Spine and lower extremity injuries in Golf

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Golf: practised by upto 10~20% of overall adult population (Canada, USA)
walking up to 8-10 km (600-1000 kcal / 70 kg)
moderate risk activity for sports injury

1. (Golf swing): 3 phase

: Each phase of swing zone- biomechanical stress to provoke injuries

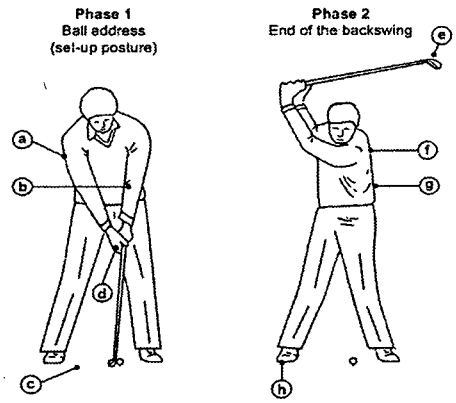
- excess tension
  twisting of tissue
  stress of physical impact of hitting ball

1) Take away phase

① set up (ball address)

② movement to top of back swing (End of back swing)

: lumbar - over tension, over rotation
shoulder (left) - compression of rotator cuff muscle & subacromial bursa (left) elbow, hand, wrist injury



2) Impact phase

① preimpact (forward swing & acceleration)

: strong muscular activity of abdominal muscle (trunk rotator) by external oblique muscle, aided by para spinal (erector spinal) muscle acting as spinal stabilizers and Rt shoulder adductor & internal rotator (schscapular, pectoralis major)

Most important lever in achieving maximum speed during golf swing

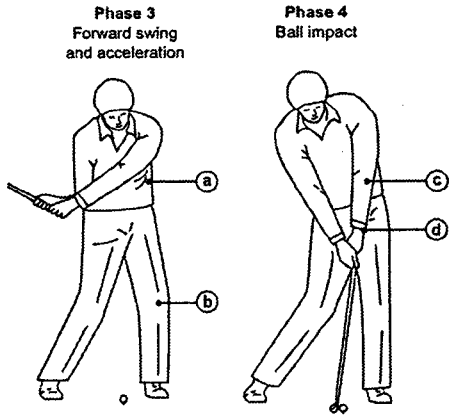
- trunk rotational capacity

(eg) less skilled person, older patient: 50% ↓

Risk for injury: abdominal muscle, dorsal muscle, pectoral muscle elbow, wrist, hand

compression force on Lt leg (esp. left hip injury)

② Impact: shoulder, elbow, wrist hand (left) injury



3) Follow through phase

: progressive deceleration of club head, rotation of body

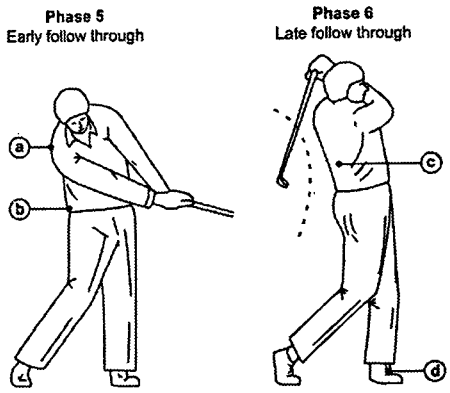
① post impact phase (early follow through)

: right shoulder, lumbar

② follow through motion (late follow through)

: deceleration stops too brusquely final range of motion of spinal rotation is too pronounced

→ lumbar dorsal zone injury, elbow (right), ankle (left)



2. Epidemiology of golf injury

: Amateur - higher prevalance injury in low handicap (1~9), aged 〉 50 year

Average: 62% (overall prevalence of injury)

: McCarrol 1990 Physician Sports Med

32% : Batt ME 1992, 1993

25.2% Theriault, 1996

Men : low back injury, Women: elbow injury

Injuried golfer

: trends for playing more games per week, taking fewer golf lesson, expressing a high index of tiredness after a day of golfing

