

# GOLF AND THE SPINE

## INJURIES, PREVENTION AND TREATMENT

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### INTRODUCTION

For professional golf players, a systematic review noted the most frequently injured region to be the spine. Within this the lumbar/lower back region is most often affected, followed by the cervical/ neck region and then the thoracic spine<sup>1</sup>.

A recent cross-sectional study of musculoskeletal complaints in 1170 male golfers, looked at the prevalence and severity of these complaints in the previous 7 days. In general, playing golf did not increase musculoskeletal complaints and persons affected by such complaints in everyday life could still play golf. The lower back was the most commonly reported area of complaints/ symptoms. The 7 day prevalence for low back pain was 37%, for neck pain 9% and for thoracic pain 5% in a population with a mean age of 55 years<sup>2</sup>.

### CLINICAL BIOMECHANICS OF THE SPINE

To understand golfers' symptoms as related to the spine, a basic knowledge of the clinical biomechanics is required. The regional and segmental range of motion is determined by the orientation of the facet joints of the motion segments (Figure 1).

### CERVICAL SPINE

The most mobile region of the spine is the cervical spine. The joints of the mid- and lower cervical spine facets are inclined approximately 45° from the horizontal plane. The axis (C2) is a transitional vertebra

between the upper and lower cervical spine. The articulation between the skull and the atlas allows the inclination and reclination of the head by approximately 25°, and side bending and axial rotation of 10°. The most mobile segment is C1/C2, where the joints are orientated almost horizontally (Figure 2), allowing initial axial rotation of approximately 40° to each side<sup>3,4</sup>, side-bending of 7° to each side and flexion/extension of 22°. The range of motion in the atlanto-axial and atlanto-occipital joint is limited by the alar and transverse ligaments.

The normal range of motion measured in symptom-free volunteers is indicated in Table 1. All values typically decrease with increasing age, except rotation with flexion of the cervical spine (this is tested clinically by atlanto-axial joint rotation). This is due to increasing degenerative changes of the intervertebral discs, facets and intervertebral joints starting from the second decade. It is an aging process, is difficult to prevent and should be appreciated when designing therapeutic procedures for golfers with neck pain. Focus is typically on the subaxial joint, and in particular the C4 to C6 mid-cervical segments, as these are the most common sites of early spinal degeneration in the neck.

### THORACIC SPINE

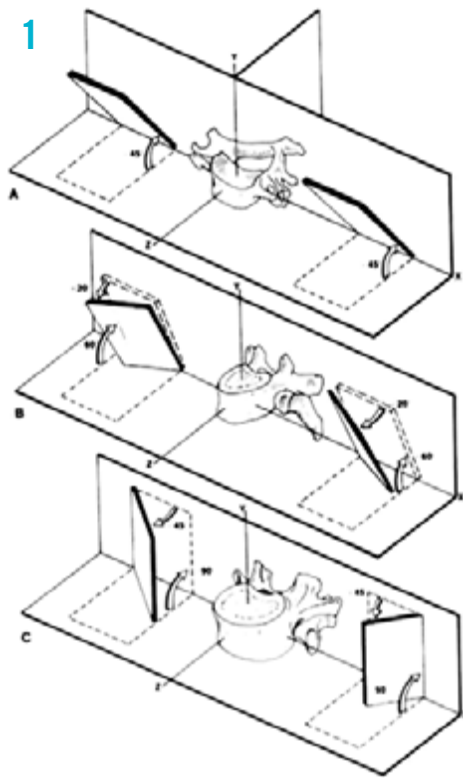
The facets of the individual vertebrae show a combined inclination, 60° around the horizontal axis and 20° around the vertical

axis. The facet orientation of the 12 motion segments allows flexion/extension (in total 76°), rotation (77°) and side-bending (73°). The measurements have been obtained in vitro, while in vivo the connection with the ribs and sternum limits the total range of motion.

### LUMBAR SPINE

Flexion/extension is the orientation with most mobility, followed by side bending and rotation. These motion characteristics are easily explained on account of the inclination of the facet joints, which in the lumbar spine stand vertically, while facing forward at an angle of 45° (Figure 1c). The mean value of total flexion/extension of lumbar spine is 87°, for side bending it is 29° and for axial rotation 13°. The mean segmental motions are indicated in Table 2. Similar to the cervical spine, the range of motion of the lumbar spine continuously decreases with age, due to degenerative changes of the intervertebral discs, predominantly L5/S1 and L4/L5, as well as their facet joints. In the lumbar spine, side bending is strongly coupled with axial rotation, which is an important component of the golf swing.

