

Electrician's Job Demands Literature Review – Low Back (Slab)

An electrician's job is physical in nature, and physical job demands are affected by postures employed and environmental factors. A main task of high-rise residential electrical work sector is called "slab work". Slab work's main task involves installing conduit and securing it to rebar via metal ties. As an electrician can be placed on a team that does slab work for years, the workers are at risk of developing a spinal injury.

During the month of April in 2005, the International Brotherhood of Electrical Workers (IBEW) local 353 commissioned the Toronto clinic of Occupational Health Clinics for Ontario Workers (OHCOW) to complete a musculoskeletal discomfort/symptom survey of its membership. OHCOW found that in the last year (at the time of survey), 67% of reporting union members experienced work related aches, pain, discomfort or numbness of the low back. Of the reporting members, 37.8% had sought a health care professional's advice for low back pain.

In a research article by Hanna et al. (2005) about the factors affecting absenteeism in electrical construction, 52% [of electricians] reported they had a work-related injury sometime during their career that caused them to miss work. Identifying potential mechanisms of injury within the job tasks of electrical work may prevent or lead to the reduction of work related injuries.

Mechanisms of Injury

There are three main injury mechanisms (McGill, 2002). Most individuals can identify the "specific incident" injury mechanism where a load greater than the individual's tissue tolerance is applied, resulting in an injury (Appendix). An injury may also occur from the continuous application of a load resulting in an injury from the reduction in an individual's tissue tolerance over time. The final injury mechanism involves repeated loading, which decreases an individual's tissue tolerance over time until an injury finally occurs (McGill, 2002; Marras, 2003).

Potential Injuries

Disc degeneration:

Disc degeneration is one of the leading causes of spine instability and is caused by excessive wear and tear on the spine resulting in disc tearing, loss of height and nucleus degradation (Kumar, 2001). These changes alter the ability of the disc to withstand compression and shear forces, which in turn greatly alters the spine's ability to stabilize itself (Furman & Simon, 2006).

Disc herniation:

Disc herniation occurs from repeated flexion or from full flexion with lateral bending and twisting (McGill, 2002). Disc herniation is a condition in which part of or the entire

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Completed: August 18, 2006

disc nucleus leaks through a weak portion of the disc and presses on the spinal nerves causing leg and back pain (Furman & Simon, 2006).

Endplate fracture:

An endplate fracture occurs when a vertebral endplate cracks as a result of excessive compressive pressure. The endplate is a permeable membrane which allows the transport of nutrients and wastes into and out of the cell. The disc that rests on the vertebral endplate may eventually leak through the crack causing pain, lack of mobility, swelling, etc (McGill, 2002).

Risk Factors for Injuries

Spinal Composition:

The spine is composed of cervical, thoracic, lumbar, sacral and coccyx vertebrae. This review is specifically examining the lumbar spine, also referred to as the low back. The low back is made up of five lumbar vertebrae. Vertebrae are round bodies of cortical bone with projections (spinal processes) that allow for muscle and tendon attachment. The top and bottom of each vertebral body (endplate) is porous, allowing for nutrients and wastes to pass through (McGill, 2002).

Between each vertebral body are intervertebral discs. The discs are gel-like in composition and assist the vertebral bodies in withstanding compression and shear forces. The disc nucleus is surrounded by annulus fibres (Appendix) that wrap around the nucleus like layers on an onion (McGill, 2002).

Slab Work:

Research indicates that static lumbar flexion is considered a risk factor for low back disorders. Chengalur et al. (2004) reported that awkward posture is strongly associated with low back injuries, while static posture and compression are good risk factors for low back injuries. Workers who maintain static lumbar flexion for prolonged periods of time also experience high rates of low back disorders (Olson et al., 2004). Cheung et al. (2003) wrote that prolonged static loads may cause disc degeneration by limiting transfer of nutrients and wastes from the spinal discs. As such, occupations with cumulative loading have increased injury risk (Marras, 2003).

