Workplace interventions to reduce Musculoskeletal Disorders associated with Prolonged Sitting

Introduction

Many individuals spend the majority of their day in a seated position and according to Zemp et al., (2013), more than 75% of all individuals, in developed countries, remain seated for prolonged durations during their working days. Prolonged sitting is, however, directly related to developing musculoskeletal disorders and other health problems such as; respiratory problems, poor cardiovascular functioning, circulatory problems, eye strain and poor performance (Dubey et al., 2019). Occupational drivers and office workers are among the individuals at risk for developing health complications due to prolonged sitting (Lee et al., 2018).

Other common complications arising from prolonged sitting are musculoskeletal disorders. Musculoskeletal disorders are injuries to the muscles, tendons, ligaments, joints, nerves, spinal discs and cartilage. This commonly leads to increased levels of discomfort and pain, as well as mental health problems, work-related complications, and increased medical - and social costs (Fennelly et al., 2020).

Common causes of musculoskeletal disorders include repetitive movement, overuse, postural deviation, poor ergonomics, prolonged immobilization, and inadequately designed workspaces. Trauma or particular injuries such as falls, fractures or direct blows are more prevalent among individuals with physically demanding jobs (Al-Nakhli & Bakheet, 2020).

Even though work-related musculoskeletal disorders (WRMD's) occur more frequently among individuals with physically demanding jobs, employees who remain seated for long periods are also at risk for developing other unique complications (Al-Nakhli & Bakheet, 2020).

This review will address common musculoskeletal disorders associated with prolonged sitting, and the leading factors thereof. Lastly, it will also review different modifications and improvements, which can be made to the workstation to reduce the prevalence of WRMD's, among individuals spending prolonged durations in a seated position.

Musculoskeletal disorders associated with prolonged sitting

Office workers spend on average 6-12 hours, in a static sitting posture, per day (Chandwani et al., 2019), which regularly leads to WRMD's such as; shoulder pain, carpal tunnel syndrome, tendonitis and various back disorders.

Shoulder pain, carpal tunnel syndrome and tendonitis generally occur due to repetitive movements and/ or overuse in the workspace. Carpal tunnel syndrome is an extremely common complication associated with excessive computer use and causes injury to the median nerve resulting in pain, numbness, as well as pins and needles in the palm (Shiri & Hassani, 2015). Tendinitis refers to inflammation of a tendon caused by repetitive movements such as the extension of the wrist and phalanges when typing on a keyboard (Shiri & Juntura, 2011).

Back disorders are also one of the most prevalent WRMD's in individuals spending long durations in the seated position. These back disorders include; non-specific low back pain, neck pain, sciatica, herniated discs as well as disc degenerative changes, facet arthritis and stenosis (Dubey et al., 2019)(Adraham & Simsek, 2016)(Billy et al., 2014).

Main factors leading to WRMD's due to prolonged sitting

The main factors leading to WRMD's during prolonged sitting are poor posture, poor ergonomics and inadequate workstation design. The workstation design has a direct impact on an individual's sitting posture and therefore also increases physical symptoms (Chandwani et al., 2019).

Poor posture can be observed when individuals sit asymmetrically while leaning laterally or crossing their legs. Other aspects of poor posture include; the feet not being supported, keeping the legs motionless, hunching the shoulders, slouching forward, or the elbows not being supported (Dubey et al., 2019).

Postural load such as static muscle load and repetitive neck movement when looking up and down the screen or from one screen to the other is an additional risk factor for developing WRMD's (Mohammadipour et al., 2018).

Inadequate workstation design such as the incorrect chair - or desk height, improper back support, hard sitting-surfaces, no arm support, incorrect screen height, and insufficient space for the feet, are all factors that increase the risk for developing WRMD's (Switzer, 2019). Additional muscular activity is required to maintain an ideal posture when sitting in a chair providing insufficient support. This will contribute to fatigue in the transverse abdominis-, obliques- and other lumbar stabilizing muscles which will then lead to the passive posture of slouching. Slouching of the lumbar spine refers to the loss of lumbar lordosis and therefore increased the pressure through the intervertebral disks. Prolonged loading, in turn, causes reduced oxygenation to tissue and degenerative changes in the spine (Akkarakittichoke & Janwantanakul, 2017).