Sugaya et al. analysed the relationship between low back pain and radiological changes in professional golfers<sup>6</sup>. They reported significant degenerative facet joints on the right side suggesting a mechanical aetiology related to the

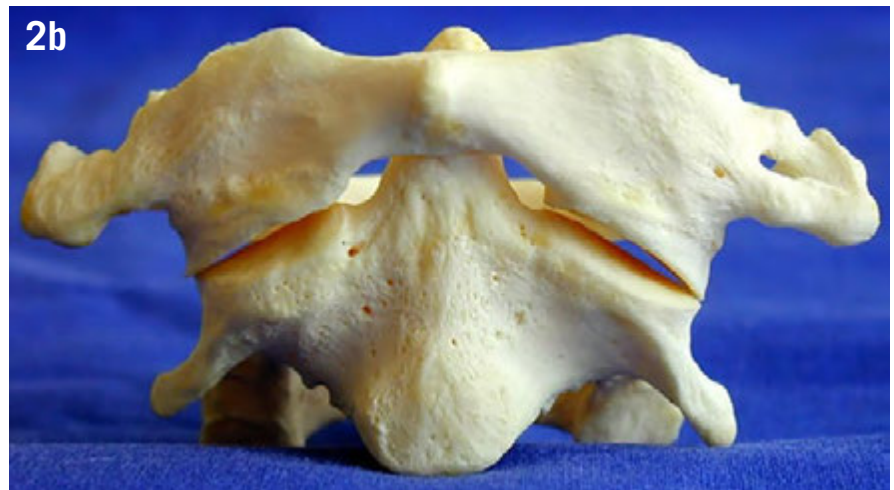
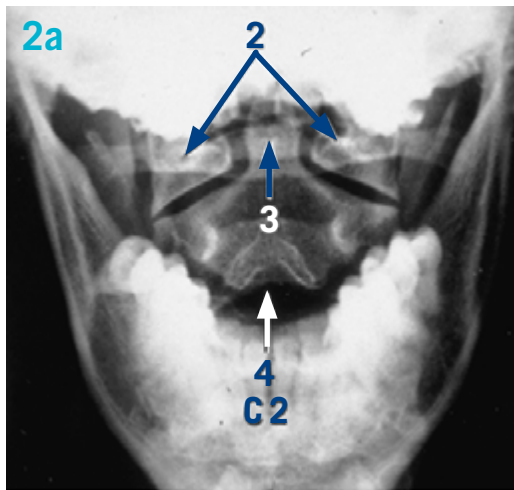


**TABLE 1**

Function Cervical Spine in degrees (SD)	Age 20-29	Over 60
Flexion/Extension men	153 (20)	116 (9)
women	150 (12)	133 (8)
Side-bending men	101 (13)	74 (14)
woman	100 (9)	80 (18)
Axial rotation men	184 (12)	146 (13)
woman	182 (19)	154 (15)
Rotation with Flexion men	75 (12)	79 (8)
woman	73 (13)	81 (21)
Rotation with Extension men	162 (16)	131 (24)
women	171 (10)	154 (15)

**Figure 1:** Facet orientation of typical cervical(A), thoracic(B) and lumbar(C) vertebra adapted from White and Panjabi, Clinical Biomechanics of Spine, Lippincot Williams & Wilkins, 1990.

**Table 1:** Normal range of motion values (with standard deviations in parenthesis) of the cervical spine, according age and sex (adapted from Dvorak et al, 1992)<sup>5</sup>.



**Figure 2:** AP view of the upper cervical spine (1: dens of the axis, 2: lateral mass of the atlas, 3: posterior arch of the atlas, 4: spinal process of the axis).

**TABLE 2**

Spinal segment	Flexion/Extension	Side-bending	Axial rotation
L1-L2	12	6	2
L2-L3	14	6	2
L3-L4	15	8	2
L4-L5	17	6	2
L5-S1	29	3	5
Total	87	29	13

**Table 2:** Mean values of segmental motion of lumbar spine in degrees (adapted from Dvorak et al 1991).

motions occurring during the golf swing. This conclusion was supported by Walker et al. (2018) who demonstrated a repetitive traumatic discopathy as a driver of early lumbar degeneration in modern era golfers (Figure 3)<sup>7</sup>. This is thought to result from the excessive torsional forces that occur in high-level golfers with concomitant lateral bending and axial rotation that go beyond the typical limits of mechanical constraint for intervertebral disc annuli and facet joints.

