

## Left-Hand Injuries in Guitarists: Literature Review and Some Solutions

### *Lesões de Mão Esquerda em Violonistas: Revisão da Literatura e Algumas Soluções*

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**Abstract:** Guitarists are susceptible to multiple injuries directly related to faulty left-hand technique: carpal tunnel syndrome, lateral epicondylitis, median epicondylitis, neuropathy of the ulnar nerve, supinator syndrome, osteoarthritis and capsulitis of the first carpometacarpal and digital neuritis. A literature review shows that the causes of these injuries are all related to excessive flexion or extension of the wrist, exaggerated bending of the elbow, prolonged periods of maximal supination of the wrist and large amounts of tensioned positions. The article analyzes guitar left-hand technique and proposes technical and postural approaches that address these causes and theoretically decrease the risk of playing-related injuries.

**Keywords:** Classical guitar technique; Musician's health; Left-hand injuries; Injury prevention.

**Resumo:** Violonistas estão expostos a múltiplas lesões diretamente relacionadas a técnica problemática de mão esquerda: Síndrome do túnel do carpo, epicondilite lateral, epicondilite mediana, neuropatia do nervo ulnar, síndrome do supinador, osteoartrite e capsulite do primeiro carpometacarpo e neurite digital. A revisão literária mostra que as causas dessas lesões convergem para flexão ou extensão excessiva do punho, flexão exagerada de cotovelo, prolongados períodos em máxima supinação do punho e grandes quantidades de posições tensionadas. O artigo analisa a técnica violonística de mão esquerda e propõe soluções técnicas e posturais que abordam as causas e teoricamente reduzem os riscos de lesões relacionadas a prática instrumental.

**Palavras-chave:** Técnica violonística; Saúde do músico; Lesões de mão esquerda; Prevenção de lesões.

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## 1 – Guitarists and Left-Hand Injuries

From the early technical concepts of Fernando Sor and Dionisio Aguado to more polished ones encountered in the publications of Abel Carlevaro, Christopher Parkening and Scott Tennant, the refinement of left-hand technique has allowed guitarists to reach a level of artistry and musical accuracy never before achieved. Though these, among other guitar masters, include relaxation as a foundation of guitar technique, their focus on execution never filled the gap of injury prevention.

Left-hand injuries threaten guitarists, teachers and students. SUNG et al. (2013, p.1653) states that guitar players have a higher incident rate of overuse syndrome than orchestra players, and that 45% of such injuries are “strongly tied to the hand and wrist.” The authors attribute the high

incidence of such injuries in guitarists to the fact that these players exert “excessive strain on the hand and wrist” (SUNG et al., 2013, p.1653). To guitarists, the left arm and hand work together with the goal of fretting the strings and without an effective technique, it may require repetitive motion or tensioned gestures that overload muscles and cause injuries. A literature review shows carpal tunnel syndrome, lateral epicondylitis, median epicondylitis, neuropathy of the ulnar nerve, supinator syndrome, osteoarthritis and capsulitis of the first carpometacarpal and digital neuritis as some of the most frequent in the left arm and hand of guitarists. This article investigates the causes of left arm and hand injuries and proposes a technical approach that theoretically decreases their risks.

