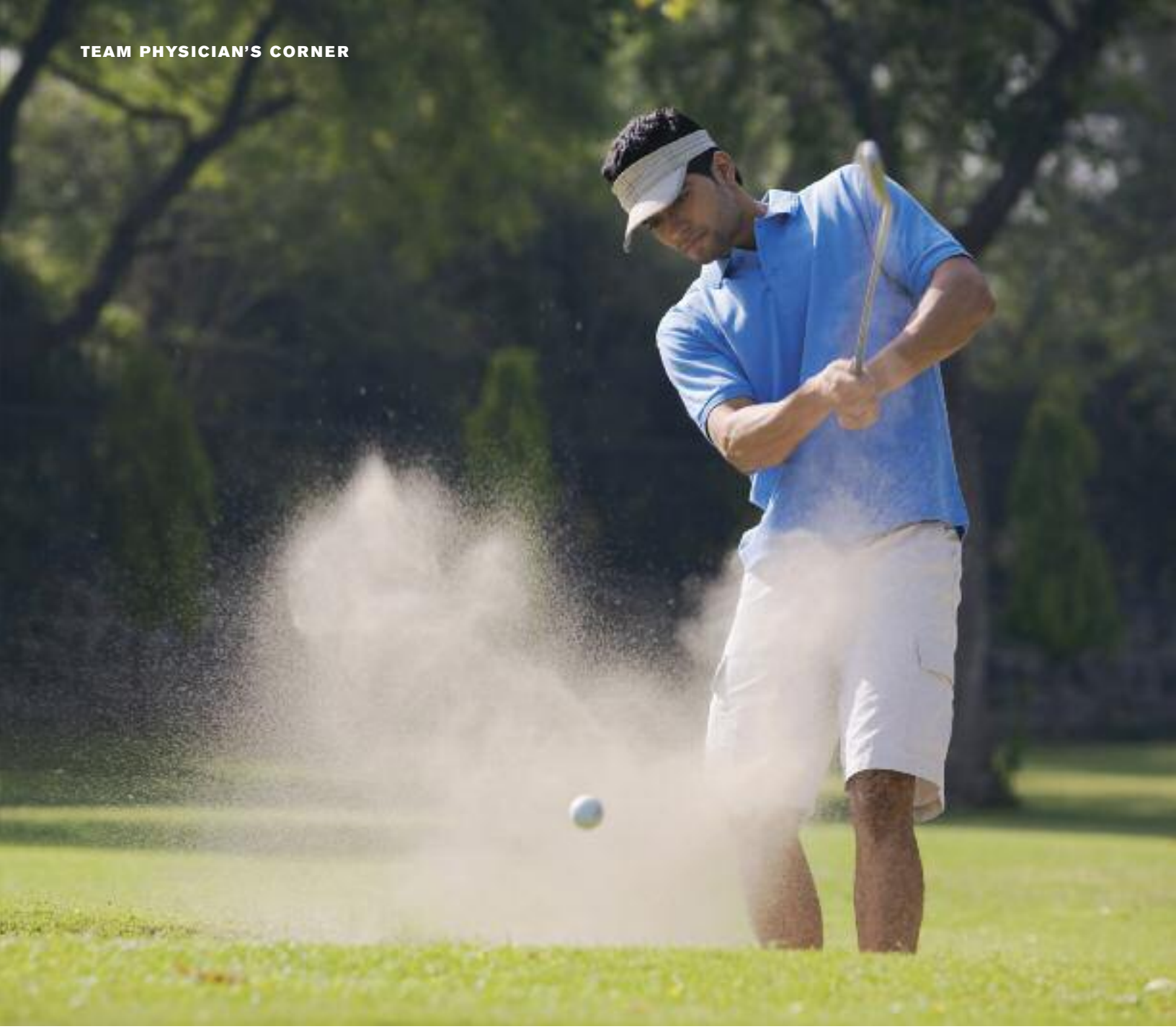

Golf Injuries

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Golf is a popular international sport, with participation extending across all ages and abilities around the globe. Arising from its origins on the eastern links of Scotland as early as the fifteenth century, the game of golf has experienced a surge in popularity in the United States in recent history.

