Golf Epidemiology and Injury
A. Lynn Millar, PT, PhD, FACSM

Department of Physical Therapy
Winston-Salem State University

Learning Objectives
Identify the most common types of golf related injuries and risk factors for each of those injuries.
Identify the prevalence and implications of older adults returning to golf following lower quarter surgery.

Golf Participation
Nation
- 25.3 million participants – 2015
- Males ~ 80%
- Females ~20%
Ages
- ~6.25 million over the age of 65
  - National Golf Association 2015
  - “account for more than half of the total games played” Cann et al. 2005

Prevalence of injuries
- General prevalence 57-62% amateurs
- Trauma
- 47.6% had been struck by golf ball!
- Overuse
- 15.8 – 43% for amateurs
- 35.7% - professionals

Injuries
- Low back – 18.3%- 34.5 (higher with professionals)
- Upper extremity – 17.2% - 89%
- Lower extremity – 20 – 40.5% (multiple sources for all %s)

Predictors of Injury
- 1 year study with female golfers
- Handicap
  - Lower increased risk
- Warm-up behavior
  - No or seldom increased risk Fradkin et al, 2007

Lower extremity
- LE Site
- Pelvis 3.8%
- Groin/hip 4%
- Knee 6 - 10%
- Ankle & foot 8 - 12.9%
  - Less skilled – hip, elbow & knee; older – knee, groin & foot  
    Fradkin et al, 2005; 2008

Types of Injuries
- 31.4% had 1 injury; 3.6% 2 injuries  
  Fradkin et al. 2005

Effect on Participation
- 78.9% Reported altered performance
- 29.6% Unable to play
- 17.6% Altered swing
- 16.7% Decreased performance

Knee
- Arthritis
- Meniscus
- Patellofemoral
- Fracture - rare

Foot and Ankle
- Sprain
- Plantar fasciitis

Mechanism of injuries
- Overuse 43.6%
- Technical error 18%
- Contact with static object 11.3%
- Sudden change of club speed 9.8%  
  Fradkin et al. 2005

Survey
- 46.2% - golf swing
- 23.7% - ball impact
- 21.5% - follow through  
  McHardy et al. 2007

Prevalence of Lower Quarter Surgeries
- Arthritis – 52.5 million
- 45 – 64 yrs = 30%
- > 65 yrs = 49.7%
- Total joint replacements
- Knee – 757,000
- Hip - 512,000
“the question of the replacement on golfing activity is of much interest”  McHardy et al 2006

Return to Golf after THA
- 99% of MD’s do not have restrictions to return to Golf (Swanson et al, J Arthroplasty, 24, 2009)
- Return to golf post THA - mean of 21 weeks
  - Range 6 – 76 weeks (Chatterjl, ANZ J. Surg, 74, 2004)
- No adverse effects of return to Golf 3 years after THA (Seyler et al, Sports Med, 36. 2006)

Post Knee Replacement in Golfers
- 87% had no pain during play, 35% mild pain
  - Difference from left to right
  - No guidelines from physician
  - Those that did said to “use short shots” Mallon & Callaghan

Return to Activity Post Replacement
- Unable to return to sport activity
- ~ 10% THR did not return
- ~3% TKR did not return
  - Wylde et al, 2008

Return to Golf
- TKA – dropped by 70% post surgery

Special Populations
- LE Amputees
- National Amputee Golf Association
  - 2500 members

Biomechanics of the Golf Swing

Judy L. Foxworth, PT, PhD, OCS
Department of Physical Therapy
Director, Human Performance and Biodynamics Laboratory
Winston Salem State University

Learning Objectives
- Describe phases of the golf swing and discuss biomechanical stresses on joints of the lower extremity
- Describe biomechanics stresses of the lower extremity during golf swing after lower extremity injury or surgery

The Golf Swing
- Complex motion with large trunk and hip range of motions
- Lead leg vs. trail leg
- Large forces secondary to acceleration/deceleration through IR/ER
• Both legs support almost all body weight at some point in the swing

Address Position
— Feet shoulder width apart
— Hips in slight ER
— Knees slightly flexed
— 3 main vertical axis of rotation