These degenerative changes and increased loading on intervertebral discs may lead to facet arthritis, stenosis and herniated discs, as well as compression of neural structures observed in conditions such as sciatica.

Possible solutions according to research

Research suggests that exercise, ergonomic modifications and taking frequent breaks can effectively reduce and prevent low back pain and other WRMD's (Okunribido, 2007)(Gupta 2011)(Shariat, 2016).

Modifications to the design of the workstation are essential to ensure optimal ergonomics and therefore prevent and/ or manage WRMD's. The optimal workstation design will reduce the risk of developing musculoskeletal injuries while improving and/ or maintaining productivity and performance. This will allow an individual's sitting posture to provide the least amount of postural stress on their spine and musculoskeletal system.

It's important to recognize that there is no 'ideal' chair or workstation since no human body is identical. However, researchers have established workstation-design guidelines for the best possible outcome.

Workstation guidelines

The Monitor

The monitor should be inline or just below the eye-level and directly in front of the individual. Experts generally suggest an arm's length between the individual and the monitor. However, a large discrepancy is seen in distance-requirements and research recommends that it is dependent on the individual and encourages them to rather change the font size if needed (Woo et al., 2016).

The Backrest

The recommended height for the backrest is 45-53 cm, the width 36-48 cm and the range between 90 - 120°. The backrest should also be adjustable, provide sufficient back support and maintain lumbar lordosis to reduce intervertebral disk loading and sufficient buttocks clearance (Woo et al., 2016)(Szcsygiel et al., 2017).

Without external back support provided from the backrest, the muscular activity increase drastically and ultimately leads to muscle fatigue, sliding into a slouched posture and therefore, increased discomfort and pain (Curran et al., 2015).

The Armrest

Most guidelines agree that the armrests should be adjustable and optional. It is suggested that the armrests should be removed if it restricts movement and function. The height should be adjusted according to the individual's body to ensure the elbows are supported without depressing or elevating the shoulders (Woo et al., 2016)(Szcsygiel et al., 2017).

The Workspace/ Desk

Guidelines indicate that the height of the workspace should also be adjusted according to the individual's needs. The individual should have sufficient leg clearance and the desired keyboard-forearm relationship to prevent constant pressure on the forearms while maintaining neutral wrists (Woo et al., 2016).

The keyboard-forearm relationship refers to the forearm being supported by the desk or the chair's armrest, during mouse or keyboard use.

The Seat

One of the most important aspects of the workstation design is the seat.

A recent randomized control trial conducted by Lee et al. (2018), determined that gel seat cushioning effectively improve chronic lower back pain in occupational drivers. Occupational drivers spend prolonged durations in the seated position and are, therefore, at risk of developing low back pain. Fortunately, a seat cushion effectively improves low back pain by correcting the posture, relieving pressure off the spine and buttocks, as well as promoting comfort and absorbing shock.

A previous study explains the biomechanical changes that occur when adding additional support (Makhsous et al., 2009). Additional support, such as a cushion, reduces the load on the ischial tuberosities by increasing the base of support and transferring the weight towards the thighs, as well as utilizing back support to maintain lumbar lordosis. These biomechanical changes will, in turn, reduce muscle fatigue, improve comfort and therefore relieve pain (Makhsous et al., 2009).

The seat should be adjustable so that the individual's feet are supported on the floor and with thighs more or less parallel to the floor. The rule of thumb for setting the height of the seat is the individual's knee-height (Montolalu & Sjaaf, 2018). Seat cushions should be at least 5cm thick, allow 2.5cm of compression and be covered with a non-slippery material. The cushion should also distribute the pressure and encourage the anterior rotation of the pelvis, to maintain and facilitate the natural curvatures of the spine (Woo et al., 2016)(Lee et al., 2018).