This can be attributed at least in part to expanding television coverage, the increasingly diverse array of golf courses designed by famous developers, the introduction of the game to younger players through golf instructional programs and camps, and the emergence of professional icons across several generations such as Bobby Jones, Arnold Palmer, Jack Nicklaus, and Tiger Woods. The National Golf Foundation estimates there were 28.6 million golfers in the United States in 2008, and more than 60 million golfers playing on over 32,000 golf courses around the world.[2,5]

Epidemiology

While sometimes considered a low-risk sport, the demands of the golf swing as well as the volume of practice and play required to improve one's ability can contribute to a significant number of injuries in both amateur and professional players. A recent large epidemiological study found that throughout a 2-year period, 60% of professionals and 40% of amateurs experienced an injury that removed them from play.[7] While some acute, traumatic injuries do occur, the majority of golf injuries are related to overuse.

Overuse injuries have been reported to account for up to 82% of all golf injuries.[7] In one survey, too much play or practice was the most commonly reported mechanism of injury in both professionals and amateurs.[10] Amateurs also commonly report poor swing mechanics and unintentionally hitting the ground as contributing to a large portion of their injuries.[1] One study has established a correlation between increased time spent on the golf course or driving range and higher rates of injury. This study reported that golfers who hit more than 200 practice balls per week or played four or more rounds in a week sustained significantly more injuries to the back, shoulder, wrist, and hand.[7]

Anatomic Distribution of Injury

Golf injuries can be characterized by the region of the body affected, such as the upper extremity, lower extremity, spine, and head. Studies have reported that 54% of all golf injuries occur in the upper extremity, including the shoulder, wrist, elbow, and hand.[7] The spine is typically reported as the next most frequently affected region of the body, followed by the lower extremity, and head. There is a reported difference in anatomic distribution of injuries between professionals and amateurs.[14] The most common injuries in professional golfers include back injuries, followed by wrist, and then shoulder injuries. The top three locations of injury in amateurs have been reported to be the elbow, back, and shoulder, respectively.[7] Furthermore, the distribution of injuries at the elbow, wrist, and hand tend to differ between professionals and amateurs. Professionals tend to be less prone to injury of the elbow, but appear to be more vulnerable to wrist and hand injuries.[13] In this article, we will discuss the most commonly affected regions of the body with a more detailed look at the potential for both acute and chronic injury.

Professional vs. Amateur

Not surprisingly, the number of injuries per player increases along with skill level, likely due to the increased number of rounds of golf played and range balls hit while practicing to maintain or improve one's ability. Multiple studies have reported between 1.16 and 2.07 injuries per player in amateurs, compared with professionals experiencing between 2.07 and 3.06 injuries per player.[1,7,11] The frequency of injury amongst amateurs has also been stratified by handicap, with a 59% rate of injury in those with handicaps greater than 18, a 62% injury rate in those with handicaps between 10 and 17, and a 68% injury rate in those with handicaps less than 10.[12]

Injury Severity

The severity of golfing injuries is often underestimated. Overall, golf injuries have been reported to contribute to an average of 28 days of lost play per injury, with the injuries to the thoracic and lumbar spine, elbow, and wrist accounting for the longest absences from play.[7] Minor injuries, defined as absence from golf for less than one week, are the most common, accounting for more than 51% of all injuries.[7] Despite that, there is still a significant potential for major injury, with almost 30% of injuries leading to more than 1 month of lost time from play.[7] A high percentage of those injuries that cause chronic symptoms, defined as lasting for longer than 1 year, have been reported to occur in the knee (30%) and back (18%).[7]

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Risk Factors

In addition to the number of rounds played and practice balls hit per week, several other risk factors for injury have been identified in the literature. Failure to warm up for at least 10 minutes before playing has been shown to more than double one's risk for injury (from 0.41 injuries per player who warmed up to 1.02 injuries per player who failed to do so).[7] Carrying one's golf bag also increases one's risk of injury, contributing to a reported increase in injuries to the lower back, shoulder, and ankle.[7] Finally, poor

conditioning and faulty swing mechanics have also been shown to be independent risk factors for injury in amateur golfers.[1,10]

