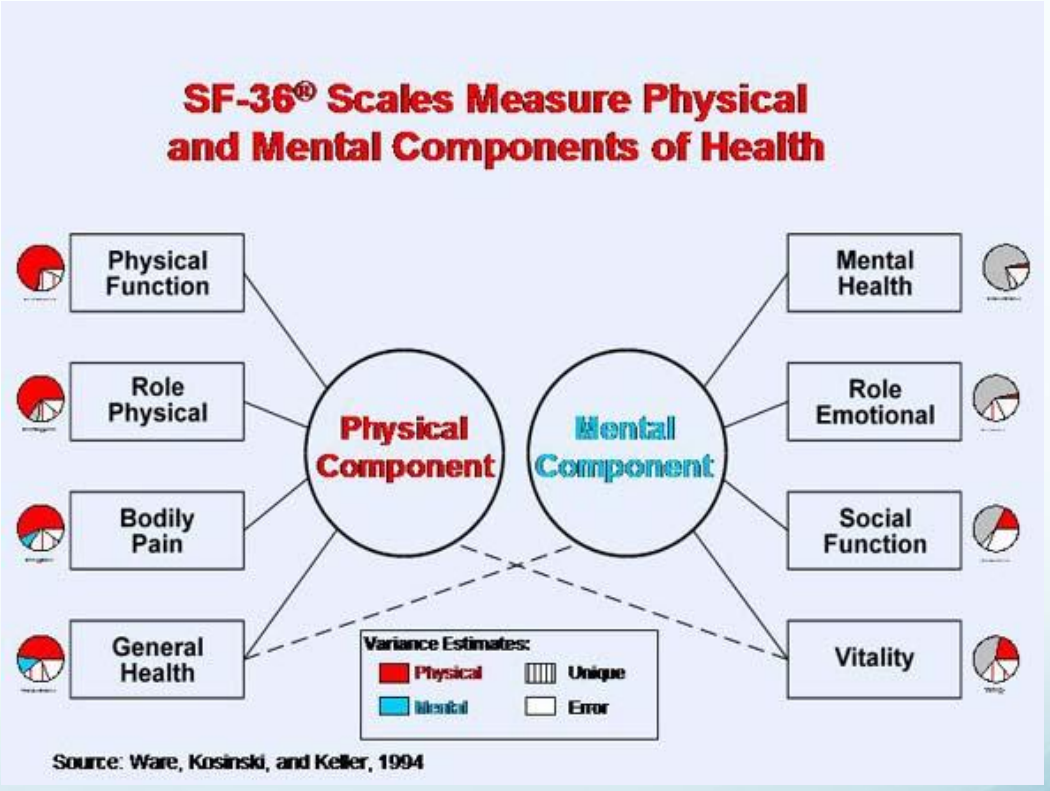
Methods

- A detailed history and examination was performed
- AP, lateral and skyline views of the knees were obtained on patients only
- MRI scan was performed in those with atypical presentations

Methods

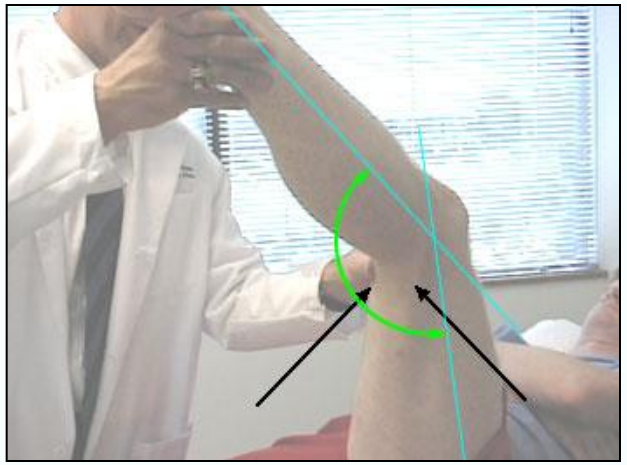
Functional scores were recorded using SF-36 questionnaire

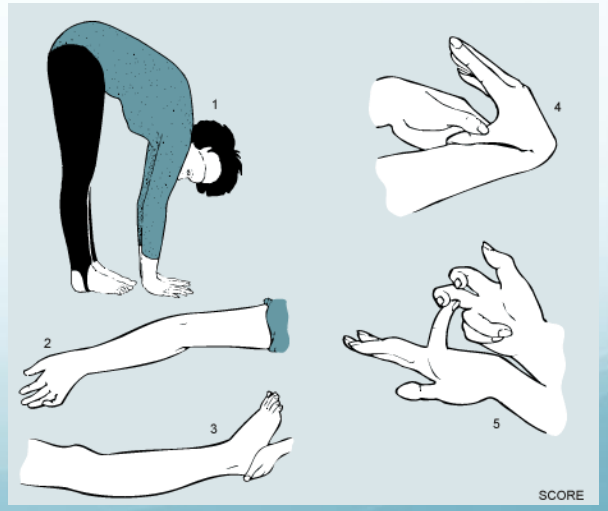
Pain was recorded using visual analogue scale



Biometric parameters

- Flat feet +/- hindfoot malalignment
- Hip movements
- Patellar tracking and crepitus
- Q angle
- Hamstring tightness (Popliteal angle)
- Joint laxity (Beighton's index)
- Knee laxity (KT-1000)





Results

86 patients (Anterior Knee Pain Clinic)