Finally, a consensus between studies and experts emphasize that when seating devices are designed, the following should be considered;

- Maintain the natural curvature of the spine.
- Reduce the pressure directed through the ischial tuberosities and coccyx.

This will reduce muscle strain and pressure through the spine (Samuelsson et al., 2009)(Makhsous et al., 2003).

Seat cushions also have fewer adverse effects and are more cost-effective than additional treatment procedures for back pain and other musculoskeletal disorders (Lee et al., 2018).

Other Solutions

Recent research also indicates that ergonomics modifications should be addressed in combination with frequent breaks and regular exercise. For this reason, healthcare professionals advise individuals to include regular physical activity and active breaks throughout their day (Woo et al., 2016).

Physical activity is essential for maintaining a healthy musculoskeletal system. Frequent exercise is proven to strengthen muscles, increase bone density, improve joint range of motion and support and improve the structural integrity of joints. Individuals are encouraged to take part in regular physical activity to effectively reduce their risk of developing musculoskeletal disorders such as arthritis, osteoporosis, muscle atrophy and other pain-related complications (Garber et al., 2011) (Sharma & Golchha, 2011).

Another solution for low back pain and other musculoskeletal disorders is taking active breaks such as stretching or walking. Active breaks are proven to effectively reduce pain and discomfort by enhancing oxygenation to muscles, improving muscle activity as well as joint range of motion, circulation and posture. Frequent active breaks also improve concentration, productivity and motivation, while reducing stress and anxiety (Barredo & Mahon, 2007)(Waongenngarm et al. 2018). Montolalu & Sjaaf (2018), suggest the 20-20-20 method, which includes taking a 20 seconds break every 20 minutes and relieving eye strain by looking 20 feet away, as well as taking 15 minutes stretching break every two hours.

Professional Recommendations

Although studies have found that active breaks effectively reduce pain and discomfort among individuals spending long durations in a seated position, no consensus of frequency and duration has been established yet. However, short breaks, even as little as standing up or doing 5 stretches every hour for 2 minutes can be extremely effective. Active stretches may include neck- and back stretches or stretches of the upper - and lower extremities.

Another simple way to reduce pain and discomfort is to walk while you talk during phone calls and/ or virtual meetings.

When it comes to the cushion design, a common issue observed is the cushion being too narrow, especially among women with broader hips. If the cushion is too narrow, its ability to reduce pressure and improve posture is reduced, due to the smaller base of support. Therefore, it’s recommended to ensure the cushion’s width is at least 45 cm. The edges should be round, to prevent added pressure or discomfort, and the cushion covered with non-slippery material.

Another aspect to consider when designing a seat cushion is to ensure the cushion is less firm, or allow an opening, in the area of the coccyx. Many individuals experience pain around their coccyx when sitting for long periods and this will allow pressure relief over that area when sitting.

Lastly, one of the most common reasons for low back pain, arising from long periods of sitting, is the loss of lumbar lordosis due to the pelvis rotating posteriorly. This increases the pressure through the intervertebral disks and causes pain in the lower back area. To prevent the pelvis from rotating posteriorly, adjustments can be made to the cushion by contouring it just anterior to the ischial tuberosities to hold the pelvis in a neutral or slightly anterior tilt. This will encourage the normal curvature of the lumbar lordosis.

Other than the seat cushion, individuals are also advised to use a lumbar support cushion for additional support. The lumbar support cushion in combination with a seat cushion will significantly improve postural alignment and therefore reduce muscle strain, joint compression and other pain-related complications.

Conclusion

Sitting for prolonged periods has a significant health impact and attention has been placed on the ergonomic design of seats to combat this. Currently, the available evidence supports the use of seat cushions to assist postural alignment of the pelvis and spine, as well as relieving pressure at the buttocks and spine. Seat cushions ultimately produce biomechanical changes to the seated position to alleviate pain and discomfort experienced in low back pain and other WRMD's.

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