**PELVIC GIRDLE**

The pelvic girdle as a functional unit comprises the sacrum, the ilium, the 5th lumbar vertebra, the sacroiliac joints and the symphysis pubis. The sacroiliac joints allow very minimal movement. The direct

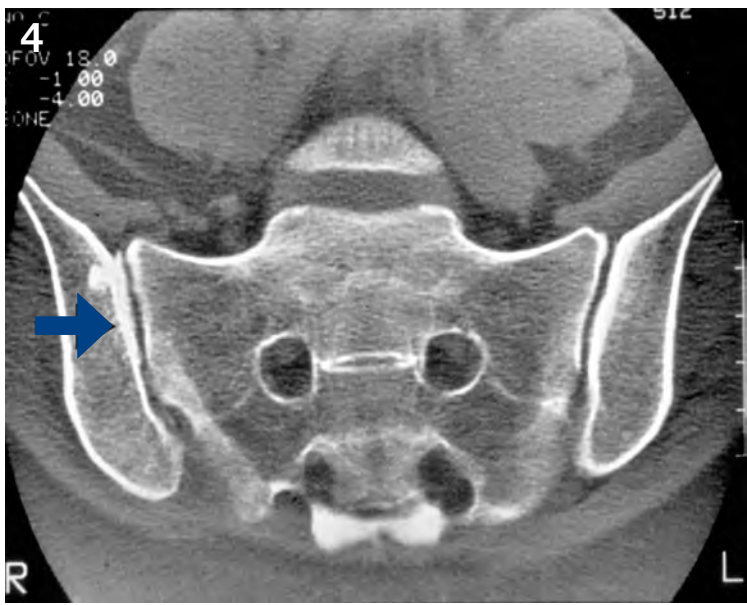
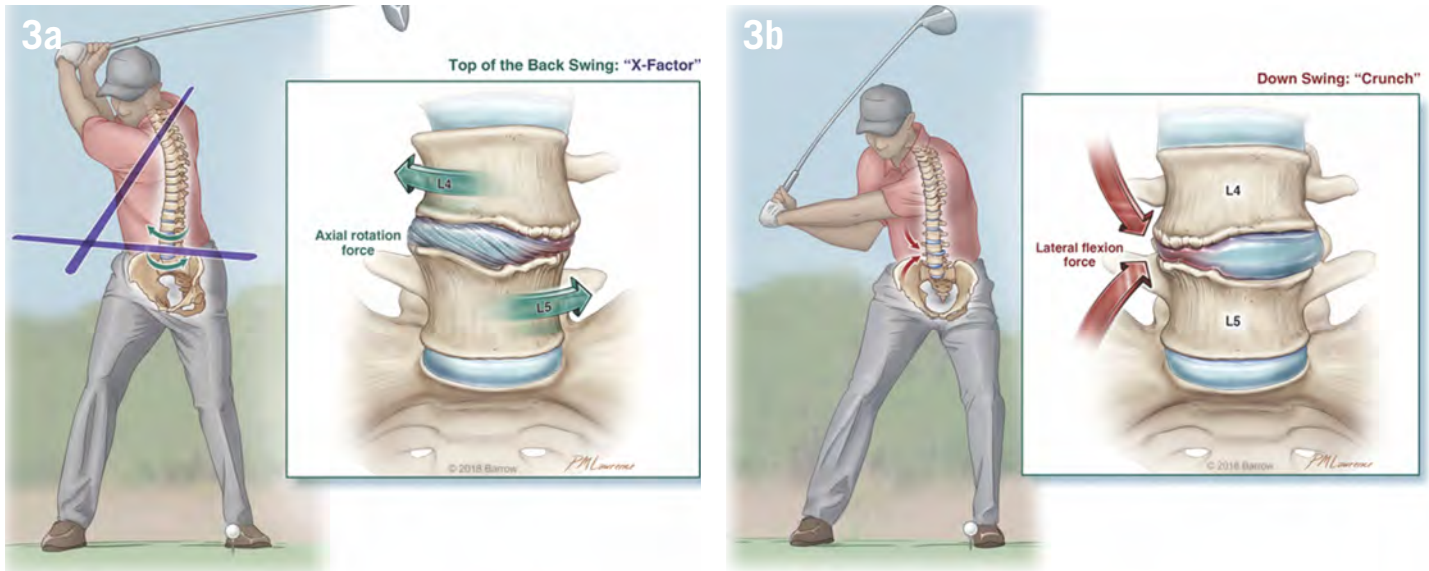
connection to the lower extremities creates a leverage on the sacroiliac joints, which can cause pain while walking due to early onset of degenerative changes. Additionally, individuals with a loss of range of motion at the lumbosacral junction or hip joints, such as after spinal fusion or hip replacement, can transfer additional loads to the sacroiliac joints resulting in premature degeneration and pain. The cartilage surface starts to thin from the 3rd life decade (Figure 4), leading to ankylosis in the 7th to 8th decade.

