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Evaluation of Sleep Position for Possible Nightly Aggravation and Delay of Healing in Tennis Elbow

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Abstract

Introduction: Tennis elbow symptoms are reportedly most severe in the morning, which prompted a search for a pathological process while asleep. A “pathological sleep position” was hypothesized that repetitively aggravates an elbow lesion if the arm is overhead and pressure is on the lateral elbow. This hypothesis was tested by using a restraint to keep the arm down while asleep.

Methods: This study was a retrospective review. All patients were advised to use a restraint to keep the arm down at night. The presence of the restraint in the morning was correlated with the subjective report. The control group consisted of the noncompliant patients.

Results: Compliance and subjective improvement was documented in 33 of 39 patients (85%). Subjective improvement was reported by 66% of the compliant patients after 1 month. Pain continued after the first 3 months only in 6 of 39 noncompliant patients (15%).

Discussion: In this pilot study, patients who kept the arm down at night improved, whereas patients who were noncompliant continued to be symptomatic. Sleep position should be considered as a possible aggravating factor that delays healing of an acute injury and results in chronic pain. If validated, keeping the arm down at night can be recommended for tennis elbow.

Chronic lateral elbow pain (tennis elbow) is a common, frustrating, and idiopathic condition.¹⁻³ Surgical and nonsurgical treatments are generally ineffective. Multiple attempts have been undertaken to understand this condition without success. Even the name of this condition is controversial depending on the presumed pathophysiology: tennis elbow, lat-

eral epicondylitis, and lateral epicondylitis.⁴ It is completely unknown why an acute injury does not heal but instead takes up to 2 years to resolve. This pilot study attempts to answer the question posed by the director of the National Institutes of Health: What prevents healing of an acute injury that transitions into chronic pain?⁵

Figure 1



Photograph showing an example of pressure on the lateral elbow while sleeping with the arm overhead.

Figure 2



Photographs showing a restraint made from the belt from a robe. Two knots can make a small loop for the wrist and a large loop above the knee.

A little known clinical observation was considered in formulating a novel hypothesis about lateral elbow pain: Symptoms are frequently the worst in the morning after awakening from sleep.⁶ When asked, patients will describe extreme pain while holding a cup of coffee or trying to brush one's teeth in the morning. Pain is present throughout the day, but the pain is worst in the morning. This observation suggested that a pathological process was possibly occurring at night. Could a "pathological sleep position" delay healing of a primary acute lesion of the lateral elbow?

Isolated reports have previously documented that nocturnal malposition can be pathological in other conditions. Night splints are used for carpal and cubital tunnel syndrome to prevent joint hyperflexion and nerve compression.⁷⁻¹⁰ Night splints are also recommended for plantar fasciitis, a condition that is exquisitely painful in the morning.¹¹ The overhead arm position is hypothesized to cause nocturnal shoulder and neck pain.¹² Gastroesophageal

reflux disease is aggravated by sleeping in the left lateral decubitus position.¹³ Irritation of the cornea can occur from mechanical ocular pressure while asleep.¹⁴ Although musculoskeletal complaints are common at night, the best research on sleep positions was performed in 1930 according to De Koninck.^{15,16}

Side sleeping with the arm overhead is the most common sleep position, representing 55% of the time asleep in bed.^{16,17} It was hypothesized in this study that when the arm is overhead, mechanical pressure could be applied to the lateral elbow (Figure 1). If an initial lateral elbow lesion was present, local mechanical pressure could hypothetically aggravate the initial lesion on a repetitive nightly basis while asleep. Nightly aggravation could delay healing of the initial lesion and also explain the severe morning pain. It was hypothesized that if the overhead position is pathological, keeping the arm down while asleep would be beneficial. To test this theory, a therapeutic study was designed that used a restraint (Figure 2) to keep the

arm down while asleep. The result of this study confirmed the benefit of keeping the arm down, which suggests that the overhead sleep position is pathological.

