
Basic science and injury of meniscus

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(1) FUNCTION & ANATOMY

joint filter

prevent capsular & synovial impairment during flexion-extension movements

joint lubrication

stability in all planes (esp. rotary stabilizers)

shock or energy-absorbing functions

- X-ray changes after meniscectomy (by Fairbank)
 - narrowing of the joint space
 - flattening of the femoral condyle
 - Osteophyte formation
- medial meniscectomy → contact area ↓ (40%), joint laxity
- medial meniscus excision & ACL resection → anterior translation
(medial meniscus contributes to restraining primary anterior translation of the tibia)
 - : meniscus loading force : 40~60% of weight in standing

Anatomy

crests, roughly triangular in cross section

cover 1/2 to 2/3 of the articular surface of the corresponding tibial plateau.

- dense, tightly woven collagen fiber
 - circumferential fiber(main)
 - radial fibers
 - perforating fibers
- Hoop tension developed in menisci acts to keep them between bones.
- peripheral edges of meniscus

- convex, fixed & attached to the inner surface of the knee joint capsule
except where the popliteus is interposed laterally
: There peripheral edges are also attached loosely to the borders of the
tibial plateau by the coronary ligament
- Inner edges of meniscus
 - concave, thin & unattached
 - : Inferior surface - flat
 - superior surface - concave
- Medial meniscus
 - C-shaped structure larger in radius than lateral meniscus
posterior horn being wider than the anterior
 - anterior horn : attached firmly to the tibia anterior to the intercondylar
eminence & to the ACL
 - posterior horn : anchored immediately in front of the attachment of the PCL
posterior to the intercondylar eminence.
- Lateral meniscus
 - more circular, covering up to 2/3 of the articular surface.
 - anterior horn : attached to the tibia medially in front of intercondylar
eminence.
 - posterior horn : inserts into the posterior aspect of the intercondylar
eminence & in front of the posterior attachment of the
medial meniscus
- Why the lateral meniscus is injured so much less often than the medial
meniscus
 1. smaller in diameter, thicker in periphery, wider in body
 2. more mobile.
 3. attached to both cruciate ligament
Humphry or Wrisberg ligament
 4. attached to the popliteus muscle
 5. external rotation or Abduction injury(多)
- Mechanism of Injury
 - during rotation the meniscus follow the femur & move on the tibia
 - medial meniscus becomes distorted

- lateral meniscus attach to popliteus M, Wrisberg lig., Humphry Lig.
during rotation lateral meniscus follow lateral femoral condyle
→ less injured than medial meniscus
- when knee flexion & I/R, popliteus M. draws lateral meniscus posterior
→ prevent meniscus from caught

Vascular supply

lateral & medial geniculate vessels(both inferior & superior)

- perimeniscal capillary plexus (10% to 25% of the menisci)
10% to 30% of the width of the M.M
10% to 25% of the width of the L.M

(2) MENISCUS HEALING & REPAIR

- Three zone of vascularity
 - : perimeniscal capillary plexus (10~25% of the menisci)
 - red (fully within the vascular area)
 - red-white (at the border of the vascular area: in meniscal rim)
 - white (within the avascular area)
- after injury of peripheral vascular zone
 - fibrin clot form(rich in inflammatory cells)
 - proliferation of vessels from the perimeniscal capillary plexus
 - cellular fibrovascular scar tissue
- Meniscus regeneration
 1. total meniscectomy
 - the entire meniscus must be resected to expose the vascular synovial tissue
 2. subtotal meniscectomy
 - the excision must extend into the peripheral vasculature of the meniscus.
- white-white zone의 meniscal repair 후 healing 촉진
 1. vascular access channel
 2. parameniscal synovial abrasion

3. coverage of fascia sheath
4. Exogenous fibrin clot

(3) TEARS OF MENISCI

most commonly produced by rotation as the flexed knee moves toward an extended position.

- predisposing condition to meniscal injury
 1. menisci with peripheral cystic formation
 2. less mobile from previous injury or disease.
 3. abnormal mechanical axes in a joint with incongruities or ligamentous disruptions
 4. congenitally relaxed joints & inadequate musculature
 5. degenerative change

1) Mechanism of tear

- : usually torn by a rotational force while the joint is partially flexed
- : vigorous internal rotation of femur on tibia with knee in flexion
 - femur tends to force the medial meniscus posteriorly and center of joint
 - posterior part of medial meniscus is caught between femur and tibia
 - sudden extension position → longitudinal tear
 - extend anterior beyond MCL → locking and classic bucket handle tear

2) Classification

- components
 1. longitudinal tears (most common)
 2. transverse & oblique tears (medial < lateral)
 3. a combination of longitudinal & transverse tears
 4. tears associated with cystic menisci (medial < lateral)
 5. tears associated with discoid menisci

3) Diagnosis

Locking

- : only with longitudinal tears & much more common with bucket handle tear

usually of the medial meniscus

- conditions
 1. bucket handle tear of meniscus
 2. intraarticular tumor
 3. osteocartilaginous loose body
 4. other conditions
- false locking (soon after an injury)
 - hemorrhage - posterior part of the capsule
 - hamstring spasm prevents complete extension of the knee

A sensation of giving way

- condition
 1. loose bodies
 2. chondromalacia of the patella
 3. instability resulting from injury to the ligaments
 4. weakness of the supporting musculature
 5. meniscal tear etc.
- giving way의 원인이 meniscus posterior horn tear로 인하여 발생하는 경우
 - knee joint의 rotary movement에 의하여 증상 유발
- quadriceps weakness 등의 다른 원인에 의한 경우
 - 계단을 내려올 때 등의 simple flexion against resistance에 의하여 증상이 유발

Effusion

something is irritating synovium

effusion이나 hemarthrosis가 없다고 meniscus tear을 배제할 수 없다.