**DIAGNOSTICS; CLINICAL, X-RAYS, CT, MRI, SCINTIGRAPHY**

The main symptom of golfers presenting to medical professionals is pain in the low back (similar to the general population), neck, shoulder region, and less commonly pain

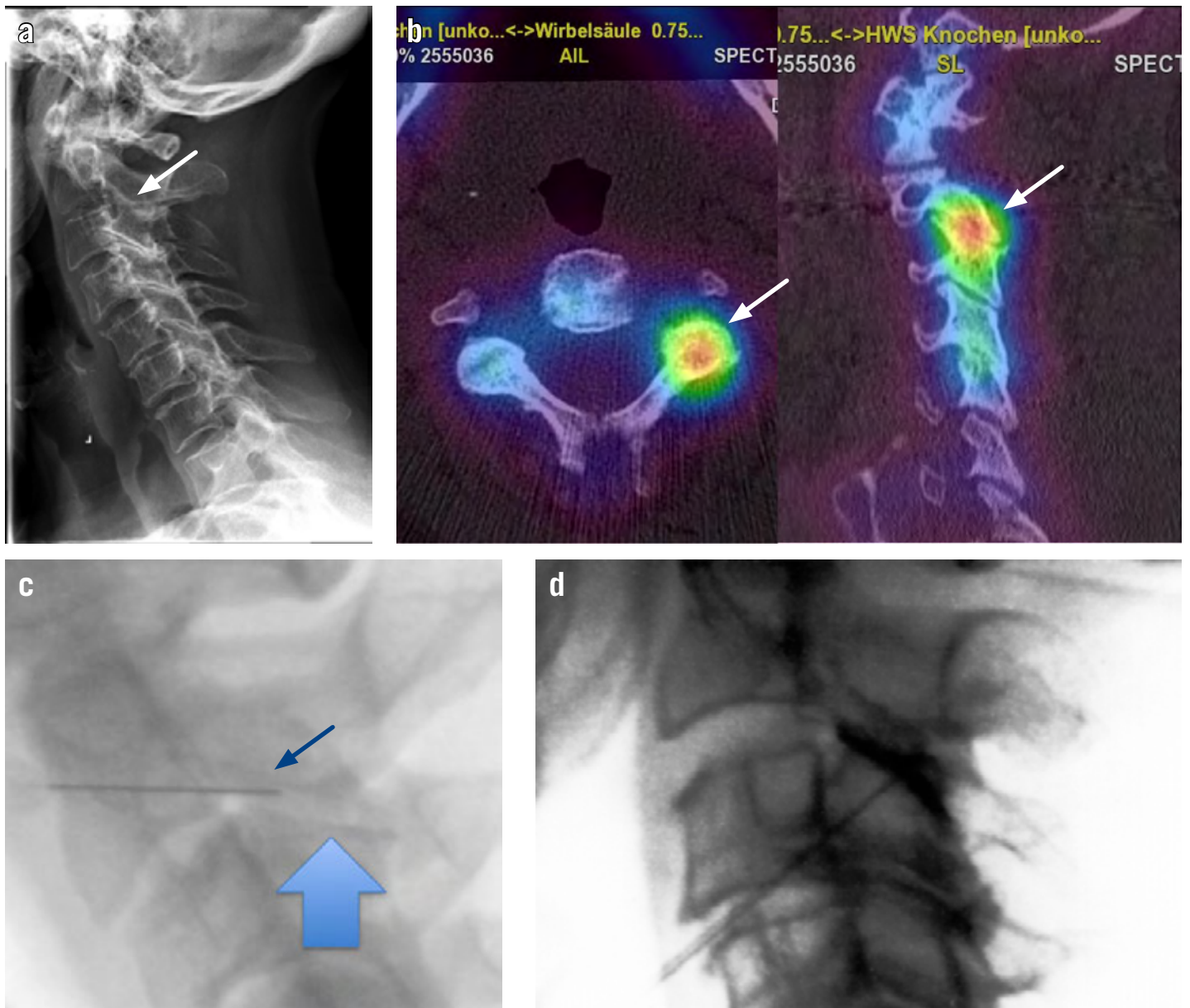
within the thoracic spine. Mostly the pain is motion-induced and commonly associated with reduced range of motion.

