Ergonomics

Risk Factors – Awkward Postures

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Neutral Range of Postures

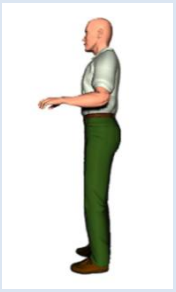
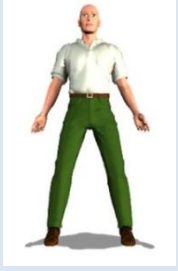
- *Muscles are at or near their resting length*
- *Joints are naturally aligned and relaxed*
- *Usually the most comfortable position for our joints*

Neutral Postures

The optimal design of work provides tasks that can be performed while maintaining a neutral range of postures. A neutral range of postures is not just one posture or position of a joint, but includes a range of postures where the muscles are at or near their resting length, and the joint is naturally aligned. Neutral ranges of postures are usually the most comfortable positions for our joints. Postures within this range:

- Allow for the greatest control
- Result in maximum force production
- Minimize the stress and strain applied to muscles, tendons, nerves and bone

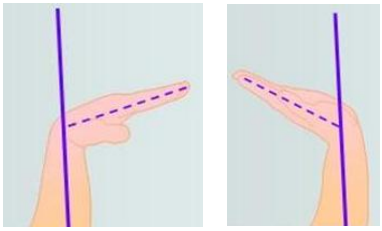
For many joints, the neutral range of postures occurs around the midpoint of motion for that joint. Descriptions of these midpoints for the major body joints are shown below (1) (2).

Joints	Descriptions of Midpoints for Neutral Range of Postures	
Head and Neck	Level, or bent slightly forward, forward facing, balanced and in-line with torso	
Hands, Wrists & Forearms	All are straight and in-line	
Elbow	Close to the body and bent 90 to 120 degrees	
Shoulders	Relaxed and upper arms hang normally at the side of the body	
Thighs and Hips	Parallel to the floor when sitting; perpendicular to the floor when standing	
Knees	Same height as the hips with feet slightly forward when sitting; aligned with hips and ankles when standing	
Back	Vertical or leaning back slightly with lumbar support when sitting; vertical with an S-curve when standing	

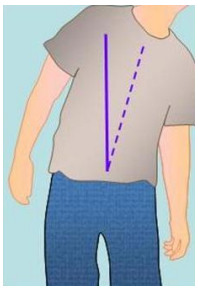
Awkward Postures

Awkward postures occur when joints are not in neutral positions. The following list provides examples of awkward postures that may involve range of movement near extreme positions (3) (4) (5):

- bending neck forward greater than 30 degrees
- raising the elbow above the shoulder
- Bending the wrist downward with palm facing downward greater than 30 degrees
- bending the back forward greater than 45 degrees
- squatting



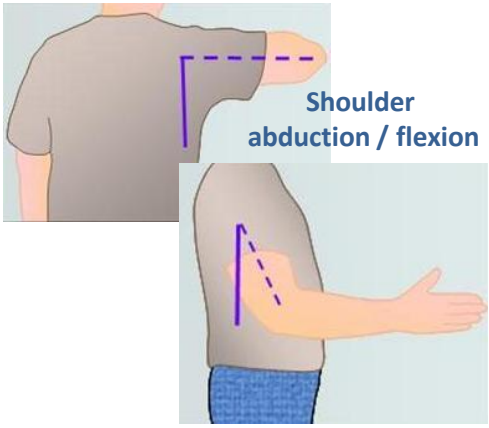
Wrist flexion / extension



Lateral bending

Other joint postures, not necessarily involving extreme range of motion, are known to be associated with increased risk of discomfort and MSDs. These include:

- twisting the trunk
- bending the trunk to either side
- leaning backward
- turning the head to either side
- bending the neck to either side
- bending the neck backwards
- bending the wrist upward with palm facing downward
- bending the wrist outward with palm facing downward
- rotating the forearm or resisting rotation from a tool
- Kneeling



Shoulder abduction / flexion

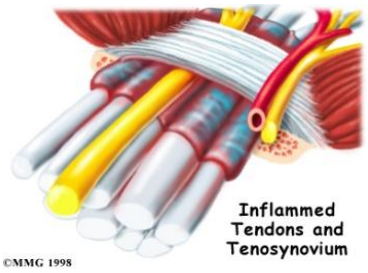
There are other awkward postures that occur because of the orientation of the body with respect to gravity, and do not necessarily involve extreme ranges of movement. These postures usually require the worker to support the weight of a body part or a tool. An example would be lying under a vehicle to complete a repair.