Excluded: 52

Included: 34

21 had OSD/SLJ

1 patellar tendonitis

2 had chondral lesions

1 had patellar instability

5 were aged>25yrs

22 lost to follow up

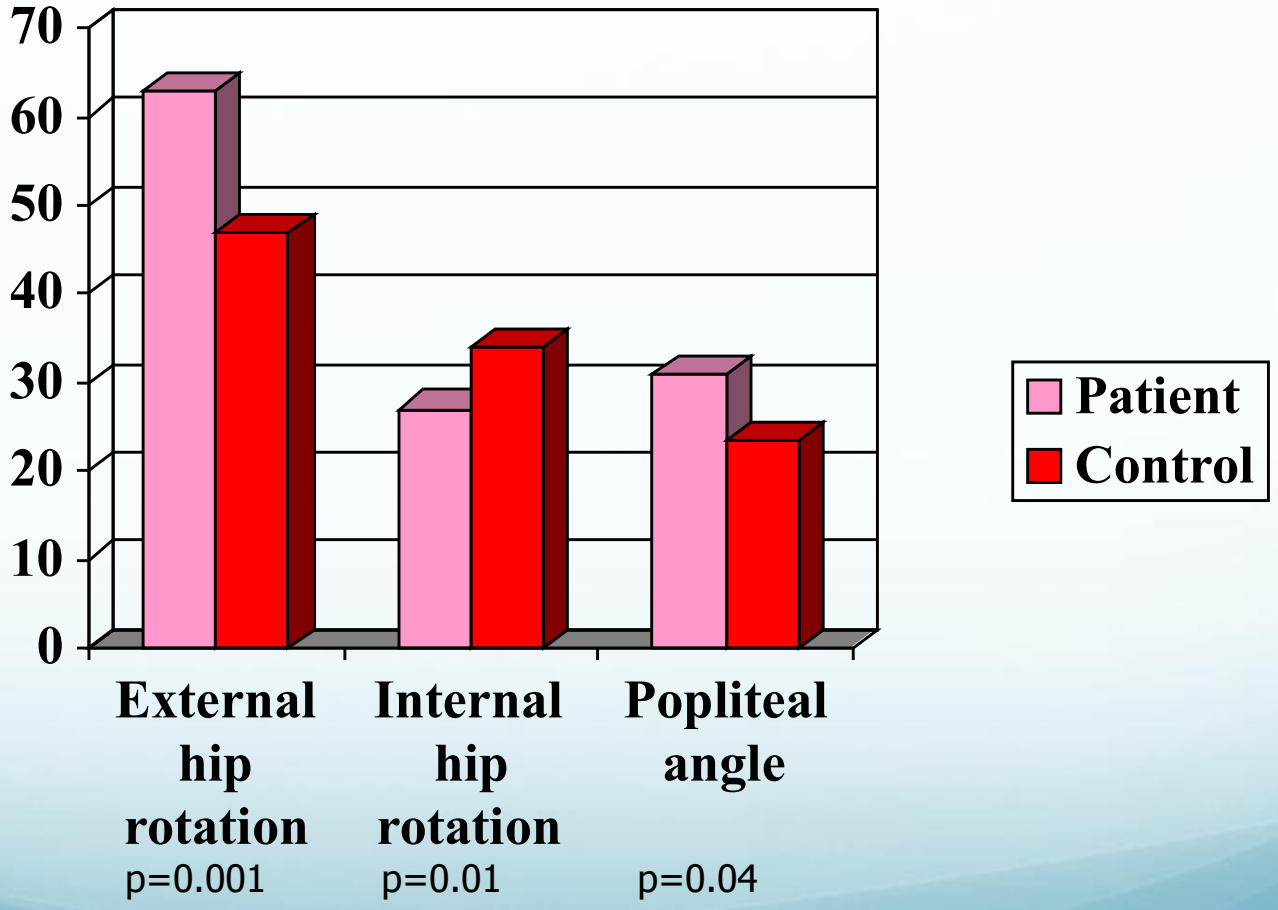
Results

- Mean age of patient and controls : 17yrs (12-24)
- Male : female 14:20
- 26 had bilateral knee pain
- Mean follow up: 20 months (14-48)

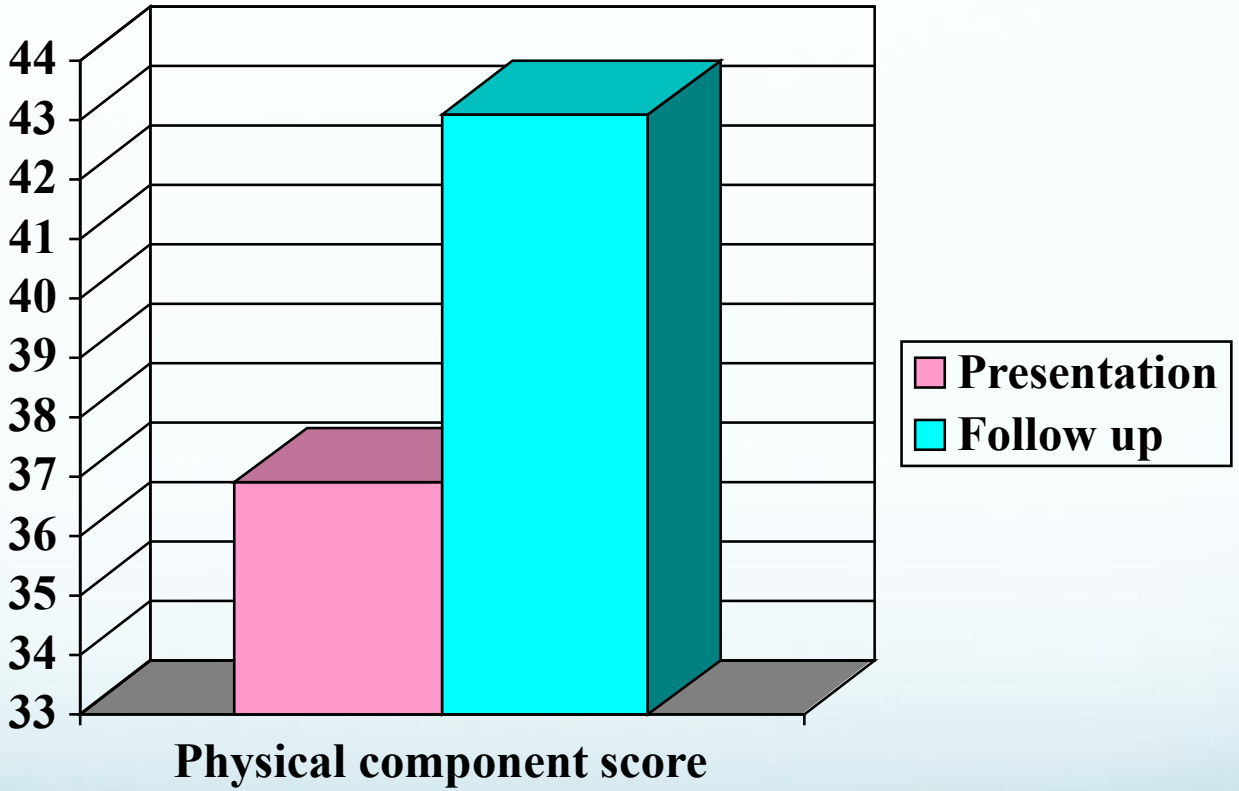
Chart showing comparison of patients and controls

	Patients, Median	Controls, Median	p value
Q angle in degrees	10.5	11	0.86
Beighton's index	2	2	0.85
KT-1000	5.5	6	0.49

Results

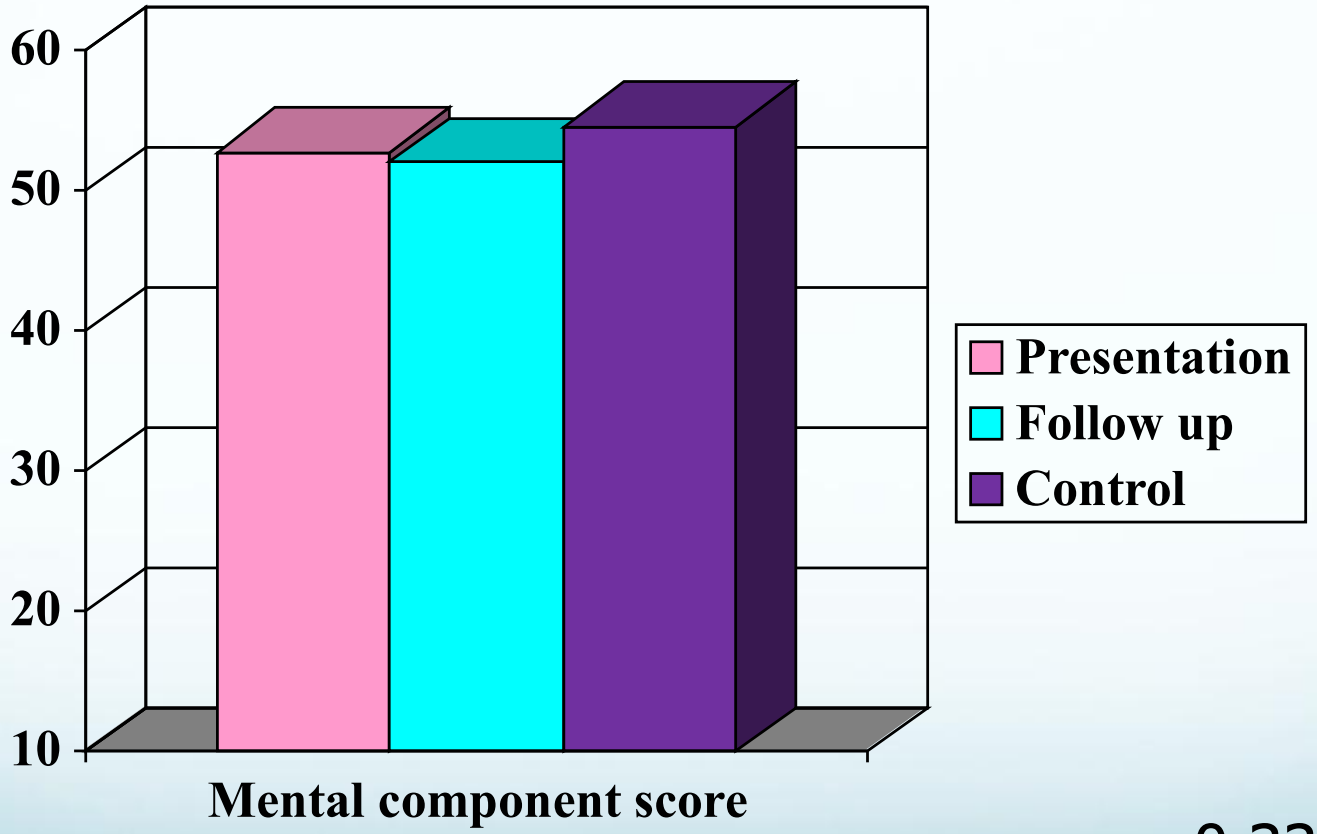

70
60
50
40
30
20
10
0
External hip rotation
Internal hip rotation
Popliteal angle
p=0.001
p=0.01
p=0.04
Patient
Control

