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Sitting as a hazard

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Abstract

Back pain is a major problem amongst the growing number of seated workers, and enormous medical and design effort goes into reducing it. Improvements are evident, but the problem does not go away. The paper argues that the seat shape itself is a major hazard, causing initial loadings which can exceed those from the work. Research to demonstrate this has been growing over some 50 years, but until it is incorporated into chair design a serious reduction in back problems is unlikely.

Keywords: Back pain; Sedentary work injuries; Work seat design; Keyboard user injuries

1. Introduction

For many centuries, it was seen as the natural order of things that various occupations exposed their practitioners to particular hazards, giving rise to identifiable ailments. Although many people had drawn attention to actions and procedures which might have reduced the severity and incidence of such ailments, the social and political attitudes of the time did not encourage their adoption. It was left to particular industrialists and philanthropists to make changes where they had the power to do so. Only slowly was legislation introduced which enforced action across whole industries, and hence the reduction of the hazards which led to these industrial accidents and injuries.

Hazards remain today, and not only in third world countries. Changes are rarely brought in until legislation compels it. But problems cannot be fully attacked until the hazards are clearly understood. Identification of hazards depends on advances in scientific understanding of the total situation, in its context, and in advances in technology to measure and record events as they occur.

As an example of this, "human error" is no longer a term which can be used to generalise the cause of any accident involving people. It is a term which now covers an increasingly detailed understanding of how people respond to a range of circumstances, where stimuli and responses, attention and memory can be involved,

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usually with time constraints. In consequence, by understanding some of the effects and interactions of these factors we can design to avoid much error, as well as reducing the probability of other errors arising.

Sometimes an accident leading to injury may demonstrate the existence of an obvious hazard. In other cases, particularly when the injury is long in making its presence known, the connection is not made until the evidence is overwhelming. This was the case with RSI (repetitive strain injury) otherwise known as work related upper limb disorders (WRULD). It was a long time before the link between keyboard work and the arrival of wrist injury was accepted. This was not beneficial for those who suffered from RSI, who were well aware of the link but not how to avoid it. Scientific evidence from those who had researched the problem, if presented in court, went against "common sense". But the consequences of the rapid increase in keyboarding in so many industries/businesses, which was a world-wide increase in these injuries, eventually made the evidence undeniable.

The problem of back pain amongst sedentary workers is a case of a long gap between the research and its acceptance. To sit down is a simple act which we do without giving it much thought. Although we recognise discomfort from a period of sitting in some chairs, we do not consider it a hazard but an inconvenience. With the increase in sedentary work, where workers have to sit for many hours a day, every working day, sitting becomes a different experience. The workers' postures are restricted to those necessary to do the job and they have few opportunities to vary them due to the constraints of the equipment and tasks. Limited groups of muscles and joints thus experience long-maintained loads. Shoulders, neck and particularly back respond with pain, and eventually damage.

To combat this problem, many work seats have been designed, some designated "ergonomic" but with limited evidence of any serious claim to the title. The seat is, with other items in the workplace, a tool for doing the work. But few seat designs show signs that the work, the person and the seat were considered as interlinked parts of a system. Neither has the recent research been fully studied. Some items have been picked up and incorporated in chairs, such as height adjustment, a lumbar pad or a curved front to the seat but the problem of working back pain still does not go away. If the damage is still there, we clearly have not understood the problem.

2. Understanding sitting

The background to sitting has been reviewed in an earlier paper (Corlett, 2006) in which the structure of the spine and its reactions to various postures and seat surfaces are discussed. Whilst there have been gradual changes in seat design over recent years the increasing numbers of people exposed to longer periods of sedentary work have shown that the current concept of a work seat is inadequate to reduce the physical consequences of these long periods. The conventions underlying seat design need re-assessing.

2.1. The horizontal seat

Why is the conventionally accepted horizontal seat inadequate? A paper by Åkerblom (1954) pointed out that the importance of a lumbar support was demonstrated by Staffel in 1884. He also noted that Strasser, in 1913, suggested the use of a higher backrest which had a backward slope above the lumbar support, so allowing the sitter to lean back and the lumbar curve to be reintroduced, but at the expense of putting the sitter further back from the work point. However, the lumbar support was seized on by chair designers and became a required feature for work chairs, although some upright domestic chairs had used a design which followed the shape of the back for two centuries. But a lumbar support is not the same as a lumbar curve and the importance of the retention of the lumbar curve in the spine whilst working was not recognised, and mostly ignored.

What had been missed was an important paper by Keegan (1953). This presented X-ray images to show the movement of the pelvis (of one subject) as the hips were flexed, bringing the thighs from being in line with the trunk until close to the chest. About the first 70 ° of rotation of the thighs were achieved by rotation round the hip joint. Further thigh rotation was obtained by the pelvis rotating backwards, which flattened, and in some cases reversed, the lumbar curve. This flattening, due to the pull of the hamstrings, as well as increasing the pressure on the discs due to the tension in the muscles at the back of the spine, caused the front edges of the faces of the lumbar vertebrae to close towards each other, pinching the front edges of the discs. This effect has been noted in several studies since then (see the survey by Bridger and Bendix (2004)).