Methods

This level 3 therapeutic case study was analyzed retrospectively. The study consisted of consecutive patients who were diagnosed with tennis elbow on the clinical basis of reported chronic pain in the lateral elbow, local tenderness at the lateral epicondyle and/or the extensor wad of muscles, aggravation by active wrist extension, and a negative radiograph. Patients were queried regarding the onset and duration of symptoms, previous treatments, severity and the timing of the most severe symptoms, sleep position habits if known, handedness, occupation, and hobbies. After a discussion and informed consent, patients were advised to use a restraint (Figure 2) to keep their arm down while asleep.

The cloth belt from a bathrobe was the principal device used to loosely

tether the ipsilateral wrist and thigh on the affected side. The belt was tied with two knots into a figure-of-8 shape. If bilateral, patients were advised to sleep with both arms inside of a long night shirt, without placing the arms into the sleeves. Patients were asked to keep a daily diary recording if the restraint was on or off in the morning, which became the principal measured variable. If the restraint was on in the morning, it was assumed that the arm was down all night. If the restraint was off in the morning, that was a noncompliant night and the sleep position was unknown. Patients were asked to record the subjective benefit in a binary way: improved or not improved? Visual analog pain scores were requested at the 2-year follow-up. Patients were asked about the difficulty using the restraint and if they would recommend this treatment. Patients were also advised to avoid repetitive and painful elbow activities during the daytime, including aggressive physical therapies. Rest, ice packs, and acetaminophen were advised for controlling pain. Patients were asked to follow-up monthly for the first 3 months and at 2 years. The results were obtained from chart review and telephone survey and registered on a survey form by one supervised staff member. Institutional review board approval was obtained. After the study was completed, the noncompliant patients were identified as an internal control group because they shared unique and similar important findings.

Results

Forty-six patients were diagnosed with tennis elbow and treated. Seven patients were lost to follow-up, leaving 39 patients in the study. Age ranged between 23 and 81 years with a median age of 47 years. The

study included 23 men and 16 women. The minimum follow-up was 2 years. All patients reported that they attempted to use the restraint.

Six patients (15%, 6/39) (five men and one woman) were noncompliant with the use of the restraint and considered as treatment failures. Treatment failures had ongoing tennis elbow symptoms that persisted unchanged over the initial 3-month study period. They said that the restraint prevented falling asleep or staying asleep, and they would not recommend the restraint. The treatment failures were recognized to share the same complaints and, on that basis, were considered as an internal control group.

Thirty-three patients (85%, 33/39) (18 men and 15 women) reported successful compliance with the restraint. Twenty-two of the compliant patients (66%, 22/33) reported subjective improvement in 1 month. All compliant patients reported subjective improvement within 3 months. Compliance was a major issue reported by the compliant patients and the noncompliant patients. Overall, 82% (27/33) of the compliant patients reported 75% compliance or better meaning that the restraint was on when they awoke 3 of 4 days. All of the compliant patients would recommend the restraint.

Using the Fisher exact test, the difference between the compliant and the noncompliant groups in the proportion with symptom improvement in 3 months was significant ($P < 0.001$). That is, 100% of the 33 compliant patients and 0% of the 6 noncompliant patients had symptom improvement in 3 months. The rate of improvement was analyzed to see whether it correlated with better compliance, but the data are underpowered.

Other than insomnia, the use of the restraint was uncomplicated in all

patients. At the 2-year follow-up, 27 of 33 compliant patients (82%) reported that they had stopped using the restraint, and they had returned to sleeping with the arm overhead without any notable complaints. All compliant patients had remained asymptomatic after initial healing, and no symptom recurrence or complaints were found.

Discussion

This pilot study investigated whether the early morning severity of tennis elbow symptoms might be the result of repetitive injury of an initial primary lesion while asleep. On the basis of previous investigations, a “pathological sleep position” was hypothesized to exist. The overhead arm position was tested to determine whether it contributed to mechanical aggravation and nightly generation of chronic pain. If the arm is overhead, a very common sleep position, applying pressure to the lateral elbow is possible, which could aggravate a primary lesion if present. Sleep positions are extremely habitual, so patients would continue to sleep in their habitual sleep positions even after an injury such as a lateral elbow sprain. This proposed mechanism would explain the nighttime complaints, the increased morning severity, and the delay in expected healing of a mechanical sprain-strain type of primary lesion.