Backswing
— Video of backswing V3D
— Torso rotates 80 – 100°
— Hip turn 30 - 50°
— Trail Hip IR 9 - 35°
— Lead Hip ER 15 – 48°

Downswing
— Video of downswing V3D
— Weight Shift to lead leg
— Then Rotate toward the target
— Pelvis:
  • Lead hip – IR
  • Trail hip - ER
    — Trunk Rotation
    — Shoulder Turn

X-Factor vs. X-Factor Stretch

Phases of the Golf Swing
— Impact Still shot in V3D
— Weight on Lead foot
— Trail foot moves into Plantarflexion
— Lead hip stability very important

Follow Through
— Primary axis of rotation switches to Lead leg
— Max amount of Lead hip IR
— Lead ankle moves into inversion

3D Gait Analysis:
Kinematics vs Kinetics
• Three Dimensional Motion Analysis
• A little more about Joint Torques (Moment)
Internal vs. External Moments (Torques)

**Internal Torque**
- Produced by soft and hard tissue inside the body
- We cannot directly measure
- Assume to be equal in magnitude but **opposite** in direction of external torques

**External Torques**
- Produced by things outside the body
- We can directly measure

Hip Torque in Amateur Male Golfers

**Inclusion Criteria:**
- Healthy males
- Age 18-35 and 50-69 years
- Golf handicap ≤ 18

**Exclusion Criteria:**
- Current Lower extremity or LB pain/surgery in last year
- Neuromuscular disorder limiting full golf swing
- Left handed golfer
- Subjects: Healthy Male Golfers

Conclusions

• Young and Senior golfers generated similar club head speeds, hip joint torque magnitude and patterns.
• All peak torques occurred during the downswing.
• In general, the Trail hip peak torques were larger in magnitude (Extensor torque was greatest)
• Return to play should take into consideration the side of injury and club head speed.

Hip Joint Torques after THA

- On-going study
- Male golfers S/P THA > 1 year
- Seeking 10 with left THA and 10 Right THA
- Subjects 5 participants: 3 left sided THRs and 2 right sided THRs

- Exclusion Criteria: any other total joint replacement of the lower extremity, current low back pain, or neuromuscular diseases affecting balance

Methods

- Case Series
- Basic same procedure
- Driver
- 7 Iron
- Driver vs 7 iron
Discussion

- Those with THR generated a similar pattern of hip torques compared to reference group.
- Trail leg hip extensor torque was the largest.
- Hip torques generated by swings with a 7-iron were generally larger than when swinging with the driver.
- Club head velocity was lower than the reference group.

Female Golfers

Hip Rotational Velocity

- Injury Risk
- High rotational velocities may lead to acetabular labrum tears
- Collegiate golfers
- Unknown on Senior females

Hip Summary Slide

- Side matters
- Club head velocity matters
- Hip torque comparable to high intensity activates
- High Rotational velocities may put hip structures at risk

Biomechanics of the Knee

- 13 healthy male amateur golfers
- (35 ± 14 years)
- USGA handicaps 4 – 18
- 3-D Motion Analysis
- 2 different types of shoes

Peak Knee Moments

- Knee Moments
- All peak moments occurred during down swing
- Largest moments in LEAD knee
- ER moment equivalent to side-cutting maneuver
- Foot wear had no effect on knee joint loads
- No correlation with skill level

Effect of ER on Knee Moments

- College age players (n = 7)
- Completed swings with 5 iron
- 2 conditions
- Lead leg aligned parallel to the target
- Lead leg externally rotated 30°
- Only assessed the lead limb

Results

- 30° ER of lead foot
- Peak occur just prior to ball contact
– 15 % reduction in knee adductor (varus) torque with foot ER
– Large abductor (Valgus) torque AFTER ball impact
– Not effected by foot position
– ACL strain?