Atrophy of the musculature

especially vastus medialis component of the quadriceps mechanism

Localized tenderness

probably the most important physical finding

- posteromedial or posterolateral side

pain is related to synovitis in the adjacent capsular and synovial tissues

Diagnostic tests

1. McMurray test

positive in external rotation → medial meniscus lesion

positive in internal rotation → lateral meniscus lesion

- complete flexion~90° flexion 상태에서 click → posterior peripheral tear
- middle & anterior portion tear → greater extension 시 joint line에서 popping

2. Apley grinding test

- prone position
- distraction & rotation test : ligament injury
- compression & rotation test : meniscus tear

3. Squat test

routine X-ray : AP, lateral, intercondylar notch view with tangential view.

Arthrography

CT, MRI

Arthroscopy

4) Nonsurgical management

- Many incomplete tear will not progress to complete tear if the knee is stable.

restoration of the power of the muscles is most important

Indication

1. incomplete meniscal tear
 2. small(5 mm) stable peripheral tear with no other pathologic condition
 3. tears with ligament. instability(+)
 4. stable longitudinal tear with body involve
 - intact peripheral rim에서 3 mm ↓ displace
 - 1 cm ↓
 - partial thickness tear
- chronic tears with a superimposed acute injury cannot be expecter to

heal with nonsurgical Tx.

- Nonsurgical Tx. is never appropriate in locked knee caused by a bucket handle tear.
- Chronic tears even within the vascularized zone will not heal without surgery

Treatment method

- groin to ankle cylinder cast or knee immobilization for 4 to 6 weeks & progressive isometric exercise program
- symptom recur → surgical treatment

5) Surgical Tx

- total menisectomy 는 repair 가 불가능한 경우만 시행하고 가능한 meniscal rim을 보존
- total menisectomy is no longer considered the Tx of choice in young athletes or other people whose daily activities require vigorous use of the knee
- peripheral rim에 현저하게 병소부위가 있더라도 subtotal menisectomy 하는 것이 long term result 가 더 좋다
- indication of repair
 1. traumatic
 2. within vascular zone
 3. minimal change to meniscal body fragment
 4. vertical, longitudinal, peripheral 1cm ↑ tear
- Complication after menisectomy
 1. Two most common complication
 - postoperative hemarthrosis (from inferior geniculate a.)
 - chronic synovitis
 2. Synovial fistulas
 3. painful neuroma - resection usually is required
 4. thrombophlebitis

5. postoperative infection

6. R.S.D (Reflex sympathetic dystrophy)

: arthroscopic procedure is the most common precipitating event in RSD

• Regeneration of menisci after excision

regenerated menisci is frail & the function of the regenerated meniscus is probably insignificant

→ therefore, subtotal rather than total meniscectomy always is preferable

• Late changes after meniscectomy

-meniscus없이도 knee function에 지장을 주지 않을 수도 있으며, 때로는 관절의 late degenerative change를 일으킬 수도 있다.

-incidence of radiologic evidence of degenerative changes: 40%~89%

• Surgical repair of torn menisci

: Ideal indication for meniscal repair

-acute, 1~2 cm, longitudinal, peripheral tear that is repaired in conjunction with ACL reconstruction in a young individual.

: Zones of potential meniscal healing → red-red & red-white zone

• Meniscus repair materials

-ideal suture material(-)

-absorbable sutures such as polyglycolic acid(Dexon), polyglactin-910(Vicryl) or polydioxanone(PDS)

• Meniscal autograft & allograft

→ allogenic substitutes : quadriceps & patellar tendons & infrapatellar fat pad

→ autogenic graft : unsatisfactory

→ efforts to replace with silicon, carbon fibers or Dacron : unsuccessful

→ meniscal allograft

6) other conditions of menisci

☞ Cysts of menisci (LM > MM)

: Several etiologic theories

1. trauma
2. degeneration with age
3. developmental inclusion of synovial cells within the substance of meniscus, or a metaplastic events in which the cells secrete mucin
4. displacement of synovial cells into the substance of the meniscus through microscopic tears in fibrocartilage

→ meniscus mid 1/3 portion의 peripheral area의 손상과 가장 밀접하게 연관됨

: Cyst가 lateral side에 위치하는 경우,

fibular head의 anterior & proximal FCL의 전방부위에 위치

—firm, capsular tissue에 부착

—multilocular, clear, gelatinous materials

—Pisani sign

→ knee extension시 cyst가 prominent해지고 flexion시 less prominent

flexion시 popliteus draw lateral meniscus posterior

: Clinical finding

pain accentuated by activity

palpable mass along the lateral joint line

: Treatment

—surgery (Arthroscopic partial meniscectomy & cyst decompression)

→ Excision of meniscal cyst

☞ Discoid meniscus (lateral > medial)

: incidence : 1~26%

1. complete and incomplete type

—more common, disc-shaped

posterior meniscal attachment(+)

asymptomatic

abnormal meniscal motion(-)

2. Wrisberg type

-nearly normal in size, not disc-shaped

posterior meniscal attachment(-) except the ligament of Wrisberg

다른 type에 비해 young age에서 발생하며 trauma와 관련성은 없다.

snapping knee syndrome (+)

→ knee flexion & extension 시 popping(+)

: discoid medial meniscus 는 disc-shape이며, meniscal tear와 같은 trauma와 연관되어 발생하며, Discoid lateral meniscus 에 비해 빈도는 떨어진다.

• treatment

1. stable discoid meniscus

-observation

2. tears of complete or incomplete type

-subtotal menisectomy or saucerization of the mobile fragment under the arthroscopic tech.

3. Wrisberg type

-total menisectomy

-arthroscopic saucerization and lateral meniscus posterior half를 posterior capsule에 reattach