## 2 - Identifying Injuries and its Causes

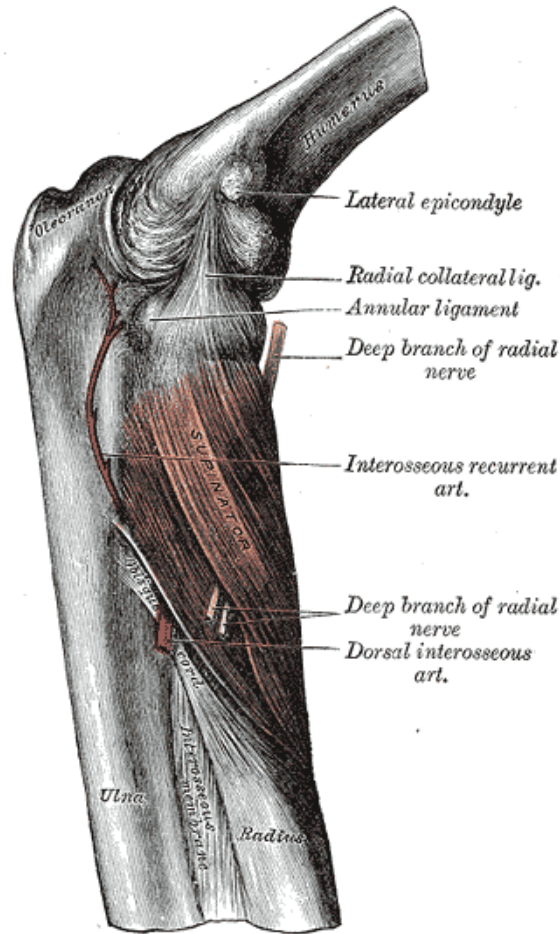
Guitarists are exposed to the risk of the common nerve entrapment known as “carpal tunnel syndrome.” This entrapment occurs when the median nerve is pressured, compressed or inflamed at the wrist.<sup>1</sup> Guitarists create these conditions in the left hand when they bend the wrist too much when playing, which generates pressure on the median nerve, contributing to this injury (MCGOWAN, 2005, p.42-46).

Bending the wrist too much is in fact a trigger for multiple injuries. Known as “tennis elbow,” lateral epicondylitis is not limited to this group of athletes, and it is just as common in guitarists (RUEDA, 2006, p.71-72). Per RUEDA (2006, p.71-72), forced wrist extension combined with repetitive finger movements are the causes of this injury, which is generally manifested as a local pain on the outer side of the elbow or forearm, possibly expanding to the wrist, hand or shoulder. If wrist extension contributes to lateral epicondylitis, wrist flexion is a risk factor for medial epicondylitis, also known as “golfer’s elbow.” RUEDA (2006, p.71-72) states that this injury is aggravated by extended “unsafe” wrist flexion, along with the playing motion of flexion and extension of the fingers to push the strings. She explains that this type of tendonitis “affects the inner elbow at the point where it is attached to the flexor muscle of the fingers and the wrist flexors,” and that it can be particularly damaging to guitarists as the affected areas are largely used in left hand finger movements (RUEDA, 2006, p.72).

Neuropathy of the ulnar nerve (ulnaropathy) in the cubital tunnel at the elbow, is an injury with surprisingly high incidence in musicians. According to RIETVELD (2013, p.432), ulnaropathy represents up to 9% of all musicians’ injuries and is caused by the intense use of the ulnar nerve during music making as it innervates almost all intrinsic hand muscles. The author points out that significant flexion of the elbow over extended periods of time stretches the ulnar nerve in the cubital tunnel increasing the risk of this injury, placing guitarists at a particularly high risk since their left elbow is often flexed at acute angles (RIETVELD, 2013, p.432). Besides ulnaropathy, the left arm positioning used in guitar playing may also cause supinator syndrome. This syndrome may occur when the left arm is used in maximal supination for extended periods, causing an entrapment of the deep branch of the radial nerve in the supinator muscle (RIETVELD, 2013, p.433) (See **Figure 1**).

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<sup>1</sup> Center for Peripheral Neuropathy. The University of Chicago. Last modified April 16, 2010, <http://peripheralneuropathycenter.uchicago.edu/learnaboutpn/typesofpn/compression/carpaltunnel.shtml> (accessed April 24, 2017).



**Figure 1:** Deep branch of radial nerve. (GRAY, 2016).

Bar chords can trigger a series of left-hand injuries. Digital neuritis, the result of an entrapment of the collateral finger nerve, often occurs because of them. RUEDA (2006, p.76) explains that the pressure applied to the side of the left index finger when performing bar chords can affect its small nerves and disrupt sensation. Bar chords may also generate an intense work-related strain of the carpometacarpal joints that could be risk factors for osteoarthritis of the first carpometacarpal joint (JENSEN and SHERSON, 2007, p.456). This injury is common in guitarists and occurs due to the gradual deterioration of the protective cartilage on the ends of the bones.<sup>2</sup>

Guitarists may also develop a joint condition called capsulitis of the trapeziometacarpal thumb joint because of bar chords. RUEDA (2006, p.74) states that this injury is an inflammation on the joint capsule that can be caused by an excessively hard grip on the guitar neck. She explains that when a joint is subject to excess or repetitive pressure, it may react by producing more synovial fluid in order to absorb impact. This will cause the joint to swell, triggering pain and limiting movement (RUEDA, 2006, p.74). RUEDA (2006, p.70) also warns that the muscles at the base of the thumb are prone to overload when bar chords and strained positions are performed, becoming still and painful to touch. These symptoms may become more evident after long practice sessions.