This hypothesis was tested by changing the arm overhead sleep position. As sleep is a state of unconsciousness in which the position is unknown, the presence or not of the restraint in the morning yielded objective proof that the arm was down. It was found that changing sleep positions was challenging for both the compliant and the noncompliant patients, and compliance was a major issue. A subset of patients who were completely

noncompliant was identified retrospectively. This cohort was analyzed separately and, based on the findings, considered as an internal control group, although a control was not in the initial design.¹⁸ Although small in number, the patients in the control group all continued to have symptoms that were unchanged over the initial 3-month period of the study, and they would not recommend the restraint. By sharp contrast, 90% of the compliant patients reported improvement within 2 months, and they would recommend the restraint.

If the restraint is on in the morning, patients were physically unable to raise the arm overhead during the night. Keeping the arm down is thought to prevent repetitive aggravation of a primary lesion and allow for healing to occur. Patients who successfully kept the arm down improved while symptoms persisted only in the control group who did not use the restraint. The likelihood that the compliant patients reported improvement within 3 months is statistically significant ($P < 0.001$ Fisher exact test). Although spontaneous healing occurs in the natural history, it is unlikely that all 33 compliant patients' improvement within 3 months resulted from random chance or by gradual improvement as would be expected over time. Although the results of this pilot study are extremely encouraging, independent validation of these results will be necessary before recommending this treatment.

Because side sleeping with the arm overhead is the most common of nocturnal positions and is reported to be 55% of the time spent asleep in bed, this sleep position cannot account for the lateral elbow pain. A primary lesion appears to be necessary in order for nightly aggravation to occur, leading to the classic picture of tennis elbow. It is of interest that many patients reported discontinuing

the restraint and returning to sleep in the overhead arm position after 3 months following resolution of symptoms, without any recurrence of symptoms. This phenomenon suggests that the overhead arm position is a common and habitual position of comfort.

The ability to awaken in the morning and document whether the restraint was on or off yielded meaningful objective data that were patient reported. This novel methodology obviates the need for direct sleep laboratory observations. Patient-generated data have been challenged, and sleep laboratory studies might ideally best provide validation of this report. Little objective research of sleep and the musculoskeletal system has been performed, perhaps, because level 1 sleep laboratory analysis is highly impractical and expensive. The current methodology may make sleep laboratory validation unnecessary. In the future, better assessment of pressures and body positions can be achieved with improved technology such as the use of smart wearable sensors while asleep.

Although reliance on patient-reported results is one of the weaknesses of this study, the concept has been validated.¹⁹ Another study limitation is the lack of quantitative measures such as the American Shoulder and Elbow Surgeons' elbow rating or the use of the visual analog scale early in this study. A visual analog scale was used at follow-up to measure patient satisfaction and outcome. The initial subjective outcomes were reported as either improved or unimproved, which has merit in a pilot study. Another weakness of this pilot study and therapeutic studies in general is the lack of a randomized control group. Although all patients were offered the same intervention, the noncompliant patients continued to be symptomatic and served an

important and instructive role as an internal control group.

Musculoskeletal complaints are commonly associated with sleep, and sleep represents one-third of our lives. Sadly, research into the orthopaedic aspects of sleep is scant. Sleep position can be considered in the etiology of other enigmatic conditions and chronic pain syndromes: Nocturnal shoulder pain, painless rotator cuff degeneration, "spontaneous" rotator cuff rupture, the seemingly asymptomatic shoulder, and idiopathic neck pain are candidates for further study of the overhead arm position at night.

Considering that tennis elbow is idiopathic, frustrating to treat, and self-limited, and on the basis of the results of this pilot study, the use of a night restraint to keep the arm down is highly recommended. Changing sleep habits is difficult, so variable compliance including complete non-compliance can be expected. The very promising result of this pilot study suggests that further study is warranted, which might include design of a decompression device to off load the lateral elbow that might improve compliance. If this report is validated, tennis elbow can be understood as an initial mechanical lesion that undergoes repetitive nightly aggravation in a pathological sleep position. Tennis elbow should be added to the list of other established conditions known to be associated with pathological sleep positions.

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