SF-36 scores in patients



p=0.001 (paired t-test)

SF-36


60
50
40
30
20
10
Mental component score
Presentation
Follow up
Control

p=0.33

Conclusions

- Hamstrings are shorter and tighter in AKP group
- AKP group has increase external rotation of the hip

A Biometric and EMG Study of the Characteristics of Hamstrings Muscles in Idiopathic Adolescent Anterior Knee Pain

S. Patil, L. White, A. Jones,
V. Kumar, J. Dixon, A. Hui

Methods

- EMG recorded using portable EMG system (ME6000, MEGA Electronics Ltd, Finland)
- Electrodes placed over vastus lateralis (VL), vastus medialis (VM) and biceps femoris (BF)
- EMG recorded during
  - Maximal isometric contractions of Q&H
  - Step up
  - With the subject on a *Biodex*® stability system

Methods

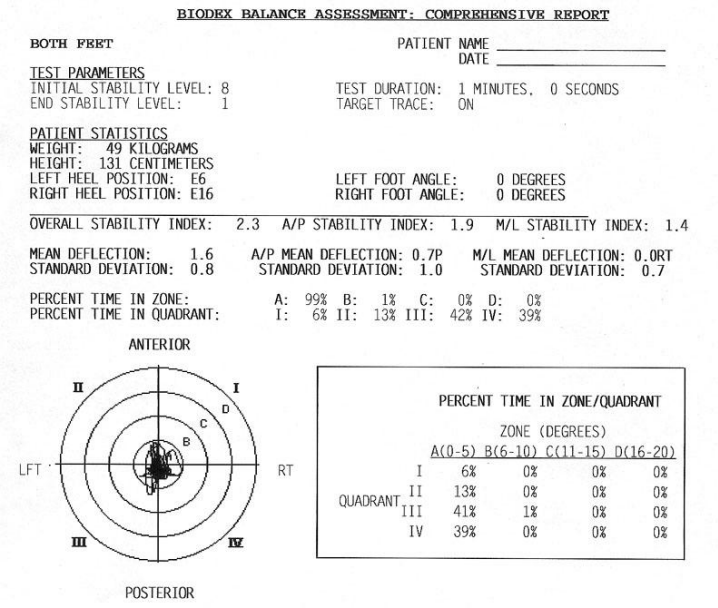
- EMG recording during step-up

Proprioception

- *Biodex*® balance system

  assesses proprioception by quantifying the ability to maintain postural stability on an unstable surface

Biodex balance system readings



BIODEX BALANCE ASSESSMENT: COMPREHENSIVE REPORT

BOTH FEET

PATIENT NAME _____
DATE _____

TEST PARAMETERS
INITIAL STABILITY LEVEL: 8
END STABILITY LEVEL: 1

TEST DURATION: 1 MINUTES, 0 SECONDS
TARGET TRACE: ON

PATIENT STATISTICS
WEIGHT: 49 KILOGRAMS
HEIGHT: 131 CENTIMETERS
LEFT HEEL POSITION: E6
RIGHT HEEL POSITION: E16

LEFT FOOT ANGLE: 0 DEGREES
RIGHT FOOT ANGLE: 0 DEGREES

OVERALL STABILITY INDEX: 2.3 A/P STABILITY INDEX: 1.9 M/L STABILITY INDEX: 1.4

MEAN DEFLECTION: 1.6 A/P MEAN DEFLECTION: 0.7P M/L MEAN DEFLECTION: 0.0RT
STANDARD DEVIATION: 0.8 STANDARD DEVIATION: 1.0 STANDARD DEVIATION: 0.7

PERCENT TIME IN ZONE: A: 99% B: 1% C: 0% D: 0%
PERCENT TIME IN QUADRANT: I: 6% II: 13% III: 42% IV: 39%

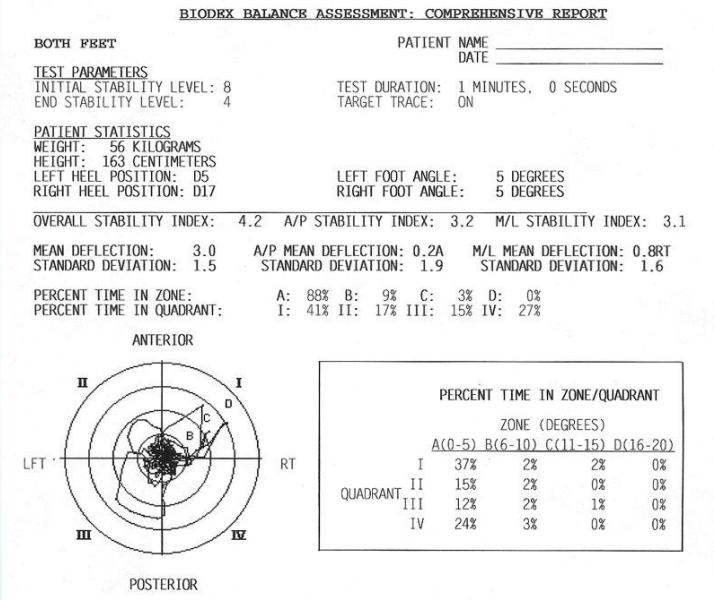
ANTERIOR

POSTERIOR

PERCENT TIME IN ZONE/QUADRANT

QUADRANT	ZONE (DEGREES) A(0-5)	B(6-10)	C(11-15)	D(16-20)
I	6%	0%	0%	0%
II	13%	0%	0%	0%
III	41%	1%	0%	0%
IV	39%	0%	0%	0%

Stability index 2.3



BIODEX BALANCE ASSESSMENT: COMPREHENSIVE REPORT

BOTH FEET

PATIENT NAME _____
DATE _____

TEST PARAMETERS
INITIAL STABILITY LEVEL: 8
END STABILITY LEVEL: 4

TEST DURATION: 1 MINUTES, 0 SECONDS
TARGET TRACE: ON

PATIENT STATISTICS
WEIGHT: 56 KILOGRAMS
HEIGHT: 163 CENTIMETERS
LEFT HEEL POSITION: D5
RIGHT HEEL POSITION: D17

LEFT FOOT ANGLE: 5 DEGREES
RIGHT FOOT ANGLE: 5 DEGREES

OVERALL STABILITY INDEX: 4.2 A/P STABILITY INDEX: 3.2 M/L STABILITY INDEX: 3.1

MEAN DEFLECTION: 3.0 A/P MEAN DEFLECTION: 0.2A M/L MEAN DEFLECTION: 0.8RT
STANDARD DEVIATION: 1.5 STANDARD DEVIATION: 1.9 STANDARD DEVIATION: 1.6

