HOW OSTEOPATHY CAN BENEFIT A GOLF SWING

A BIOMECHANICAL ANALYSIS OF THE GOLF SWING AND HOW IT CAN BE CHANGED FOR THE BETTER WITH MANUAL OSTEOPATHIC THERAPY

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Figure 1:

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Role of Biomechanics in Golf:

Golf is an extremely complex sport that is recognized and enjoyed worldwide. The aim is essentially to hit the ball into the hole with as few strokes as possible. To achieve this, the player must hit the ball with great precision, accuracy, strength, and consistency. Few movements in any sport require the technical precision and power that golfers display (Davies & DiSaia, 2019, p. ix). "The constant yearning for increased power and greater accuracy leads players to try numerous technical drills and form alterations, constantly striving to find that ever-elusive consistent swing" (Sokoloff, 2016, para. 1). While many people adjust technical aspects to their swing, it is imperative that golfers learn about the biomechanics involved as well. Osteopathic manual therapy is a great tool that incorporates biomechanically based treatment to help golfers achieve their end goals.

The golf swing is arguably the most biomechanically important aspect to the game. Golfers are constantly making changes to their swing, seeking increased power, greater accuracy, and consistent shots. There are times, however, that a swing/grip/stance change will not make a difference regarding performance. One of the main roles of the manual osteopathic practitioner, as well as the athlete, is to step back and assess whether the swing changes are really getting to the root of the problem or if we are trying to make our body move in a way that it is not capable of. "The body intuitively chooses the path of least resistance; if somewhere along the backswing or downswing, there is an impediment to this motion, problems can arise" (Sokoloff, 2016, para. 1-2). Impediments in motion can affect power produced by the body, face of the club, and the path that the club takes to get to the ball.

Many injuries occur during the swing (most frequently soft tissue). Because the swing is a dynamic movement, there is great potential to cause injuries to golfers, specifically if done incorrectly. As the golf swing is such a complex process, it can be broken down into five different phases. It is important for a practitioner to understand the mechanics of the golf swing. A proper understanding will facilitate appropriate knowledge of the etiology of the injury, thereby improving management (McHardy & Pollard, 2005, para. 3).

Understanding the Swing Components:

The golf swing requires coordination of all the body's joints and muscles along with timing and balance. Even small adjustments to movement are amplified, resulting in large changes in golf-head trajectory (due to the length of the club). Therefore, small disturbances in a movement pattern can have large disturbances in performance (Osteopathy for Golfers, para. 1). To simplify the dynamics of the golf swing, it is divided into 5 components: the backswing, the downswing, the acceleration phase, the early follow-through, and the late follow-through. Understanding the movement occurring in each phase is highly important; if one area of the body is not functioning optimally it can affect overall performance and highly increase risk of injury. We will be looking at the breakdown of the swing of a right-handed golfer.

Backswing:

The backswing is the first phase of the swing, and involves the club being brought away from the direction of the intended ball flight. The biomechanical movement is rotation of the shoulder girdle to the right, resulting in right arm abduction, flexion, and external rotation. Correspondingly, the left arm moves into adduction, flexion, and internal rotation, taking the club to the desired direction (McHardy & Pollard, 2005, para. 4).

To achieve a proper backswing, the right scapula pulls into retraction while the left protracts – this allows movement around the trunk in a clockwise direction. The predominately active muscles in this phase are the upper and middle trapezius on the right, and the subscapularis and the serratus anterior on the left (McHardy & Pollard, 2005, para. 4). "At the top of the backswing, the wrists are in radial deviation, with the right wrist also displaying submaximal extension" (McHardy & Pollard, 2005, para. 5).

In the backswing, the lumbopelvic region aids in rotating the body to the right. This movement results from hamstring group activation as the body weight transfers to the right side. The left oblique also aids rotation in the back swing (M & P, 2005, para. 21). The most active lower extremity muscles are the semimembranosus and long head of biceps femoris on the right side, and the erector spinae and the abdominal obliques on the left side (M & P, 2005, para. 11).

Downswing:

The downswing phase involves the club returning along a similar path to the backswing in preparation to hit the ball, and it involves rapid arm movement. It combines the movement of left rotation of the shoulder girdle and scapula rotation in a counter-clockwise direction around the trunk. This results in increased activity in the left medial scapula stabilizers and retractors (McHardy & Pollard, 2005, para. 6).