Prolonged flexion also causes creep in the intervertebral discs. Creep is the deformation of the intervertebral disc from constant loading. With forward flexion of the spine, the disc will deform, moving posteriorly towards the back of the spinal column (McGill & Brown, 1992). A model for creep developed by Solomonow et al. (2003) predicts that full recovery of creep may take up to 48 hours (Olson et al., 2004). McGill & Brown's (1992) research found that recovery time for creep increases as an individual ages. Therefore older workers may be at further risk of a low back injury. This would also place slab workers at increased risk for injury during weekdays, as there is a

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maximum of 16 hours of rest between shifts. Olson et al. (2004) also reported that creep resulted in spasms of back musculature and changes in muscle activity of the spine, further increasing worker risk of incurring a low back injury.

Trunk flexion generates large compressive loads on the low back and passive tissues from muscular forces (Dickey et al., 2003). Static flexion of the trunk can result in flexion-relaxation phenomenon (Dickey et al., 2003). Flexion-relaxation phenomenon occurs when the trunk is flexed anteriorly. The EMG activity of the spinal musculature in the low back decreases to zero as the trunk flexion angles increase, resulting in the passive tissues of the spine bearing the external load (Olson et al., 2004; Dickey et al., 2003). Without muscular support, the spine is at greater risk for injury.

A Physical Demands Description completed for the high-rise residential sector of electrical work revealed that workers maintain a flexed trunk posture for more than 50% of their job. When examining slab work individually, a worker maintains a flexed posture for more than 90% of the task. Informal questioning of high-rise electricians on site revealed that workers could be placed on slab for months and even years. Slab workers are therefore working in a prolonged static posture.

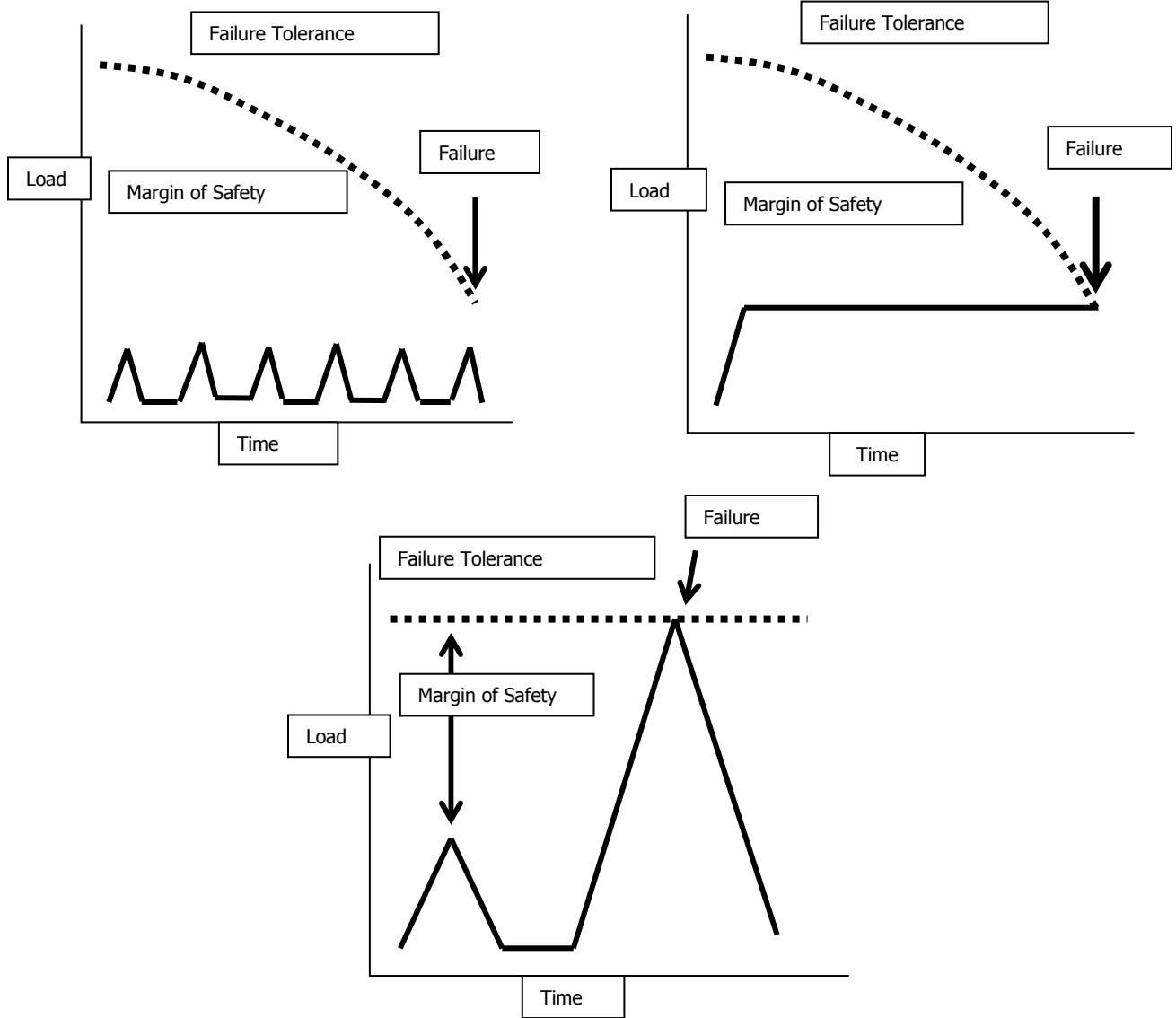
Spinal musculature is capable of producing large amounts of force due to its cross-sectional area and its line of action. Spinal musculature best protects the spine and its components from compression and shear forces when it is in a neutral orientation. Spinal flexion alters the advantageous muscular line of action decreasing the muscles' ability to withstand shear and compression forces, which increases the risk of a spinal injury (McGill, 2002). Therefore, when working, a neutral spine for maximum ability to withstand shear and compression forces is recommended. A fully flexed spine, like that of an electrician doing slab work increases shear loading of the spine and ligament damage, causing spine instability. According to McGill (2002) the best method for spinal injury prevention is to build job variability into a worker's tasks and maintain a neutral spine, both of which are currently lacking in high-rise residential work.