<sup>2</sup> Diseases and Conditions: Osteoarthritis. Mayo Clinic. Accessed April 2, 2017, <http://www.mayoclinic.org/diseases-conditions/osteoarthritis/basics/definition/con-20014749>.

Though reducing excessive pressure during performance should help reduce the risk of these injuries, musicians should keep in mind Rueda's advice to limit the practice of bar chords to a few minutes a day (RUEDA, 2006, p.58).

### **3 – Find a Neutral Position With or Without the Guitar**

The literature review shows that most playing-related injuries in the left arm and hand occur due to excessive flexion or extension of the wrist, exaggerated bending of the elbow, prolonged periods of maximal supination of the wrist and large amounts of tensioned positions. This means that the body parts involved in guitar playing are less exposed to the risk of injury when they are relaxed and the joints remain at the midpoint of their range of motion. Though guitarists will unavoidably utilize tensioned positions to reach a chord or to play a passage, they should avoid these positions whenever possible or return to a neutral position after such passages are played so that the stress in the joints, muscles and tendons is at a minimum.

MITCHELL (2015) states that the further from the midpoint the joint is moved, the more easily it will tire and the weaker it will be. Therefore, the fingers should stay “gently curved” as often as possible, even when they are not playing, as this is their midpoint (MITCHELL, 2015). This concept can also be applied to the other joints of the body. The author explains that the tendons and muscles of the forearm extend down into the hands, and therefore, in order to minimize friction on these tissues, the hands and wrists should be in a straight alignment with the forearm, avoiding unnecessary bends (MITCHELL, 2015). GOODWIN (2003) agrees, stating that in order to avoid carpal tunnel syndrome, individuals should try most of the time to keep the wrists at a “near-neutral angle,” neither flexed nor extended. The author explains that the flexed and extended positions put significant strain on the carpal tunnel, with the extended position causing nearly three times as much strain as the flexed position (GOODWIN, 2003). This is valuable information as playing the guitar sometimes uses varying degrees of both. The guitarist should, with the assistance of a proper chair, ergonomic support and a properly sized guitar look for wrist angles that allow an effective playing technique that will not require significant degrees of wrist flexion or extension. If the left hand has excessive flexion, extension, or sideways deviations, adjusting the inclination of the neck of the guitar may help balance the need for such positions.

GOODWIN (2003) also suggests players minimize the amount of time spent closing together the thumb and little finger, which contracts or narrows the palm of the hand. The author states that this movement contributes directly to carpal tunnel pressure (GOODWIN, 2003). Still, closing together the thumb and little finger is used constantly in guitar playing and is therefore unavoidable. The guitarist should simply avoid making it worse by having the hand in this position in other daily activities while away from the instrument. GOODWIN (2003) agrees that if a job requires the use of the hands, leisure activities should not cause additional stress. As an example, the author states that instead of racquet sports, one should consider sports such as soccer.

Regarding elbow positioning, an extremely bent left elbow may cause ulnaropathy. While its treatment consists of using a splint to avoid elbow flexion overnight, a significant portion of its treatment includes diminishing such flexion while playing (RIETVELD, 2013, p.433). To improve the technique of the left arm and place the elbow at a more neutral position, RUEDA (2006, p.76)

suggests that the guitarist analyzes the position of the instrument and its neck in relation to the left arm and adjust its position so that the elbow does not bend too far. The position for the guitar's body and the angle of inclination of its neck should optimize and reduce flexion in the left elbow. The guitarist should also avoid extra-musical activities that utilize elbow flexion to avoid overloading this nerve.