The pectoralis major muscle is very active. The right upper serratus anterior contracts to assist in scapular protraction. These combined muscle movements achieve right sided internal

rotation and flexion to complete the downswing movement (McHardy & Pollard, 2005, para. 6). The wrists remain in the same position as in the backswing ("cocked").

In the modern swing, the hip initiates the movement and rotates the pelvis to the left. The glutes on the right side are very active in aiding hip extension, and the right biceps femoris aids in the transfer of body weight back to the left side. The weight transfer is enhanced by the vastus lateralis and adductor magnus, and the left pelvic muscles act to pivot on left lumbopelvic rotation (M & P, 2005, para. 22).

Acceleration:

Acceleration is the continuation of the downswing; accelerating the club head with peak velocity just prior to contact with the ball. This is the most active phase of the entire swing. The pectoralis major muscles are the most active bilaterally, as the major movers of the shoulder girdle. The right-side activity is the same as in the downswing. The left pectoralis maintains contraction to control left arm abduction and external rotation (McHardy & Pollard, 2005, para. 8)

The muscles involved in scapular movement are active: upper serratus on the right protracts the scapula, and the levator scapulae on the left side aids in scapular tilting. Prior to the impact with the ball, there is an increase in wrist flexor muscle activation ("uncocking" of the wrists to return them back to a position to hit the ball) (McHardy & Pollard, 2005, para. 8).

Activity in the lower body is characterised by active lumbopelvic stabilizers and the left lateral leg. These muscles actively provide a solid base for subsequent rotation of the trunk while hitting the ball. The right obliques and gluteus medius are the active muscles assisting the rotation of the trunk back to the ball from the backswing (M & P, 2005, para. 25).

Early Follow-Through:

This swing phase takes place after impact with the ball when deceleration of trunk rotation occurs. The actions occurring here are left arm supination and right arm pronation followed by left arm external rotation and right arm internal rotation, caused by a "rolling" of the forearms. The pectoralis muscles are still active bilaterally. In this phase, the active shoulder muscles are the right subscapularis and left infraspinatus to control movement (McHardy & Pollard, 2005, para. 9).

"The lower body muscle activity is similar to the acceleration phase, with the left side acting as a stable base and the right-side rotating around the left" (M & P, 2005, para. 29).

Late Follow-Through:

During the late follow-through phase, the muscle activity decreases as the golfer is near the end of their swing. The muscles in this phase are similarly active to those in the early follow-through, however, with a lesser degree of activity. The serratus anterior is the only exception, as it aids in the protraction of the scapula around the trunk, making it more active (McHardy &

Pollard, 2005, para. 10).

In the lower body, the muscles on the left side that are the most active are the semimembranosus, vastus lateralis, and the adductor magnus. On the right, the vastus lateralis and gluteus medius are the most active (M & P, 2005, para. 15).