PERCENT TIME IN ZONE: A: 88% B: 9% C: 3% D: 0%
PERCENT TIME IN QUADRANT: I: 41% II: 17% III: 15% IV: 27%

ANTERIOR

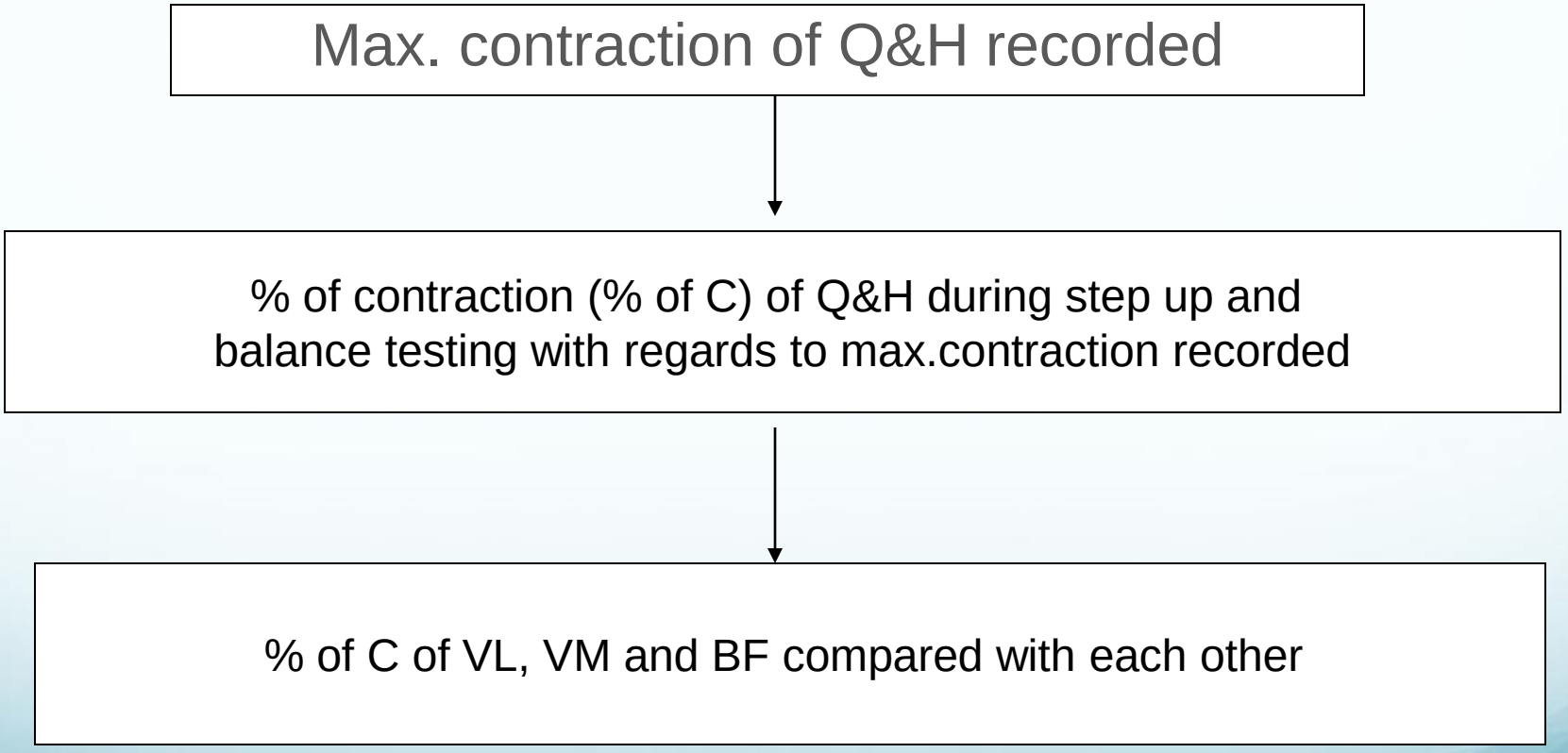
POSTERIOR

PERCENT TIME IN ZONE/QUADRANT

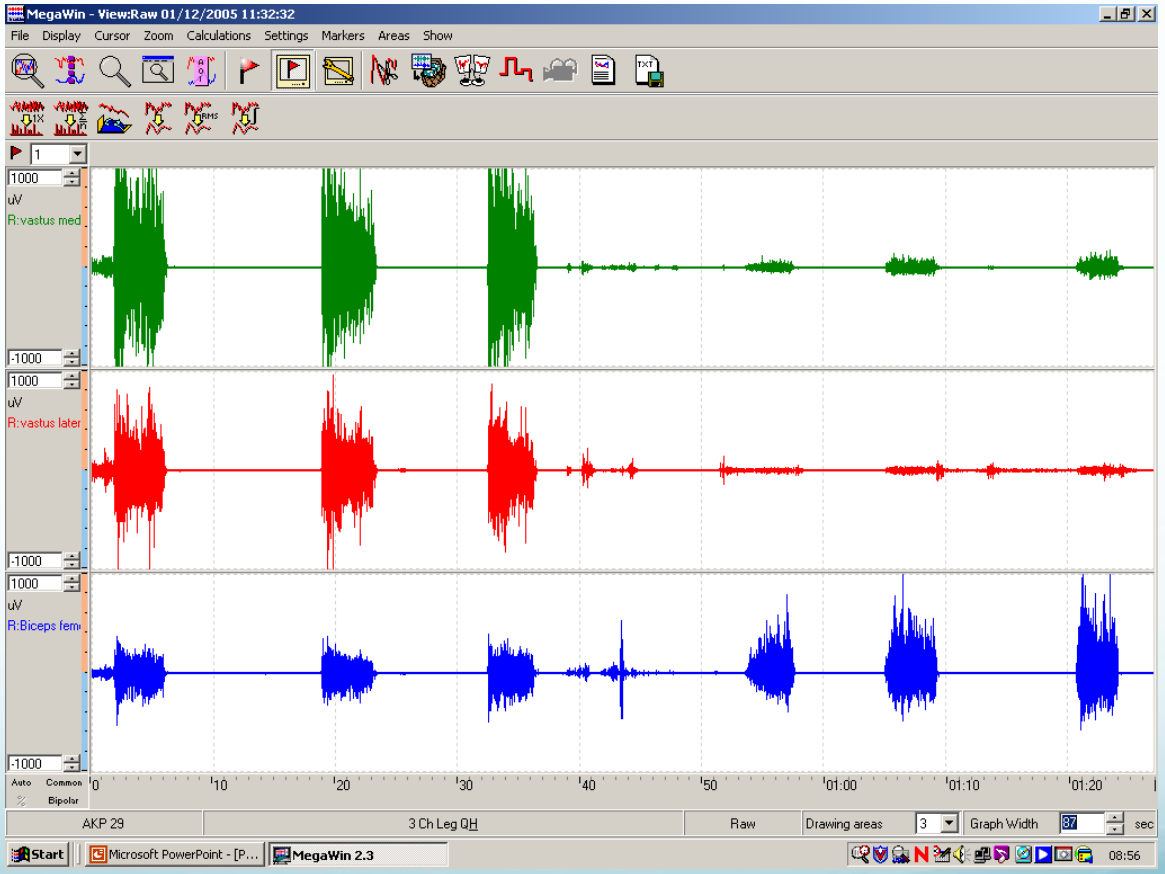
QUADRANT	ZONE (DEGREES) A(0-5)	B(6-10)	C(11-15)	D(16-20)
I	37%	2%	2%	0%
II	15%	2%	0%	0%
III	12%	2%	1%	0%
IV	24%	3%	0%	0%

