# CASE REPORT RETURN TO GOLF FOLLOWING LEFT Total HIP Arthroplasty in a right Handed Golfer

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# ABSTRACT

**Background.** Research indicates return to golf is a safe activity following total hip arthroplasty (THA). Frequently, individuals have shown both physical faults and swing faults after THA, which can persist even following rehabilitation. Physical limitations and pain often lead to faults in the golfers swing, most notably "hanging back." These problems may not be improved after surgery unless the proper re-training takes place.

**Objectives.** Using pre-surgical as well as post–surgical information, physical faults and swing faults were identified. A corrective training protocol was developed to normalize physical and swing limitations.

*Case description.* The patient is a 52-year old male golfer who underwent left total hip arthroplasty secondary to left hip OA. Video analysis both pre and post surgery indicated the patient was "hanging back". This "hanging back' can lead to an inefficient golf swing and potential injury. Following a physical evaluation, a training protocol was designed to

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*Outcomes.* The patient was able to swing the golf club with proper weighting of the lead lower extremity, significant improvement of swing efficiency, and return to play at a zero handicap following a corrective training protocol.

**Discussion.** A return to full weight bearing, functional strength, range of motion, stability, and balance are critical to regaining the physical skills necessary to properly swing the golf club. Further, mastery of these objective components lend themselves to the trust needed to load the lead leg with confidence during the golf swing.

*Key Words:* total hip arthroplasty, golf, conditioning

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# INTRODUCTION

Research indicates that a return to golf is a safe activity following total hip arthroplasty (THA). While golfers have reported hip pain following play, most are able to continue enjoying their sport.<sup>15</sup> Unfortunately, protocols to effectively and efficiently return patients to this sport have not been found in the literature.

Osteoarthritis (OA) of the hip often leads to hip pain and loss of hip range of motion, as well as possible weakening of surrounding musculature.<sup>6</sup> Kaltenborn<sup>7</sup> reports loss of medial rotation, extension, abduction and lateral rotation as the capsular pattern loss of hip range of motion. This limited range of motion can lead to compensatory changes in the golf swing. Hanging back or poor weight transfer to the lead lower extremity during the downswing of the club is a commonly seen occurrence for golfers with lead hip OA. Hanging back is diagnosed with video analysis from the face-on camera position. The golfer's lateral lead knee and hip do not match a vertical line drawn from the lateral aspect of the lead foot perpendicularly up to the height of the lead shoulder in the impact position. (*Figures1, 2*)

Perpetuation of this swing fault can lead to a lack of power and inconsistency of ball flight. Hanging back may lead the player to manipulate the club with a premature wrist release as a compensatory mechanism to getting the club to the ball.



**Figure 1:** Model of golfer hanging back at impact. The golfers lead knee and hip do not match the vertical line drawn perpendicular to the ground from the lateral aspect of the foot to the shoulder.

These faulty mechanics can lead to right side lumbar injury, weight bearing remains primarily on the trail side of the body at impact.  $^{8}$ 

While optimal post THA rehabilitation and training approaches remain undefined, all protocols will need to be modified for each individual. The purpose of this case report is to describe the evaluation and application of exercises designed to return a golfer following lead hip THA back to play, while at the same time eliminate the physical swing faults in order to improve swing efficiency

## CASE DESCRIPTION

The patient is a 52-year old male golfer who underwent left minimally invasive total hip arthroplasty secondary to OA of the left hip. A modified Harris Hip outcome score was calculated prior to surgery and found to be 72.6 out of a possible 100 points. *(Table 1)* Following surgery, the patient underwent 2 weeks of home health physical therapy. This was followed with an active rest period performing a home exercise program and walking. The



**Figure 2:** Model of golfer "matching the line" at impact. The golfer is not hanging back.

patient was then released to swing the golf club at 7 weeks post-op. At 8 weeks a golf specific physical evaluation was performed. Physical, video, and kinematic data was recollected 12 weeks status post surgery.

#### **Physical Evaluation**

A subjective history was taken including past medical, exercise, and golf history. The patient was evaluated using the Titleist Performance Institute (TPI) Medical Evaluation and standard physical therapy impairment testing.