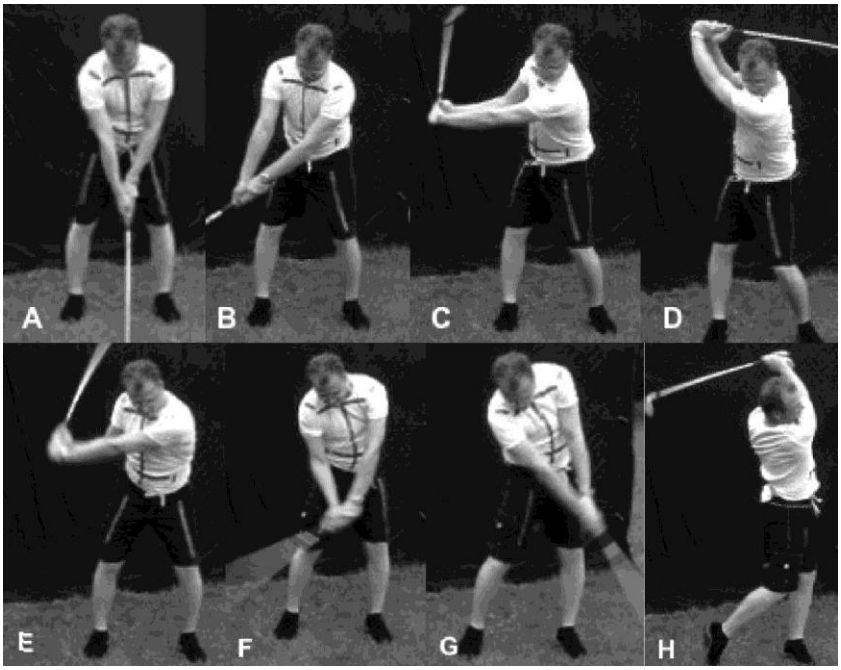

Figure 2:
A-H. Phases of the golf swing.
A. Address position
B. Early backswing
C. Late backswing
D. Top of swing
E. Downswing
F. Acceleration
G. Early follow-through
H. Late follow-through

Common Injuries in Golf:

After reviewing each phase and the muscles/movements involved, it is concluded that the proper modern swing recruits the use of the core/spine, upper extremities, and lower extremities to properly complete the action. The top golfers in the world exhibit exceptional flexibility in the hips, lumbar spine, thoracic spine, and shoulders (Sokoloff, 2016, para. 7). If one or many of the muscles utilized are injured, it can cause an impediment in motion and lead to further structures being injured or strained.

Many injuries occur as the club contacts the ball, and they are mostly muscle-related. Injuries to the upper limb are the most common golf-related injuries in comparison to the lower limb and spinal region (McHardy & Pollard, 2005, para. 34).

Wrist/Hand Injuries:

The is one of the most common injury sites in golfers. Injuries frequently occur at the impact point of the swing, and can often result from hitting an object other than the ball (e.g. branch, rock, etc.). The wrist is the anchor point during the swing between the club and the body,

resulting in the wrists going through a large range of motion. The injury is a result of a sudden change in load applied to the club and the golfer, resulting in tissue disruption to the hands and wrist (McHardy & Pollard, 2005, para. 11).

Injury can either be acute (enough force is produced, causing excessive tissue elongation) or by way of repetitive microtrauma if repeated enough times over a short period. These injuries most often occur at the hand and wrist but can also occur at the elbow. Muscular and ligamentous strains (especially flexor carpi ulnaris) are most common, but fractures at the hook of hamate can also occur (McHardy & Pollard, 2005, para. 11).

Overuse injuries are common and mainly because of repetitive wrist movement during practice or from alteration to the swing. This results in stress to areas that are not used to it (McHardy & Pollard, 2005, para. 12). Tendinopathy is another common injury at the wrist or hand, and is due to either a sudden increase in the volume of practice or alteration of the grip. Pain onset is gradual and tends to be persistent in nature until any aggravating factors are modified (McHardy & Pollard, 2005, para. 13).

The lead wrist is more commonly injured than the other, as it requires good ulnar and radial deviation. The muscles running through the wrist and hand must be strong and in control, to prevent the movements from becoming excessive (Osteopathy for golfers, para. 8).

Elbow Injuries:

Elbow injuries are more common in amateur and female golfers, potentially due to the increased carrying angle seen in the female population. Two common elbow injuries are lateral injuries (including tennis elbow) and medial injuries (including golfer's elbow). Lateral elbow injuries are more common than medial at a ratio of 5:1 (McHardy & Pollard, 2005, para. 18).

Medial elbow injuries often result from excessive traction, usually to the trailing arm. It is typically the wrist/hand flexors and forearm pronators that are injured at the insertion to the medial epicondyle. These injuries most often occur at the time of impact and are usually traumatic in nature; mechanism is sudden deceleration of the club head. Medial epicondylitis is the most common injury to the medial elbow. Signs and symptoms include tenderness and pain on palpation of the medial epicondyle; trigger point referral may occur along the radial border and into the dorsum of the hand. Pain can often be aggravated by resisted forearm flexion and pronation (McHardy & Pollard, 2005, para. 19).

Lateral elbow injuries are more likely due to overuse, and is often at the insertion of the wrist/hand extensors into the lateral epicondyle. Changes in forearm musculature, due to gripping the club too tightly during swing or changes to the grip, are potentially a cause of lateral epicondylitis. Signs and symptoms include tenderness and pain on palpation of the lateral epicondyle; trigger point referral may occur along the ulnar border and into the palmar aspect of the hand. Pain can often be aggravated by resisted forearm extension. Excessive practice may also result in injury to the lateral elbow (McHardy & Pollard, 2005, para. 20-21).