Gender Differences

Both male and female golfers, at both the professional and amateur levels, sustain more frequent injuries in the lead arm, i.e., the left shoulder, elbow, wrist, and hand for a right-handed golfer.[13] Studies of the overall distribution of golf injuries by anatomical site looking for gender differences have shown a similar pattern for male and female golfers, with a single exception.[10,12] There is an observed trend for a lower frequency of injuries in the spine as compared to the upper extremity in both professional and amateur females when compared to their male counterparts. There are several potential explanations for the relatively higher rates of spine injury in males, but the leading theory is related to swing mechanics. Males generally have higher swing velocities, which is at least in part generated by the increased torque generated from the mechanics of a greater trunk rotation during the swing. This increased spinal rotational movement, while contributing to faster swing velocity, is also thought to result in an increased risk of injury to the spine in male golfers.[13]

Golf Injuries by Anatomic Location

Elbow

Traumatic injuries to the elbow can result from striking an object other than the ball, such as a rock, tree root, or the ground in the act of taking a large divot. Elbow injuries can also arise when the forearm flexors are strained from the rapid deceleration of the club when hitting out of the long rough. Overuse injuries can be a consequence of faulty swing mechanics, such as repetitively gripping the club too tightly. Lateral and medial epicondylitis are the two most common elbow problems in golfers.[2,13]

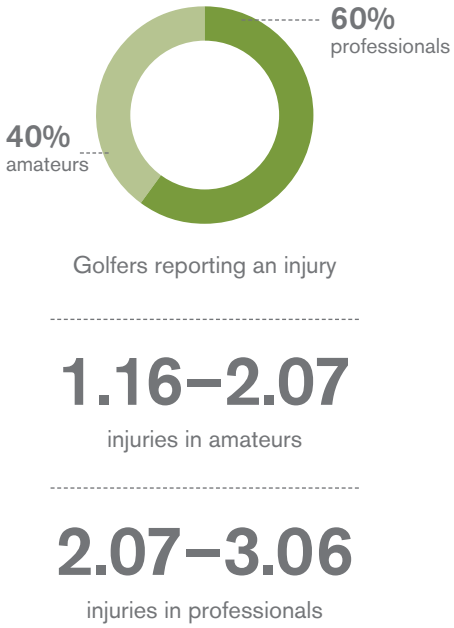
Lateral epicondylitis most commonly involves the lead arm and is usually an overuse injury due to the vigorous, repetitive contraction of the extensor carpi radialis brevis (ECRB) resulting from gripping the club too tightly.[3] The lead arm forearm extensors experience high stress at impact when they serve to stabilize the wrist, and hitting the ground firmly at impact adds to this stress. Ironically, amateurs have been shown to experience lateral epicondylitis, or "tennis elbow," five times more frequently than classic "golfer's elbow," or medial epicondylitis, likely due to the tendency to grip the club too tightly.[2,12] Symptoms include pain in the lateral elbow with gripping or shaking hands, and tenderness at the ECRB origin. Nonoperative modalities such as icing, non-steroidal anti-inflammatories, and a course of rehabilitation are commonly initiated at the onset of symptoms. Adjunct treatments such as counterforce bracing or injections with corticosteroids or platelet-rich plasma are used for more refractory cases. Surgery is typically considered only after 6–12 months of failed non-operative measures, with a high rate of success with both open and arthroscopic techniques reported.[4]