#### Hip Passive Range of Motion (PROM)

Range of motion on the left was less than the right for flexion (85 degrees on left, 15 degrees on right) and adduction (50 degrees left, and 55 degrees rifht). Range of motion was found to be the same on the left and right for extension (-10°), external rotation (50°), and internal rotation(21°).

# Pelvic Tilt Test

The pelvic tilt test was used to assess overall mobility of the hips and lumbar spine and the ability to control the position of pelvic posture in the sagittal plane. The ability to move and control the position of the pelvis is critical for optimal power transfer from the lower body to the upper body in the golf swing.<sup>8</sup>

The patient was able to achieve a pelvic neutral position in standing; however, limited anterior and posterior pelvic tilt was noted. This limitation of motion is indicative of weakness of the abdominal and gluteal muscles as well as tightness of the erector spinae and hip flexors. A lack of smoothness and the presence of jerky movement was also noted during alternating between the two tilt positions. In addition, bilateral hamstring cramping was noted during testing. Cramping of the hamstrings is commonly seen in subjects who are hamstring dominant. These subjects try to control pelvic tilt through the hips and knees.<sup>8</sup>

# **Pelvic Rotation Test**

The pelvic rotation test checks the player's ability to rotate their lower body independently from their upper body. This rotation is an important skill to properly sequence the downswing and requires good mobility of the spine, hips, and pelvis.

The patient displayed a choppy limited rotation to both the right and left with more lateral than rotatory movement occurring. This lack of rotatory motion is most likely due to the limitation with hip internal rotation. In addition, the lateral shifting is usually indicative of the lack of ability to activate the oblique abdominals and hip rotators to isolate pelvic rotation<sup>8</sup>.

# **Overhead Deep Squat Test**

The overhead deep squat test is one of the more informative tests performed on the golfer. The deep squat portion of the test is used to assess bilateral, symmetrical mobility of the hips, knees, and ankles<sup>8</sup> If the golfer is unable to complete the deep squat with the heels on the ground, then it is almost impossible to for them to maintain their posture during the golf swing. The golfer will have a tendency to thrust their lower body toward the golf ball and raise up on their torso during the downswing (early extension). This movement is usually due to either tightness in their calf muscles or lack of pelvic stability due to weakness of their core.

Due to THA precautions still being observed, this test was modified to a 1/3 depth squat. Poor stability of the left hip led to decreased femoral control as demonstrated by femoral adduction and internal rotation. This can be viewed best by observing the client face on.

#### Single Leg Balance Test

The single leg eyes closed balance test is used to assess the golfer's overall balance. This test will highlight any proprioceptive imbalance from left to right as well as overall stability of the core. The client was scored in the 0-5 second range for both the Left and Right.

#### Wobble Board Test

Front to back balancing was more difficult than side to side.

# Leg Lowering Test

This test is used to assess how the golfer uses their abdominals and overall stability of the core. The abdominal muscles are used to stabilize the spine and pelvis, rotate the torso, and maintain a neutral posture throughout the golf swing.<sup>8</sup> With the patient lying supine in a hook lying position, a blood pressure cuff is placed under the lumbar spine and inflated to 40mmHg. The client is then instructed to contract their abdominals and slowly side one leg to the ground. This is then repeated with the opposite leg.

During this test, three things were observed: First, how do they engage their abdominals? As the client initially engages the abdominals, the pressure within the cuff should elevate between 40-50 mmHg without modifying the lumbar lordosis. If the pressure in the cuff drops, it is usually indicative of an anterior pelvic tilt caused by the over-activation of the hip flexors or erector spinae rather than the abdominals. This anterior pelvic tilt causes an increase in the lumbar lordosis and, thus, a pressure drop. If the pressure increases above 50 mmHg, it is usually indicative of the client performing a posterior pelvic tilt with the pelvis when engaging the abdominals. This demonstrates an abnormal sequence of recruitment with the client also activating the hamstring muscles and quite possibly the psoas major muscle to produce a posterior pelvic tilt.

