

Repetitive Motion Injuries in the Forest Industry: A Real Pain in the Neck, Arms, Wrist...!

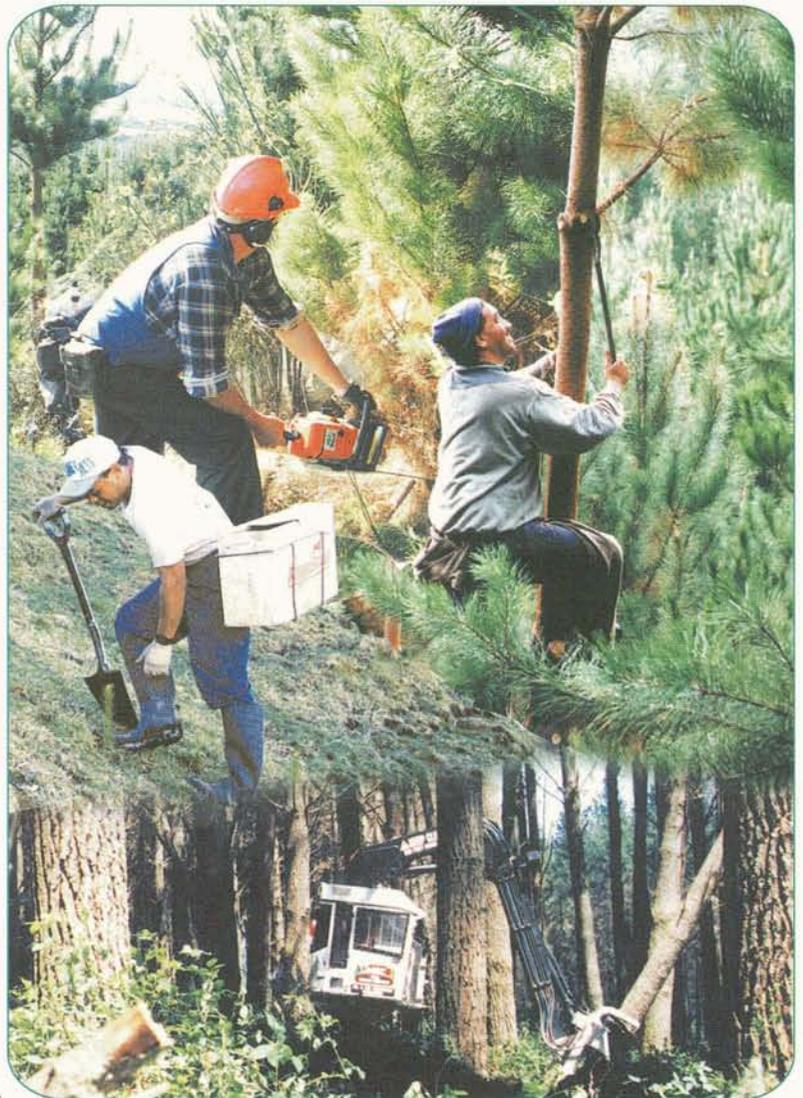
Patrick Kirk, Renzo Bertollini*, Andrew Drewczynski*

Summary

Work related disorders of muscles, tendons and nerves are a major cause of lost work in many industries, particularly ones containing risk factors such as continual repetitive movements, fixed body positions, forces concentrated on small parts of the body and lack of sufficient rest between tasks. Many of these risk factors are found within jobs carried out within the forest industry, particularly in planting, pruning and mechanised harvesting operations.

Prevention must aim to eliminate the repetitiveness of the work by proper job design, or if this is not possible, preventative strategies such as good workplace layout, tool and equipment design, and proper work practices should be considered. Early recognition of these disorders is very important because medical treatments are unlikely to be effective once these injuries become outstanding.

Preventative and control measures, in order to be truly effective, require significant involvement on the part of the workers and management to improve occupational health and safety.



 **Liro**
Forestry Solutions

*Canadian Centre for Occupational Health and Safety

Acknowledgements

Liro would like to thank Renzo Bertolini and Andrew Drewczynski of the Canadian Centre for Occupational Health and Safety for their allowing the reproduction of their material in this publication, and the New Zealand Government for financing this work through the Public Good Science Fund.

What are Repetitive Motion Injuries?