Stability index 4.2

Comparing EMG



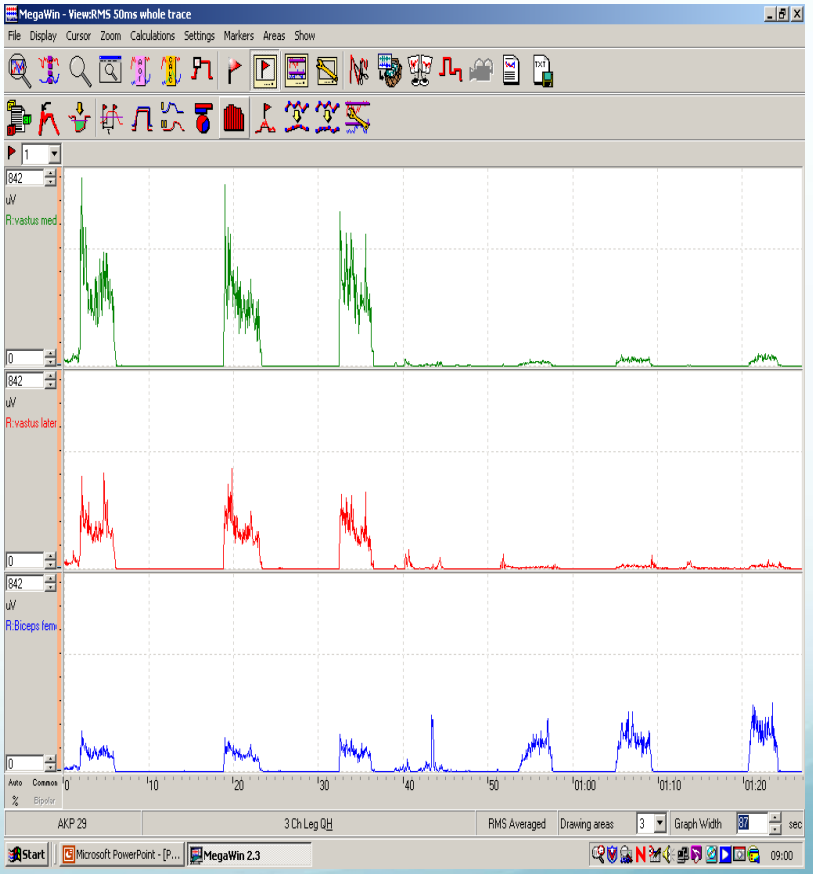
EMG


MegaWin - View:Raw 01/12/2005 11:32:32
File Display Cursor Zoom Calculations Settings Markers Areas Show
1000
uV
R:vastus med
-1000
1000
uV
R:vastus later
-1000
1000
uV
R:Biceps fem
-1000
Auto Common
Bipolar
0
10
20
30
40
50
01:00
01:10
01:20
AKP 29
3 Ch Leg QH
Raw
Drawing areas
3
Graph Width
37
sec
Start
Microsoft PowerPoint - [P...
MegaWin 2.3
08:56