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Appendix

Injury Mechanisms (McGill, 2002)



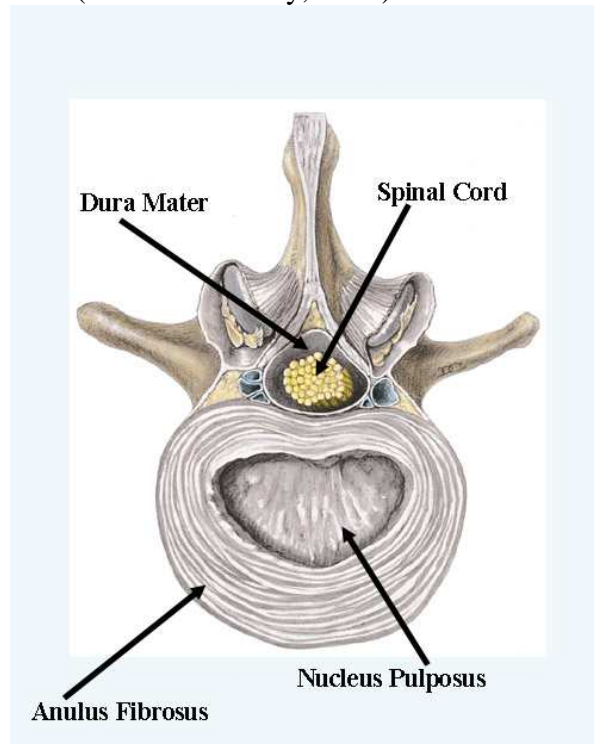
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Table 1 (Chengalur et al., 2004)

Primary Job Risk Factors Considered in Major Reviews			
Risk Factor	Low Back	Distal Upper Extremities	Neck and Shoulders
Force	Strong	Strong	Strong
Awkward Posture	Strong	Strong	Strong
Static Posture	Good	Good	Good
Repetition	Good	Strong	Strong
Dynamic Factors	Good	Weak	Weak
Compression	Good	Weak	Weak
Vibration	Strong	Strong	Weak
Combined	Good	Strong	Good

Strong = strongly correlated risk factor for MSDs in the low back/distal upper extremities/neck & shoulders
Good = strongly correlated risk factor for MSDs in the low back/distal upper extremities/neck & shoulders
Weak = weakly correlated risk factor for MSDs in the low back/distal upper extremities/neck & shoulders

Spinal Disc & Vertebrae (Ithica University, 2006)



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Low Back Work Photographs



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