Discussing forearm motion, MITCHELL (2015) points out that their rotation can "add power" to many playing gestures. In the case of guitar, forearm rotations make it possible for the fingers "to fall where they are needed" (MITCHELL, 2015). MITCHELL (2015) emphasizes that the forearm muscles must remain relaxed when forearm rotation is used to "relieve the fingers from awkward positions and unnecessary muscular motion" (MITCHELL, 2015). However, forearm rotation should be used wisely. Per MITCHELL (2015), when "the forearm muscles are tensed in a rotated position, the space between the two bones can become restricted and cause friction in the tendons and connective tissues." The forearm muscles "are optimally relaxed when [the] palms are facing each other," and that "the farther away they are from this position, the more isometric contraction" is needed in the muscles responsible for either supination or pronation of the hands (BASTEPE-GRAY, 2014, p.25).

It is not always possible to achieve a completely neutral position when playing. The inevitable supination of the left wrist generated by the guitar technique increases the risk of supinator syndrome. This injury is common in violinists and violists due to a similar supinated approach to the neck of their instruments (BASTEPE-GRAY, 2014, p.25). Though there is no technical approach to avoid this injury in guitarists, Rietveld states that its treatment revolves around "explanation, specific stretching, and support of supination in daily activities" (RIETVELD, 2013, p.433). As a general rule, paying attention to overall practicing load, resting, and monitoring wrist positioning in other daily activities seem to be the best choice for prevention of this injury.

Though neutral positions are the basis for injury prevention, guitarists should not maintain a fixed position while playing. MITCHELL (2015) believes that slightly deviated positions can be technically efficient in different circumstances of guitar playing and that "joint movement should be flexible and fluid within the midrange of motion." MULDOWNNEY (2010, p. 32) goes further and states that fluid and flexible movements help prevent injuries, reminding us that one of the leading causes of repetitive strain injuries and overuse syndromes is sustaining a rigid or fixed position. Mobility in gestures should be a sign that the hand is operating free of tension. The guitar technique should revolve around neutral positions, but guitarists are encouraged to occasionally explore deviated positions that produce technical and musical benefits.

#### **4 - Thumbs and the Other Fingers**

When discussing injuries related to the thumb technique, authors acknowledge that tension may occur in the left hand of guitarists due to holding a chord too tightly, placing too much pressure on the thumb, flexing the wrist too much, or fretting bar chords. Most of these situations can be addressed by simple improvements in technique. HOGG (2008, p.37) suggests that guitarists use a lighter touch with just enough pressure to keep notes "free of fret buzz" in order to solve the

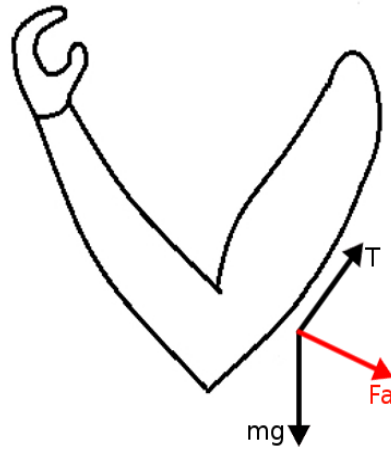
problem of gripping the neck too tightly. However, achieving such a light touch requires first a thorough understanding of the use of the thumb during performance.

MULDOWNEY (2010, p.31) states that correct positioning of the thumb is not only one of the most important factors in maintaining a healthy hand but is also a crucial factor in the correct positioning of the wrist. According to the author, the wrist position is shaped by the placement of the thumb behind the neck. If the thumb is placed too low on the neck, the wrist may end up flexed in an undesirable position; if too high on the neck, strain can result from supinating the wrist (MULDOWNEY, 2010, p.31). If the left hand thumb is left behind on hand shifts, the thumb will not be counterbalancing the strength applied by the other fingers; therefore, excessive strength is required by finger muscles to fret the strings (MULDOWNEY, 2010, p.31). Because these positions may result in unnecessary stress on the hand (BUCKLEY and MANCHESTER, 2006, p.84), the thumb should stay in an optimal position to be able to counterbalance the strength applied by the other fingers, generally staying in the midpoint between the fretting fingers and following the hand shifts to maintain this position. The proper placement of the thumb combined with reduced thumb pressure and limited amounts of bar chords practice should address the main causes of capsulitis of the trapeziometacarpal thumb joint, osteoarthritis of the first carpometacarpal joint and digital neuritis, some of the most common injuries related to bar chords and thumb technique.

