

CLINICAL BIOMECHANICS:

Golf Kinetics & Common Injuries

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Phases of the Golf Swing

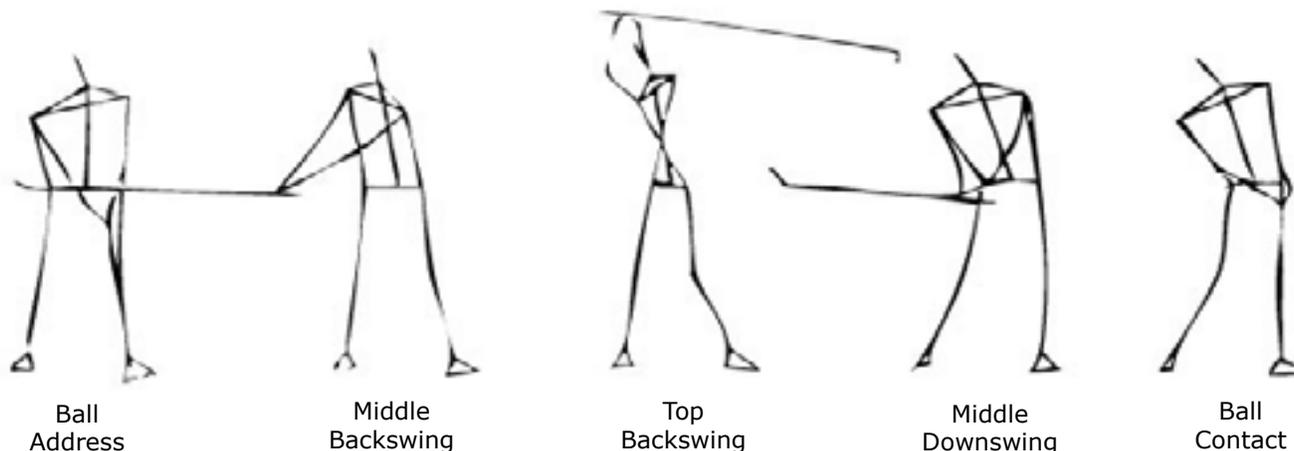


Figure 1

INTRODUCTION

Golf is a sport that involves two activities: walking and swinging (and sometimes swimming). The footwear requirements for each of these two activities may not be entirely consistent. This section will describe the foot biomechanics associated with the golf swing, how the ground reaction forces change throughout the golf swing and some of the common foot problems associated with golf.

The golf swing can be broken down into 3 phases (Figure 1):

- I. Ball address to Top Backswing
- II. Top Backswing to Ball Contact
- III. Ball Contact and Follow-through

For the right-handed golfer, the left foot is the *lead foot* while the right foot is the *trail foot*. During Phase I, the lead foot is gradually unloaded during the backswing and force is transferred to the trail foot. This involves a lateral to medial force shift in the lead foot and an increase in lateral forces in the trail foot. In the anteroposterior (A-P) direction, forces shift from anterior to posterior in the lead foot and the opposite occurs in the trail foot.

During Phase II, there is a rapid shift of force to the lead foot with that force primarily distributed laterally. The trail foot is gradually unloaded and there is a medial force shift placing stress on the hallux and 1st MTPJ. Finally,

during the follow-through, the laterally distributed force exerted on the lead foot decreases but remains above that of quiet stance. The trail foot is unloaded with increased stress to the hallux and 1st MTPJ (Williams et al., 1983).

FOOT & ANKLE GOLF INJURIES

There are several foot and ankle problems associated with playing golf. The design of the golf shoe and any orthotic intervention should ensure comfort and slip resistance. From the description of the kinetics of the golf swing, it becomes apparent that there are asymmetrical demands placed on the lower extremity and lateral stability is an important feature. The lead foot undergoes a rapid inversion from the top of the backswing through to the follow-through. The trail foot performs a rocking movement that involves inversion during the backswing followed by rapid eversion and increased forces on the anteromedial aspect of the hallux. The footwear requirements for the golf swing may be contradictory for the walking component of playing golf.

For example, researchers have suggested that valgus posting of both golf shoes may help to enhance golf swing performance. However, when the golfer transitions to walking, this could cause problems. In addition, there are concerns whether the footwear should *block* or *facilitate* the lateral movement patterns characteristic of the golf swing. The solution to these questions can only be potentially answered by

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addressing shoe/orthotic design on a case-by-case basis. For example, a golfer may present to your clinic with lateral ankle instability in the lead foot when swinging. In this case, the patient may require a shoe and/or orthotic modification that involves adding valgus support to the footgear. Conversely, a patient might present with limited ankle inversion and would benefit from a rocker to *facilitate* inversion.

Nevertheless, there are a number of common foot and ankle ailments that are characteristic in the Golfer (Pietrocarlo, 1996):

Blisters are often caused by ill-fitting shoes or by shoes that are not fully broken in. A skilled shoe retailer can help to fit shoes that are appropriate for the patient's foot shape and biomechanics. Areas of the foot that are susceptible to pressure may also blister including bunions and hammer toes. If left untreated, blisters can become acutely inflamed, painful and potentially infected.