Repetitive motion injuries (RMI) are a group of painful disorders of muscles, tendons and nerves. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome and tension neck syndrome are just a few examples. Work activities which are frequent and repetitive, or activities with awkward postures cause these disorders which may be painful during work or at rest.

Almost all work requires the use of the arms and hands. Therefore, most repetitive motion injuries affect the hands, wrist, elbows, neck and shoulders. Work using the legs can lead to repetitive motion injuries of the legs, hips, ankles and feet. Some back problems also result from repetitive activities.

What are the Risk Factors for RMIs?

Work related RMIs arise from ordinary arm and hand movements such as bending, straightening, gripping, holding, twisting, clenching and reaching. These common movements are not particularly harmful in the ordinary activities of daily life.

What makes them hazardous in work situations is the continual repetition, often in a forceful manner, and most of all, the speed of the movements and the lack of time for recovery between them.

Work related RMIs are associated with work patterns that include:

- Fixed or constrained body positions
- Continual repetition of movements
- Force concentrated on small parts of the body, such as hand or wrist.
- A pace of work that does not allow sufficient recovery between movements

Generally, none of these factors acts separately to cause RMI. Repetitive motion injuries commonly occur as a result of a combination and interaction among them. Heat, cold and vibration also contribute to the development of RMI.

Body Position

There are two aspects of body position (posture) that contribute to injuries in jobs involving repetitive tasks.

The first relates to the position of the part of the body that performs the actual task, usually the upper limb. For example, tasks that require repetitive movements to the extreme ranges of the joint in the wrist, elbow or shoulder contribute to the occurrence of a painful condition in those areas.

The other postural aspect that contributes to RMI is a fixed position of the neck and shoulders. To perform any controlled movement of an upper limb, the worker must stabilize the shoulder-neck region.

Muscles in the shoulder and neck contract and stay contracted to hold the position stable for as long as the task requires. This restricts the flow of blood all the way down to the working muscles of the hand where the blood, because of the intense muscular effort, is needed the most. The result is twofold. The neck/shoulder muscles become fatigued, even though there is no movement. This contributes to the pain in the neck area. At the same time, the reduced blood supply to the remaining parts of the upper limb accelerates fatigue in the moving muscles, making them more susceptible to injury.



Repetition

Workers performing highly repetitive tasks are at the highest risk of RMI. Tasks requiring repetitive movements always involve other risk factors for RMI such as fixed body position and force. Added to this, is the fact that in order to perform the task, the worker has to maintain the shoulder and neck in a fixed position and to exert some force.

Work involving movement repeated over and over again is very tiring. This is because the worker cannot fully recover in the short periods of time that are given between tasks. With time, the effort to maintain the repetitive movements, even if they require minimal force, steadily increases. When the work activity is continued in spite of the developing fatigue, injury occurs.

Force

The force required to do the task also plays an important role in the onset of RMI. More force equals more muscular effort, and consequently, a longer time is needed to recover between tasks. Since in repetitive work, as a rule, there is not sufficient time for recovery, the more forceful movements develop fatigue much faster.

Pace of Work

Pace of work determines the amount of time available for rest and recovery of the body between cycles of a particular task. The faster the pace, the less time is available and the higher the risk for RMI. When the worker has no control over timing and speed of work because of external factors such as quota systems, stress levels increase. With higher stress levels come muscle tension causing fatigue and again increased risk for RMI.

Controlling the pace of work externally denies the worker the flexibility to determine their own work speed. It is a human characteristic to work at varying rates at different times of the day.

Temperature and Vibration

Temperature and humidity affect the worker performing repetitive work. When it is too hot and too humid, the workers tire more quickly and thereby become more susceptible to injury. On the other hand, cold temperatures decrease the flexibility of the muscles and joints, increasing the likelihood of injury. Vibration affects tendons, muscles, joints and nerves. Workers using vibrating tools may experience numbness of the fingers, loss of touch and grip strength and develop pain.

How do Repetitive Motion Injuries Occur?

