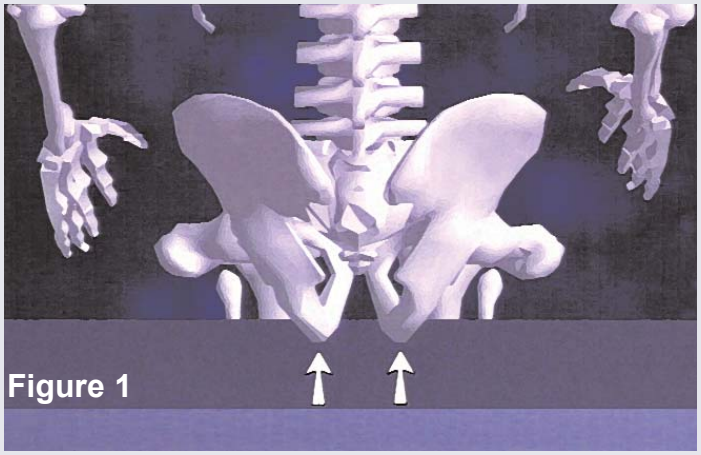
Figure 1

The Anatomy and Biochemistry of the Human Body in the Seated Posture

Research proves it. A proper chair is essential for anyone that must sit while they work. The problem is determining which of the many chairs on the market will produce the results you are looking for. It is an important decision that will affect your health and productivity for many years.

The information you acquire by merely sitting in a chair for a few minutes, or even a few days, is not enough to allow you to make informed decisions. You need to understand the effects the seated posture has on the human body over a much longer period of time.

Sitting makes sense because it provides stability for jobs that require high levels of visual or motor control. However, sitting in the wrong chair can put enormous stress on the body in ways most people do not fully appreciate. After all, the human body was designed for standing and moving, not sitting.

The purpose of this article is to review the anatomy and biochemistry of the human body in the seated posture. This information will help you choose a chair that will not only be comfortable, but will reduce injuries and improve productivity over the long term.

Stresses caused by the seated posture

There are two major veins behind each thigh that carry blood back to the heart. When we sit, our weight compresses these veins. Blood flow decreases, and over time, the veins can become swollen and inflamed. It is important to keep in mind the human body is not inherently stable, even when seated. The pelvis is shaped like a pair of inverted pyramids, so when you sit, your entire body weight is balanced on two bones called the ischial tuberosities (see Figure 1). Continuous muscle activity is therefore necessary to maintain an upright posture.

The muscle activity necessary to keep your body upright requires energy, which is produced by the chemical conversion of blood sugar and supplied to working muscles via blood vessels. One of the by-products of this process is lactic acid, which is normally converted into carbon dioxide and water. The carbon dioxide is transported by the blood to the lungs and exhaled.

When you walk, your movement increases blood flow, and there is enough energy to contract the muscles for lactic acid to dissipate.

When you are sitting, though your muscles are still working, your lack of movement keeps blood flow at relatively low levels. Without adequate blood flow to the muscles, lactic acid builds up, causing pain and muscle spasm. This process is referred to as static loading. Eventually, the muscles fatigue.

The Spine

As the body moves from standing to sitting, the pelvis rotates. Since the spine is attached to the pelvis, the lumbar spine, which normally curves inward toward the front of the body, flattens. This is the most important, yet least understood aspect of a seated posture. It has several important ramifications.

First, the spine's equilibrium is lost. To maintain balance, the spinal muscles must work harder. This greatly increases static muscle work. The muscles will eventually fatigue, causing muscular discomfort and possibly spasm.

Secondly, the flattening of the curve in the lower back causes the lumbar vertebral discs to be compressed anteriorly and opened up posteriorly (see Figure 2). If you continue to sit unsupported, the gel-like fluid inside the discs eventually migrates posteriorly (see Figure 3 and 4). Unfortunately, only the outer fibrous rings that make up the disc have pain-sensitive nerves (see Figure 5). As a result, you may not notice this process until it is too late.

If neglected, these discs can herniate or rupture, requiring surgery. Protruding discs can cause lower backache, leading to pain radiating down the legs, with possible numbness and loss of muscle function.

