Golf Injuries and their Relationship to Swing Biomechanics

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Abstract:

Objective: The purpose of this literature review is to compare and contrast the literature regarding golf injuries, especially those of the spine. This review will identify the causes of injuries in golf, analyze the phases of the golf swing, and talk about prevention and chiropractic relevance.

Data Collection: The resources utilized include indexed/referenced journal articles, and Internet websites. Pubmed, Chiroindex, and Mantis were databases used to find journal articles related to the topic.

Results: The keyword search for golf injuries turned up hundreds of articles regarding the topic. A number of different causes were related to golf injuries.

Conclusion: The research seems to agree that the majority of injuries that affect the golfers are located in the lower back. The main causes of the injuries were the result of overuse.

Key Words: Golf, injuries, overuse, biomechanics chiropractic and golf.

Introduction:

Golf, a game originated in Scotland during the 15th century, has seen a major increase in popularity recently.[1] The popularity can be directly linked to the emergence of Tiger Woods onto the professional scene. Because of this, more and more people have taken up the game on a leisurely basis. There are more than 26 million golfers in the United States.[8] That includes 6 million who play 25 or more rounds per year.[8] The average golfer is older than participants in most other sports.[3] Twenty-five percent of golfers in the United States are age 65 or older.[8] Because of this; there is a wide variety of different players with different physical conditions.[3] This paves the way for a wide variety of different musculoskeletal problems and biomechanical differences.

Golf has a number of musculoskeletal injuries related to playing the game. The most common injuries reported were of the back, elbow and shoulder. This has major implications for the doctor of chiropractic. This is because chiropractor's main focus is musculoskeletal problems, especially of the spine. A study of 1144 golfers in Indianapolis, by McCarrol et al., reports that amateur golfers were prevented from playing golf for an average of

5.2 weeks per year because of chronic injuries sustained while golfing.[9] Chiropractors can work with these people to get them back on the course faster. In fact, Joey Sindelar, golf professional, credits chiropractic care with helping him keep in shape to compete.[13]

Discussion:

Low back pain:

The most common musculoskeletal complaint by both amateur and professional golfers is low back pain.[4] Surveys have shown that 63% of injuries sustained by professional golfers were to the low back area as compared to 36% of amateur golfers.[6] Amateur golfer's low back pain is most likely attributed to poor swing biomechanics, and poor physical conditioning.[6] Professional golfers have more consistent swing biomechanics, thus their injuries tend to be more of the overuse and repetitive type.[6] Because of the twisting motion of the lumbar spine during the back swing, and hyperextension through the back swing, the modern swing is the suspected source of this injury.[4]

A paper by Germain Theriault and Pierre Lachance listed the main causes of golf injuries. From highest to lowest, the causes are (1) overuse, (2) technical errors during the swing, (3) physical fitness deficiencies, (4) no

pre-game warm-up, (5) carelessness toward other players or lack of etiquette, (6) natural environmental conditions.[9]

Table I. Main causes of golf injuries[(9)]

-Overuse -Technical errors during the swing -Physical fitness deficiencies aerobic muscular strength flexibility -No pre-game warm-up -Carelessness toward other players -Natural environmental conditions

The Golf Swing:

The biomechanics of a golf swing inherently imposes axial torques to the spine.[2] The biomechanics of a golf swing are composed of three phases: the take-away, the impact, and the follow through. [7] During the take-away, the golfer moves the club to the top of the back swing by rotating his shoulders, his, knees, lumbar and cervical spine while the head remains fixed throughout the golf swing. [7] There are two phases to the impact portion of the swing: pre-impact and impact. At pre-impact, the player begins contact with the ball. During pre-impact, the player's right wrist is in maximum extension, the left

thumb is in hyper-abduction, the left hip is rotated, and the knee is in a position of valgus stress.[7] At impact, the player strikes the ball. During impact, the left wrist ulnar deviates, while the right wrist undergoes compression, the right knee is under valgus stress and the left hip is rotated.[7] The last phase is the follow-through. During follow through, the left elbow supinates, the right elbow pronates, the hip internally rotates, the knees rotate to the left, the ankle inverts, the left shoulder hyper-abducts, and the cervical and lumbar spine rotate and hyperextend. [7]

During the golf swing, about 0.2 seconds, the speed of the club head can reach 160 kilometers per hour.[9] A golfer hits the ball an average of 50 times during an 18-hole round. A professional can hit an average of 300 balls during a practice session.[9] With these statistics in mind, it is easy to see why injuries can occur through overuse.