Shoulder Injuries:

Shoulder pain in golfers and athletes is a relatively common occurrence; excess practice can produce problems of the shoulder due to overuse (McHardy & Pollard, 2005, para. 23 – 24). Injuries are mainly restricted to the lead shoulder and studies have found that shoulder pain can be localized to the AC joint. Posterior instability and subacromial impingement are also common (this pain is reproduced at the top of the backswing) (McHardy & Pollard, 2005, para. 25).

"A lack of trunk rotation may require the much smaller shoulder rotators to become excessively active to maintain the momentum of the golf swing. Such a scenario would likely result in the shoulder dysfunction frequently noted in golfers, particularly instability in professionals" (McHardy & Pollard, 2005, para. 29). Golfers with back problems may induce shoulder problems to reduce the work load on their painful back (McHardy & Pollard, 2005, para. 29).

Assessing the Shoulder:

It is important for the practitioner to understand the phase of the golf swing that re-creates the patient's shoulder pain as it can help facilitate diagnosis.

e.g. #1: posterior shoulder pain in the left shoulder of a right-handed golfer at the top of the backswing can indicate tightness of the rotator cuff muscles, tightness of the posterior capsule, or posterior capsulitis (McHardy & Pollard, 2005, para. 26).

e.g. #2: anterior joint line pain at the top of the backswing can indicate impingement at the humeral head and anterior labrum; pain localized to the AC joint can indicate degeneration or impingement of the AC joint (McHardy & Pollard, 2005, para. 26).

e.g. #3: during the follow through phase, posterior shoulder pain may be produced due to impingement of either the posterior labrum or the rotator cuff muscles (McHardy & Pollard, 2005, para. 27).

e.g. #4: generalised pain that occurs throughout the swing may be due to scapular lag (McHardy & Pollard, 2005, para. 27)

Injuries to the Cervical Spine (Neck):

During the golf swing, the golfer must have good cervical rotation and stability in order to enable good eye-to-ball contact. Restrictions within the individual joints of the neck and upper extremities can disturb the overall movement of the neck (Osteopathy for Golfers, para. 4).

For example, a chin that sticks out excessively will lead to increased curvature in the neck; this can cause limited movement and increase the risk of neck pain (Osteopathy for Golfers, para. 4).

Injuries to the Thoracic Spine (Upper and Mid Back):

The thoracic spine is responsible for the majority of the trunks movement during the golf swing. Good trunk rotation is crucial for a proper swing. Restrictions in this area can lead to

increased/excessive strain on the lower back and neck. This can shorten the length of the overall swing, therefore reducing efficiency. To compensate for this lack of movement, other joints become more mobile. This leads to an imbalance of hypermobile and hypomobile joints, which can affect the fluidity of the swing, which can be detrimental to accuracy and consistency of shots played (Osteopathy for Golfers, para. 5).

Injuries to the Lumbar Spine (Lower Back):

The lower back is one of the most common injury sites in golfers. The low back and core strength are important, as the swing finishes with lumbar extension. "Good control and strength of the abdominal muscles is required to prevent hypertension of the lower back, which can cause disc and facet injuries" (Osteopathy for Golfers, para. 6).

Injuries to the Hips:

Strong rotation of the hips (especially internal rotation of the lead hip) is imperative for a good follow through during the swing. Restriction throughout the hips can lead to extra strains/stressors placed on the lower back and on the lead knee, which makes them more vulnerable to injury. If a golfer keeps the lead foot planted during the follow through, strong internal rotation of the hip is vital (Osteopathy for Golfers, para. 7).

The lead hip determines the path of the club on the downswing. If a player is unable to translate their pelvis forward and rotate to the left, the path is not cleared for the arms to move through, resulting in an "over the top" swing path. This can lead to what is called a "slice", as the player is instinctively trying to get the club back towards the target, only to cut across the ball from right to left (Sokoloff, 2016, para. 6).

Osteopathic Assessment of the Golfer:

Important points to assess during intake with the patient revolve around the understanding of the biomechanics involved in the swing. When examining the patient, it is important to always look at the whole kinetic chain involved in the golf swing. In manual osteopathic practice, we look at the body as a unit. This means that we do not look at just one part of the body in isolation; we examine every contributing factor to pain (Osteopathy for Golfers, para. 1).

