MECHANISMS OF INJURY IN GOLF

THE EUROPEAN TOUR PHYSIOTHERAPY UNIT

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INTRODUCTION

THE GOLF SWING

-The physical demands required of the body to execute one of the most complex athletic skills are enormous (Lennon 1998, Sell et al 2007).

The golf swing is a highly coordinated, multi-segment, rotational, closed chain activity that requires strength, explosive power, flexibility, speed and balance (Gordon et al 2009).

Sell et al 2007 found that Elite golfers have been shown to possess more of these unique physical characteristics than standard golfers.

MODERN GOLF SWING

The golf swing is a high-torque rotational movement for which the anatomy is poorly suited for a number of biomechanical reasons and involves resisting high lateral bending forces

The modern swing uses a large shoulder turn but restricts the hip turn to build torque in the muscles of the lower back and shoulders.

The modern golf swing leads to greater angular displacement of the spine and is suspected as being a major source of injury for professional and amateur golfers.

INJURY INCIDENCE

	Pro (Incidence) Year /life		Amateur (Incidence) Year / Life		Pro Male (site)	Pro Female	Amateur Male (site)	Amateur female
Batt (1992)			31%				28 % wrist 25% back	50% elbow 29% back 25% shoulder
Fradkin et al (2005)			35 %					31% back 17% shoulder
Barclay et al (2011)	31%	66%			44% Back 22% wrist 20% neck	44% wrist 23% elbow 19% shoulder		
Harrison et al (2004)	38%				32% Back			
Gosheger et al 2003	60% (2yrs)		40% (2yrs)					
Mchardy et al (1997)			18%				25% Back 15% elbow 10% shoulder	
Smith and Hillman (2012)					66% back 17% upper limb			
Mchardy and pollard (2005)					20-27% wrist 7% elbow 18% shoulder		13% wrist 25% elbow 8% Shoulder	20% wrist 33% elbow

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POTENTIAL CAUSES OF INJURY

- **REPETITIVE ACTION**
- **SINGLE INCIDENCE TRAUMA**
- **REPEATED INCIDENCE TRAUMA**
- **OVER TRAINING/PRACTICE**

PROFESSIONAL

^

- TOO RAPID INCREASE IN LOAD
- HARD SURFACES (Dry ground/ Mats)
- BIOMECHANICS
- POSTURE
- TECHNIQUE / SWING FAULTS
- LACK OF PREPERATION/WARM UP
- LACK OF FLEXIBILITY
- LACK OF PHYSICAL CONDITIONING

v

AMATEUR

In this talk we will be concentrating on mechanisms of injury relating to the golf swing.

However there are many other causes of injuries in golf including

- **ball strike ,**
- **being hit by a club**
- **injuries from carrying a bag**
- **Injuries from pulling a trolley**
- **Slipping/tripping on the course.**

A recent Australian study of 300 persons presenting to emergency rooms with golf-related injuries reported that 37% were struck by a club, 28% were struck by a ball, 10% had sprains or strains, and 7% had slipped or fallen. 15% of these led to admission

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INJURIES IN GOLF

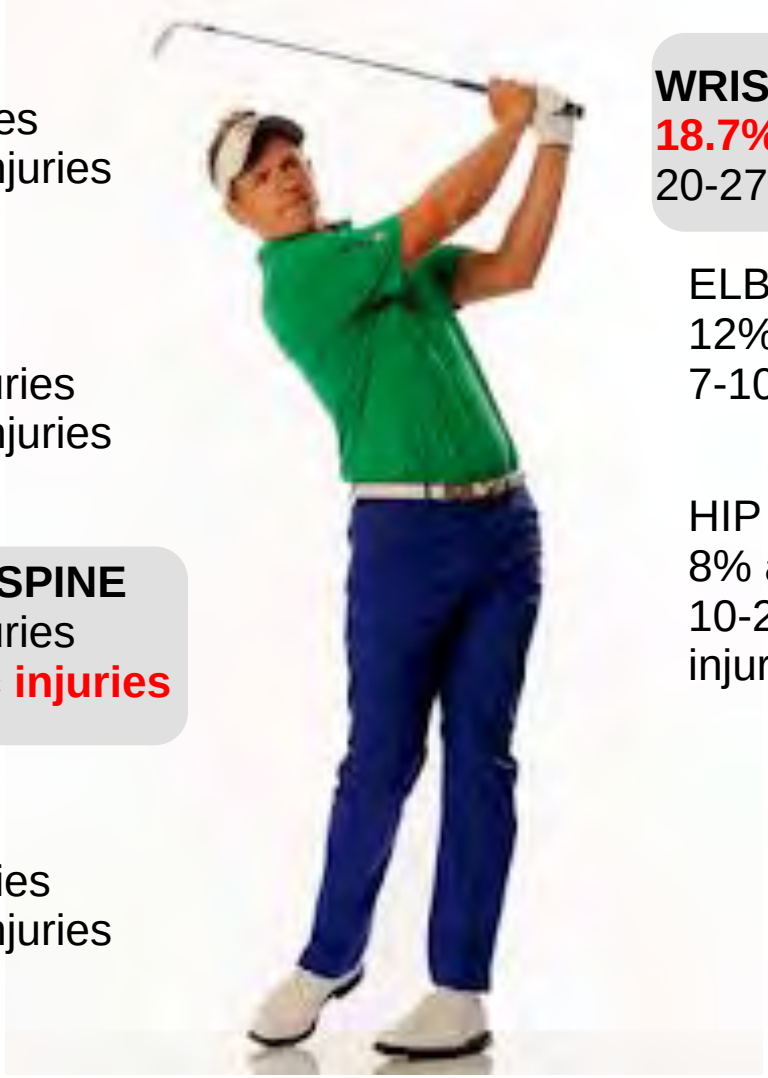
SITES OF INJURY (Professionals)