Regarding the other left hand fingers, MITCHELL (2015) states that guitarists should release them after playing a note or chord to avoid unnecessary tension. She also states that “fingers should operate independently so that the muscular effort of the finger being used does not result in muscular activity” of the other fingers (MITCHELL, 2015). The author notes that the ring and little fingers are an exception because they operate connectedly and trying to make them work independently may lead to injury (MITCHELL, 2015).

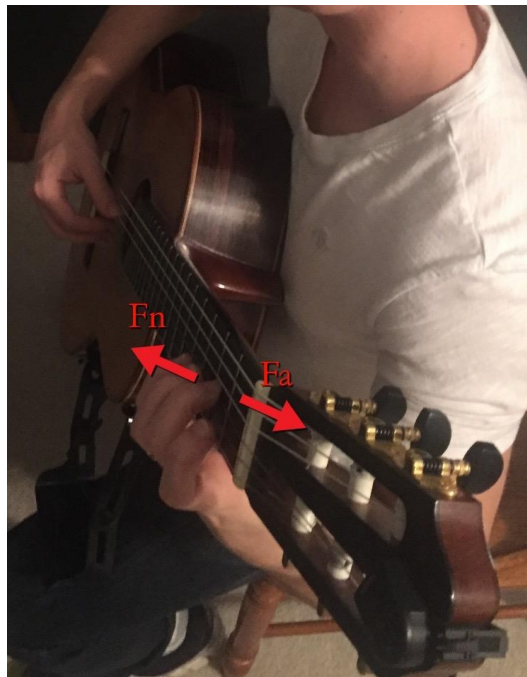
To relieve the tension in the fingers, guitarists should engage larger muscles to properly support the motions of the hand and fingers. BASTEPE-GRAY (2014, p.25) says that the musician’s trunk and shoulders need to support the forearms and hands so they can achieve their optimal functionality. Decreased engagement of the large muscles due to poor biomechanical habits, or due to lack of strength or flexibility, may cause the muscles in the arm and forearm to overcompensate with unnecessary tension (BASTEPE-GRAY, 2014, p.25). As an example, the tension in the left hand may be altered by the position of the fretboard. Guitarists should be encouraged to position the fretboard at angles higher than forty-five degrees with the horizontal plane to avoid exaggerated supination of the left hand for extended periods of time, particularly when fingertips are aligned with one string (BASTEPE-GRAY, 2014, p.25). Though having the left hand in scalar position is generally seen as correct finger positioning, if the fretboard is inclined at an angle lower than forty-five degrees, it may pull the left elbow back and increase tension in the shoulder, forearm, hand and fingers. It is important, then, to pay attention to how the entire body is used to identify the possible cause for an injury to the hand and fingers.

To support the action of the fingers and relieve the muscles of the hand, the guitarist should consider the weight of their arm to provide extra strength when fretting the strings. By positioning the left arm slightly ahead of the body and then relaxing the shoulder, its weight will pull the arm back to its resting position downwards and backwards like a pendulum, generating a diagonal vector as **Figure 2** shows.



**Figure 2:** Visual representation of the diagonal force resulted from the motion of the arm downwards and towards the body.

By maintaining the arm in this position, guitarists can relax the shoulder and explore this motion to minimize the strength needed to fret the strings. In order to have a normal force ( $F_n$ ) that cancels the vector of the weight of the arm ( $F_a$ ), the guitar neck should be positioned perpendicularly to this vector. This positioning maximizes the use of the weight of the arm to push down the strings requiring a softer left hand grip. This positioning can be achieved by slightly inclining the instrument towards the guitarist's body in the horizontal axis as **Figure 3** shows:



