رسول اللہ صلی اللہ علیہ وسلم نے فرمایا: 
تین افرادا یہ بیان کر جن کے بارے میں قیامت کے دونی تین خودی جو ہمیشہ رکون گا 
(جین تین ایک) وہ شخص ہے جس نے کسی 
مزدور کو کام پر کھڑا اس سے اپنی کام لیا 
لیکن اس کی اجرت عطا نہیں کی ....(بتاری)
ENGINEERING APPROACHES TO STANDING, SITTING, AND LYING

DR. AYESHA BHASHARAT
Relationship between postural and phasic muscles

- Postural muscles tend to spontaneous functional or even anatomical shortening ➔ a higher muscle tonus.
- Postural muscles have an inhibiting effect on their phasic partners.
- With insufficient variety in muscle use ➔ which leads to inhibition and weakening of phasic muscles (pseudo paresis) ➔ imbalance, postural dysfunction, deformities.
Distal crossed syndrome

- Shortened back extensor and hip flexor muscles
- Weakened abdominal and buttock muscles.
- Increase in Anterior pelvic tilt and hyper-Lordosis, which also manifests in walking with insufficient hip extension (normal is 5 to 10 degree).
Normal spine

Lordosis of the spine

Exaggerated lumbar curve
Proximal Crossed syndrome

- Shortened Pectoralis major, cervical Trapezius, Levator scapulae, and Sternocleidomastiod muscles
- Weakened fixator muscles of the scapulae (rhomboids, lower and middle parts of the Trapezius, and the serratus anterior muscles) and the deep flexor muscles of neck

Figure 5. V. Janda's upper and lower crossed syndromes. MediClip, Lippincott, Williams & Wilkins, 2005 with permission.
Postural deterioration with the head placed forward, the shoulder blades raised and abducted, the upper part of the cervical spine overextended, and the shoulders moved forward.
Biomechanics Of The Pelvis

- Largest forces always act in the longitudinal direction of the spine
- Position of the Intervertebral discs ➔ Perpendicular to the longitudinal orientation of the spine
- Sacroiliac joint surfaces are parallel to the largest forces and are not protected against dislocation by the closed form of a ball and socket joint.

- SI joints are vulnerable to shearing because of their predominant flat surfaces, which are almost parallel to the plane of maximal load.

- But strong ligamentous support & muscle forces ➔ compression of joint surface ➔ help in prevention of shear loading and help in self bracing.
Sitting

- A good sitting posture is characterized by minimal muscle effort, which is produced with proper support by arm rests, back rest, seat, and foot rest.
- Good sitting provide Ability to change posture regularly

- Evaluation of design criteria for sitting chair should on the basis of biomechanical aspects
Weight Transfer
• Main body weight transferred to seat. Some transferred to floor, backrest, and armrests.

Advantages
• Provides stability to tasks involving visual and motor control
• Less energy consuming than standing
• Places less stress on lower extremity joints
• Lessens pressure on lower extremity circulation
Chair and Disc Force

Disc Force

[Andersson et al., 1974a]
ARM RESTS

- The importance of arm rests is often underestimated.
- Arm rests unload the shoulder girdle almost 10% of body weight varies as variety of arm positions.
- A proper arm rest must be placed below the mass centers of upper and lower arm (b/w wrist & elbow joint, but vary under different upper limb position & anthropometric measurements).
Armrest and Disc Force

Disc Force

[Andersson et al., 1974a]
Back Rest

- Provides stability for the vertically erected trunk
- In prolonged sitting, the prevention of a lumbar kyphosis (straightening) ➔ most important function of the back rest
- Lumbar Lordosis is the result of a mass center of gravity of the trunk at the ventral side of the ischial tuberosities
The mass center of gravity of the trunk dorsal to the ischial-tuberosities forces the lumbar spine into kyphosis.

- The latter can be prevented by the exertion of lumbar support on the upper side of the pelvis and the lumbar spine.

- **The function of a lumbar support** is to exert a firm force on the upper side of the pelvis and the lumbar area to prevent tilting in kyphosis (straightening).