NECK
13% acute injuries
7-17% chronic injuries

SHOULDER
15.9% acute injuries
8-20% chronic injuries

LOWER BACK/SPINE
16.6% acute injuries
24-52% chronic injuries

KNEE
6.3% acute injuries
8-20% chronic injuries



WRIST/HAND
18.7% acute injuries
20-27% chronic injuries

ELBOW
12% acute injuries
7-10% chronic injuries

HIP
8% acute injuries
10-20% chronic injuries

Gosheger et al 2003, Smith + Hillman 2012,
Barclay et al 2011 Harrison et al 2004,

SITES OF INJURY (Amateurs)

SHOULDER
8%

ELBOW
32%

WRIST/HAND
20%

LOW BACK
36%

McCarroll 1982, Batt 1992, Mchardy and Pollard 2005, Fradkin et al 2005

LUMBAR SPINE

DISC DEGENERATION

DISC HERNIATION

FUNCTIONAL INSTABILITY

SPONDYLOSIS

SPONDYLOLYTHESIS

FACET JOINT ARTHOPATHIES

MUSCLE STRAINS

SPINAL INJURIES

▪There is a possibility of four different forces acting on the lumbar spine in the golf swing;

-Downward compression in the cranial to caudal direction
-Side to side bending / lateral to lateral direction force and shear
-Shear force in the anterior to posterior direction
-Rotation shear force from twisting along the long axis of the spine

The amount of damage to the lumbar spine, depends on the magnitude of the sum of these individual forces.

▪Facet joints resist more than 50% of the back to front shearing load

▪Only 2-3 degrees of intersegmental rotation can produce mictrotrauma in the lumbar facet joints

▪Most common cause of disc herniation in a healthy disc is lateral bending combined with compression and torsion, all of which are major components of the golf swing (increased enormously in amateurs)

▪Amateurs take 31% more time to rotate through the same range as professionals. (conditioning/ flexibility/movement efficiency)

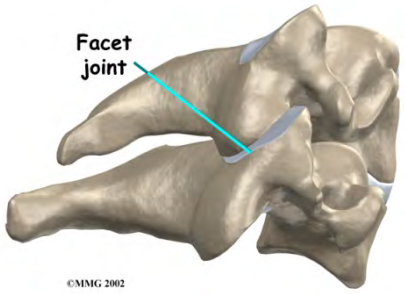
▪This Speed of rotation in professionals is important in regards to the generation of high explosive power and high clubhead speeds and the importance of control and stability is even more important to minimise injury potential.

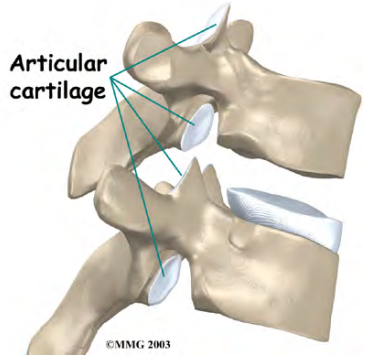
- Compression loads of 8 times body weight in professional golfers – approx 7,500+/-2400 newtons

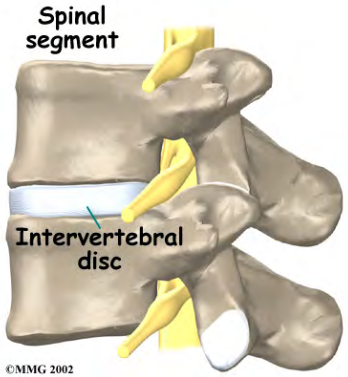
- Cadaveric studies showed disc prolapse with loads of 5,450 N

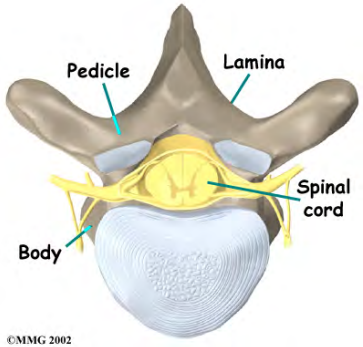
- Peak shear loads of 596 +/- 514 N seen during swing of amateur golfers with shear of 570 +/- 190 N capable of producing pars interarticularis fractures in cadavers

- Amateurs produce 80% more peak lateral bending as shear loads than professionals and more in general shear loads through the swing.









