WHAT IS INSTABILITY?

- Resistance of musculoskeletal tissues to forces applied to a joint
  - Control of joint motion
  - Contributions from subsystems
    - Passive
    - Active

PASSIVE STABILITY STRUCTURES

- Non-contractile
  - Osteology/Arthrology
  - Labrum
  - Joint capsule
  - Ligamentous structures

HIP DYSPLASIA

- Lateral center edge angle < 20°
- Shallow acetabulum
- Malformed femoral head
- Angle of inclination
  - Coxa valga (>140°)

ANTERIOR & POSTERIOR HORN ANGLE

- Moderate relationship to acetabular anteversion

OPENING ANGLE OF THE INFERIOR ACETABULUM

LABRUM

- Deepens socket 20%
- Provides “suction” of the joint
- Proprioception
- Nociception

iliofemoral ligament

- Lateral band tightens in flexion + adduction
- Controls external rotation in flexion
- Controls internal and external rotation in extension

pubofemoral ligament

- Blends anteriorly with medial band of iliofemoral ligament
- Controls external rotation in extension
- Forms sling inferior to femoral head

ischiofemoral ligament

- Courses posterior to anterior
- Controls internal rotation in flexion and extension
ZONA OBICULARIS

LIGAMENTUM TERES
• MARTIN RL, KIVLAN BR, CLEMENTE FR. A CADAVERIC MODEL FOR LIGAMENTUM TERES FUNCTION: A PILOT STUDY. KNEE SURG SPORTS TRAUMATOL ARTHROSC. NOV. 2012

MODEL FOR HIP INSTABILITY
• OSSEOUS
• CONGRUENCY
• CAPSULE + LIGAMENTS
• LAXITY
• LABRUM

ETIOLOGY OF HIP INSTABILITY
• TRAUMATIC
• ATRAUMATIC
• AQUIRED
• MICROTRAUMA
• FEMOROACETABULAR IMPINGEMENT
• IATROGENIC

ATRAUMATIC HIP INSTABILITY
• INJURY OCCUR FROM RECURRENT TWISTING OR PIVOTING WITHOUT FEMOROACETABULAR IMPINGEMENT (MCCARTHY, NOBLE ET AL. 2001)
• ATHLETES MAY NOT NEED EXCEED THEIR NORMAL JOINTROM (DY, THOMPSON ET AL. 2008)
• LATERAL ROTATION AND ABDUCTION GENERATE SUBSTANTIAL TENSILE STRAINS IN THE ANTERIOR PART OF THE ACETABULAR LABRUM.

ATRAUMATIC HIP INSTABILITY
• GOLF
  • LEAD LEG FINISHES IN POSITION OF NEAR MAXIMUM MEDIAL ROTATION
  • HIGH MEDIAL ROTATIONAL VELOCITY (LEAD LEG)
  • LATERAL ROTATIONAL VELOCITY (TRAIL LEG) (GULGIN 2009)
  • LATERAL ROTATION AND EXTENSION PLACE DAMAGING TORSION TO THE ANTERIOR LABRUM WITHOUT EXCEEDING NORMAL ROM (MASON 2001)

ATRAUMATIC HIP INSTABILITY
• OVERHEAD ATHLETE
  • BATTING
  • 714 DEG/SEC OF ROTATIONAL VELOCITY (WELCH, BANKS ET AL. 1995)

ATRAUMATIC HIP INSTABILITY
• OVERHEAD ATHLETE
  • THROWING
  • LEAD LEG – MEDIAL ROTATION AND FLEXION
  • TRAIL LEG – ROTATIONAL TORQUE, RAPID LATERAL ROTATION AND EXTENSION
• BALLET
  • IMPINGEMENT AND SUBLUXATION ARE FREQUENTLY OBSERVED IN
    TYPICAL BALLET MOVEMENTS EVEN IN NORMAL MORPHOLOGY
    (CHARBONNIER, KOLO ET AL.)

