EFFECT OF SEAT AND TABLE TOP SLOPE ON THE BIOMECHANICAL STRESS SUSTAINED BY THE MUSCULO-SKELETAL SYSTEM

Alain Hamaoui (1), Myriam Hassaine (1), Bruno Watier (2), Pier-Giorgio Zanone (3)

1. Laboratory of Posture and Movement Physiology, University Champollion, Albi, France; 2. LAAS, University Paul Sabatier, Toulouse, France; 3. CERCO, University Paul Sabatier, Toulouse, France

Introduction

The most widespread work posture today in industrialised countries is sitting, which induces biomechanical stress on the osteoarticular chain. In an attempt to prevent back pain, many authors have advocated the use of "ergonomic" workstations using sloping tables and seats, whose main principle is to reduce lumbar and neck flexion. The purpose of this study was to assess the effect of table and seat slope on the biomechanical stress sustained by the musculo-skeletal system.

Methods

Twelve asymptomatic male participants took part in this study. The mean (±SD) age, height, weight and body mass index were 20.4 (±1.5) years, 179(±5) cm, 72.9 (±8.8), 22.8 (±2.5) kg/m²

Angular position of the head and trunk (T1 and S1 levels) was recorded using a wireless inertial orientation system. Muscular activity of eleven superficial muscles (neck extensors, trapezius pars descendens, deltoideus pars clavicularis, rectus abdominis, erector spinae at T4, T11 and L3 levels, rectus femoris, vastus lateralis, vastus medialis, soleus) was assessed by means of surface electromyography. Recording were taken under different conditions of seat slope (0°, 15° forward) and table slope (0°, 20° backward) (Fig.1). The specific stress sustained by C7-T1 joint was estimated with isometric torque calculation.

Table 1: angular positions as a function of table slope and seat slope (°). Mean values±SD are presented in different conditions of seat slope (S0, S15) and table slope (T0, T20). Negative values represent an angular position in extension. *P < 0.05, **P < 0.01, NS non significant.

Results

Backward sloping table was associated with a reduction of neck flexion (Table 1) and neck extensors EMG, contrasting with a concurrent overactivity of the deltoideus (Fig. 1). The forward sloping chair induced an anterior pelvic tilt, but also a higher activity of the knee (vasti) and ankle (soleus) extensors.

Figure 2: normalized mean EMG of neck extensors (NE) and deltoideus (Delt) as a function of table slope (T0, T20)(%); *P<0.05, **P<0.01.

The calculated torque due to gravity at C7-T1 level was consistently smaller when using a sloping table (p<0.001), and to a lesser extent when seating on a sloping chair (p<0.05)

Discussion

As spine and head flexion are reduced when using sloping table and seat, it can be assumed that they favour a more erect posture of the spine. However, they are also associated with an overactivity of the deltoideus, vasti and soleus to prevent the body from sliding. This phenomenon might lead to muscular tension and articular overload on the upper and lower limbs. Therefore, the benefit of the sloping surfaces on the spine induces a cost that is supported by the lower limbs.