**Figure 3:** Guitar inclined towards the guitarist's chest.

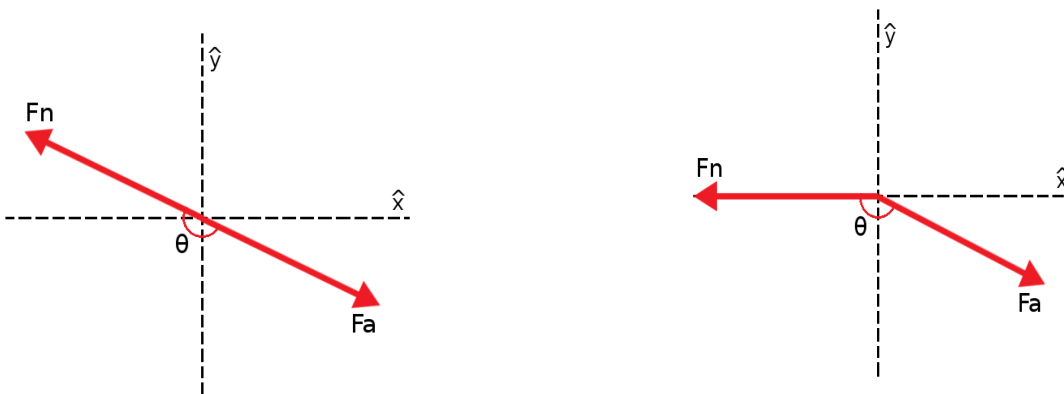
The fretboard will act as a resistance against the pendulum motion of the arm. The resulting vector of the arm movement ( $F_a$ ) in **Figure 3** is opposed by the resistance of the guitar neck ( $F_n$ ), transferring all the force to the guitar neck, requiring then a softer left hand grip to fret the strings.

Though the guitarist can still use the weight of his arm to assist his hand when the guitar is not inclined towards his body (without rotation in the horizontal axis), he will need to add strength to his hand to compensate for the decreased efficiency (**Figure 4**):



**Figure 4:** Guitar placed without inclination.

**Figure 4** shows how the normal force ( $F_n$ ) created by the guitar placed without inclination does not cancel the force applied by the arm ( $F_a$ ). The farther away from a  $180^\circ$  angle between the resulting vector of the arm ( $F_a$ ) and the normal force ( $F_n$ ), the less strength will be applied to the string and the more strength the hand will have to apply when fretting the strings. The approximated free-body diagrams below (Figures 5a and 5b) show the difference in strength applied:



**Figures 5a and 5b:** Free-body diagrams of the forces applied with the guitar inclined and without inclination, respectively.



Once the fretboard is inclined (**Figure 5a**),  $F_a$  and  $F_n$  are perfectly cancelled ( $\theta = 180^\circ$ ), which means that the point of contact between the fingers and fretboard/strings will receive the maximum pressure from the weight of the arm. When the fretboard is placed without the inclination (**Figure 5b**), the forces  $F_a$  and  $F_n$  do not cancel out each other entirely ( $\theta < 180^\circ$ ), having then less force applied to the point of contact between the fingers and fretboard/strings.

As the muscles in the hands are smaller and are in constant use during guitar playing, the position without inclination can be counterproductive to guitarists. Using the force resulting from the weight of the arm to its maximum efficiency to fret the strings helps prevent fatigue and overload of hand muscles, allowing the musician to play in a more relaxed manner while reducing the chance of injury.

## 5 - Applied Concepts of Economic Fingerings

An important part of a healthy technique revolves around fingering choices. Fingering is important to guitarists because they affect voice-leading and timbre; however, it may sometimes be advised to sacrifice some level of musicality for the sake of a less stressful hand position.

It is a common technical problem of musicians, including guitarists, to maintain tension in a finger after it is used. MITCHELL (2015) states that releasing the tension may take practice, and specific playing and relaxation exercises may be necessary. For example, she recommends that guitarists “play a scale slowly, one note at a time, relaxing all the fingers not involved in playing the note and relaxing the whole hand between notes” (MITCHELL, 2015). BASTEPE-GRAY (2014, p.25) agrees with this general idea, while adding that a “repertoire with concentrated rapid passages in the upper positions, where the string action is high and where there is limited time to fully release and re-press the strings,” maintain constantly high levels of tension in the left-hand. RUEDA (2006, p.70) expresses concern regarding fast passages, especially on how they affect the extensor muscles of the wrists and fingers. According to her, these muscles “are frequently affected by intense action involving force and speed” (RUEDA, 2006, p.70). RUEDA (2006, p.70) also states that even though these muscles possess fast contractile fibers, they are easily tired, forcing them “to maintain wrist stability while repeatedly performing rapid movements [and running] the risk of overloading the musculature.”