IMPINGEMENT = INSTABILITY?
  • HIGH RATES OF FAI ARE PRESENT IN PATIENTS WITH HIP INSTABILITY.
  • FAI MAY PREDISPOSE THE HIP TO INSTABILITY
  • ANATOMIC CONFLICT LEVERING THE FEMORAL HEAD POSTERIORLY.
  • (CANHAM, 2016)

ACTIVE + NEURAL SUBSYSTEMS

MUSCLES OF THE ANTERIOR HIP
  • ILIOPSOAS:
    • MOST POWERFUL HIP FLEXOR.
    • ATTACHES TO THE ANTERIOR HIP CAPSULE
  
PECTINEUS:
  • ADDUCTOR, FLEXOR AND INTERNAL ROTATOR
  • ATTACHES AND SUPPORTS ANTERIOR HIP CAPSULE

RECTUS FEMORIS:
  • FLEX THE HIP AND EXTEND THE KNEE

MUSCLE FUNCTION
  • TENSOR FASCIA LATA (TFL):
    • COUNTERACTS THE GLUTEUS MAXIMUS ON THE ILIOTIBIAL BAND.
    • ASSISTS IN FLEXING, ABDUCTING, AND INTERNALLY ROTATING THE HIP
    • TROCHANTERIC BURSEAS DEEP TO THIS MUSCLE.
  
GLUTEUS MAXIMUS:
  • POWERFUL EXTENSOR AND EXTERNAL ROTATOR
  • MOST EFFECTIVE WHEN THE HIP IS FLEXED.

GLUTEUS MEDIIUS:
  • MAIN ABDUCTOR OF THE HIP
  • IMPORTANT IN STABILIZING THE PELVIS.

GLUTEUS MINIMUS:
  • INTERNAL ROTATOR?

• DEEP ROTATORS
  o IN LINE TO CREATE COMPRESSION
Comprehensive Evaluation of Hip Instability

- The injury pattern of the shoulder known to occur in the throwing athlete can be used to understand the issues of focal rotational instability of the hip.
- The biomechanics of throwing leads to progressive laxity of the anterior capsule in the shoulder.
- Similarly, excessive repetitive forceful hip rotation can contribute to focal rotational instability.
- The most common injury pattern is repetitive forceful hip external rotation beyond the limit of normal motion leading to iliofemoral ligament laxity.
- In the presence of instability that results from the laxity, abnormal loading of the anterior-superior labrum can occur resulting in subsequent labral chondral damage.

Comprehensive Evaluation of Hip Instability

- A shallow acetabulum resulting from dysplasia is the most familiar deformity that can contribute to instability.
- Rotation deformities of the femur and acetabulum in the transverse plane may also lead to excessive loading of capsuloligamentous structures.

- The labrum is critical to joint stability and if damaged from trauma and/or impingement the pathology associated with instability could be accelerated.
- Labrum acts as a buttress to mechanically prevent excessive joint movement and enhance the congruency of the femoral head and acetabulum.
- It establishes a seal, maintaining the negative intra-articular joint pressure.

- Capsuloligamentous structures will be placed under abnormally high

Neuromuscular control of the hip and lumbopelvic regions is important to assess

Comprehensive Evaluation of Hip Instability

- Deviations from normal transverse plane orientation (anteversion or retroversion) of the acetabulum and femur may lead to progression of this process.
- As this process progresses the severity of the labral tear and complaints of instability could worsen.
- When the hip is subject to higher physiologic demands, neuromuscular control is a crucial component of joint stability and function.
- As dynamic stability of the hip is compromised, weight-bearing forces will be unevenly distributed potentially leading to the progression of labral pathology.

Instability Algorithm

Comprehensive Evaluation of Hip Instability

- Sports that require excessive hip external rotation may be at risk for anterior focal rotation instability.
- The risk factors for anterior focal rotational instability include:
• Shallow acetabulum
• Excessive acetabular anteversion
• Excessive femoral anteversion.

• Capsular laxity may be evident in those with increased hip external rotation range of motion when compared to the opposite side.
• Those with signs of general ligament laxity and neuromuscular deficits leading to poor lumbo-pelvic control may be at greater risk for instability.