3. Etiology

: 82.6% overuse injury - back, upper extremity

17.4% single trauma

· Excessive practice

· Poor swing mechanics

· Hitting the ground

· Swing to hard

· Poor warm up

· Physical fittness deficiencies

; aerobic, muscular strength, flexibility

4. Golf injury characteristics

: most - overuse, technical deficiency

1) Distribution by anatomical site

Gosheger G et al (2003 Am J sports Med)

injury site	percentage	
	prof(n=60)	Amateur(n=643)
Head	**10.9**	**5.9**
Spine	**34.5**	**24.7**
cervical	10.0	8.5
dorial	2.7	1.0
lumbar	21.8	15.2
Lower limb	**9.1**	**11.4**
hip	2.7	2.9
knee	5.5	3.2
ankle & foot	0.9	5.3
Upper limb	**42.7**	**56.4**
shoulder	12.7	18.6
elbow	10.0	24.9
wrist & Hand	20.0	12.9
Ribs	2.7	1.7

2) Gender difference (Amateur golfer)

McCarroll et al 1990.

site	Men (%) ave. handicap (14)	Women (%) ave. handicap (35)
lower back	36%	27.4%
elbow	32.5%	35.5%
hand&wrist	21.2%	14.5%
shoulder	11%	16.1%
knee	8.9%	11.3%

Back problem : take away 21%, follow through 29%
Elbow problem : impact phase 50%

3) distribution of injuries during a golf season

: amateur golfers: 〉50% of all injuries occured in midseason

→ affected upper limb

beginning of golf season: 〉 1/3 of total injury

A. Spine injuries

: most common muscle skeletal disorder in golf

McCarroll et al 1990. 34%

Theriault G 1998. 36.4% → lumbar spine is common injury site

Gosheger G 2003. 24.7%

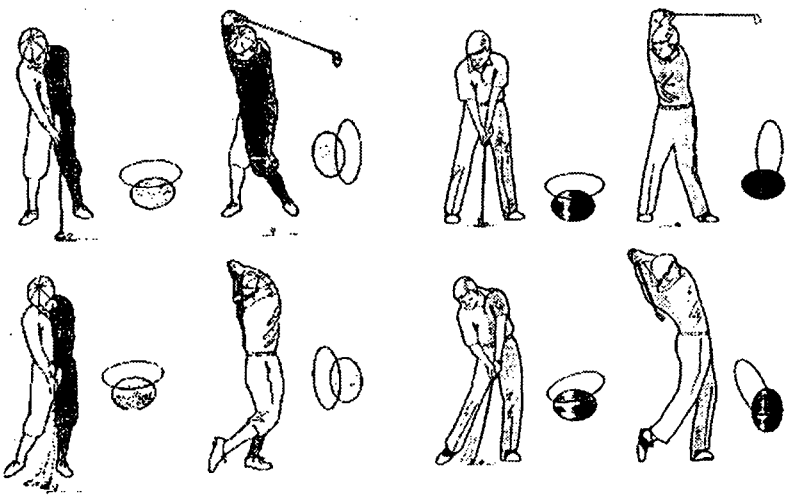
Repetitive and increased rotational & compression forces

→ affect bony structure, intervertebral disc, ligaments and muscles

Different form of classic & modern swing pattern

〈classic form〉 〈modern form〉

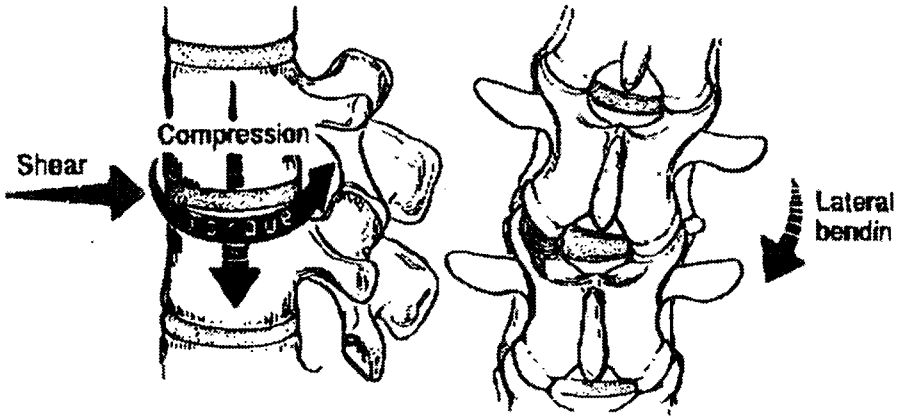
- spine injury: classic form 〈 modern form



1. Golf swing

: complex loading pattern (4 multidirectional force of dorsolumbar area)

- ① shear, ② lateral bending
  ③ compression, ④ axial torsional load (Hosea, 1996)



ㄱ. lateral bending force: lat-lat direction

ㄴ. shear force: anteroposterior traction

ㄷ. compression force: cranio-caudal direction compression load peak= eight times body mass

ㄹ. rotational(torsional) force: result of twisting the vertebral motion segment about long axis of the spine associated with development of lower back pain

ㄱ bone: compression load resistent, cancellous bone 50%, cortical bone 10%

ㅏ disc: viscoelasticity, hydraulic mechanism by squeezing water out under pressure with increasing load.