Normalisation of EMG

- Signals were averaged using 50ms RMS window

- Mean voltage of max contraction for each muscle used as max EMG level



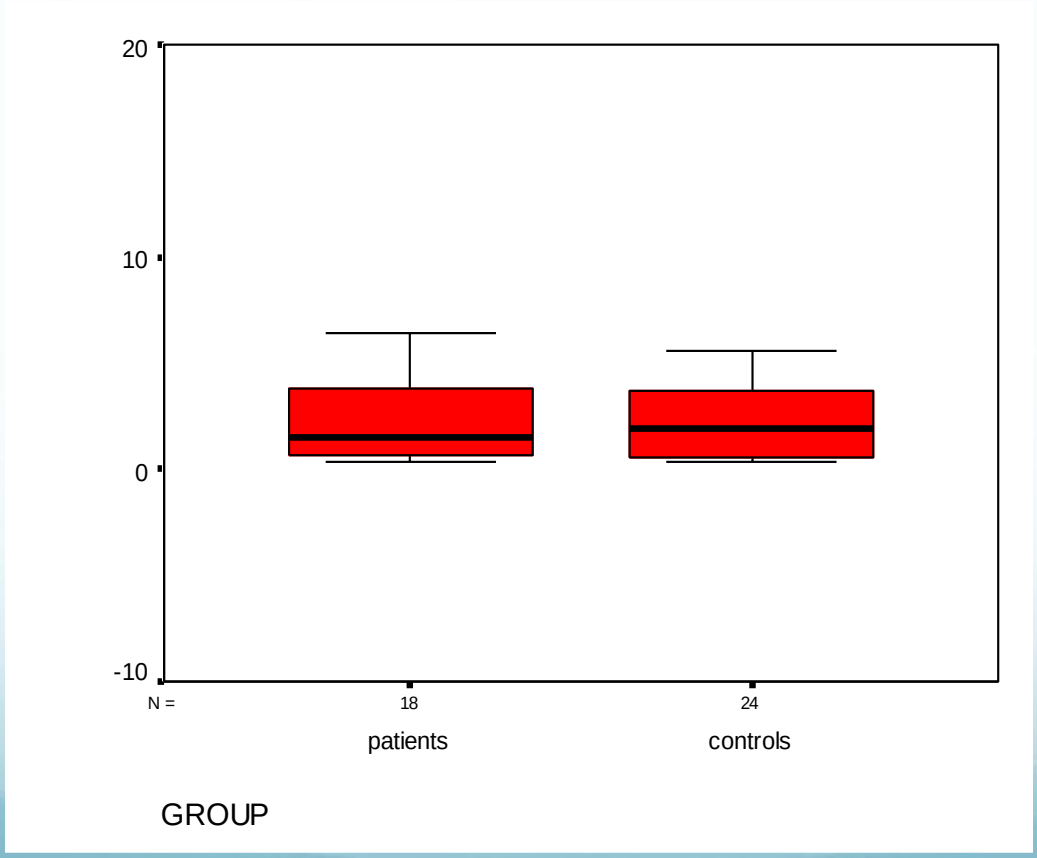
Results

- 18 patients
- Males 8 Females 10
- Average age 16.4 years

- 27 controls
- Males 8 Females 19
- Average age 17.9 years

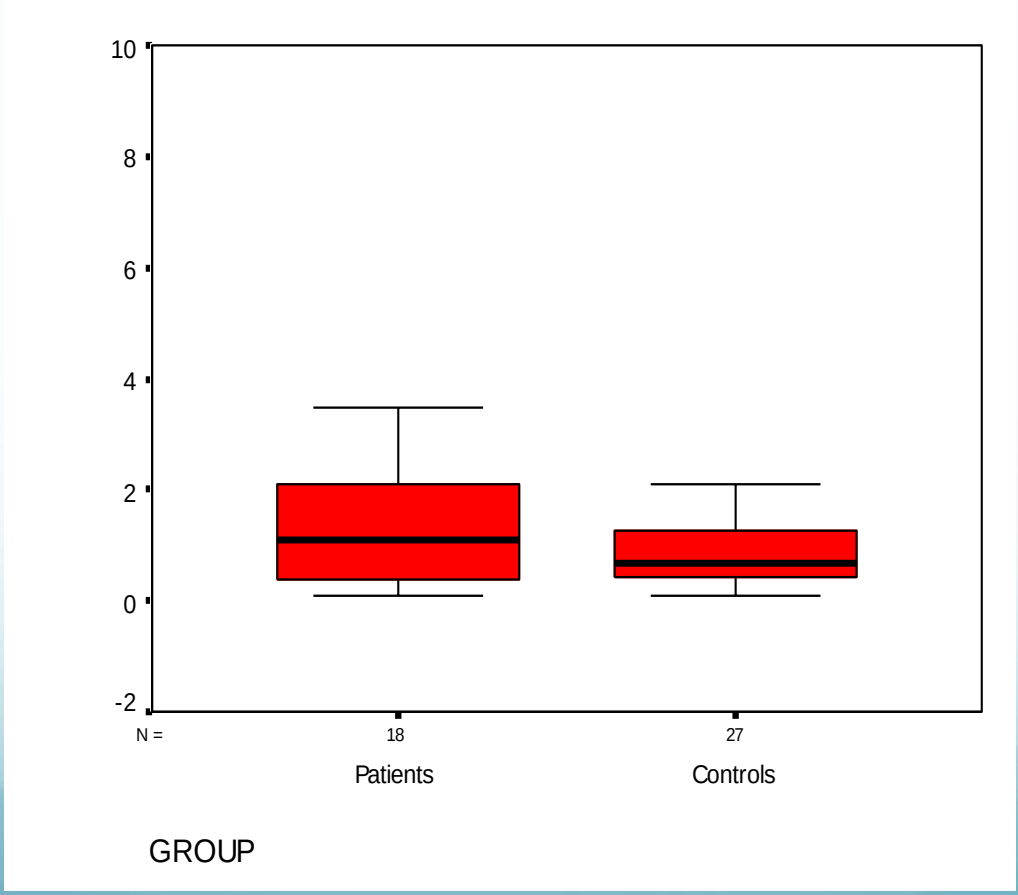
Results

- EMG - VL:BF during step up; p=0.84



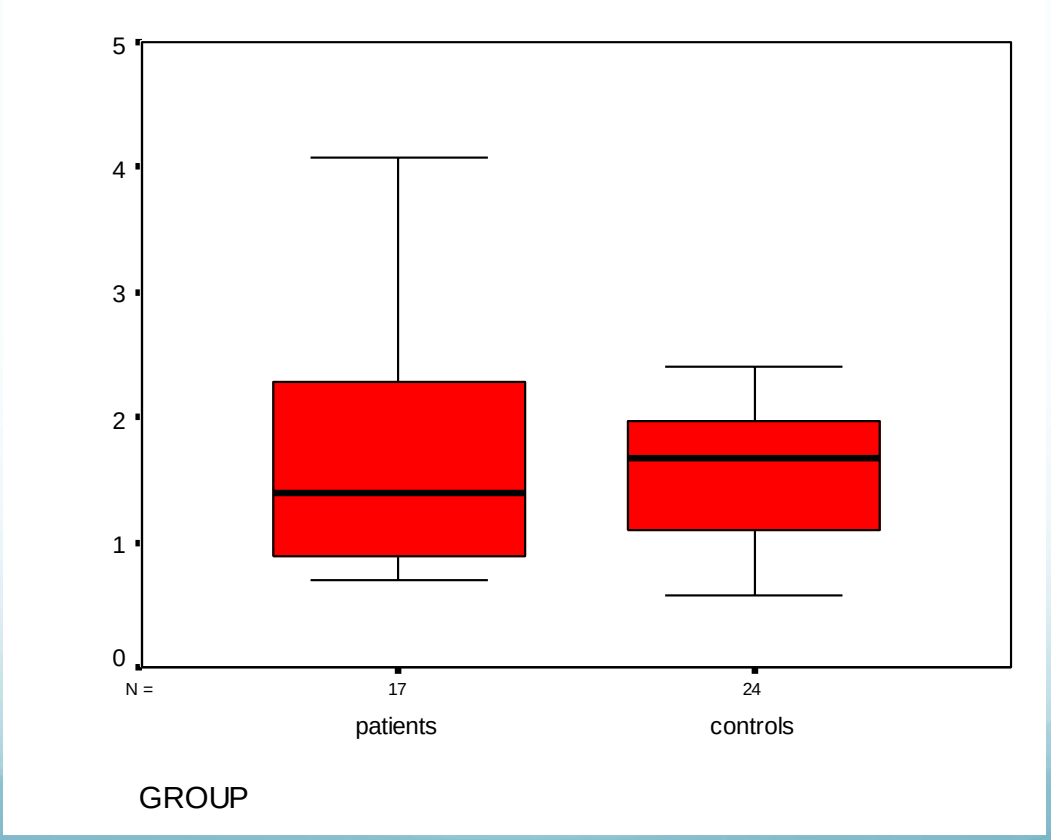
Results

- EMG - VL:BF on balance machine; p=0.51



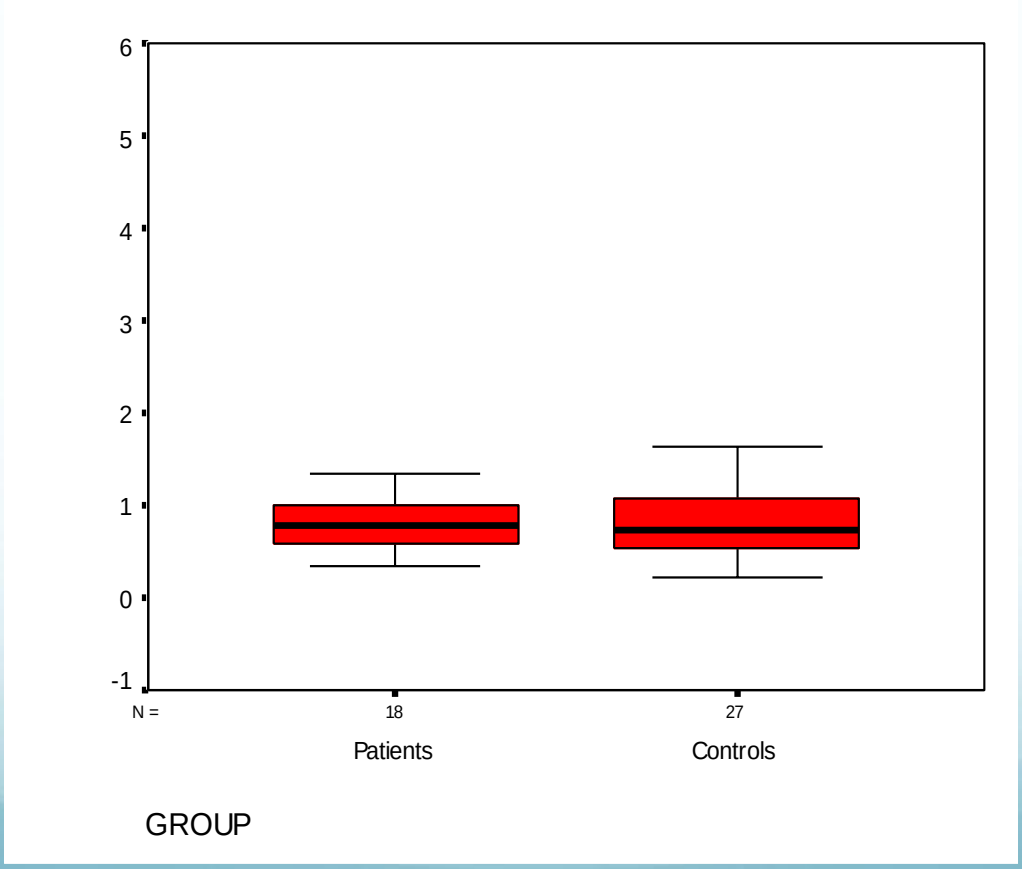
Results

- EMG - VL:VM during step up; p=0.74



Results

- EMG - VM:VL on balance machine; p=0.64



Balance test results

- Overall stability index from level 8 to level 1
  - Mean index in patients 4.5
  - Mean index in controls 4.4

Summary

- Hamstring and quadriceps muscle activity levels do not differ in patients compared to healthy controls
- No significant difference in proprioception was observed between patients and controls
- Further research:
  - Temporal relation between quadriceps and hamstrings
  - EMG during isokinetic exercises