Repetitive motion injuries do not happen as a result of a single injury. Rather, they develop gradually as a result of repeated trauma. Excessive stretching of muscles and tendons can cause injuries that only last a short time. Repeated episodes of stretching causing tissue inflammation can lead to long lasting injury or repetitive motion injuries. Repetitive motion injuries include three types of injuries:

- Muscle injury
- Tendon injury
- Nerve injury

Muscle Injury

When muscles contract, they use chemical energy from sugars and produce by-products such as lactic acid which are removed by the blood. A muscle contraction that lasts a long time reduces the blood flow. Consequently, the substances produced by the muscles are not removed fast enough, and they accumulate. The accumulation of these substances irritates muscles and causes pain. The severity of the pain depends on the duration of the muscle contractions and the amount of time between activities for the muscles to get rid of those irritating substances.

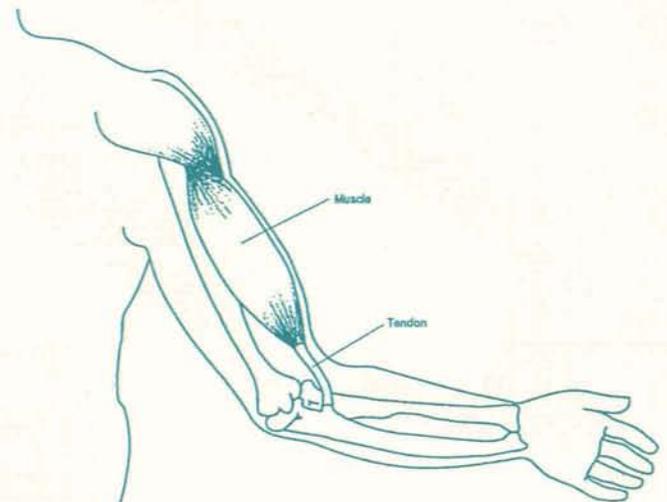


Figure 1 - Tendon, Muscle, Bone Unit

Tendon Injury

Tendons consist of numerous bundles of fibres that attach muscles to bones. Tendon disorders related to repetitive or frequent work activities and awkward postures occur in two major categories - tendons and sheaths found mainly in the hand and wrist; and tendons without sheaths, generally found around the shoulder, elbow and forearm.

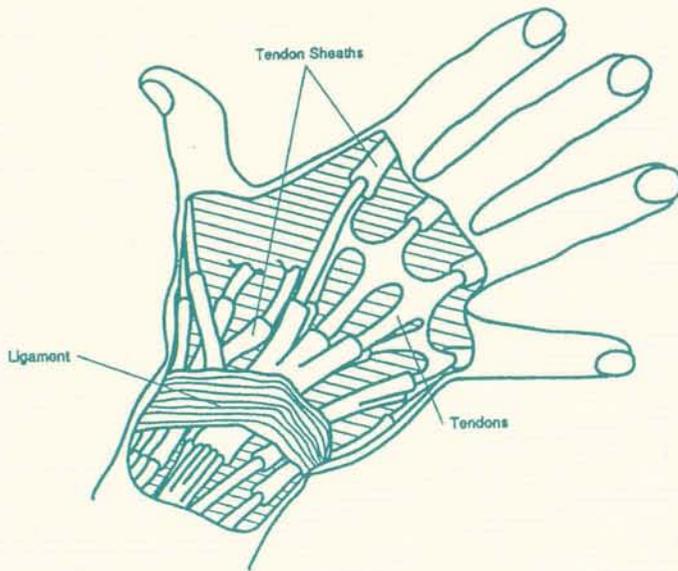


Figure 2 - Finger tendons and their sheaths

The tendons of the hand are encased in sheaths through which the tendon slides. The inner walls of the sheaths contain cells that produce a slippery fluid to lubricate the tendon. With repetitive or excessive movement of the hand, the lubrication system may malfunction. It may not produce enough fluid, or it may produce a fluid with poor lubricating qualities. Failure of the lubricating system creates friction between the tendon and its sheath, causing inflammation and swelling of the tendon area.

Repeated episodes of inflammation causes fibrous tissue to form. The fibrous tissue thickens the tendon sheath, and hinders tendon movement. When inflamed, a tendon sheath may swell up with lubricating fluid and cause a bump under the skin. This is referred to as a ganglion cyst.