ㄴ facet: standing, upright position: resist up to 20%compression load
forward-flexed position: 50% compression load

· cyclic or continuous loading activity will negate hydraulic mechanism

=> spinal compart damage

(disc(key role), paraspinous muscles, facet joint, post arc, abdominal m)

(Trunk muscle action during golf swing)

1) Take away of club from address during back swing (Rt handed golf)
: left external oblique muscle

rectus abdominus
L3 paravertebral
- initiate twisting of trunk

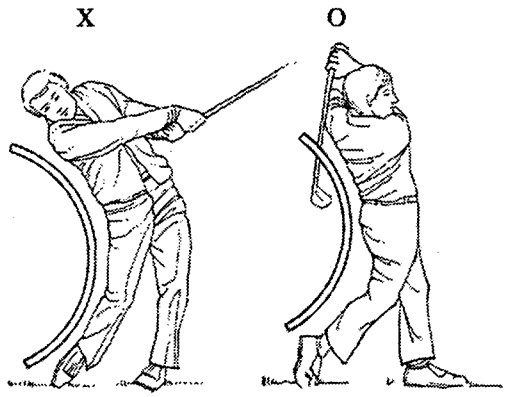
2) From top of backswing to impact
: muscle on right side of trunk lead to swing
- right external oblique muscle, paraspinal muscle fires maximally during this phase: peak muscle force

3) Follow through
Anterior muscles continue to fire during follow through while paraspinals are essentially inactive
: Rt side external oblique & rectus muscle of abdomen develop higher peak activity than left.
Paraspinals are nearly symmetrical

Magnitude of force on lumbar spine
→ sufficient enough to produce pathologic changes overtime
: Intervertebral disc, pars interarticularis, facet joints

2. Injury free golfer
: right & left paraspinal muscles fire simultaneously (spine stabilizing action)
multifidus, transverse abdominalis muscle group
; lumbar spine segmental stabilizer during golf swing- ligament structure support
Golfer with chronic lower back pain
: significant delay in lead onset time of external oblique muscle with respect to start of back swing

3. Injury pattern
: sprain, herniated lumbar disc, arthrosis, facet arthropathy with associated spinal stenosis, spondylolysis etc.
: exaggerate reverse C position



4. Diagnosis

: physical exam, X ray, CT Bone scan, MRI

5. Treatment

NSAID medication, PT, traction or manipulation and long term lower back rehabilitation (key muscles(abdominal muscle, paraspinal m) strengthening, technical skill, maximal range of motion of pelvic and dorsolumbar zone) dorsolumbar corset

6. Injuries prevention

1) Preventive technique

① straighter back posture during the golf swing and weight transfer

② speed control during trunk rotation

③ reduction of the shoulder range of motion and trunk angular motion

④ lumbar conditioning through flexibility & muscular strengthening exercise

⑤ use of a dorsolumbar corset if needed

2) 10 minute warm up (Hosea TM 1996, Clin Sports Med)

① stretching (2 minutes): 5 stretch (20 seconds, each)

neck rotation

shoulder stretch

trunk side bends

trunk rotation
toe touchs

② Driving range practice (3 minutes)
: sand wedge, 5 iron, driver - 1 minute with each club
i) half swing - sand wedge
ii) 3/4 swing - 5 iron
iii) full swing - driver

③ Putting (4 minutes)
: 2 minutes - putting back & forth across green
2 minutes practice: 3 foot putts

④ Waiting to tee off (1 minute)
: 30 seconds - making practice swing with club you plan to use on 1st tee
30 seconds - relaxing, visualizing your drive

B. lower extremity injuries

lower extremity - foundation around which swing takes place

(Incidence)

11.4% (Gosheger G et al. Am J Sports Med. 2003)
6.3% (서경묵 등. 대한스포츠학회지. 2003)