Injuries Related to Hip Rotation:

Several doctors conducted a study to try to correlate decreased lead hip rotation and lumbar spine range of motion with a prior history of low back pain in

professional golfers. The authors of the study hypothesized that the lead hip in golfers acts as the primary pivot point while experiencing a significant amount of torque. Thus, the lead hip may be experiencing repetitive forces. These forces are similar to those experienced by the dominant shoulder in baseball pitchers. It was further hypothesized that these forces result in capsular contractures and range of motion deficits. These range of motion deficits results in increased load on the lumbar spine, and thus the cause of low back pain. In this study, 42 male golfers were categorized as group 1 and group 2. Group 1 had a history of low back pain greater than 2 weeks affecting quality of lay within the past year. Group 2 had no such previous history. All the golfers underwent measurements of hip and lumbar range of motion and FABRE's distance. The results were analyzed using the Wilcoxon signed rank test. Results showed that a statistically significant correlation was observed between a history of low back pain and decreased lead hip rotation, FABRE's distance and lumbar extension.[4]

Relation of the golf swing and the foot:

Dr. John T. Kinnard, DC and Jeffery Kinnard, DC believe that that lateral aspect of the foot is the focal

point of stress in the golf swing.[5] This stress causes contraction of the foot unleveling muscles.[5] Repeated swings can cause the kinetic chain up to the knee, pelvis and then the back to become in a state of dysfunction.[5] This dysfunction can lead to back pain in golfers.

Abdominal Muscle Activity Patterns during the golf swing:

A study was done to determine whether elite male golfers with chronic low back pain exhibit different abdominal muscle activity patterns during the golf swing than an asymptomatic control. The study was also looking to determine whether elite male golfers with chronic low back pain experience greater fatigue in the abdominal muscles than the asymptomatic control group after a typical practice session. The conclusion of the paper was that "abdominal muscle activity and muscle fatigue characteristics were quite similar between the asymptomatic control and the chronic low back pain subjects after repetitive golf swings. Despite this, it was clear that repetitive golf swings were aggravating some part of the musculoskeletal system in the chronic low back pain patients, which resulted in increased pain in the low back area."[6]

Facet Syndrome and the Golf Swing:

A topic that is well known to chiropractors is Facet Syndrome. This is another injury acquired by golfers and Susan T. Mackey, D.C, has discussed it in a paper. She conveys that players who present with an acute facet syndrome will describe a "click" or a "snap" sound after a traumatic incident.[7] The pain is usually well localize over one area. Facet injury can refer pain to the buttocks, hip, groin, and posterior thigh as far as the knee.[7] Pain is exacerbated by extension and relieved by rest and lying prone with knees bent.[7] Facet syndrome is acquired by repetitive swings and incorrect form.[7] With this, the lumbar facets sustain the majority of abnormal forces that are being placed on the lumbar spine.[7] Dr. Mackey sites Woods by saying "a rotational force coupled with a bending motion when the ligaments are at an appropriate degree of stretch to allow play, with the muscles surrounding the area weakened or caught off guard, could result in a subluxation and irritation of the synovial lining of the facet joints".[7] She goes further with this when she sites Kirkaldy-Willis as saying "The posterior segmental musculature protects the injured facet joint by reflex hyper-tonic musculature contraction. The

production of pain is caused by sustained contraction, because it results in ischemia. As a result of the ischemia of the muscles, metabolites are produced that aggravate the condition, as well as help maintain the muscles in their contracted state. Because of the muscles maintaining a contracted state, the subluxation of the posterior facet joint is maintained, thus leading to dysfunction."[7] The author concluded the article by saying "low back injuries are more common in athletes than in non-athletes; this is especially true for injuries of the neural arch."[7]

Golf Rehabilitation:

In 1993, John R Parzale, MD., developed a study in multi-disciplinary golf rehabilitation. This study included (1) the evaluation of patient history and physical examination by a physiatrist; (2) a physical therapist evaluation, including the manual muscle test and goniometry measurements of the spine, shoulders, elbows, hips, and knees;, and (3) a class A professional Golf Association golf professional swing analysis.[8] A total of 145 individuals were involved in the study; 109 male amateurs with a mean age of 55.3 years (range 11-80), 7 male professional golfers with a mean age of 37.1 years (range

24-55), and 29 female amateur golfers with a mean age of 55.9 years (range 23-75).[8] Results of the study showed that 65 of the 145 injuries seen were injuries of the lower back. Just as a comparison, the next incidence of injury was to the shoulder. 20 of the 145 injuries were of the shoulder.