For those who are blister-prone, the selection of a properly fitting golf shoe is essential. Golf shoes that are properly fit, comfortable and that limit friction are recommended. A properly designed orthosis with a top cover that has a lesser coefficient of friction, i.e. micro-suede or X-Static™ can also help. Polypropylene socks can also be useful and help to wick away moisture. If there are areas of concern, moleskin application can be used as a preventative measure.

Tinea Pedis and **Contact Dermatitis** are two other dermatologic problems that can occur. Tinea Pedis infections or athlete's foot often occur in feet that are moist (Figure 2). The infection is often exacerbated by shoes that do not breathe properly or when the feet are exposed to repetitive moisture. Typically, it is the digital interspace that is affected and chronic cases may also spread to the plantar aspect of the foot. Symptoms can include itching, weeping, oozing, redness (erythema), scaling and skin maceration. This condition is often prevented with daily antifungal powders, absorptive socks, and/or shoes with breathable uppers (the X-Golf OS is perfect!).



Figure 2

Contact dermatitis is often the result of an allergic reaction to the components of the golf shoe. Dichromates used in tanning leather shoes, formaldehyde, dyes and artificial leather have all been identified as potential irritants. Dermatitis often presents redness and itching on the dorsum of the foot and toes (Figure 3). Management includes eliminating any potential irritants and controlling perspiration with topical drying agents.



Figure 3

Lesser toe deformities such as hammer, mallet and claw toes can often cause problems for golfers. The deformity will often lead to increased shoe pressure and irritation in the form of blisters, corns and calluses. Insufficient toe box volume is often the culprit and can be remedied with either selecting a more appropriate shoe or accommodating with a ball-and-ring stretcher. Etiological factors can also include excessive pronation and/or a cavus foot type. Prevention revolves around the proper shoe fitting and addressing biomechanical issues in a custom foot orthosis. Areas that are susceptible to irritation can be dressed with moleskin, aperture pads and/or crest pads.

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Morton's neuroma is an entrapment of the common digital nerve at the point of bifurcation into the proper digital nerve (Figure 4). The most common site of involvement is the third metatarsal interspace and, to a lesser extent, the second interdigital space. The nerve becomes trapped between the adjacent metatarsal heads and transverse metatarsal ligament leading to chronic irritation and perineural fibrosis. The symptoms often involve pain, burning, paresthesia and numbness in the adjacent toes.

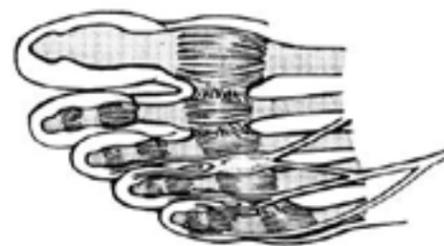


Figure 4

Removing the shoe and/or massaging the foot often resolve symptoms. Prevention often starts with ensuring that there is ample toe box volume in the golf shoe. Foot orthoses are often prescribed as part of a treatment program.

Hallux rigidus/limitus can present problems for the golfer during the walking and swing phases of the game. As a result of the joint changes associated with these disorders, the golfer typically experiences symptoms of pain, swelling and joint stiffness that interfere with the normal toe-off and rolling necessary for the golf swing. Increasing the stiffness of the golf shoe by adding a spring plate intervention can decrease stress to the 1st MTPJ. In addition, adding a rocker sole to the shoe will help to facilitate motion in the sagittal plane. A Morton's extension can also be added to the foot orthosis.

Hallux valgus is a complex deformity characterized by a medial deviation in the 1st metatarsal, lateral deviation of the 1st phalanx and a valgus rotation of the hallux. Although its etiology remains controversial, it can be a source of discomfort for the golfer both through shoe irritation and a disruption of the 1st MTPJ function. Footwear solutions include ensuring sufficient toe box volume, accommodating for any exostoses with a ball-and-ring stretcher and/or addressing abnormal biomechanics with prescription foot orthoses.

Achilles tendinopathy and **Haglund's deformity** are two rearfoot injuries that can develop in the golfer. Achilles tendinopathy is common in the middle and older aged golfer and typically develops secondary to: 1) walking on uneven terrain, 2) inflexibility in the gastrocnemius/soleus stretching, custom foot orthoses to address biomechanical issues, the Strassburg Sock and eccentric heel drops.

Similarly, Haglund's deformity affects the posterosuperior aspect of the calcaneus and is a prominence caused by friction or pressure between the posterior heel and heel counter of the golf shoe. As mentioned previously, there is a great deal of mediolateral shear during the golf swing and this tends to complicate matters. Conservative management includes: 1) ensuring proper shoe fit, 2) ensuring that any custom foot orthotic intervention fits properly in the housing shoe, and 3) accommodating or adding material to minimize shear.

Lateral Ankle Instability is one of the most common problems in golfers and particularly in the lead ankle during follow-through. Walking or swinging on uneven terrain can compromise the position of either ankle. Conservative management can involve:

- Adding a valgus wedge to the midsole of the golf shoe,
- A lateral flange or arch fill to a custom foot orthoses and/or
- Wearing an ankle brace (ie: STS ankle brace) in conjunction with a custom foot orthosis.

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