1. Golf injury of hip

Incidence : 2.8% (U.S.A)

① Trochanteric bursitis: common
· especially female golfer
· caused by rotation of hip during practice or by overuse
· (Tx)
rest, ice. NSAID medication,
PT (cross-friction massage, ultrasound, stretching of tight tensor fascia lata or iliotibial tract)

② Osteoarthritic change
· motion limitation (abduction, internal rotation), pain
· joint space narrowing, osteophyte
· (Tx): physical therapy . NSAID medication. THR

(Total hip replacement)

① suggest use of cart while playing
- restriction only for 1st year following THR

92% - no discomfort while playing golf

② Cement less hip prosthesis (thigh pain while playing)
: decrease golfing activity for 6~8 months

③ Most patients returned to golf: 3~4months after THR

④ No higher complication or revision rate

2. Golf injury of knee

(Incidence) 3.2~9.3% (U.S.A.)

① Medical meniscus tear (50%), osteoarthritis (33%), lateral meniscus tear, loose body, chondromalacia patellae etc. (Guten, 1996 Clin. Sports Med.)

② Medical meniscus tear
- caused by incorrect swing / miss-hit, uneven ground
- trail knee is increased risk of acute injury
- more commonly in amateur golfer
- (Tx): meniscal repair, partial menisectomy

③ Osteoarthritis
- (Dx): 45° flexion standing view (Rosenberg view), bone scan
- (Tx): rest, medication, PT, steroid injection, brace
  Hemiarthroplasty, Total knee replacement

(Total knee replacement)

① Suggest use of cart during play

90% - no discomfort while playing golf

② should not start playing golf for 3 months after TKR

③ not noted a (+) or (-) correlation to problems or revision rates relative to active golf play: Mallon WJ et al (Clin.Sports Med. 1996)

What makes the knee feel better have less pain
- Frequency: rest, and reduce the frequency and intensity
- Use short irons: 7-, 8-, 9 iron and wedge

· Lessons golf swing
· Swing: equal distribution of weight on both knee, less knee flexion
· Clubs: longer, lighter, more flexible clubs, graphite shaft - reduce force 30%
· Shoes: spikeless golf shoes or old golf shoes with worn down spikes but wet, early morning games, spike shoe should be used to prevent slipping
· Exercise: increase flexibility, endurance,s peed, strength

3. Golf injury of foot and ankle

· acute injuries: rare
· 2 - 5.3% (U.S.A.) 2.1%(Korea)

1) Foot problems in Golf

① Morton's Neuroma: entrapment of common digital N third metatar -sal interspace (most common)
· pain, paresthesia, numbness of adjacent toes
(Tx): avoid compression of forefoot, metatarsal padding injection (lidocain + steroid), resection

② Plantar fascitis: heel pain (mc) pain in the morning and after sitting for long periods
(Tx): rest, icing, NSAID medication, plantar fascia and achilles tendon stretching, strapping of the arch of the foot, biomecha -nical support, surgery (plantar fascia release)

③ Achilles tendinitis: not uncommon in middle aged or elderly golfer
(Tx): rest, NSAID medication, heel lift stretching exercises

④ Hallux valgus: hereditary factors. inadequate shoe gear (high heels, narrow box) pronation of the feet etc.

⑤ Hallux rigidus: degenerative arthritis of the metatarsophalangeal joint of great toe.

⑥ Blister : improperly fitting shoes.
Contact dermatitis: allergic reaction of shoe
Tinea Pedis: Moisture shoes pruritis, weeping, oozing, erythema, skin maceration

Lesser toe deformity: hammer toes, mallet toes, claw toes, narrow, restrictive toe box shoes, congenitally long second metatarsal bone,

2) Ligament injury of Ankle
- inversion injury due to walking and swing on uneven lies, or excessive rolling of the ankle in follow-through of the swing.
- chiefly lateral ligament involved
- diagnosis: stress view talar tilt 9° twice the uninjured side

(TX): ice compression, elevation, immobilization, brace, repair operation.