The aim of the clinical examination is to identify anatomical structures responsible for pain and exclude important differential diagnoses. Palpation combined with functional examination of the painful region might help to differentiate the soft tissue, i.e. muscular, tendon or ligamentous from facet joints and/or discogenic pain<sup>8</sup>. The functional examination is always complemented by neurological assessment, including muscle jerk reflexes, muscle force, skin and vibration sensation. Often golfers present before or after training or competition with non-specific low back pain, and if neurological causes are excluded, treatment can be provided aiming



**Figure 3:** Schematic drawings demonstrating the local effects of the modern golf swing on the lumbar spine (example shown at the L4–5 level), contributing to RTD. Left: During the backswing, maximal rotation of the golfer’s shoulders relative to the hips creates wound-up potential energy known as the “X-factor,” while also creating a supramaximal amount of torsional axial rotation of the lumbar spine. Right: During an explosive downswing, lateral flexion results in a “crunch” of the trailing side of the spine, asymmetrically loading the disc and facet joints. © 2018 Barrow Neurological Institute. Used with permission.

**Figure 4:** The right sacro-iliac joint shows signs of degenerative changes on CT scan.



**Figure 5:** 76 years old female with chronic motion induced pain. Lateral x-ray reveals multiple degenerative changes (a), with SPECT CT demonstrating increased activity at C2/C3 on the left side(b), followed by infiltration of the joint (c), confirmation with contrast (d).

to minimise pain and maximise the ability of the player to perform. If neurological examination reveals no signs, a muscular, functional, or non-specific dysfunction can be suspected.

If symptoms persist, conventional x-rays are often conducted. These can assess the degree of degenerative or age-related changes (Figure 5a) of the spine region in question and exclude significant findings such as osteolysis. Moreover, standing radiographs may allow for detection of spinal instabilities, such as spondylolisthesis, or spinal alignment issues, including underlying scoliosis or kyphosis.

In cases presenting with neurological symptoms such as radiating pain to the

extremities with signs such as diminished jerk reflexes, decreased muscle force of segmentally examined muscles and altered sensation, magnetic resonance imaging (MRI) is the examination of choice. MRI primarily helps evaluate the soft tissues, such as nerve roots, the width of the spinal canal, potential encroachment of the nerve roots at their exit by narrowing of the intervertebral foramen or disc protrusion/prolapse (Figure 6). MRI is an appropriate method to assess the width of the spinal canal and compression of the spinal cord causing symptoms and signs of myelopathy, in particular in an aging population. MRI is also the method of choice to rule out or confirm stress fractures or reactions of pars

interarticularis in young golfers due to high volume of repetitive loading, often suffering from low back pain, but without sciatica.

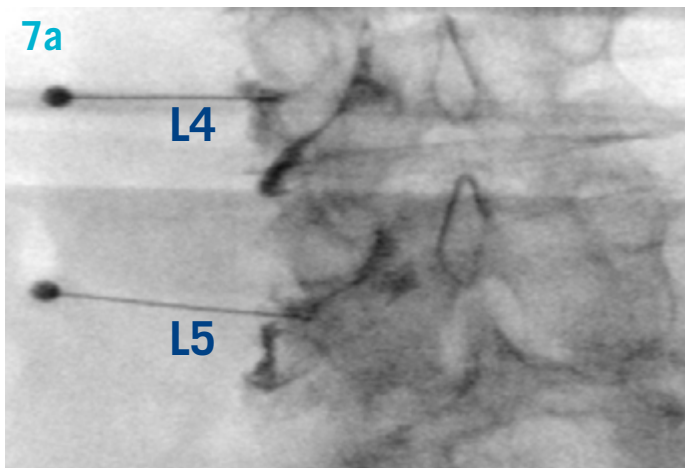
Patients/golfers with chronic motion induced pain and a positive clinical examination confirming such pain, may benefit from SPECT - CT to document the suspected active facet joints osteoarthritis (Figure 5b, 5c) or chronic discitis.