Table II. Patients treated in Healthy Swing Program[8]

Diagnosis	Male	Female	Total
Low Back Pain	57 (53a, 4p)	8	65
Shoulder	12 (10a, 2p)	8	20
Elbow	11	4	15
Neck Pain	10	4	14
Knee	10 (9a, 1p)	2	12
Cerebrovascular accident	10	1	11
Cancer	3	1	4
Amputation	1	0	1
Thoracic fracture	0	1	1
Miscellaneous	2	0	2
Total	116	29	145

Effects of a short back swing:

An article by Ronald Bulbulian, PhD, Kevin A. Ball,PhD, and David Seaman, DC studied the effects of a short back swing on performance and spinal health. They claim that full recoil golf swings have been linked to back pain and injury in golfers.[10] Their study objective was to examine golf swing performance and muscle actions of the trunk and shoulder during a full recoil swing as compared with a modified short swing.[2] Electromyography recordings were taken of muscles including, lumbar, external oblique, latisimus dorsi, and right pectoral muscles.[2] These readings were taken on 7 golfers during a full swing and a modified short swing. To measure back swing angle, a high-speed videotape was used. Club-head velocity was quantified by using a swing speed indicator. Ball contact accuracy was quantified by using a clubface contact tape.[10] Results were favorable. The results showed that shortening of the back swing from 46.5 degrees +/- 24.7 degrees had no effect on stroke accuracy.[2] Club-head velocity was not significantly reduced.[2] EMG root-mean square in the right oblique muscle action was decreased by 19%, and left lumbar muscle action was decreased by 12%. Although right latisimus dorsi muscle was increased by 21%.[2] All of these results were a significant in change.[2] The study conclusions were that

short back swings in golf may reduce trunk muscle activation and possibly reduce back injury and pain without negatively impacting swing accuracy or club-head velocity. But, the short back swing increases shoulder muscle activation and may, in turn, promote risk for shoulder injury.[2] Shoulder injuries in golf are related to the biomechanics of the golf swing and typically occur in the lead arm at the top of the back swing.[10]

Prevention of Golf Injuries:

To a chiropractor, prevention is a very important aspect of health. David Seaman, DC, MS, DACBN, FACC wrote an article entitled "Golf and Chiropractic: A Natural Combination". In this article, he cites three main reasons to urge chiropractic patients to adopt a short back swing that reduces spinal rotation. These are, (1) A short back swing with less spinal rotation gives a golfer more control of the golf club and club head throughout the swing, which translates into better control of the golf ball.[11] (2) Research has demonstrated that short backswings achieved the same club head speed at the ball impact as long backswings.[11] (3) A short back swing will help to minimize torsional stress in the lumbar spine.[11]

Case Report of Back Pain:

A case report done by Paul Grimshaw studied the reduction of low back pain in a professional golfer. The study consisted of a 3-month period of muscle conditioning on trunk and paraspinal muscles of a golfer with low back pain.[12] EMG of the erector spinae were recorded at the start and the end of the 3-month period. The training resulted in an increase in the range of hip turn, and a decrease in the amount of shoulder turn. Also, a reduction in the amount of trunk flexion and lateral flexion during the downswing occurred. This combined changes results in reduction of torsional and compressive loads acting on the thoracic and lumbar spine.[12] The authors conclude by saying that these changes may have contributed to the cessation of the low back pain and would reduce the reoccurrence in the future.[12]

Chiropractic Advice:

With all the talk about back pain, I would be remiss if I didn't talk a little more about chiropractic advice about golf. In an article entitled "Golf and Chiropractic", there is advice recommended by Dr. La Fountain. His biggest piece of advice is to stand off to the side, reverse your grip, and take 30 swings from the opposite side.[14] He goes on to say, "This will restore some

balance to the muscles that were stressed from repeated unilateral rotation during the round".[14] If golfers follow this advice, they may be able to play longer, play safer, feel better, and maybe even play better. As a chiropractor, helping a patient play better golf will result in high compliance and many referrals.

In an article entitled, "Chiropractic Recommendations for Golfers", Dr. Seaman gives his advice for golfers. He recommends a stance that is no wider than shoulder width apart to minimize stress.[15] One of his major recommendations is to strengthen the gluteal muscles and stretch shortened hip flexors and quadriceps.[15]

Conclusion:

Golf is a game that has been around for a long time. Today, both young and old participants are taking up the game more than ever. With the increasing number of participants in the sport, there are an increasing number of injuries related to the sport. This is because the golf swing causes stress to the body, especially to the spine.

The research seems to agree that the majority of injuries that affect the golfers are located in the lower back. These injuries are related to improper swing

mechanics and the repetitive nature of the golf swing. This repetition leads to overuse injuries. Although there are other causes of injuries such as, physical fitness deficiencies and inadequate pre-game warm-up, research has shown that overuse injuries are the leading cause of injuries in golfers.

Prevention of injuries can be done in several ways. It can be done by improving physical fitness, proper warm-up, shortening the back swing, and taking swings from the opposite side after the round.

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