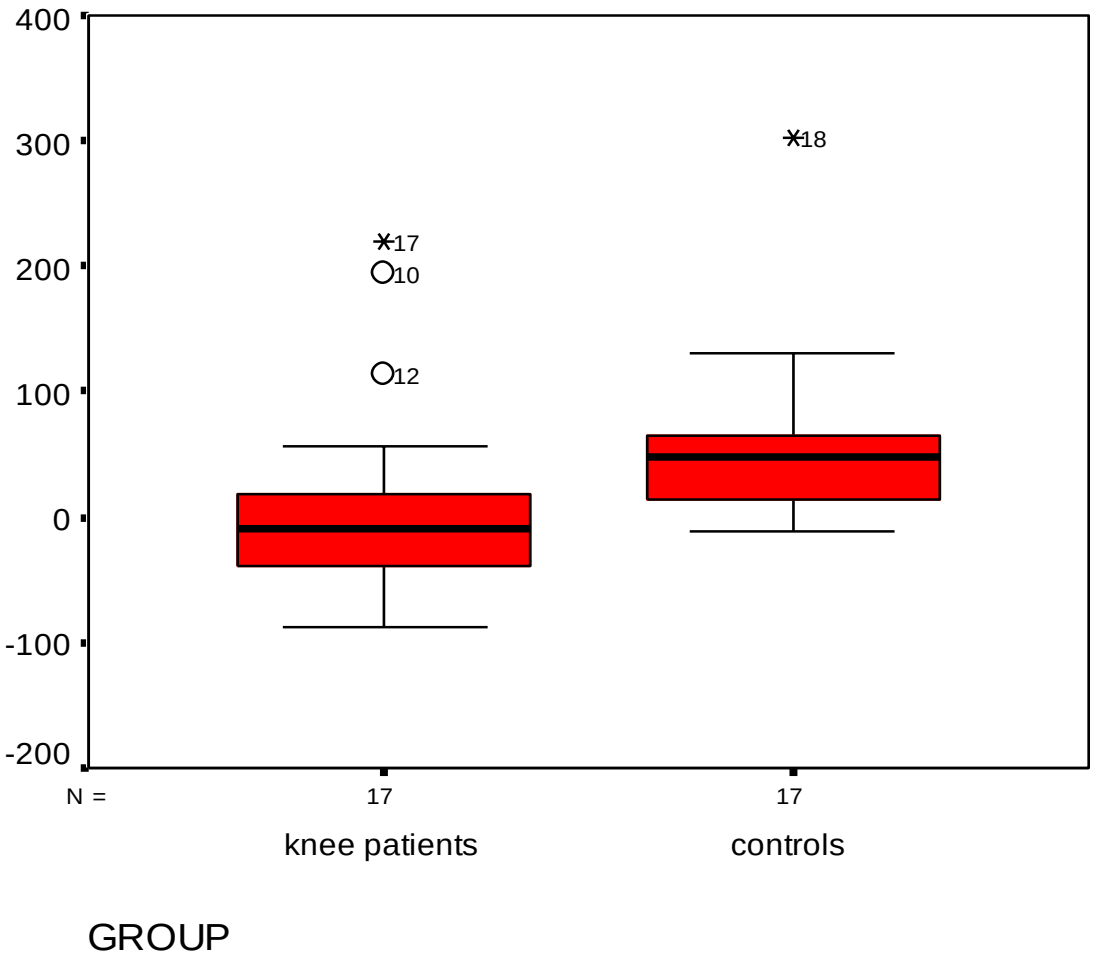
EMG study

Slough, 2006

- No difference in the amplitude of signals between hamstrings and quads, and between medial (MH) and lateral hamstrings (LH)

- *Need to conduct a study comparing the temporal relationship between medial and lateral hamstrings*

EMG Results


400
300
200
100
0
-100
-200
18
17
10
12
N =
17
17
knee patients
controls
GROUP

EMG Results

- Median difference in onset of action between medial and lateral hamstrings:
  - Patients: -10 msec
  - Controls: 47.3 msec
    - P=0.006 (Mann Whitney U test)

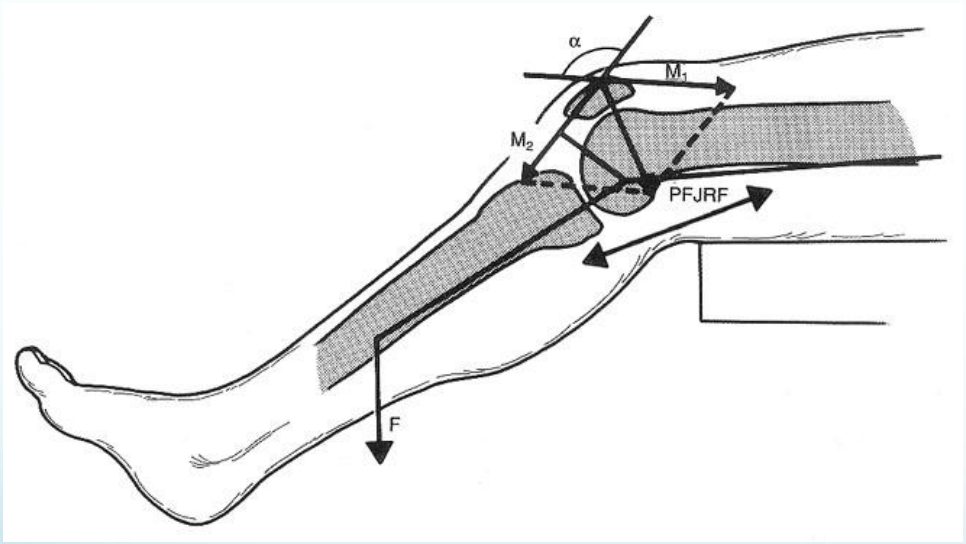
Discussion

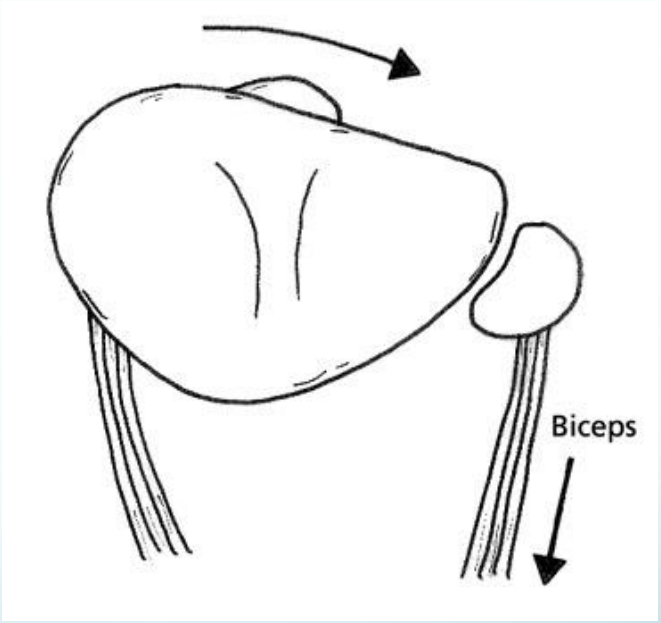
- 50% of patients with IAKP improve spontaneously in the first few years
  - Nimon et al, Journal of Pediatric Orthopaedics, 1998
- Hamstring tightness: Cause or Effect?

Discussion

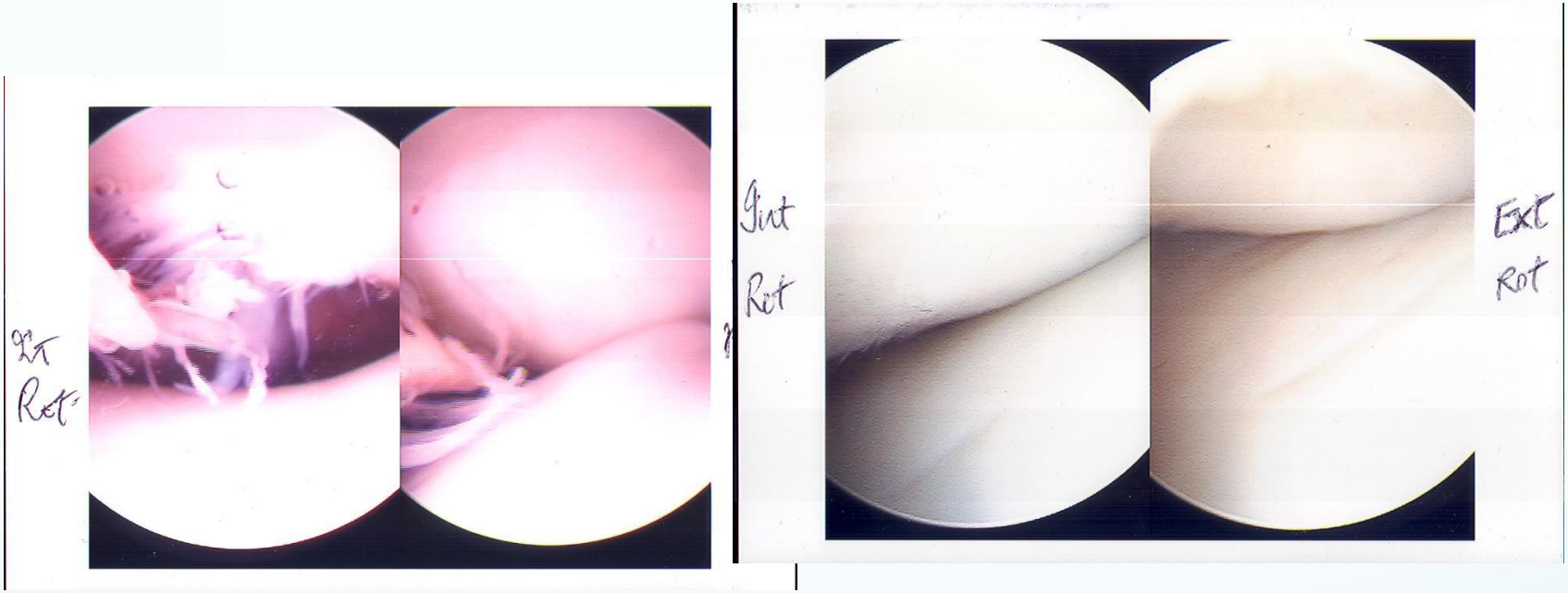
- AKP has been associated with femoral anteversion
  - Insall, JBJS (Am) 1976
- Fairbank et al found no difference in hip rotations between patients and controls
  - JBJS (B), 1984
- Cibulka described asymmetrical hip rotation in AKP
  - Phys Ther Nov 2005