Second, can their abdominals work independent of hip extension? In other words, can the client maintain a good abdominal brace with movement of the lower extremity? When you ask the client to slide their leg all the way down, hip extension should occur. Normally, hip extension should not affect pelvic or lumbar spine motion, especially when the abdominals are actively bracing the spine and pelvis. If the musculature of the hip is shortened and pulls on the lumbar spine and pelvis, the abdominals must resist this tension. If the mmHg in the blood pressure cuff drops during hip extension, then either the lack of mobility in the hip musculature or lack of strength of the abdominals is evident. Weak abdominals can be the main reason for loss of stability during this test however, any restriction in hip mobility will make extension of the hip difficult to isolate without movement of the pelvis and lumbar spine.8

Third, is there an asymmetry between the left and right hip? In other words, if the mmHg in the blood pressure cuff drops during left hip extension, but does not during right hip extension, then an asymmetry exists.

The client demonstrated a pressure increase above 50 mmHg with the initial engagement or bracing of the abdominal musculature. In addition, with hip extension pressure was lost for both the right and left sides: Pressure lost: Left 21-40 mmHg; Right 21-40 lbs mmHg

## Bridge with Leg Extension Test

This test evaluates stability in the pelvis, lumbar spine, and core musculature. In addition, this test will highlight any inhibition or weakness of the gluteus maximus muscle due to over recruitment of the synergistic muscles, such as the hamstring and erector spinae muscles. As the client attempts to single leg bridge and hold the position with the contralateral leg extended for 10 seconds, observe for a drop of the pelvis on the leg extension side (contralateral to the stance leg) or ipsilateral pelvic shaking which is indicative of weakness of the gluteals muscle on the ipsilateral or stance side. Another key indicator is hamstring cramping in the down or stance leg, which also indicates inhibition of the gluteals and recruitment of the synergistic muscles8. Weakness in the right gluteals can cause the player to lose lower body stability in their backswing and may limit their power on the downswing. Weakness in the left gluteals can cause instability in the left leg through impact or forward movement toward the golf ball during the downswing. The client demonstrated bilateral gluteal inhibition with hamstring cramping.

# VIDEO

Video analysis of the patient prior to training was performed. The patient was found to demonstrate the swing fault of hanging back.

# KINEMATIC SEQUENCE

In sports such as golf that need to create maximal speed of a distal segment or implement (club, bat, racquet, etc), it is generally found through motion analysis techniques, that a precisely timed sequence of body segment motions exists progressing from the proximal, large segments to the distal, smaller segments. In biomechanical literature this is often called "proximal-to-distal-sequencing", "kinetic linking," or the "kinematic sequence."<sup>8</sup> The kinematic sequence (swing signature) is one of the most important pieces of information that used to assess the golf swing. Using data collected from 3-D motion analysis systems, the efficiency of a golfers swing can be determined how golfers generate speed and transfer this speed or energy throughout their bodies can be assessed.

In analyzing how speed is transferred to the club head, it was discovered that all great ball strikers have the exact same kinematic sequence or the same basic signature of generating speed and transferring this speed throughout their body.<sup>8</sup> What style they use to complete this signature is completely unique to each player. During the downswing in golf, all body segments must accelerate and decelerate in the correct sequence with precise and specific timing so that the club arrives at impact accurately and with maximal speed. This sequence *(Figure 3)* of speed generation is: lower body first (red line on graph), trunk or next segment. All of the body segments peak and then decelerate before impact, with the club speed peaking at impact.



Parameter	Units	Pelvis	Trunk	Arms	Club
Acceleration	kd/s/s	2.1	3.0	4.9	7.8
Deceleration	kd/s/s	-3.0	-3.9	-5.3	-6.2
Max Speed	d/s	470	678	1,051	2,082
Speed Gain	d/s	0	208	373	1,031
Transition Order	ordinal	1	2	3	4
Transition Timing	msecs	48	31	13	0
Peak Order	ordinal	1	2	3	4
Peak Timing	msecs	98	81	75	8
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**Figure 3:** *Proper Kinematic Sequence: The graphic representation between T (top of back swing) and I (impact) represents the down swing.* 