Static Postures

Static postures involve little or no movement. Because blood flow through muscles, which provides energy and removes waste, depends on movement, static postures elevate the risk of discomfort and MSDs. Even neutral postures can result in discomfort if one posture or position is maintained for a prolonged period of time. Tasks that involve static postures quickly lead to discomfort, especially if combined with exposure to other risk factors, such as awkward postures or forceful exertions.

Why Awkward Postures Lead to MSDs

When a joint is not in its neutral range of postures, its muscles are either shorter or longer than resting length. When joints are exposed to postures that involve range of movement near the extreme positions, the tissues around the joint are stretched or compressed. Ligaments, in particular, are stretched in extreme postures, and if the exposure to extreme postures is prolonged, the ligaments do not immediately return to their resting length.



With carpal tunnel, the median nerve is compressed when the tendons become inflamed and the space within the carpal tunnel is reduced making it more difficult for the tendons to move.

Tissue compression may also occur with extreme postures. For example, extreme flexion or extension of the wrist increases the pressure within the carpal tunnel, resulting in compression of the median nerve as it passes through the carpal tunnel (6).

When a muscle is in its neutral range of postures, it can produce the greatest amount of force, that is, a muscle is strongest when in a neutral posture. When doing a task that requires a specific amount of force, exerting that force with the joint and muscles in a neutral posture will result in the muscles using a lower percentage of its maximum capability. In contrast, when a joint is in an awkward posture, the muscles have less strength. So if they have to produce the same amount of force, the muscles will be working closer to their maximum level. Fatigue will occur more quickly, increasing the risk for injury (7).

References:

1. OSHA (2008). Computer workstations: good working positions. [http://www.osha.gov/SLTC/etools/computerworkstations/ positions.html] Date accessed: June 2008.
2. Warren N, Morse TF (2008). Neutral posture. Farmington, CT: University of Connecticut Health Center, ErgoCenter. [http://www.oehc.uchc.edu/ergo_neutralposture.asp]. Date accessed: June 2008.
3. Washington State Department of Labor and Industries [2008a]. Caution zone checklist. [http://www.lni.wa.gov/wisha/ergo/evaltools/CautionZones2.pdf]. Date accessed: June 2008.
4. Washington State Department of Labor and Industries [2008b]. Hazard zone jobs checklist. [http://www.lni.wa.gov/wisha/ergo/evaltools/HazardZoneChecklist.PDF]. Date accessed: June 2008.
5. OSHA [1995]. OSHA draft proposed ergonomic protection standard. Appendix A: Getting started. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.
6. Keir PJ, Bach JM, Hudes M, Rempel DM (2007). Guidelines for wrist posture based on carpal tunnel pressure thresholds. *Human Factors*, 49(1):88-99.
7. Chaffin D, Andersson GBJ, Martin BJ (2006). *Occupational Biomechanics* (4th Edition). J. Wiley & Sons, New York, New York.

Awkward Postures and Mining Tasks

Shoulder Flexion
Securing a tarp
Operating a drill
Oiling a loader
Opening a rail car bin

Shoulder Abduction
Loading blasting materials

Twisting Back and Neck
Loading blast holes

Wrist Extension / Flexion
Operating equipment

Back Flexion
Lifting blasting supplies
Tagging a rail car hatch

Squatting
Tagging a rail car bin

Kneeling
Oiling a screen motor
Cleaning an air filter

What's Next

The next newsletter will discuss the risk factor of vibration. Vibration exposures include both whole-body and hand-arm vibrations. Details about vibration, including examples found during mining tasks, will be presented.

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