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SHOULDER

Golf is a unique sport with regards to the shoulders in that each shoulder has to do a very specific & opposite manoeuvre through large ROM's.

The leading shoulder is forced and stretched into an extreme adducted position at the top of the backswing and the non lead shoulder is in an abducted ext rotated position. This creates different forces and pathologies in each shoulder.

The repeated horizontal add and int rot of the Lead arm creates horizontal plane compression of the AC Jt leading to Susceptibility of degeneration, OA & dist clavicle osteolysis. This position can also lead to excessive posterior capsular stretch & posterior instability → posterior labral tear, ant sup int imp & SAI

The repeated external rotation on the non-lead arm leads to issues of anterior instability, SLAP tears, impingement

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SHOULDER INJURIES

LEADING SHOULDER:
AC joint pathologies (OA)
Posterior instability (full add)
Subacromial impingement
Rotator cuff tears

NON LEADING SHOULDER
SLAP tears
Anterior instability (forced ext rot)
Subacromial impingement
Rotator cuff tears

ALTHOUGH NOT CONSIDERED AN OVERHEAD SPORT 30% OF THE SWING IS SPENT VERTICALLY ELEVATED ABOVE 90 deg. THE COMBINATION OF HORIZONTAL & VERTICAL EXTREMES HAS BEEN SHOWN TO BE A MECHANISM FOR SHOULDER INJURY PARTICULARLY AS VOLUME INCREASES (MITCHELL ET AL 2003)

WRIST

During the golf swing of a right-handed golfer, the left wrist undergoes a smaller arc of dorsi- and palmar-flexion (60 deg) but a larger arc of Ulna and Radial deviation (50 degs) than the right wrist (30 degs).

The Non lead wrist moves through more dorsi and palmar-flexion during the swing (can be more than 100 deg).

This is important when understanding the mechanisms of injury and varying injury types between sides.

Trauma (impaction and compression forces), Overuse, poor wrist control (or any combination) during the swing can cause excessive movement, tissue overload, structural damage and injury.

WRIST INJURIES

NON-LEAD WRIST
Dorsal rim impaction syndrome
TFCC injuries
Cyst/ganglion formation
Scapho-lunate joint dysfunction
(Dorsal wrist pain)

LEAD WRIST
ECU Tendonopathies ECU Subluxation
Dequervains tenosynovitis
Fractured Hook of hamate
Ulnar wrist pain
Radial wrist pain

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WRIST INJURY OVERVIEW

67 % of wrist problems in elite golfers affect the leading wrist

•Ulnar sided problems – 87% leading wrist 13% non-leading wrist

•Radial sided problems – 100 % leading wrist

*Dorsal Problems – 21% leading wrist, 79% non leading wrist

Ulnar sided problems – ECU pathology, ECU subluxation

Radial sided problems – De Quervains

Dorsal Problems – ganglia, extensor tenosynovitis, DRIS

Commonest acute in injury - **Pros** ECU subluxation/pathology
- **Amateurs** TFCC injuries

Commonest Chronic issue - **Pros** synovitis of some sort (teno/DRIS)
- **Amateurs** as above plus middle aged plus sig inc of pisotriquetral pain

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HIP INJURIES COMMONLY SEEN ON TOUR

TFL/ITB/PSOAS, TENDINOPATHIES & ENTHESIOPATHIES

HIP ARTHROSIS

LABRAL TEARS

FEMORO-ACETABULAR IMPINGEMENT (CAM/PINCHER)

REPEATED LOADING (extreme end of range), DEGENERATIVE CHANGES, CONGENITAL ISSUES (HIP BIOMECHANICS ANATOMY) LACK OF FLEXIBILITY, POSTURE, TECHNIQUE

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PROFESSIONAL GOLFERS

MOST COMMON INJURIES

Male = Low back, left wrist, left shoulder
Female = Left wrist, low back, left hand

MOST COMMON MECHANISM

Male & Female =
High Volume
Repetitive practice
Abrupt deceleration of the club head at impact