Tendons without sheaths are vulnerable to repetitive motions and awkward postures. In fact, when tendon is repeatedly tensed, some of the fibres can tear apart. The tendon becomes thickened and bumpy, causing inflammation. This is commonly called tendonitis. In some cases, such as in the shoulder, tendons pass through a narrow space between bones. A sac called the bursa, filled with lubricating fluid, is inserted between the tendons and the bones as an anti-friction device. As the tendon becomes increasingly thickened and bumpy, the bursa is subject to a lot of friction and becomes inflamed. This condition is called bursitis.

Nerve Injury

Nerves carry signals from the brain to control activities of muscles. They also carry information about temperature, pain and touch from the body to the brain, and control bodily functions such as

sweating and salivation. Nerves are surrounded by muscles, tendons and ligaments. With repetitive motions and awkward postures, the tissues surrounding nerves become swollen, and squeeze or compress nerves. Compression of a nerve causes muscle weakness, sensations of "pins and needles" and numbness. Dryness of skin, and poor circulation to the extremities may also occur.

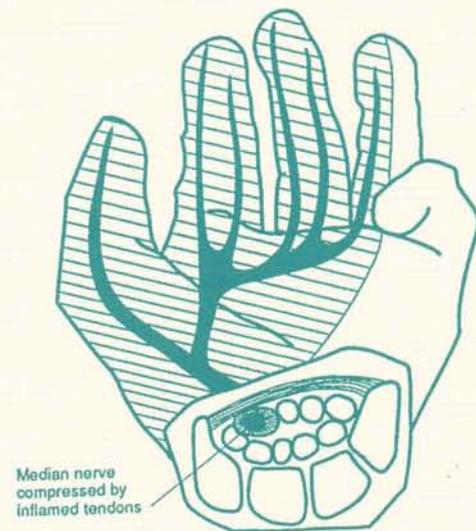
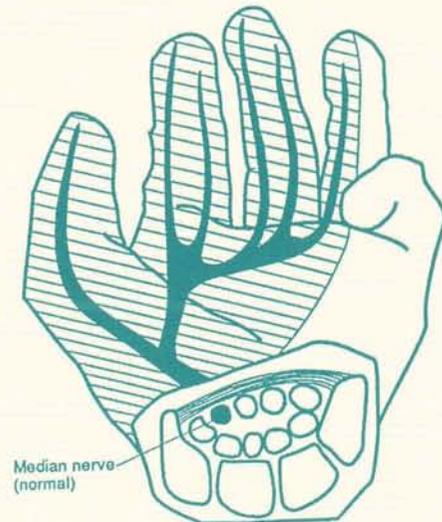


Figure 3 - Wrist in natural condition and showing symptoms of carpal tunnel syndrome.

What are the Symptoms of Repetitive Motion Injuries

Pain is the most common symptom associated with repetitive motion injuries. In some cases there may be joint stiffness, muscle tightness, redness and swelling of the affected area. Some workers may also experience sensations of "pins and needles", numbness, skin colour changes and decreased sweating of the hands.

Repetitive motion injuries may progress in stages from mild to severe

• **Early Stage:**

Aching and tiredness of the affected limb occur during the work shift but disappear at night and during days off work. No reduction in work performance.

• **Intermediate Stage:**

Aching and tiredness occur early in the work shift and persist at night. Reduced capacity for repetitive work.

• **Late Stage:**

Aching, fatigue and weakness persist at rest. Inability to sleep and to perform light duties.

Not everyone goes through these stages in the same way. In fact, it may be difficult to say exactly when one stage ends and the next begins. The first pain is a signal that the muscles and tendons should rest and recover. If these muscles and tendons are not rested, an injury can become longstanding, and sometimes irreversible.

Table 1 - Identified disorders, occupational risk factors and symptoms.

Disorders	Occupational Risk Factors	Symptoms
Tendonitis/Tenosynovitis	<ul style="list-style-type: none"> • Repetitive wrist motions • Repetitive shoulder motions • Sustained hyperextension of arms • Prolonged load on shoulders 	Pain, weakness, swelling, burning sensation or dull ache over affected area.
Epicondylitis (Elbow Tendonitis)	<ul style="list-style-type: none"> • Repeated or forceful rotation of the forearm and bending of the wrist at the same time. 	Same symptoms as tendonitis
Carpal Tunnel Syndrome	<ul style="list-style-type: none"> • Repetitive wrist motion 	Pain, numbness, tingling, burning sensations, wasting of muscles at base of thumb, dry palm.
DeQuervain's Disease	<ul style="list-style-type: none"> • Repetitive hand twisting and forceful gripping. 	Pain at base of thumb
Thoracic Outlet Syndrome	<ul style="list-style-type: none"> • Prolonged shoulder flexion • Extended arms above shoulder height • Carry loads on the shoulder 	Pain, numbness, swelling of the hands.
Tension Neck Syndrome	<ul style="list-style-type: none"> • Prolonged restricted posture 	Pain

How are Repetitive Motion Injuries Treated?