Understanding the mechanics of the swing will facilitate appropriate knowledge of the etiology of the injury, which will help improve management. This is particularly important in the case of upper limb injuries, because the arms go through such a large range of motion during the

swing while still providing the link between the club and the torso (McHardy & Pollard, 2005, para. 3).

Common Postural Assessment Findings:

A standard osteopathic evaluation often begins with a postural assessment. There are specific postural findings that can often be noticed in a golfer. The postural alignment from all angles can help determine potential muscle imbalances and functional limitations. While a patient standing in neutral is the standard approach for postural evaluation, analyzing the golfer's address position can be even more beneficial to determine the underlying problem (Ochsendorf, para. 1).

Spinal position in the address position can indicate many things:
e.g. #1: excessive arch in low back can indicate weak abdominals and tight hip flexors, this can make it challenging to maintain proper posture throughout the swing (Figure A) (Ochsendorf, para. 2).
e.g. #2: round spine angle can indicate a lack of extension and rotational mobility (Figure B) (Ochsendorf, para. 2).

Movement screening is recommended for the clearest picture of physical limitations. Movement screenings assess the mobility and stability throughout the pelvis, torso, hips, and shoulders (Ochsendorf, para. 3).

Figure 3:

Figure A

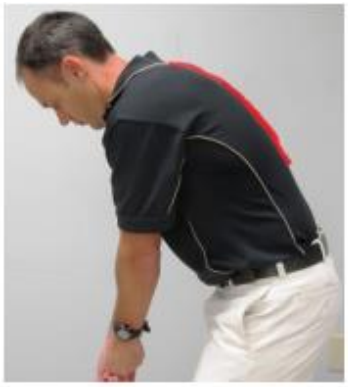

Figure B

Figure C (normal)

Common Assessment Tools and Screens:

Static postural assessment is important to help identify imbalances or movement complications. Specific orthopedic/muscular testing is beneficial as well. The golfer should be examined in all planes. The most common and specific for golfers are the pelvic rotation test, torso rotation test, and 90-90 shoulder mobility test. A transitional/movement assessment should be done as well. Having a patient perform the overhead squat and the single leg squat (depending on their level of strength) can help identify inefficient movement patterns that can be corrected to optimize the patient's game (Elmore, 2018, para. 1-2).

There are many other orthopedic and manual muscle tests that can be performed to assess specific areas of pain and differentiate between different clinical diagnoses.

Osteopathy Treatment for Golfers:

One of the main roles of the manual osteopath is assistance in gaining full muscular and joint range of motion to ensure that the technical faults are not brought on by mechanical restrictions (Sokoloff, 2016, para. 8). Although goals of treatment outcome will vary for each patient and practitioner depending on the area of injury, there are some general osteopathic outcomes. These aims include preventing injury, recovering from existing injury, and optimizing performance (Osteopathy for Golfers, para. 3). More specifically, the aim of osteopathic intervention in golfers is to increase muscle and joint ROM, increase strength/endurance, decrease muscle tone and restrictions, and to increase function (power, accuracy, consistency, etc.)

Increasing Function:

Increasing function and optimizing performance are one of the most important goals for most golfers. Manual osteopathy can play a huge role in achieving these goals. This is where a proper biomechanical assessment and understanding of the fundamental movements in the swing comes in to play, as it will help facilitate appropriate treatment measures.

"In order to generate torque and power, you must have adequate rotational mobility, but you must also demonstrate the ability to stabilize each individual segment. This allows you to fire muscles in the correct sequence and more effectively builds momentum leading up to impact with the ball. Stability is also critical for consistency. Stability comes primarily from core strength in the abdominals and lower back and hip musculature and is paramount, but often deficient. Identifying and addressing these strength and flexibility deficiencies can prevent injuries, make your swing more efficient, and allow you to continue golfing well into your "later years" (Ochsendorf, para. 3).

Treating Physical Restrictions vs. Functional Control:

The practitioner should examine and treat physical restrictions. Often, a golfer with strong physical movement is not able to actively rotate through their full range of motion using the control of their own muscles. This is what is known as "poor functional control". If a golfer has poor or weak movement, this must be addressed before the practitioner can begin rectifying functional movement. For example, good functional activation of the trunk muscles facilitates better control during the follow through of the swing. If necessary, exercises to retrain the ability to move through the full range of motion can be beneficial. With the appropriate intervention, the

golfer can learn to hold the spine in a neutral position and increase the ROM and power, as well as lower the risk of injury (Osteopathy for Golfers, para. 9-10).