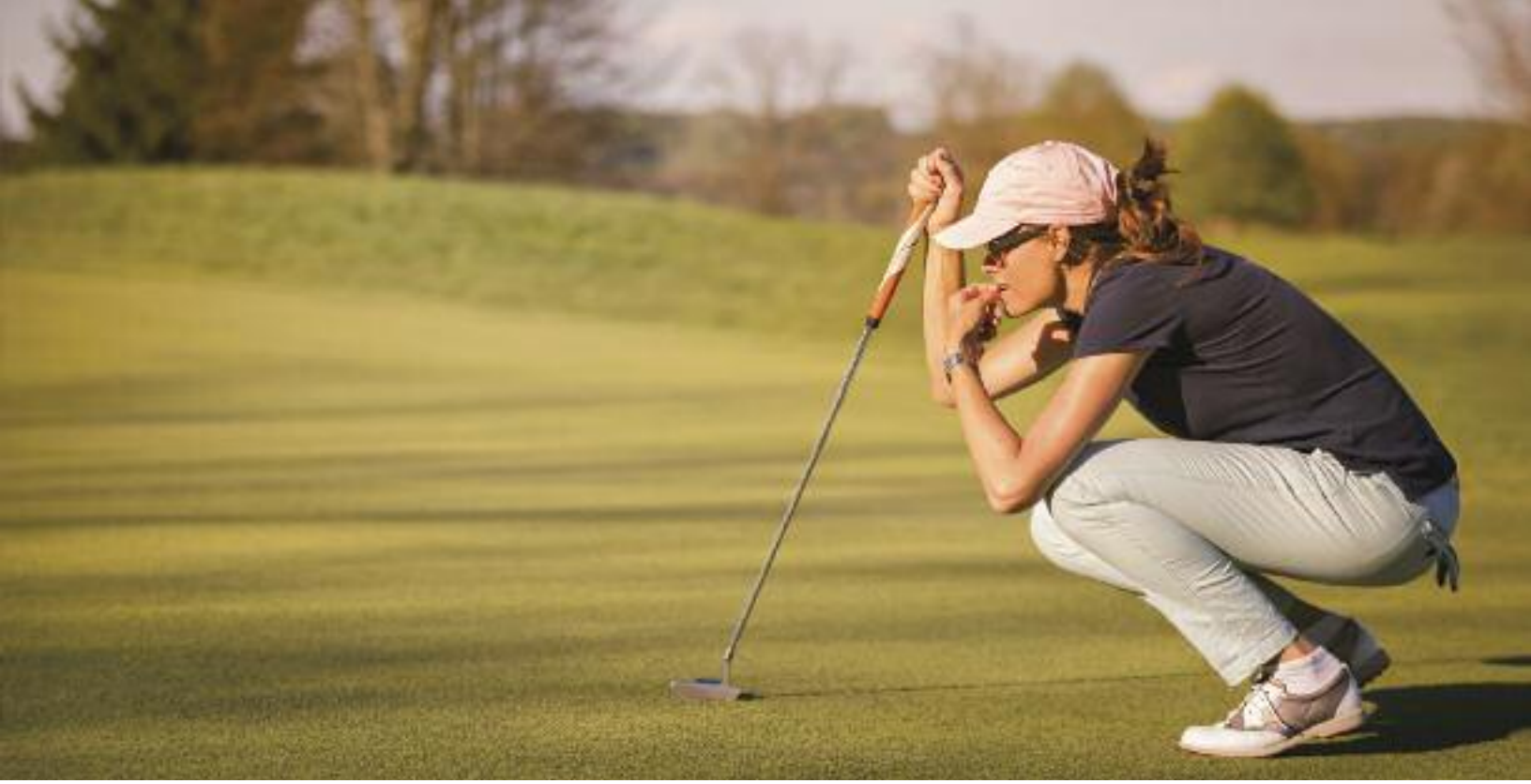
Medial epicondylitis, or "golfer's elbow," occurs more often in the trail arm either as a result of repetitive, excessive muscular contraction, or after a single traumatic force such as inadvertently striking an immobile object with the club. Nonoperative treatment of medial epicondylitis is similar to that of lateral epicondylitis, including a combination of rest, ice, non-steroidal anti-inflammatories, physical therapy, bracing, and injections. Operative treatment involves the open debridement of pathologic tissue and repair of the flexor origin, commonly involving the flexor carpi radialis and pronator teres. Symptoms of ulnar nerve compression have been described in up to 24% of patients treated for medial epicondylitis, and nerve transposition should be a consideration in these cases.[2]

Wrist

It is not surprising that the wrist is a common site of injury for golfers, considering the extensive range of motion that both wrists must travel through to execute a proper swing. Most wrist injuries occur at the moment of impact, and result from the traumatic, sudden deceleration

The Professional vs. Amateur Golfer





of the club. Amateurs typically experience these injuries when hitting a "fat" shot, while professionals tend to get injured hitting a rock, tree root, or particularly thick rough. Three common resulting injuries include flexor carpi ulnaris tendinitis, extensor carpi ulnaris dislocation, and hook of the hamate fracture.