The reason discs are so strongly affected is the enormous amount of pressure exerted on them in an unsupported seated posture. The inflexible thoracic spine acts as a lever, dramatically increasing force on the discs of the flexible lumbar spine. Studies indicate this pressure is the same as if you bent forward at the waist and held a 10-kg weight. You know you should not do this for very long, yet it is exactly what we do to our spines for hours a day, simply by sitting.

The goal of proper seating

The goal of proper seating is to reduce these stresses so you can take full advantage of the positive aspects of a seated posture. There are various aspects of design and construction to consider.

First, the chair must be safe - meaning it must be stable and not subject to failure, such as the back breaking off. One fall can be very costly, so the chair must be well built. The size of its base and the type of casters or glides must be appropriate for its use.

Casters and glides

Glides are metal or plastic discs affixed to the bottom of the chair's legs to facilitate moving it across the floor. Casters are wheels that do the same job.

Urethane casters are best for hard floor surfaces. Casters that lock only when there is weight on the chair are helpful where the chair must be stable when in use, but must also be moved from time to time. Conversely, casters that lock only when there is no weight on the chair are useful on uneven factory floors or slippery tiles.

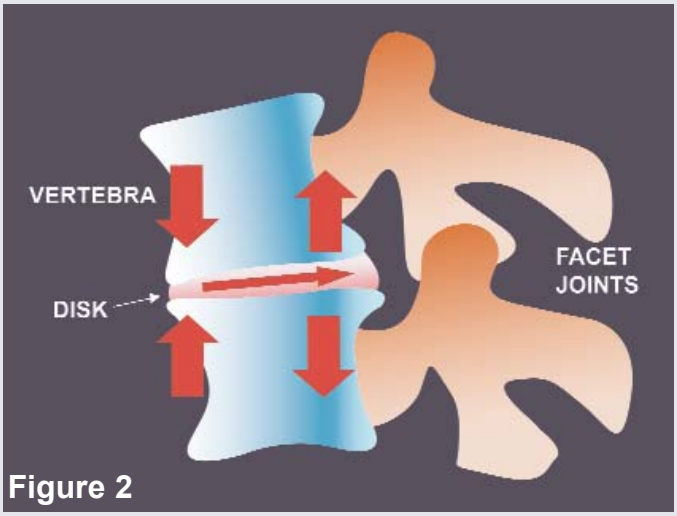

Figure 2

The seat pan

In general, a shorter seat pan is best. The longer it is, the more pressure it will place on the veins at the back of your thighs, and the more likely you will be prevented from sitting against the backrest.

The seat pan should be just deep enough to distribute your weight evenly. There should be a waterfall curve at the front edge to reduce pressure on the veins and contoured sides to redistribute weight away from the ischial tuberosities.

The foam should be high-density, covered with fabric that breathes and designed so you do not bottom out onto the underlying structure. In turn, the structure beneath the foam must have the same configuration as the seat pan to support the foam's function over the long term.

As most of the body's weight is on the seat pan, it should tilt forward and backward to provide a maximum range of postures. Changing the angle throughout the day creates movement to provide nutrients to the discs. It also changes the pressure points on the seat and relieves pressure on the veins.

A forward tilting seat pan is only useful when the pan and backrest can be adjusted to an angle greater than 90 degrees and can both be locked firmly into position. As the seat pan tilts forward, the angle between the thighs and upper body increases, allowing some of the natural curve to return to the lumbar spine.

Pneumatic height adjustment

The chair should have a pneumatic cylinder, which acts as a shock absorber when you sit down. It also facilitates height adjustment and allows the seat to swivel, so you do not have to twist your back when reaching for something.

Back support

A proper backrest has a lateral curve, which reduces muscle activity by providing stability for the upper body, and a forward curve, which helps position the lumbar spine into its natural curvature. The lumbar curve must be built into the structure of the back support and not just the foam, which cannot supply the necessary force by itself.

The backrest must adjust vertically so the lumbar support can be placed precisely where it is needed. The lumbar support must also adjust horizontally to vary the amount of support. And the angle of the backrest in relation to the seat must be adjustable to more than 90 degrees.

The larger you are and the more you can lean back while working, the larger your backrest should be. When doing dedicated task work, you should lock the backrest firmly into place. And for people who have neck injuries or just lean back a lot, a headrest can reduce stress on the neck.