Comprehensive Evaluation of Hip Instability
• Subjective complaints/History
• Objective Measures
• Special tests
• Static Balance/Dynamic Stability tests Functional Performance Tests

Comprehensive Evaluation of Hip Instability
• Subjective
  Diffuse extra-articular
  • Myofascial pain
  • Psoas
  • Rectus femoris
  • Gluteus Medius/Minimus
  • Piriformis/Short Rotators
  • Activities that increase symptoms
  • Weight bearing with forced ER beyond end range
  • Over head throwing
  • Gymnastics
  • Deep squatting
    • ER and ABD in flexion
    • History joint instability in other joints

Comprehensive Evaluation of Hip Instability
• Gait
  • Toe in vs Toe out
  • Trendelenburg
  • Miserable malignment
  • Valgus
  • Internal rotation
  • Pronation

Lumbosacral Spine
• Similar to the evaluation process for the shoulder where ruling-out radiating symptoms from the cervical spine should be first considered, pain radiating from the lumbosacral spine should be first.
  • Miserable malignment
    • Valgus
    • Internal rotation
    • Pronation

Secondary to the kinetic relationship between the hip and lumbosacral complex, conditions in these areas commonly coexist.

• This holds particularly true in more chronic cases where muscle
dysfunction (i.e. gluteus medius) causes gait deviations that negatively affect the lumbosacral spine.

**Lumbosacral Spine**

- If tests are positive for a lumbosacral disorder, treatment may be directed toward this area.
  - The effect of this treatment on hip pain can be evaluated and modified accordingly.
- In our evaluation and treatment of lumbosacral problems we use a classification system includes categories for:
  - manipulation/mobilization
  - Stabilization
  - specific direction preference exercises (flexion, extension, or lateral shift)
  - traction.

  • Delitto A, 1995.

**Manipulation/ Mobilization**

- The technique involves positioning the patient, with respect to the lumbar spine, in side bending toward and rotation away from the painful side.
- A force directed anterior to posterior is applied to the ipsilateral anterior superior iliac spine in Grade 5 thrusting maneuver.
  - It should be noted before this manipulation is applied contraindications for a thrust mobilization must be thoroughly cleared.

**Eval and Treat Extra - Articular Pathology**

- Flexibility/ROM
  - Thomas
  - Obers
  - Adductors
- Strength
  - Abductors
  - External rotators
  - Extensors

**Eval and Treat Extra - Articular Pathology**

- Myofascial pain
  - Psoas
  - Rectus femoris
  - Gluteus Medius/Minimus
  - Piriformis/Short Rotators

**Muscle Strain**

- Pain commonly located near the muscle tendon junction.
- Musculotendinous disorders including muscle strains and/or tendon disorders should be:
  - Painful with palpation
  - Stretching
– Resisted movements directed at the involved muscle and/or tendon.
  • If the source of pain is solely from intraarticular origin, palpable pain is rarely present.

Classify injury
  – Acute
  – Sub-acute
  – Chronic/remodeling

Chronic/Remodeling
• Criteria for chronic/remodeling phase
  – Range of motion equal to uninvolved side
  – Strength approximately 75% of uninvolved side.

  • Pain with resisted testing should be minimal.

Treatment
  – Emphasize eccentric exercises and sport specific training
  – Throughout this rehabilitation process, strengthening of the lumbopelvic stabilizing muscles should be encouraged.
  – However, educating the patient to engage these muscles during sport specific activity we find to be critical.

Posterior Hip Pain
• Assessment
  – Seated palpation
• Sub-Gluteal Nerve Entrapment
• Hamstring Syndrome
• Sub-Gluteal Nerve Entrapment
  – Active Piriformis
  – Passive Piriformis
• Hamstring Syndrome
  – Active-30 and Active-90

Posterior Hip Pain
• Sub-Gluteal Nerve Entrapment
• Active Piriformis
• Passive Piriformis

Impingement: Location of Labral Tear
• DIRI
• DEXRI
• Posterior Rim

Hypermobility
• Beighton's scale
• Range of motion
  – ER/IR
• Distraction
• Anterior instability
• Prone External Rotation Test
• Log Roll
• Ligament Teres Test
• Squat test

Ligament Teres Test
• Based the findings of the previously described string model a clinical test was developed to assess for LT lesions.
  • This LT test was performed with the hip moved to 70° flexion and 30° short of full abduction.
  • The hip was then internally and externally rotated through full range of motion assessing for reproduction of pain.
  • Using arthroscopy as the gold standard in identifying LT lesions the test was found to have a sensitivity and specificity values of .90 and .85, respectively.
  • The authors concluded that partial LT tears could be identified by the Ligament Teres Test.

  • It should be noted that the one subject is this study with a complete tear had a negative LT test.
  • Because this test relies on the reproduction of pain it may not be useful for those with complete LT tears.