Osteopathic Techniques:

Manual osteopathic practitioners can use a wide range of modalities to achieve treatment goals. This includes trigger point release, progressive stretching, muscle energy technique (MET), positional release, joint mobilization, soft tissue manipulation, harmonics, and exercise prescription. The exercise prescription can include strength training, stretching, balance, proprioception, functional control, and core stability) (Osteopathy for Golfers, para. 11).

Therapeutic Exercise Routines:

Achieving a body fit for the demands of the golf game will greatly reduce the risk of injury. Therefore, an elaborate therapeutic exercise routine is one of the most imperative modalities that a manual osteopath can help a golfer with. "Creating a golf fitness program that focuses on the proper movement of each body part gives you the best chance to not overload one area of the body" (Davies & Disaia, 2019, pg. xii, para. 3).

"Success in sports often comes down to the athlete who can move more effectively than his or her competitors. At it's most fundamental level, prodigious movement requires an athlete to have both the ability to move and control movement at each joint through the required action" (Davies & Disaia, 2019, pg. 2-3, para. 6).

Each exercise program must be designed specifically to tailor to each athlete's different needs. Every player has a unique skill set, so it is important to design a program specific to that. A common aspect of fitness that most golfers and other athletes lack is mobility. Mobility can be defined as the range of motion that an athlete can control, or the ability to stabilize your flexibility. Overall, devoting an exercise program to mobility, balance, proprioception, and rotational resistance will often lead to the greatest long-term results (Davies & Disaia, 2019, pg. 17, para. 3).

A standard golf-focused exercise routine is based on the following: warm-up (pre-workout), mobility exercises and stretches for optimal swing angles, balance and proprioception training for efficient energy transfer, rotational resistance and deceleration for injury-free swings, strength for increased distance, and power for longer drives. For beginners, it is recommended to focus on warm-up, mobility, and balance/proprioception. After exceptional range of motion has been achieved, the athlete can then move to more complex exercises to focus on strength and mobility using the body weight.

When advanced body weight exercises can be performed properly, an external resistance (dumbbells, etc.) can be added to the routine. Sample routines are shown below:

Lydia Ko's Program for Mobility, Balance, and Proprioception		
Exercise	**Repetitions**	**Notes**
Big Toe Raise	20	- try to keep toe coming straight up and not angled out
Pronation Supination	20	- initiate movement from the feet and not from the hips
Segmental Cat Camel	5 (1 minute per rep)	- try to move just one segment at a time
90/90 Transition	5-8/side, slowly	- attempt to keep the legs as far apart as possible at a time
Scapular Circles	5 in each direction	- attempt to move only the shoulder blade; move through as big a range as possible
Prone Swimmers for Shoulders	2 in each direction, 1 minute per rep	- keep elbows and hands as high as possible and move slowly
Three-Position Side Lunge	5 in each position	- focus on maintaining a straight knee on the side of the non-moving leg when in the lunge
Combat Frog Isometrics for Abduction and Adduction	1 in each direction, 60 seconds duration	- maintain a long spine at all times
Single Arm Tubing Punches	8-12 per side	- get back and load the back hip so you can use your legs to effectively push off; pull with the free hand to drive the rotation

(Davies & Disaia, 2019, pg. 187, Table 8.1)

Byeong-hun An's Program for Developing Strength and Mobility through Body-Weight Exercises		
Exercise	**Repetitions**	**Notes**
90/90 Transition	5/side, slowly	- try to keep front leg on the ground as long as possible while you move the back leg into external rotation on each repetition
Spine Wave from Loaded Beast	3-5	- take your time and focus on each level of the spine moving against the previous segment
Cossack Squat	5-8/side	- keep your spine long at all times
Arm Reach from Crab	5/arm, slowly	- begin the movement with a focused push of the feet into the ground to lift the hips; breathe through the belly and let the upper body and arm relax as it hangs