Arm support

Stability and durability are essential in arm supports. They help stabilize the upper body, thereby reducing static muscle activity and minimizing stress on the back and legs when getting in and out of a chair. The front edges must be placed back from the front of the seat so the chair can be pulled close to the work surface to avoid unnecessary forward leaning.

The arm supports should adjust in, out, up and down to ensure your arms are comfortable and to reduce stress on your neck and shoulders.

Essential functions

All features discussed herein have two essential functions. The first is to allow the chair to be customized to your body to provide the necessary postural support. The second is to provide the movement and variation between postures which is so important to the human body.

The more often you adjust your chair to change your posture, the better. Do not wait until you feel discomfort.

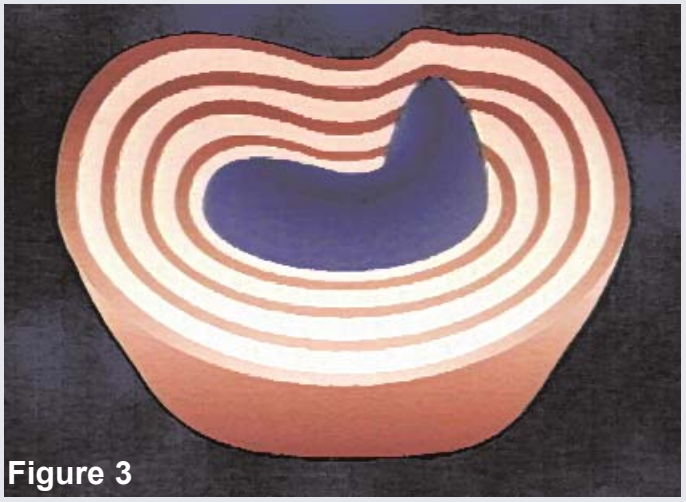
Figure 3

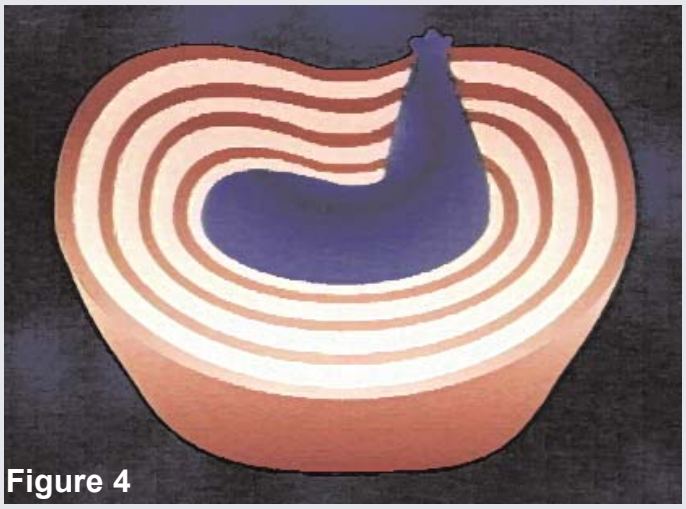
Figure 4

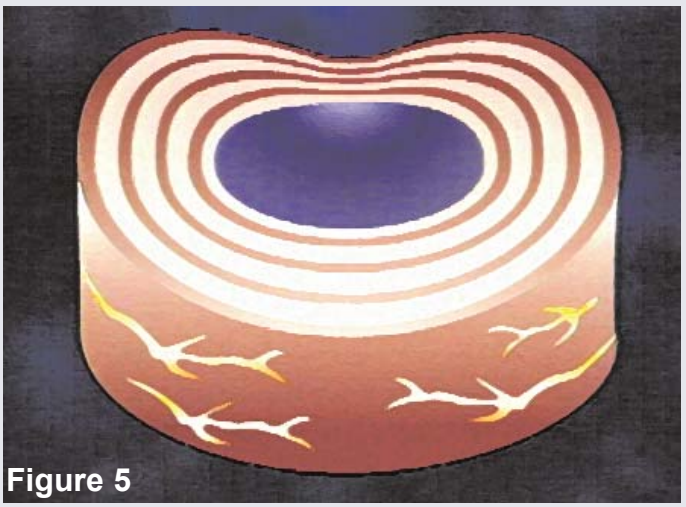
Figure 5