Squat Test
  • The LT was found to for a “sling” in flexion-abduction –external rotation in a cadaver study
  • Ligament Teres
  • An atraumatic mechanism of injury was noted by 65% of subjects suggesting an overuse or degenerative mechanism with possible interrelationship between the abnormal osseous structures and complete LT tears.

Comprehensive Evaluation of Hip Instability
  • Examination: Special Tests
    • Craig's Test

Comprehensive Evaluation of Hip Instability
  • Strength – Plank Tests
    • Trunk
    • Hip

Functional Assessment
  • Single Leg Stance
  • Single Leg Squat
  • Medial Hop

Functional Assessment
  • Single Leg Stance
  • Single Leg Squat
  • Medial Hop

Single Leg Stance Test
  • Passing
    • No evidence of pain, pelvic drop, or trunk compensation
  • FAIL

Biomechanical Examination
  • Contributors to “miserable malignment”
    • Excessive pronation
    • Correct LE malpositioning
PHYSICAL THERAPY MANAGEMENT OF THE UNSTABLE HIP JOINT

PASSIVE + ACTIVE + NEURAL = STABILITY

ACUTE PHASE

PHASE I

• PROTECTIVEWEIGHTBEARING
• EARLYMOTION
• NOURISHES JOINT
• MECHONORECEPTOR STIMULATION
• FLEX TO 90
• MEDIAL ROTATION
• ABDUCTION TO 30
• CIRCUMDUCTION
• CPM
• BIKE RIDING

PROM SEQUENCE

SUPINE PROGRESSIONS

PHASE I

• NEUROMUSCULAR REEDUCTATION
• INITIATE NON-WEIGHTBEARING STRENGTHENING
• ISOMETRICS
• POSTURAL/POSITIONAL AWARENESS
  LUMBOPELVIC BIOFEEDBACK
  IMPORTANCE OF LUMBOPELVIC STABILIZATION

SUPINE HIP FLEXION

SUPINE MARCH PROGRESSION

• HEEL SLIDE
• SUPPORTED MARCH
• TOE TOUCH MARCH
• UNSUPPORTED ALTERNATING LEG

PRONE HIP EXTENSION PROGRESSION

• KNEE FLEXION
• HIP EXTENSION WITH KNEE BENT
• HIP EXTENSION WITH KNEE EXTENDED
• HIP MEDIAL ROTATION
• HIP ABDUCTION

PRONE MANUALLY RESISTED EXERCISES

• INTERNAL AND EXTERNAL ROTATION
• RHYTHMIC STABILIZATION

PHASE II: SUBACUTE

PHASE II

• NORMALIZATION OF MOVEMENT
• MOBILIZATIONS???
  • ANTERIOR MOBILIZATION IMPROVES GLUTEUS MAXIMUS MUSCLE ACTIVATION
  • INFERIOR AND LATERAL MOBILIZATION INCREASES ABDUCTION TORQUE
  (MAKOFSKY, 2008)
• PROGRESSIVE STRENGTHENING
  • DEEP ROTATORS
  • PRIME MOVERS
• ADVANCE LUMBOPELVIC STABILIZATION

QUADRUPED PROGRESSION
  • LEG EXTENSION
  • LEG EXTENSION IN PLANE OF ACETABULUM

CLOSED CHAIN HIP ROTATION
SIDELYING PROGRESSION
  • CLAM SHELLS
  • LONG LEG ABDUCTION WITH LATERAL ROTATION
  • LONG AXIS ROTATION IN ABDUCTION
  • RHYTHMIC STABILIZATION

CHOP/LIFT PROGRESSION

PARTIAL WEIGHTBEARING EXTERNAL ROTATION

LONG AXIS HIP ROTATION IN STANDING

LUNGE PROGRESSION

SQUAT PROGRESSION

ADVANCED PHASE III
  • DYNAMIC STRENGTHENING
  • ADVANCED STABILIZATION AND PROPRIOCEPTION
  • FUNCTIONAL MOVEMENT PATTERNS

  PLANK PROGRESSION
  KNEE CIRCLES
  MEDICINE BALL TOSS
  CLOSED CHAIN HIP ROTATION
  DYNAMIC NEUROMUSCULAR TRAINING
  ROTATIONAL BALL TOSS