TRAUMA SINGLE AND REPEATED INCIDENCE

- TFCC TEARS/INJURIES
- ECU TEARS/INJURIES/ SUBLUXATIONS
- OBLIQUE TEARS
- LEAD SIDE ROTATOR CUFF INJURIES

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REPETITIVE AND HIGH LOAD

Anterior and posterior shoulder instability

Huge torsional stresses at lower back/trunk

AMATEUR GOLFERS

Most Common injuries

-Low back, wrist, elbow (left), shoulder
-Female = Lead elbow

Most common Mechanism

-Poor biomechanics/technique with too much play/practice (excessive cellular overload)
-Insufficient warm up
-Poor flexibility
-Lack of conditioning

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COMMON SWING FAULTS

POSTURAL FAULTS

- S-Posture
- C-Posture
- Early extension
- Flat Shoulder Plane
- Reverse Spin angle

TECHNIQUE FAULTS

- **Slide**
- **Sway**
- **Early Release**
- **Over the top**
- **Steep angle of approach**
- **Chicken Winging**
- **Reverse C**

OVER THE TOP

Common Causes:
-Abdominal weakness poor core stability/strength
- Problems separating torso from pelvis during the swing especially at start of downswing & impact.
-Poor lead leg balance/glut strength

Common injury sites;
- Elbow, wrist
- Low back

CORRECTIVE EXERCISE

1) HOLD MEDICINE BALL AND STEP TO LEFT ONTO STEP AND ROTATE AND FLEX RIGHT HIP UP AND ACROSS TO LEFT
2) SIDE STEP TO RIGHT AND LOAD HIP AND THEN TURN MEDICINE BALL TO RIGHT

BOTH HELP DEVELOP SEPERATION AND LATERAL SIDE CONTROL AND HIP STABILITY

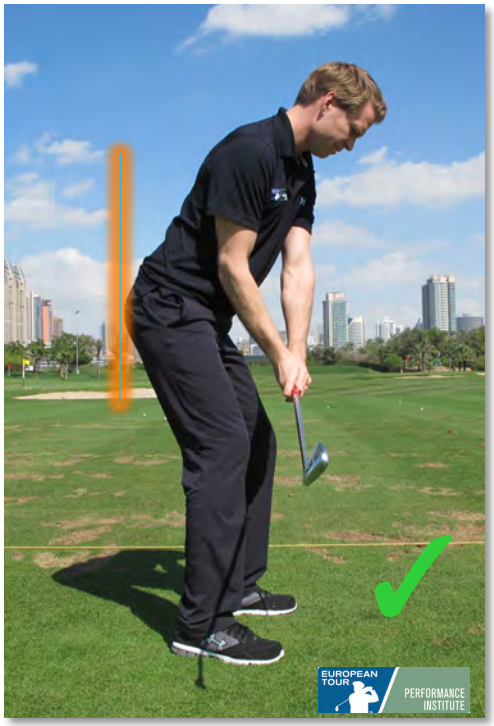
EARLY EXTENSION

Common Causes:

-Poor squat mechanics
-Decreased lead hip internal rotation
-Poor thoracic rotation
-Inability to separate torso from hips
-Weak gluteals and abdominals

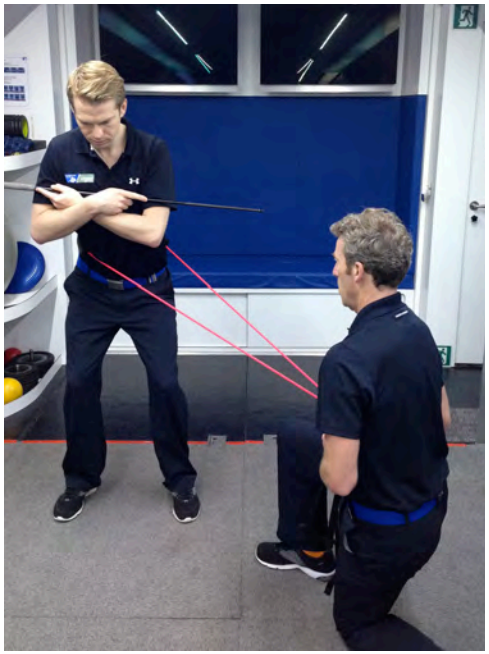
Common Injury sites:

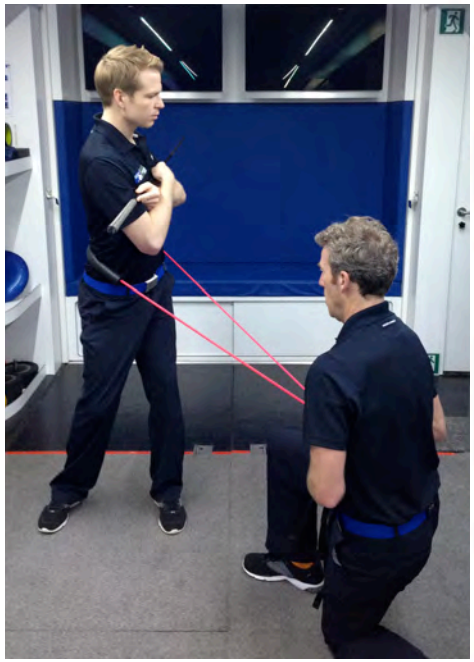
- Low Back



CORRECTIVE EXERCISE

1) STANDING IN SWING POSITION WITH CLUB ACROSS SHOULDERS. HAVE THERATUBE AROUND WASTE AND TRAINER STANDS IN FRONT AND PULLS DOWN AND AWAY FROM RIGHT HIP. I.E PULLING THEM FORWARD TO OVEREMPHASISE THERE PROBLEM THEY WILL NATURALLY ACTIVATE IN THE OPPOSITE DIRECTION TO INCREASE PROPER LOADING OF THE LEFT HIP AND GLUT AND WEIGHT ONTO HEELS RATHER THAN FORWARD ONTO TOES





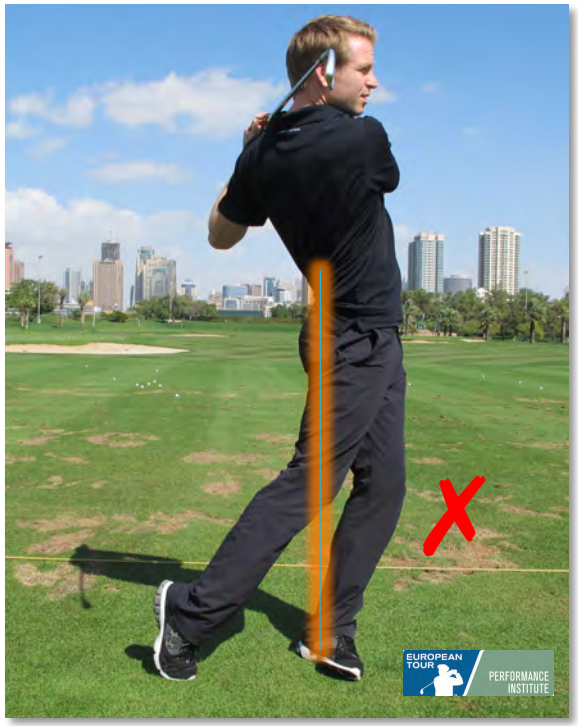
SLIDE

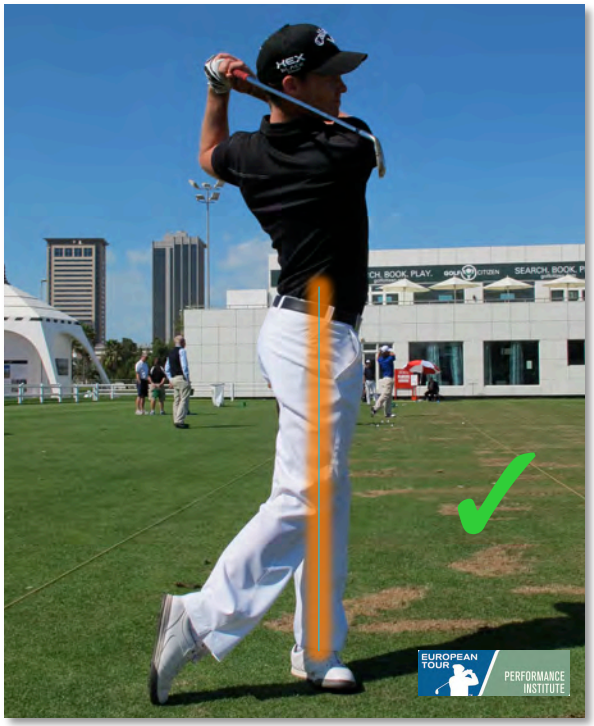
Common Causes:

-Poor lead side lateral strength, poor glut strength
- Weak abdominals
- Decreased lead hip internal rotation
-Difficulty separating upper body from lower body

Common Injuries sites:

- lead Hip pain
- Medial knee
- Lateral ankle
- Low back





CORRECTIVE EXERCISE

1) THERATUBE AROUND LEFT THIGH AND PULL FROM LEFT AS PLAYER COMES DOWN TO IMPACT TO FORCE THEM TO STABILISE LEFT SIDE AND HIP AND PREVENT SLIDING THROUGH