#### TREATMENT OPTIONS

When designing a treatment strategy, the duration of symptoms should be considered. It is also worth noting that the physiotherapists and doctors working at a professional golf event will see about 30% of the players each week with spinal



**Figure 6:** MRI examination of a 32 years old golfer with acute sciatica without neurological signs due to disc herniation L5/S1 on the left side.



**Figure 7:** Periradicular infiltration of L4 and L5 nerve root right (a) and L3/4 facet joint left (b).

symptoms that affect their health and/or their performance. These symptoms include chronic pain and loss of range of motion. Often players in training or competition environments may consult looking for advice as to whether serious pathology is suspected, and how to improve their symptoms and quickly allow them to compete and train. Immediate imaging is not practical in this setting. In acute situations without neurological signs it is helpful to use conservative measures such as heat packs, soft tissue massage and pain medications (e.g. non-steroidal anti-inflammatory medications, muscle relaxants, lidocaine patches/creams). Players also benefit from advice on how to decrease future symptoms through strength and conditioning, management of load, ensuring good sleep and nutrition habits, and conducting appropriate warm-up and recovery activities.

For acute spinal symptoms, those without neurological symptoms should have a plain X-ray and, depending on the

level of symptoms, can benefit from soft tissue treatment, heat packs, pain relief, and advice regarding future injury prevention. The vast majority of acute back pain episodes without neurological symptoms will improve within a few days to four weeks. Appreciating the evidence and depending on the level of experience in the treatment of spinal disorders, active physiotherapy, manual therapy, osteopathy or chiropractic treatment can be applied. Such an approach is indicated, if spontaneous recovery does not occur. The treatment has to take into account the age of the golfer, as from 6th and 7th life decades the segmental mobilising techniques used in manual therapy and chiropractic medicine should be applied with caution. In all golfers, but particularly those with increasing age, the treatment focus is muscular rehabilitation with strengthening of the paravertebral and abdominal muscles to stabilise the lumbar spine. Golfers suffering chronic neck pain without clear imaging findings should be instructed in the system of so-called inner

stabilisation of the cervical spine. The aim is not to increase range of motion in an aging golfer, but reducing motion induced pain. In such chronic situations, inflammatory changes on SPECT CT scans are common.

In cases with a confirmed inflammatory diagnosis (Figure 7) an image guided (fluoroscopy) injection can be performed, ensuring the use of contrast dye helps avoid intraspinal application of the medication. Such a procedure has to be applied by a trained specialist (neurologist or invasive radiologist).

In cases with radicular symptoms and imaging findings, an infiltration of the nerve root again performed by trained specialists might be considered (Figure 7). Transforaminal epidural steroid injections in the acute setting of a nerve impingement syndrome as encountered after disc injury or herniation can provide significant relief within one to two weeks.

In cases with disc protrusion or spinal stenosis in aging golfers, a sacral block might be the therapy of choice. The indication

for a surgical procedure is the presence of clear neurological symptoms, dermatomal radiating pain and clear imaging findings in accordance with the presenting symptoms and signs. It is recommended to exhaust all conservative treatment prior to discussing surgical procedure. However, fast action is required in cases with suspected cauda equina syndrome, rapidly developing symptoms of motor weakness and signs of cervical myelopathy.

#### SWING TECHNIQUES, SEASONAL PREPARATION AND PREVENTION

Appropriate seasonal preparation and prevention of spine injuries is an important topic for any golfer hoping to maintain their health and well-being on the course.

The rotation of the upper body is the most important component of the golf swing.

It has to be appreciated that the lumbar spine allows only a few degrees of rotation. While downswing rotation is initiated at the pelvis, the rotation force is transferred proximally through the lumbar spine and thorax to the shoulder girdle. Forcing the lumbar spine to rotate (biomechanically limited), particularly on a repeated, daily basis, can lead to unpleasant consequences later in golfing life. Stabilization of the lumbar spine with the aim to reduce strain on the facet joints and intervertebral disc relies on developing strong core and paraspinal musculature. Ensuring the strength of the

muscles and ligaments around the lumbar spine is vital for reducing or preventing golf swing-related lower back pain. Therefore, one of the most important components of seasonal preparation for golfers is strength training. Building strength in key areas such as the core, lower back, hips, and glutes can help improve posture while swinging and provide a strong foundation that can reduce the risk of back pain while playing. Exercises such as planks, bridges, side bends, bird dogs, squats and lunges are all excellent options for strengthening these areas. Performing these exercises two or three times per week should be a part of every golfer's seasonal preparation routine.