Overuse tendinitis of the wrist typically involves the lead arm, and can be associated with excessive radial deviation of the left wrist or thumb extension at the top of the backswing.[2] Extensor carpi ulnaris (ECU) instability results when the ECU tendon sheath is ruptured during a sudden flexion, ulnar deviation, supination movement, and can lead to painful snapping during repeated pronosupination.[2] Typically, a 2-month period of splint and then brace immobilization is recommended prior to surgical intervention with either direct repair or reconstruction of the ECU sheath. Fractures of the hook of the hamate occur when a severe compressive force is transmitted through the butt of the golf club to the upper hand (left hand in a right-handed swing) during a particularly forceful ground strike. Standard radiographs can miss the diagnosis, and special radiographic techniques such as the carpal tunnel view or CT scan should be used when the condition is suspected. Initial treatment typically involves immobilizing the wrist to allow for fracture healing, but persistent symptoms or the onset of associated neuropathy or tendon irritation can prompt surgical intervention with fracture fragment excision.[2,13]

Dorsolumbar Spine

The golf swing produces large loads in the spine, especially the dorsolumbar region, and acts across four primary directions: lateral flexion, anteroposterior traction, rotation, and compression.[13] The intense loads generated from downswing through follow-through can strain muscles, injure facet joints and lumbar discs, and cause injury to the posterior arc leading to spondylolysis.[6] In the older populations, the increased incidence of osteoporosis additionally places these golfers at risk for vertebral and rib stress fractures.[6] Additionally, since the intervertebral disks play a significant role in cushioning and providing the capacity for angular trunk rotation, any degree of disk degeneration will limit the power of the swing and make other spinal components vulnerable to injury.[13]

Paraspinal muscle injuries, such as tears and strains, are common in golfers, especially with the advent of the modern golf swing. The modern swing emphasizes more separation of the hips and shoulders in angular rotation, as well as a progressive downswing in which the hips lead the upper body and continue through impact where the hips are more open to the target than the shoulders. The "reverse-C" follow-through position places additional stress on the lumbar facet joints due to increased hyperextension, especially concerning in aging golfers predisposed to injury by pre-existing spinal degeneration.[6]

Most dorsolumbar conditions can be improved through rest, anti-inflammatory medications, physical therapy, traction or manipulation, and a lower back-focused exercise regimen designed to restore and maintain flexibility and core strength. Long-term management of lower back pain is centered on developing good habits

such as a thorough pre-participation warm-up routine, core strengthening exercises, and improvement in technique and swing mechanics. One study reports a 79% return to sport rate for golfers following symptomatic disc herniation, at an average of less than 5 months.[9]

Several preventive measures suggested to help with dorsolumbar spine injuries include:

- Maintaining a straighter back posture during the golf swing and weight transfer
- Controlling speed of swing during trunk rotation
- Reduction of the shoulder range of motion and trunk angular motion
- Improving dorsolumbar conditioning through flexibility and muscular strengthening exercises
- Use of a lumbar corset if needed.[13]

Shoulder

Most shoulder injuries are due to overuse and are related to the mechanics of shoulder rotation during the swing, as well as the cross-arm position required during both the backswing and follow-through. Acromioclavicular joint arthrosis can lead to pain in the lead shoulder at the top of the backswing, as well as contribute to subacromial rotator cuff impingement and bursal-sided tears in older patients with chronic spurring.[2] Both young and older golfers are susceptible to shoulder impingement due to the excessive range of motion required at both the beginning and end of the swing. External impingement can lead to inflamed bursal tissue and partial rotator cuff tears, while internal impingement can lead to labral tears, articular-sided rotator cuff tears, and humeral head articular cartilage lesions.[2] The damage can be enhanced by certain predisposing risk factors such as:

- Glenohumeral joint hyperlaxity or instability in younger players
- Weak or imbalanced rotator cuff musculature
- Tight and constricted posterior capsule in young or old players alike[13]

Summary

In summary, golf may be considered a rather safe activity for players of all ages and abilities, as long as the risks of overuse and traumatic injury can be avoided. The majority of golfing injuries are related to overuse problems, with the number one preventable risk factor being the amount of time spent playing or practicing the game. To reduce the risk of golfing injuries, players should consider warming up for at least 10 minutes per round or practice session, reducing their frequency of play to less than 4 rounds and 200 practice shots per week, and avoiding carrying their bag. Many overuse injuries can also be prevented by adopting a year-round physical conditioning program that focuses on muscular strengthening, flexibility, and aerobic conditioning.

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