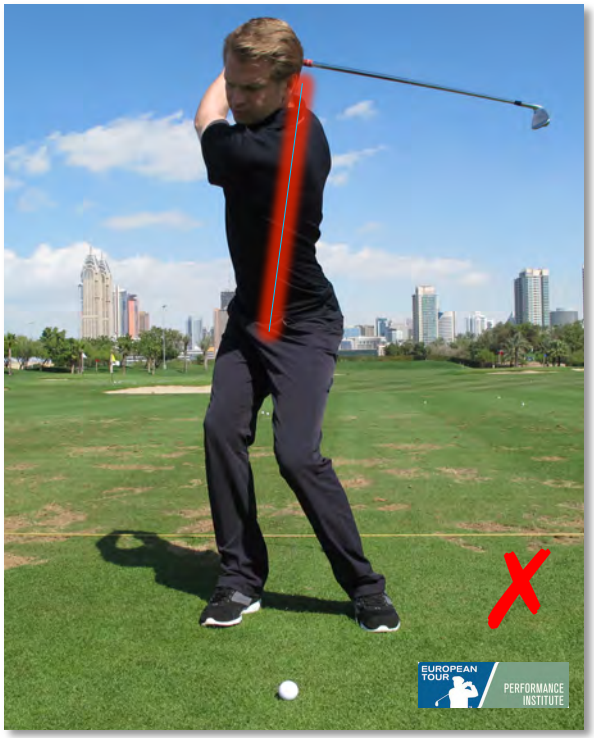
REVERSE SPIN ANGLE

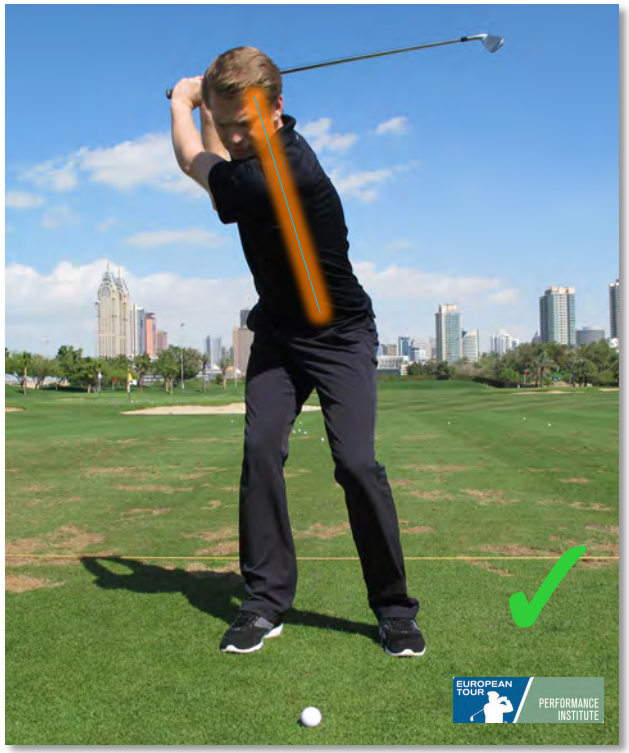
Common Causes;

- Non-lead hip internal rotation deficit
- Poor Thoracic rotation
- Weak abdominals (poor eccentric control)
- Reduced lateral flexibility
- Reduced separation of pelvis and shoulders in backswing

Common Injuries sites:

- Low back
- Lead shoulder
- Non lead hip





SWAY

Common Causes:

-Poor trail side lateral strength

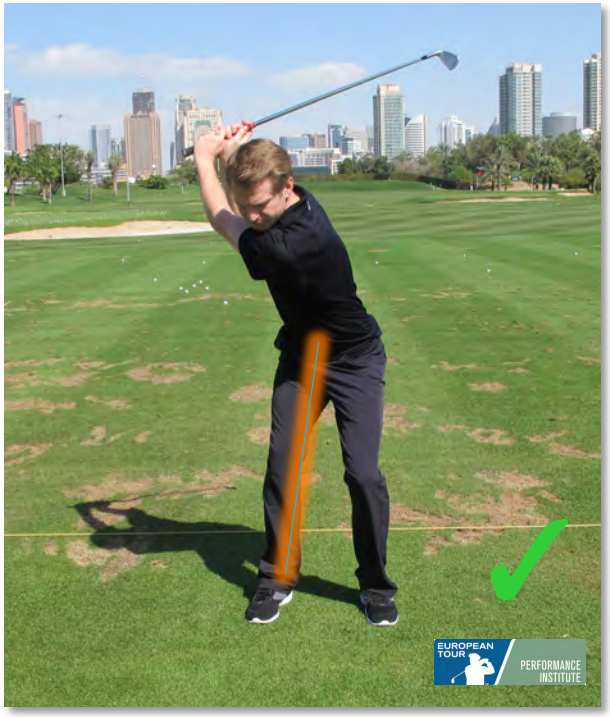
-Difficulty separating upper body from lower body

