Ergonomics

MSD Risk Factors – Contact Stress & Torque Reaction

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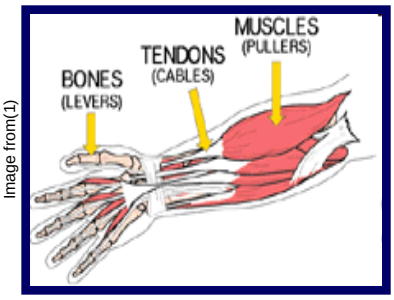


Image from(1)

Illustration by Christine Geier

Contact Stress

What is Contact Stress?

Contact stress results from occasional, repeated or continuous contact between soft body tissue and a hard or sharp object, such as workstation edges, tools, machinery, products or the floor. Contact stress commonly affects the soft tissue on the fingers, palms, forearms, thighs, shins and feet. This contact may create pressure over a small area of the body, such as the wrist or forearm, that can inhibit blood flow, tendon and muscle movement, and nerve function.

How Contact Stress May Lead to MSDs

Contact stress may lead to musculoskeletal disorders (MSDs) when tendons that are being used or nerves or blood vessels in vulnerable locations are compressed. Contact stress can restrict the movement of the tendon, which will then require greater effort and could result in inflammation of the tendon and surrounding tissues. Contact stress that pushes sharply into deeper tissues may also reduce blood flow and result in early muscle fatigue. Tissue that is compressed for prolonged periods of time may be damaged. Nerves that are exposed to contact stress in multiple sites are especially vulnerable. The problem becomes worse with extended or repeated exposure and when tasks require forceful exertion. The addition of force adds to the friction created by the repeated or continuous contact between the soft tissues and a hard object. It also adds to the irritation of tissues and/or to the pressures on parts of the body, which can further inhibit blood flow and nerve conduction. Examples would be tightly gripping a hand tool or using the hand as a hammer.

When the palm is used to deliver a blow to an object, the force from the blow passes into the soft tissues and then deeper into the tendons, nerves and muscles. Consequently, the tendons and muscles can be subjected to frequent disruption of blood supply, irritation, and trauma due to the reaction force from the hit. The more force that is required to hammer the part, the greater the residual force transferring to the tendons, nerves and muscles. The forces from the hit may also cause bruising of the muscles and add to swelling and inflammation of tendons.

How Contact Stress May Lead to MSDs Cont.

Contact stress can occur when working surfaces with sharp edges are too high or too low. The incorrect height can create contact points that would not exist if the surface was at the correct height or angle. In addition, contact stress can occur when employees, whose arms and shoulders are fatigued from prolonged awkward and static postures, place their forearms, wrists or hands on hard or sharp edges in order to rest them.

Illustration by Christine Geier

Poor tool design can often result in contact stress. For example, gripping handles that are too small may press the handle or handle edge into the skin, and pre-molded tool handles may press against the fingers because they do not fit the operator's hand.

Torque Reaction

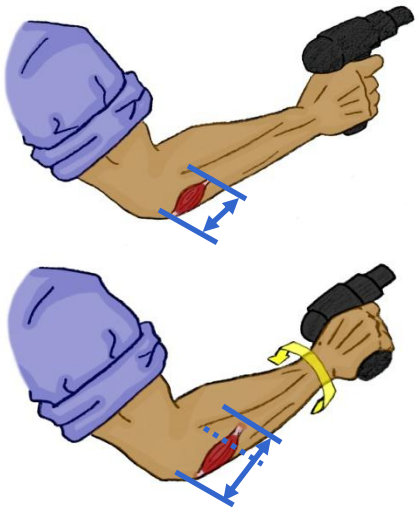
What is Torque Reaction?

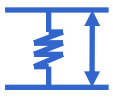
Air and electric powered hand tools are widely used to tighten threaded fasteners. The torque reaction or jerk when a powered hand tool reaches torque can be felt by the worker in their hand, wrist, arm and shoulder. Over a period of time this reaction can cause injuries and are often associated with upper limb musculoskeletal complaints.

How Torque Reaction May Lead to MSDs

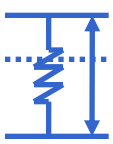
Torque reaction may lead to MSDs because the worker compensates for the torque reaction by shortening and tightening the affected muscles. As the force rises, the tool eventually overcomes the worker and forces the muscle to lengthen. Unfortunately, repeated forced lengthening causes pain, soreness, stiffness and sometimes muscle damage.

Image from(2)





Muscle length at run down phase before torque buildup



Muscle length at the end of torque buildup

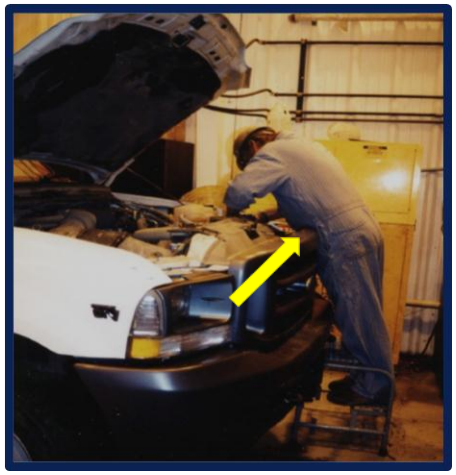
Adapted from (3). Illustration by Christine Geier

Contact Stress /Torque Reaction and Mining Tasks









What's Next

The next newsletter will discuss solutions for reducing MSD Risk Factors. MSD Risk Factors include forceful exertions, awkward postures, vibration, repetition, contact stress, and torque reaction.

References:

1. Apple (2011). Upper Body Risk Factors.[http://www.apple.com/about/ergonomics/uprsk.html]. Date accessed: April 2011.
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3. Lin, J., Radwin, R., and Richard, T. (2003). Handle Dynamics Predictions for Selected Power Hand Tool Applications. *Human Factors*, 45(4):645-656.

COLORADOSCHOOLOFMINES
EARTH ENERGY ENVIRONMENT

Authors: Michelle Reiher (mreiher@mines.edu) and Janet Torma-Krajewski (jtorma@mines.edu)