3) Golf shoes
- Proper fit criteria
  - ㄱ. fit: fit measured for width and length of both foot
  - ㄴ. length: allow 1/4 to 1/2 in of length between the end of the longest the and of the shoe
  - ㄷ. stability: lat. stability - important, firm heel counter midtop design (chronic instability)
  - ㄹ. cushioning: shock absorb, ethylene vinly acetate (EVA) midsoles
  - ㅁ. uppers: water resistant and breathable, Gore-Tex

C. Prevention of golf injury

① muscular strengthening, flexibility and aerobic exercise components
② short, practical, pre-game warm-up routine (10~15 min)
③ adjustment of an individual golf swing to meet their physical capacities and limitations through properly supervised golf lessons
④ correct selection of golf equipment and awareness of the environmental condition
⑤ etiquette of golf

D. Preventive exercise in golf

Exercise program: prevent injury and improve the individual game of golf

Component of exercise program

: warming up, streching, strengthening improving muscular endurance and cardiovascular conditionings

① Warming up

- increase the heart rate, metabolic rate and the temperature of tissue
- entails about 5 minute of a few gentle stretches and a few jumping jacks or runing in the place
- starting slowly and gently and building up the intensity
- warming up is done before the game, but if a wait of 15 or 20 minute between the warm-up and the first swing, additional few stretches and cardiovascular activity are necessory

② Stretching

- regular exercise program for athletes of all ages
- done slowly and gently, each stretch for 20 to 30 seconds
- spine streching
- extreme degree of trunk rotation necessory in the swing lumbar spine, erector spinae, abdominal muscle -important in trunk rotation

i) Cervical area motion
ii) Lateral trunk stretch
iii) Trunk rotation,
iv) Trunk flexion/extension
v) Hip flexor and extensor
vi) Hamstring stretch

③ Strengthening and muscular endurance :

ㄱ. Three sets of 10 repetition: somoothly, slowly,
ㄴ. Muscular endurance training: isokinetically or isotonically. after multiple days of consecutive play
ㄷ. Isometic contraction of neck & lower back
ㄹ. Abdominal crunches: rectus abdominus, internal/external abdominal obligues supply part of trunk-support system
ㅁ. Gluteal muscle: initiate movement on the ball and contribute power to the swing

④ Cardiovascular conditioning

ㄱ. consist of at the best 20 minutes three times a week of consistent

exercise that elevates the heart rate

ㄴ. 220 - age = maximum HR

80% of maxmum exercise: proper

Reference

1) Gosheger G, Liem D, Ludwig K, Greshake O and Winkelmann W: Injuries and overuse syndromes in golf. Am J Sports Med, 31(3): 438-43, 2003.
2) Grimshaw P, Giles A, Tong R and Grimmer K: Lower back and elbow injuries in golf. Sports Med, 32(10): 655-66, 2002.
3) Hame SL, Kohler-Ekstrand C, Ghiselli G: Acute bucket-handle tear of the medial meniscus in a golfer. Arthroscopy, Jul;17(6):E25, 2001.
4) Hosea TM, Gatt CJ: Back pain in golf. Clin Sports Med, 15: 37-53, 1996
5) Lindsay D and Horton J: Comparison of spine motion in elite golfers with and without low back pain. J Sports Sci, 20(8): 599-605, 2002.
6) Mallon WJ, Liebelt RA, Mason JB: Total joint replacement and golf. Clin Sports Med 15: 179-190, 1996.
7) McCarroll JR and Gioe TJ: Professional golfers and the price they pay. Physician Sports Med 10: 54-70, 1982.
8) McCarroll JR, Retting AC and Shelbourne KD: Injuries in the amateur golfer. Physician Sports Med 18: 122-6, 1990.
9) Pietrocarlo TA: Foot and ankle considerations in golf. Clin Sports Med. 15(1): 129-46, 1996.
10) Pink MM, Jobe FW, Yocum LA and Mottram R: Preventative exercises in golf: arm, leg, and back. Clin Sports Med, 15(1): 147-62, 1996.
11) Seo KM and Kim DK: Golf-related pain and its anatomical distribution in amateur golfers. The Korean Journal of Sports Medicine, 21(1): 27-34, 2003.
12) Theriault G and Lachance P: Golf injuries. An overview. Sports Med, 26(1): 43-57, 1998.
13) Theriault G, Lacoste E, Gadoury M, Ouellet S, Leblanc C: Golf injury characteristics: A survey from 528 golfers. Med Sci Sports Exerc, 28(5): 56, 1996.
14) Wallace P and Reilly T: Spinal and metabolic loading during simulations of golf play. J Sports Sci, 11(6): 511-5, 1993.