- Reduced trail hip internal rotation

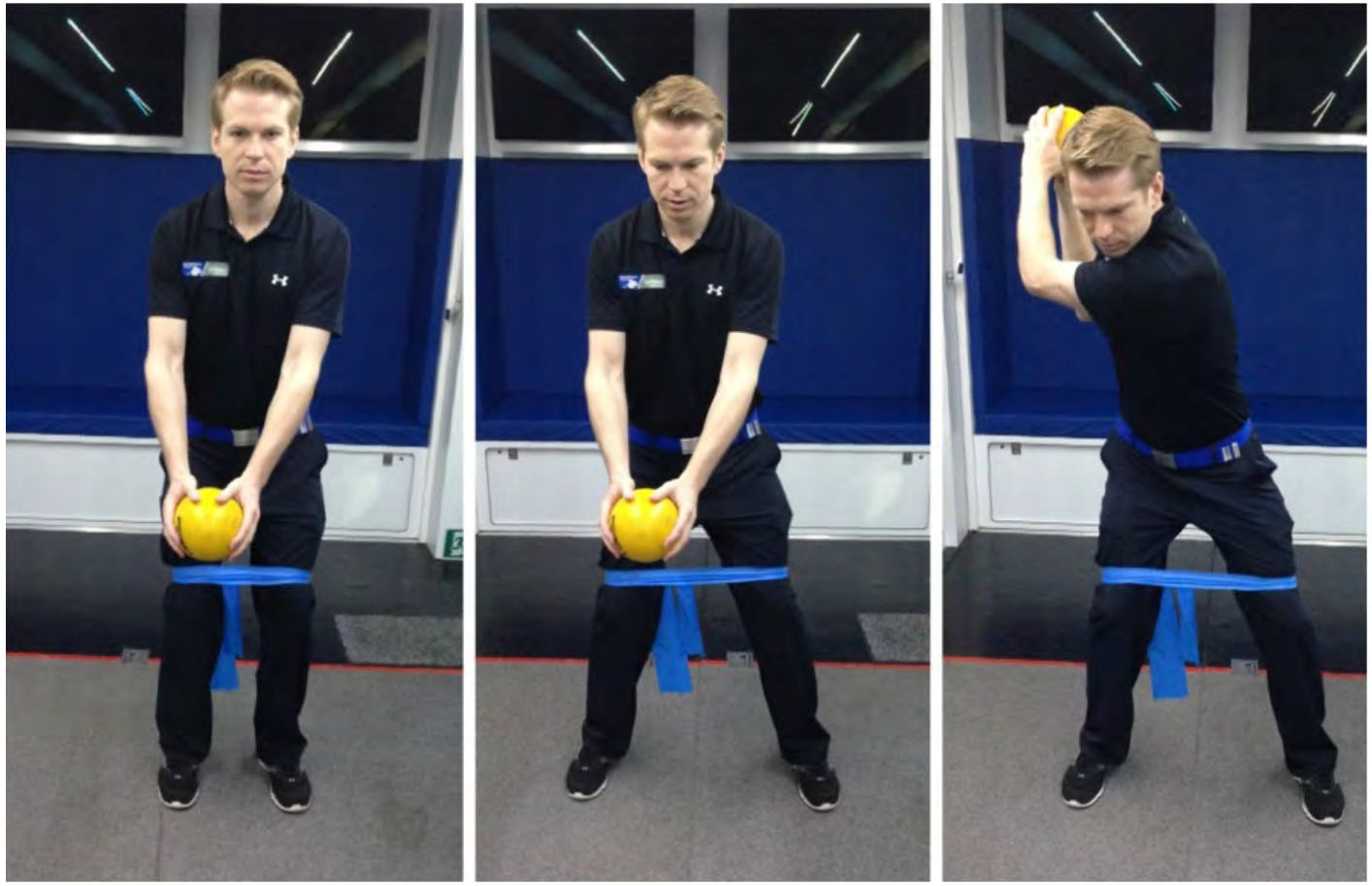
- Poor glut strength hip stability

Common injuries sites:

- Hip
- Medial knee
- Lateral ankle
- Low back



CORRECTIVE EXERCISE



EARLY RELEASE / SCOOP

Common Causes:

- Poor lead leg balance / gluteal weakness
- Decreased lead hip mobility
- Abdominal weakness / reduced core stability
- Poor separation of torso from pelvis at start of downswing

Common Injuries sites:

- Elbow pain
- Wrist pain
- Low back pain

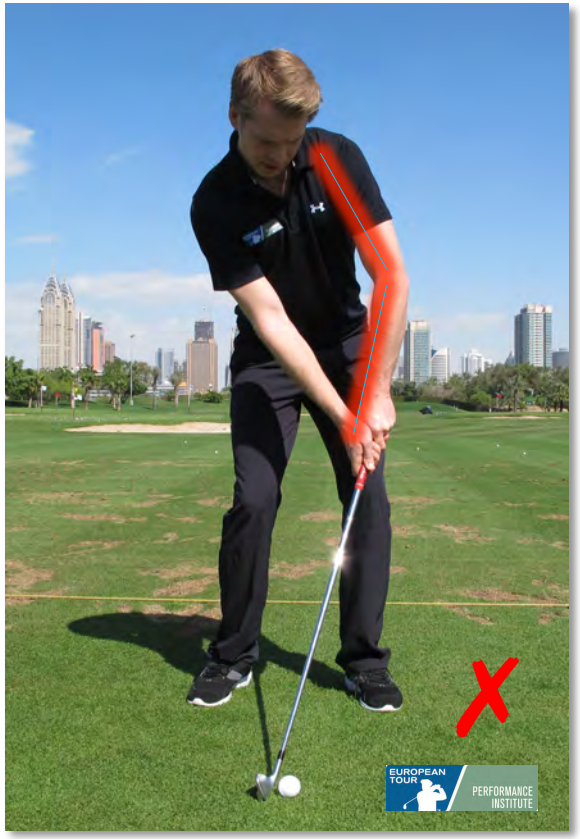
CHICKEN WINGING

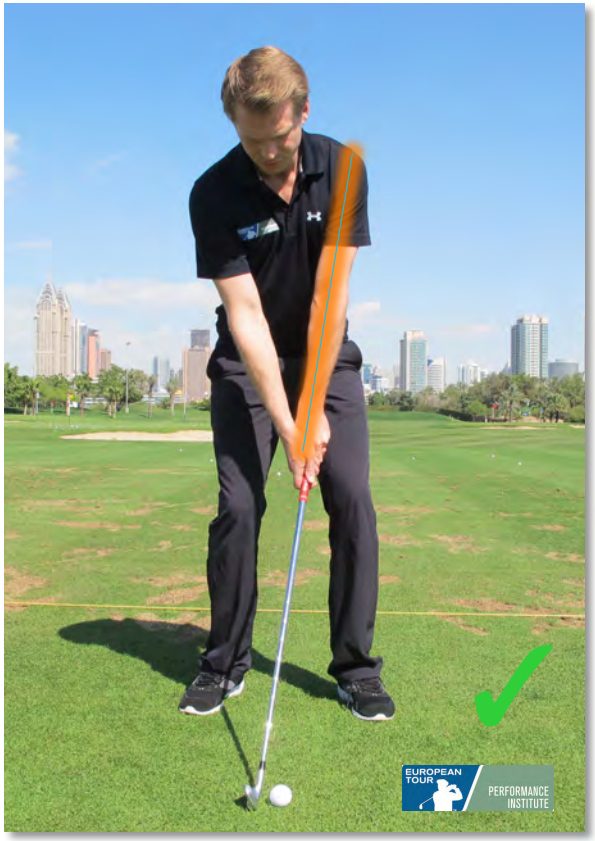
Common causes:

- Poor hip mobility
- Poor ankle mobility
- Poor core/pelvic/lumbar spine stability
- Poor shoulder strength/stability

Common injuries sites:

- Wrist
- Elbow





WAYS TO REDUCE INJURY POTENTIAL

SCREEN PLAYERS TO IDENTIFY AREAS OF POOR CONDITIONING AND FLEXIBILITY

DEVELOP AND ENCOURAGE PLAYERS TO WORK ON FLEXIBILITY AND STRENGTH AND CONDITIONING PROGRAMMES ON A REGULAR BASIS

AVOID EXCESSIVE OVERLOAD – STRUCTURE PRACTICE AND PLAY LEVELS

AVOID EXCESSIVE HARD GROUND / MATS PRACTICE

ENSURE EFFECTIVE AND APPROPRIATE WARM UP PREPERATION IS COMPLETED BEFORE ALL PRACTICE AND PLAY

CREATE GOOD WORKING RELATIONSHIPS AND REGULAR REVIEWS WITH MDT, COACHES AND PLAYERS AND CORRECT SWING FAULTS.

CONCLUSIONS

THE GOLF SWING IS A HIGHLY COORDINATED, MUTLI-SEGMENT, ROTATIONAL, ACTIVITY THAT REQUIRES STRENGTH, EXPLOSIVE POWER, FLEXIBILITY, SPEED & BALANCE.

INJURIES IN GOLFERS ARE COMMON PLACE

MECHANISMS OF INJURY AND LOCATION OF INJURIES CAN DIFFER BETWEEN PROFESSIONALS & AMATEURS

TYPES OF INJURIES VARY BETWEEN LEAD & NON-LEAD SIDES

MECHANISMS OF INJURY ARE VARIED & OFTEN MULTIFACTORAL

INJURIES IN PROFESSIONALS ARE MORE RELATED TO THE REPETITIVE NATURE AND HI LOAD OF TISSUES THROUGH PROLONGED PRACTICE AND PLAY.

INJURIES IN AMATEURS ARE OFTEN RELATED TO SWING FAULTS AND TECHNIQUE WITH A LACK OF CONDITIONING & LACK OF FLEXIBILITY KEY CONTRIBUTING FACTORS

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