The treatment of repetitive motion injuries involves several approaches including:

- Restriction of movement
- Application of heat or cold
- Exercise
- Medication and surgery

Restriction of Movement

The first approach to treatment of RMI is to avoid the activities causing the injury. This often requires work restrictions, and in some cases, transfer of the worker to a different job. If this cannot be done, then the job should be redesigned to avoid the extreme load of the worker's joint in the first place.

Application of Heat or Cold

Applying heat or cold seems to relieve pain and may accelerate the repair process. Heat is recommended for pain relief of minor injuries. It is not recommended for injuries with significant inflammation and swelling. Heat increases the flow of blood and increases swelling. Ice reduces pain and swelling.

Exercise

Stretching is beneficial because it promotes circulation and reduces muscle tension. However, people suffering from RMI should consult a physical therapist before exercising. Stretching or exercise programmes can aggravate the existing condition if not properly designed.

Medication and Surgery

Aspirin, non-steroidal anti-inflammatory drugs and injected corticosteroids can reduce pain and inflammation. The doctor may try more elaborate treatments or even surgery if all other approaches fail.

How can Repetitive Motion Injuries be Prevented?

Hazards are best eliminated at the source. This is a fundamental principle of occupational health and safety. In the case of RMIs, the prime source of hazard is the repetitiveness of the work.

Other components of work such as the applied force, fixed body positions and the pace of work are also contributing factors to RMI.

Therefore, the main effort to protect workers from RMI, should focus on avoiding repetitive patterns of work through job design which may include job rotation, job enlargement and enrichment. Where elimination of the repetitive patterns of work is not practical, prevention strategies involving workplace layout, tool and equipment design, and work practices should be considered.

Job Rotation

Job rotation is one possible approach. It requires workers to move between tasks, at fixed or irregular periods of time. Such a rotation must result in the worker doing something completely different. Different tasks must engage different muscle groups in order to allow recovery for those already strained.

However, job rotation alone will not be effective in reducing RMI if not combined with proper design of workstations. It will also not be effective while the high pace of work persists.

Job Enlargement

Another approach is job enlargement. This increases the variety of tasks built into the job. It breaks the monotony of the job and avoids overloading one part of the body.

Team Work

Team work can provide greater variety and more evenly distributed muscular work. The whole team is involved in the planning and allocation of the work. Each team member carries out a set of operations to complete the whole job, allowing the worker to alternate between tasks, hence reducing the risk of RMI.

Workplace Design

The guiding principle in workplace design is to fit the workplace to the worker. Evaluation of the workplace can identify the source or sources of RMI. Proper design of the workstation decreases the effort required of the worker to maintain a working position. Ideally, the workstation should be fully adjustable and fit the worker's body size and shape.

Work Practises

A well designed job, supported by a well designed workplace and proper tools, allows the worker to avoid unnecessary motion of

the neck, shoulders and upper limbs. Training should be provided for workers who are involved in jobs that include repetitive tasks. Workers need to know how to adjust workstations to fit their individual needs. Training should emphasize the importance of rest breaks and teach how to take advantage of short periods of time between tasks to relax the muscles, and how to control muscle tension throughout the whole work shift.

Conclusion

Work related disorders of muscles, tendons and nerves are a major cause of lost work in many industries. Occupational risk factors include continual repetitive movements, fixed body positions, forces concentrated on small parts of the body and lack of sufficient rest between tasks.

Prevention must aim to eliminate the repetitiveness of the work by proper job design. Where this is not possible, preventative strategies such as good workplace layout, tool and equipment design, and proper work practices should be considered. Early recognition of these disorders is very important because medical treatments are unlikely to be effective once these injuries become outstanding.

Preventative and control measures, in order to be truly effective, require significant involvement on the part of the workers and management to improve occupational health and safety.