In addition to pre-season preparation activities such as strength training and dynamic stretching, it is advisable to get professional advice to optimize the golf swing. Investing in proper golfing equipment can significantly reduce the stress on your back and ensure that you play comfortably and without pain. The right set of clubs, grip size, shaft length, and lie angle can improve your swing mechanics, decrease stress on the spine, and increase your accuracy, making you a better golfer overall.

#### CONCLUSION

Golf is a wonderful sport that combines strategy and skill with a healthy dose of physical activity. But it is important to

play smart and practice safety precautions for golfers of any level or experience. A recent published epidemiological survey revealed that only 27% of all golfers perform an injury prevention program<sup>1,8</sup>. There is therefore room for improvement in education and practice. There are many proactive measures that a golfer can take both before starting a season and during playtime itself to ensure their safety from spine injuries associated with playing golf regularly throughout the year. The golfer should not wait until symptoms and pain occur, but instead should consider reducing their risk for lower back injuries by investing in the right equipment, developing their strength and flexibility, and improving their technique. With the help of these strategies and preventative measures, anyone can enjoy the fun and physical benefits of golf without putting their wellbeing at risk. Prevention is better and easier than cure!

#### ADVICE

There are number of exercises to strengthen the back, abdominal and pelvic girdle muscle. The following are the three most important that should be done daily, similar to brushing the teeth (with permission of Swiss Golf Medical Center, Schulthess Clinic, Zurich, Switzerland). A more comprehensive program is available at <https://www.youtube.com/watch?v=JTU-DKOilbo>.

## EXERCISE 1



**Positioning and setup:** Lying position (if it is more comfortable place a cushion under the head). Push the golf club with the left hand against the right foot with the right hip bent to 90° and inhale.

**Procedure:** During exhalation, press the abdominal muscles towards the spine, stretch the left leg and right arm towards the floor. Then return to position of the setup. Repeat the procedure 5 to 10 times for each side with two follow-up series.

**Caution:** During the entire exercise the lumbar spine has to keep in contact with the floor.

**Aim of the exercise:** Strengthening of the lower back and abdominal muscles.

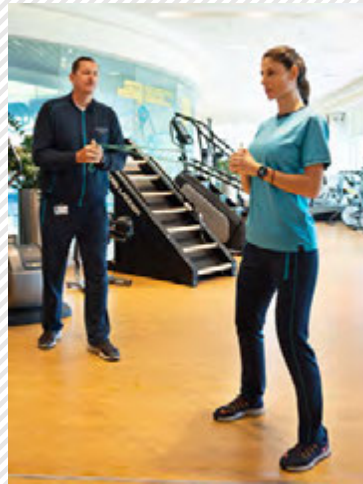
## EXERCISE 2

**Positioning and set up:** Standing position with slightly abducted legs, the rubber band is placed under tension fixed on an object or being held by a partner. In front of chest (Partner exercises have good motivating factor), inhale.

**Procedure:** During exhalation, the stomach muscles are pressing against the spine and the arms are stretched outwards. During inhalation the arms are returning to the set up position. 10 repetition for each side with two follow-up series

**Caution:** the rubber band has to be stretched straight forward resisting the rotation

**Aim of the exercise:** Strengthening of the trunk rotatory muscles through counter rotation.



## EXERCISE 3

**Positioning and setup:** Golf position, the rubber band is fixed to the shaft, the golf club is held in front of the chest while standing to the side of the rubber band.

**Procedure:** Perform a backswing then push the body 90 degrees aiming to the achieve a follow through position, while stretching the arm forwards. Hold the end position with consistent tension of the upper body. Perform 10 repetitions for each side with two consecutive settings.

**Caution:** At the end position the body weight is transferred to the front leg the back hill is slightly elevated, the stomach point to the aim, the lower body and shoulder are in vertical line over each other and the deep stomach muscles are under tension.

**Aim of the exercise:** Functional strengthening of the rotatory core muscles.





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**Image:** Illustration

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