torso second (green line), arms third (blue line), and the club last (maroon line) (pelvis, torso, arms, club). This motion must occur sequentially with each peak speed being faster but later (shifted to the right slightly) than the previous one. Each segment of the body builds on the previous segment, increasing speed up the chain (red is less than green, which is less than blue, which is less than maroon). This sequence reflects as efficient transfer of energy across each joint and facilitates an increase in energy from the proximal segment to the distal one. Each segment of the chain slows down once the next segment begins to accelerate in order to facilitate acceleration of the The kinematic sequence for this client was measured at the Titleist Performance Institute using a full-body 12-sensor analysis using the AIM-3D golf swing biomechanics system (Advanced Motion Measurement LLC; Phoenix, AZ) and the Liberty electromagnetic tracking hardware (Polhemus Inc; Phoenix, AZ). As shown in Figure 4, this golfer had an improper kinematic sequence. While the pelvis did peak first, the second segment to peak was the arms, followed by the torso, and lastly the club (pelvis, arms, torso, club, hand). If the timing and energy transfer is wrong, energy can be dissipated instead of added, as a result speed will be lost. Also if one body part has to compensate

because another is not doing its job, injury may result. As noted on the proper kinematic sequence (Figure 3), the peak after is reached, each segment should decelerate rap-The kinematic idlv. sequence of a golfer with lead hip OA may be illustrated by an initial normal pelvic acceleration followed by a flattened slope and an extended or flattened deceleration This lack of slope.



Figure 4: Pre operative kinematic sequence

rapid deceleration of the hips and pelvis is secondary to the golfer trying to minimize discomfort and forces through the hips.

### **INTERPRETATION OF FINDINGS**

Five significant findings exist including four physical faults and one swing fault.

1. The patient displayed a lack of full hip extension along with inhibition of the gluteal musculature. This is an aspect of "lower crossed syndrome" which increases the probability of developing low back pain. The lower crossed syndrome, first described by Czech physical therapist Vladamir Janda, can be defined as a pattern of muscle imbalances leading to increased lumbar lordosis due to over active lumbar musculature and subsequent reciprocal inhibition of the abdominal musculature. The hip flexors are tight and the gluteals are inhibited.6 In this case, the patient presented with normal anterior pelvic tilt in standing but decreased lumbar lordosis. He also demonstrated inhibited abdominals during pelvic tilt activity which may be indicative of overactive global lumbar musculature. The global lumbar muscles include the spinalis, longisimus, and iliocostal muscles. The hip flexors were shortened and overactive, the gluteus maximus muscle was inhibited secondary to a loss of hip extension, and the hamstring musculature was over-utilized.

2. The patient also displayed limited hip internal rotation. Loss of hip internal rotation can lead to undue stress on the lower back during the golf swing and swing faults such as lateral movement away, from, or toward the target, and loss of spine angle. This subject was able to avoid these faults; however, limited lead hip internal rotation can also lead to a hanging back swing fault. This

fault is possibly due to the golfer's anticipation of discomfort that is associated with forced internal rotation.

3. The patient exhibited decreased lumbopelvic mobility and stability in non-weight bearing and weight bearing positions as demonstrated by the pelvic tilt, pelvic rotation, and bridging with leg extension tests. The client had difficulty with full sagittal plane pelvic excursion as well as poor neuromuscular control through his available range. Inability to achieve a posterior pelvic tilt at impact can have a negative influence on the right side of the lumbar spine; especially true when combined with hanging back.

4. The patient exhibited deficits with balance. Proper balance and proprioceptive ability is necessary during static positions at address, as well as dynamic positions of the golf swing.

5. Upon 2-D video analysis the patient displayed less than normal transfer of weight to his lead lower extremity. Hanging back produces loss of power/distance and ball flight inconsistencies. Further 3-D kinematic sequence analysis revealed an improper order of activation/sequencing: Pelvis-arms-torso-club head.

#### INTERVENTION

At 8 weeks post-op, training was performed in nine sessions over a twenty-five day period. A training protocol was

developed and modified to address the client's physical limitations.

1. Strategies to improve hip extension were employed as follows: side lying passive range of motion, proprioceptive neuromuscular facilitation (PNF) hold relax stretch and active assist during hip extension stretch emphasizing gluteus maximus activation (*Figure 5*). A neutral pelvis and abdominal bracing was held throughout the stretch. Pillows were placed between legs and care taken not to allow internal rotation of hip or break THA posterior precautions.