While the statements of Bastepe-Gray and Rueda are generally true, the guitarist can use fingering workarounds to reduce these problems to a certain degree. When playing in positions on the fretboard where string tension is higher, the guitarist can reduce stress by using the stronger first and second fingers rather than the weaker third and fourth fingers or favoring the third finger over the fourth finger whenever possible. The same concept can be applied to fast passages. The lack of time to release tension in a fast passage will not cause significant muscle overload in the stronger first and second fingers. **Figure 6** and **Figure 7** exemplifies these suggestions:



**Figure 6:** Original fingering (2, 4, 2 and 3, 4, 3) in Joaquin Rodrigo's *Fandango*. (RODRIGO, 1963).



**Figure 7.** Suggested fingering (1, 3, 1 and 1, 2, 1) in Joaquin Rodrigo's *Fandango* to reduce finger tension. (RODRIGO, 1963).

Rodrigo's *Fandango* is a technical challenge for most guitarists, and extended tension may be worsened by poor technical decisions. In both measures of **Figures 6** and **7**, tension in the left hand will be entirely at a high level since this passage is played in a range where string action is at its highest. However, by favoring the stronger first and second fingers, the passage in **Figure 7** will require less tension compared to **Figure 6**, where the weaker fingers have a more active role.

Villa-Lobos's *Etude 7* is another famous work that often generates tension in the left hand if the guitarist does not approach fingerings smartly. The fast slurs (**Figure 8**) extend over a long period of time and its repetitive movement may generate fatigue:



**Figure 8:** Typical left-hand fingering (1, 3, 1, 3) in Villa-Lobos' *Etude 7*. (VILLA-LOBOS, 1953).

This section is often played with each slur gesture performed with the same finger (often the third finger). Such gesture stresses the hand as it maintains the same finger in action for prolonged time without any opportunity for its relaxation. Alternating fingers such as third and fourth (or second and third) in this gesture (see **Figure 9**) distributes the tension between the fingers involved and allows extra time for them to relax before being activated again:



**Figure 9:** Suggested left-hand fingering (1, 3, 1, 4) in Villa-Lobos' *Etude 7*. (VILLA-LOBOS, 1953).

This is a common solution that divides the effort among the third and fourth fingers. While this passage remains challenging and may still tire the hand if practiced for extended minutes, alternating fingers should help the guitarist achieve accuracy with a significantly less amount of effort.

## 6 - Conclusion

The analysis of left hand playing-related injuries of guitarists showed that its causes generally converge to excessive extension, flexion or sideways deviations of the arm and hand and excessive tension during music making. This article proposed solutions that theoretically decrease such left-hand injuries by addressing entirely or partially its main causes.

The guitarist should consider resting their arm and hand while away from the instrument as guitar playing inevitably produces flexion of the left elbow and supination of the hand among other positions that poses risk to the left arm and hand. Limiting the practice of passages that require more tension in the left hand, such as bar chords or fast passages in high positions, is also advised. The guitarist should use larger muscles to support the smaller ones. An effective example is using the weight from the left arm falling to its resting position to help the hand fret the strings and reduce tension. They should also tilt the neck of the guitar towards their body to maximize the pressure transferred from the arm and hand to the fretboard. When playing passages that are stressful to the hands, smart fingerings can provide some relief. The examples provided showed how alternating fingers in repetitive slur passages provides them a small rest, and that stronger fingers will require less effort in fast passages in high positions.

Based on the current literature available, the ideas provided in this article target the causes of left hand injuries without requiring any abrupt changes in current guitar technique approaches and should be widely accessible to this audience. The proposed technical approach in this article should not narrow the strategies for injury prevention of left hand injuries in guitarists, and they are not necessarily the only ones. New research in the field of performing arts medicine should continue shaping the technique of the instrument.

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