Role of hamstrings





The effect of tibial rotation



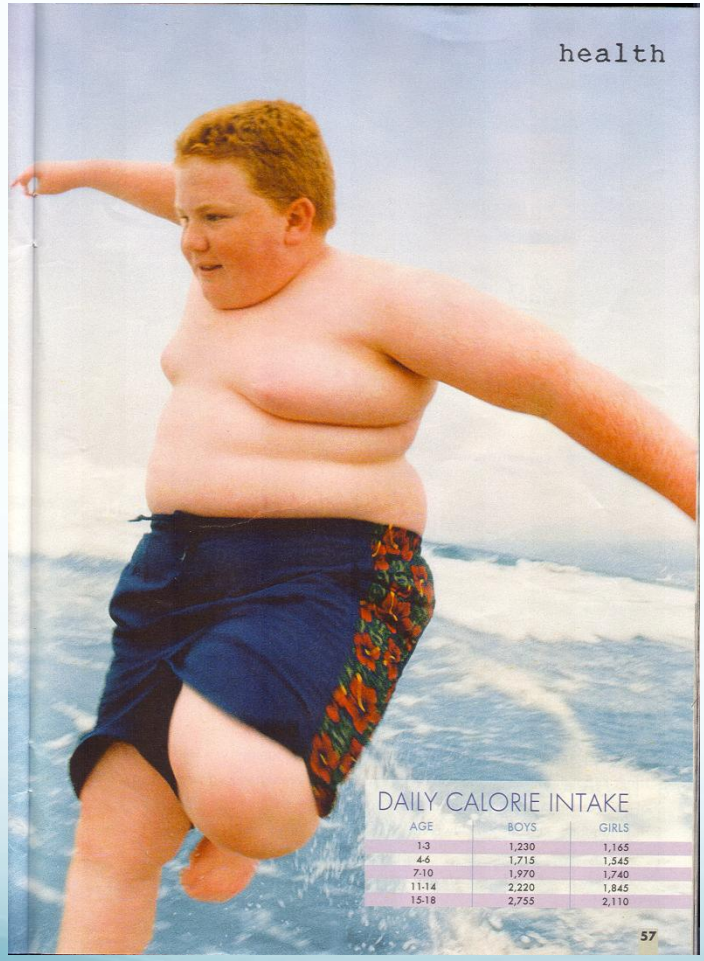
Summary

- AKP is a multi-factorial and self limiting disorder
- Patients with IAKP have asymmetric hip rotation (ER>IR)
- Patients have hamstring tightness
- Earlier contraction of the lateral hamstrings may cause tibial external rotation and contribute to the symptoms

Treatment - physiotherapy

- Hamstrings stretching

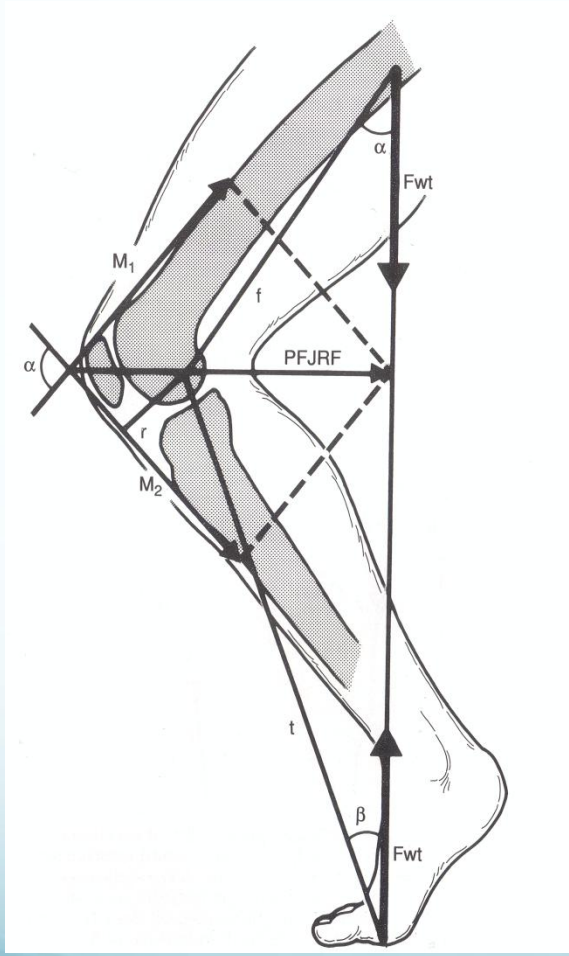
Life style modifications

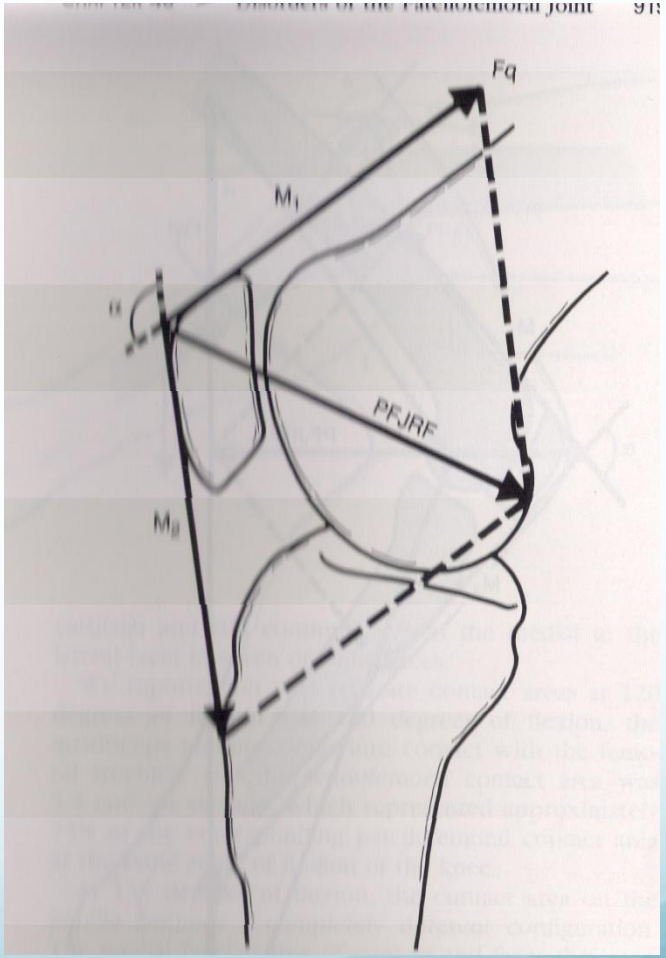


- Weight control

Footwear

Biomechanics: free body diagram





Footwear - good

Bad

Ugly

The Non-Operative Treatment of Anterior Knee Pain

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Abstract: Anterior knee pain is a common presenting complaint, and in many cases no identifiable cause can be found. In these circumstances it is commonly known as anterior knee pain syndrome or patellofemoral pain syndrome. The management for this condition is most commonly non-operative. Treatment strategies include physiotherapy, pharmacotherapy, orthoses and combinations of the above. There are many described methods in the literature with a wide spectrum of outcomes, which in itself is testimony to the lack of any generally accepted gold standard of care for these patients. It is thus unclear to the health care professional treating these patients which is the best treatment to offer. In this review we aim to summarise historical and most up to date literature on the subject and in so doing allow the health care professional pick whichever treatment strategy they feel most beneficial and also provide a guide for appropriate patient education.

Keywords: Anterior knee pain, patellofemoral syndrome, physiotherapy, orthoses, pharmacotherapy.

The End