Beast to Crab to Beast Flow	3-5 in each direction	- focus on the shoulder movement and don't let them shrug up towards the ears
Scorpion Reach from Loaded Beast	2-3 in each direction	- make sure the arms are straight as you drive the hip up; focus on using a clam-shell motion and not hip extension as you lift towards the ceiling
Asymmetrical Opener Rotation	8 in each direction	- keep the shoulder blade low as you move into the backswing
Single-Leg Airplane	10 on each leg	- big toe should stay in contact with the ground at all times
Kneeling Soccer Throw	8-12	- focus on not letting the ribs hike up when raising the ball overhead; this will keep the lower back more stable

(Davis & Disaia, 2019, pg. 189, Table 8.2)

Gary Woodland's Program for Strength and Power		
Exercise	**Repetitions**	**Notes**
Kneeling Soccer Throw	8-12	- create power from the arms but maintain a braced spine
Jumping Split Squat	5-8/leg	- get as much air as possible with each jump
Weighted Vest Plyometric Front Squat	5-8	- don't get sloppy in the lower back at the bottom of the squat
Deadlift with Hex Bar	3-8	- pull yourself down to the ground to lock in your shoulders and lats, then focus on driving the ground away from you as you stand up
Push-up to Plank	12/arm	- push the ground hard as you move from plank to push-up
Single-Arm Rotation Press	8/side	- pull the arm without the weight to allow the trunk to rotate properly
Goblet Walking Lunge	30 seconds of consecutive lunging	- pull the knee of the front leg back to drive up and out of the lunge
Reverse Woodchop with Tubing	8/side	- always return to the start position

(Davies & Disaia, 2019, pg. 190, Table 8.3)

5 Sample Exercises to Improve the Golf Swing:

A tailored training routine that focuses on the muscles most used by the player is the most beneficial. The focus should be on core strength and flexibility to reduce overuse of the arms and wrists, which will prevent lower back strain (Pletcher, 2016, para. 3).

1. **Standing Wood Chop:** integrates movement of back, hips, and shoulders while increasing strength and flexibility; best performed with cable system:

- place resistance band beneath left foot and slightly bend the knees
- pull band overhead to the right like you're about to swing an axe
- 8-12 reps, rest for 30 seconds, and switch sides – repeat 1-3 times
- (Pletcher, 2016, para. 7).

2. **Lateral Lunges:** increases ROM, strength, and power of the hips by working them in the frontal plane with lateral movement:

- keeping good posture, step to the left and shift weight to that side
- left leg should be bent while right is extended to the right, make sure toes are pointed straight ahead
- alternating legs; 8-12 reps, rest for 30 seconds – repeat 1-3 times
- (Pletcher, 2016, para. 8)

3. **Glute Activation Lunges:** used to improve mobility in hips, resulting in greater strength and a more powerful swing:

- feet together and hands on hips; take a big step forward bending the front leg at 90 º or until thigh is parallel to floor
- back leg should remain strong and straight; step back into standing position
- repeat 8-12 times, alternating legs 1-3 times, resting in between
- (Pletcher, 2016, para. 9)

4. **Front and Side Plank:** helps to activate core muscles promoting stability and strength in the torso:

- lying face down with palms flat on the floor, tuck toes under and roll shoulders onto back and push away from the floor
- keep back flat and engage abdominal muscles
- hold 20-60 seconds and release back onto floor; repeat 3-5 times
- side plank: lie on side with legs stacked, lift hips so that body is in a straight line and hold 20-60 seconds, repeat 3-5 times on each side
- (Pletcher, 2016, para. 10-11)

5. **Supine Spinal Twists:** increases core strength while enhancing torso mobility, shoulders will also be stretched if performed correctly:

- on back with feet raised and bent at 90º so that calves are parallel to floor, extend arms out wide with palms facing down
- slowly lower legs to right side of body while keeping knees together, hover above ground for 20-30 seconds and return to center
- switch sides, repeat 1-3 times
- (Pletcher, 2016, para. 12)

Conclusion:

As a practitioner, it is highly important to have a thorough understanding of the biomechanics involved in the golf swing. This includes the muscles and joints in use and the movements being performed. Understanding this can help us better design a functional treatment plan to more effectively manage injuries and achieve performance goals. Osteopathic manual therapy is extremely beneficial for any player who wishes to not only treat injury and dysfunction, but also to improve their overall golf game, including increasing accuracy, consistency, and power of shots. Understanding the role that biomechanics plays during the entire swing process will greatly increase patient outcomes.

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