2. Increasing hip internal rotation without breaking total hip precautions of posterior movement presented a challenge. This physical fault was not directly addressed in training, however it eliminated itself with the application of

weight bearing rotational exercises and the patient's continued swinging of the golf club as approved by the physician. These exercises occurred within 2 weeks of initial testing which was a total of 9 weeks post op *(Figures 6-11)* 

3. The patient's inability to assume and maintain a stable core was another concern addressed in training. This training was addressed through exercises in supine, quadruped, standing, and in golf stance positions. Neuromuscular re-education was performed for proper pelvic tilt in the sagittal plane. This exercise was executed both in-clinic training and in his home exercise program. Abdominal holowing and bracing, bridges, single leg bridging, and front planks were employed as part of training and home exercise program (*Figures 12-17*)

4. Testing also revealed that balance was deficient. The patient was given several weight bearing exercises aimed at challenging tri-planar balance in single limb stance as well as weight shifting activi-

ties. Balance exercises also focused on maintenance of spine angle throughout performance. *(Figures 6, 8-11)* 

5. Correction of the swing fault was addressed by the patient's PGA teaching professional as training progressed.

#### Reassessment

The client was reassessed following 9 training sessions over a period of 25 days. While this is perhaps not an optimal



Figure 5: *Hip extension stretch* 



**Figure 6:** *X*-walks with red tubing





**Figure 7:** Front lunge with "helicopter" torso rotation

length of training period the reader will find that positive changes had occurred.



Figure 8: Front and lateral step ups



Figure 9: Forward shift with neutral pelvis



**Figure 10:** Elastic band with right shoulder to left hip tension to back lower extremity-minimal resistance. Band used as a means to increase proprioceptive awareness of lead lower extremity weighting only.



Figure 11: Weighted ball toss: Back swing to follow through with proper lead lower extremity weight



Figure 12: Supine pelvic tilts



Figure 13: Supine Bridges

# **Review of Problem List**

1 and 2. Overall hip function was improved. Not only was hip range of motion improved, but gluteal muscle activation was improved as well. Hip flexion was increased to equal the right side. Hip internal rotation as measured prone was increased bilaterally with the left side improving almost 10 degrees and the right 15 degrees. The patient was also able to perform the bridge with leg extension without hamstring cramping, indicating improved gluteal muscle activation.



**Figure 14:** Front lunge 1/3 depth



Figure 15: Chops and lift with tubing



Figure 16: Standing pushes narrow staggered stance



Figure 17: Standing pulls narrow staggered stance

3. The patient also displayed increased core stability. Neuromuscular control was enhanced as evidenced by improved control with weight bearing sagittal plane pelvic motion. The patient was also able to maintain pelvic stability when performing the leg lowering test. He demonstrated improved stability and control when performing a modified 1/3 squat test.

4. Significant improvements in balance were demonstrated as the patient was now able to maintain single limb stance for 8 seconds. The patient subjectively scored each direction of the wobble board balance test as "easy."

5. The patient was able to eliminate his swing fault. He no longer exhibited hanging back at impact. In addition, 3D kinematic sequence analysis revealed that the client's sequence returned to the pre-injury normal pelvis-torsoarms-club head sequence.

6. Reassessment of function with the Modified Harris Hip score produced a score of 100 out of the possible 100 points available.

#### DISCUSSION OF RESULTS

The THA procedure is becoming more prevalent and occurring in younger individuals. As these trends continue, therapists, golf professionals and fitness professionals, will be presented with the challenge of designing treatment protocols to most effectively and efficiently return the patient to normal function, as well as leisure activities such as golf.

The goal of this article was to present a case study that exhibited many of the physical faults and swing faults that are typically encountered when treating a patient with a left lead leg THA who wishes to return to golf. Several physical faults were identified including decreased hip extension and internal rotation, inhibition of hip extensor musculature, decreased core stability and diminished balance. One significant swing fault, hanging back, was also identified.

By initially addressing the clients specific physical faults the authors aimed to eliminate the injury potential that can be caused by training for strength, power, and speed on top of those faults.

#### SUMMARY

The author's rationale for the treatment approach, as well as specific treatment modalities, were detailed. Post-treatment results were given showing improvements in all five of the faults detailed in the problem list. The client was able to eliminate the vast majority of his physical faults and was able to eliminate his swing fault. The key to this success was multifactorial. Improvement in hip mobility, proper activation of hip extensors, improved lumbopelvic stability and control, improved weight bearing balance and stability, and technical weight bearing exercises to improve weight shift and rotation onto the lead side were all important components in eliminating the most significant swing fault- hanging back. Restoration of proper swing mechanics followed without incident.

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