Clinical Recommendations
– ER of lead foot is recommended for those with medial compartment knee OA
– Foot position did not affect lead knee valgus (Abduction) torque
– Precautions with lead knee ACL pathology
– Knee Rotation post TKA
– Average of 18.7° axial rotation in trail knee during backswing
– Excessive rotation lead to high contact forces on edges of tibial polyethylene surface

Limitations
– n = 4
– Different prosthesis types
– Peak Vertical Loading during Golf with TKA
– Lower Extremity Amputees and Golf
– Loss of 3-D movements

Advances of prosthetic design include torsional devices
– Growing population needs more research
– Does Side Matter?
– 3 Transtibial amputees (Right handed)
– Torsional devices improved trunk rotations for Left (Lead) side amputees only
– Torsional devices cannot make up for loss of planter flexion of Trail limb

Key Points
– Side matters
– Club head velocity
– Slight modifications may alleviate potential risks

Return to Play

Michael Way, PT, DPT, SCS, ATC
Titleist Performance Institute Golf Fitness Professional
Sports Physical Therapy, Wake Forest Baptist Medical Center
Winston-Salem, North Carolina

– Disclosure
Titleist Performance Institute Golf Fitness Professional, Level 1

Learning Objectives
– Determine appropriate assessment strategies for return to play following lower quarter injury or surgery
– Design a rehab program (intervention strategies) for a golfer who wishes to return to play following a lower quarter injury or surgery
Agenda
- Assessment strategies
- Golf swing review
- Intervention strategies
  - Early, intermediate, and advanced recovery phases

Special considerations
- Post-op precautions
- Swing adjustments - TREAD LIGHTLY, we are not Golf Professionals
- Assessment Strategies

Basic Function
- Address primary injury / deficit
- Functional movement screen
- Golf swing analysis
- 2D video
- 3D kinematic motion capture

Golf Swing Review – Lower Extremity
- Weight shift to trail limb
- Internal rotation of trail limb during back swing
- Initiation of force through trail limb to begin acceleration
- Weight shift to lead limb
- Deceleration and internal rotation of lead limb during follow through

Golf Swing Review – continued
- Trunk posture and movements
- Kinematic sequencing - Disassociation

Early Rehab Intervention Strategies
- Address primary injury
- Adhere to precautions
- Build a **foundation** for golf specific skills

Early Rehab Intervention Strategies
- Lumbo-pelvic control and stabilization
- Disassociation
- Glute strengthening
- Progressive weight shift
- Static and dynamic balance

Early Rehab Intervention Strategies
- Disassociation
- Pelvic tilts in hook lying
- 3 planes and multinplanar
— Pelvic tilts/clocks sitting on large exercise ball
— Pelvic tilts/clocks in standing

**Early Rehab**
- Perform basic arm and trunk exercises standing in golf posture.
- Do not allow loss of posture.

**Intermediate Rehab Intervention**
- Trunk stabilization
- More aggressive lower extremity strengthening

**Trunk stabilization**
- Bridges with pelvic rotations
- Single leg bridges
- Quadruped UE/LE reaches
- Standing pelvic/trunk rotations

**Standing Pelvic Rotations**
- Stand on one leg
- Keep shoulders straight ahead
- Twist lower trunk/pelvis each direction.

**Lower Extremity Strengthening**
- Squats: bilateral and single
- Overhead squat
- Lunge with rotations

**Advanced Rehab Intervention**
- Advanced full body motions with exercises
- Explosive movements
- Simulate golf swing with resistance or balance exercise
- Allow golf swings with short – mid level irons

- Trunk Chops Medicine ball
- Trunk Rotation with Cable
- Explosive movements
- Ball throws
- Punches
- Olympic Lifts
- Jumps

- Ball Throws
- Golf Swings
- Partial swings
- ¼, ½, ¾
Single leg bias
- Focus on one swing phase: back, forward, follow through
- Swing against resistance or with assistance

Single leg swings
- Helps strengthen target limb
- Encourages correct weight shift

Swing against resistance
- Develops strength in trail limb for generating force

Swing with elastic assistance
- Develops deceleration strength in lead limb and helps weight shift over lead foot

Post-Op Precautions
- Which surgical approach for Total Hip
- Internal Rotation?
- Premorbid condition

Swing Modifications
- Reduce back swing
- Toes turned out
- Encourage work with Golf Teaching Professional

Return to play
- Putting, chipping
- Hitting on the range
- SMALL bucket of balls

On the course
- Use a cart
- 9 holes (or less)

Special Needs
- Amputees
- www.nagagolf.org

Epidemiology References


Biomechanical References


Rehabilitation References

1. http:www.mytpi.com/articles/biomechanics/kinematic_sequence Basics