- Support should not reach higher than the lower edge of the scapulae.
The thoracic spine is stiff enough (ribs) and a higher back rest pushes the shoulder blades forward, which over-rules the lumbar support and hinders the shoulders to stretch and to turn to the left and the right.

The absence of a back rest, like sitting on a crutch always leads to a C-form of the spine.
Erector Spinae Muscle
• Extends down the back
• Involved in lateral (sideways) **flexion of back & extension activities**, e.g. maintaining back posture in any “sitting” position
• The greater the EMG (electromyography) muscle activity, the greater the compressive force on discs
Muscle Activity & Backrest Inclination

Andersson & Ortengren, 1974

EMG signal in lumbar erector spinae muscles.

![Graph showing the relationship between backrest inclination and EMG signal in lumbar erector spinae muscles. The graph indicates a decrease in EMG signal as backrest inclination increases.]
The weight of the trunk, head, and part of the arms is almost completely carried by the ischial tuberosities.

Horizontal seat always raises friction at the ischial tuberosities, this friction can be completely eliminated by:

- means of a moderate seat angle and that the angle between seat and back rest is optimal between 90 and 95°
- Back rest inclination is larger in auditoriums, cars, and easy chairs at home
Chair And Table

- A chair is important for a good posture.
- In tasks such as reading and writing are involved, the height and inclination of the desk or table play a dominating role.
- Despite good chairs, postures with the back bent, sagging, or twisted can be observed.
- Vicious cycle of pain.
Ergonomic Design Guidelines

**Seat pan**
- Height: 15"-22" (range of adjustability)
- Width: 17"-19"
- Depth: Minimum 17"
- Slope: 0-7° (range of adjustability)

**Contour Waterfall front Backrest**
- Height: 6"-20"
- Width: 13"-14"
- Lumbar support: 4"-10"
- Tilt angle: 5-30°

**Armrest**
- Height: 7"-11"
- Length: 6"-10"
- Width: 2" minimum

**Support, swivel Five star base**

**Material and padding Permeable**
Office Desk and Disc Force

[Andersson et al., 1974b]
The majority of people cross their legs often when sitting, alternating left over right & right over left.

There are many reasons to do this, but in the literature there is no scientific proof about the benefit or demerit of leg-crossing.

Less activity of the internal oblique abdominal muscles (legs not crossed).

By crossing the legs, an alternative and less fatiguing means is found for self-bracing of the SI joints.
Lying

- A bed is a body support surface on which prolonged and complete rest must be found.
- Combination of a mattress, a mattress carrier, and a bed frame or bedstead important aspects.
- Several kinds of mattress carriers.
- Spread-out mat on the floor.
A good bed should

- Adapt to body curvatures
- Remain flat
- Have a pleasant spring action
- Have good ventilation, and
- Not be too warm or too cold

Aspects 1 to 3 concern body support that evenly spreads the pressure on protruding (bony) parts.

- Gives a straight spine when lying on the side, and gives a natural S-shape to the spine in the supine posture

- For static equilibrium, muscle action is superfluous
- For separate support of the head, a pillow is needed.
- The thickness of the pillow is related to the curvature of the spine.
- Pillows must be pliable to also support the neck.
- Normally people change posture 20 times per night.
- A bed that is too hard results in increased restless change of posture to unload areas with disturbed blood flow.
- Muscle running from the lumbar spine to the femur: Psoas major, part of the iliopsoas can be shortened, which raises tension in this muscle and causes a hollow back in supine posture.
Sitting In Bed

- Sitting in bed is common, especially in hospitals in which the head portion can be raised upward.
- Sitting in bed on a horizontal mattress gives rise to shear forces (in the order of magnitude of 100 N) on the skin and underlying tissues of the bottom. (may produce pressure on bony prominences)
- As a consequence, the pelvis moves little by little on the mattress to avoid excess stress/stress induce ischemic pain.
Taller people have the advantage that they can come to a stop with the feet against the board at the foot end.

Lumbar support is absent, which causes lumbar kyphosis and the pelvis to rest on the coccyx instead of on the ischial tuberosities.

The combination of pressure and shear is a provocation of decubitus skin ulcerations.