Journal of Advanced Research (2017) 8, 201–207

Cairo University

Journal of Advanced Research

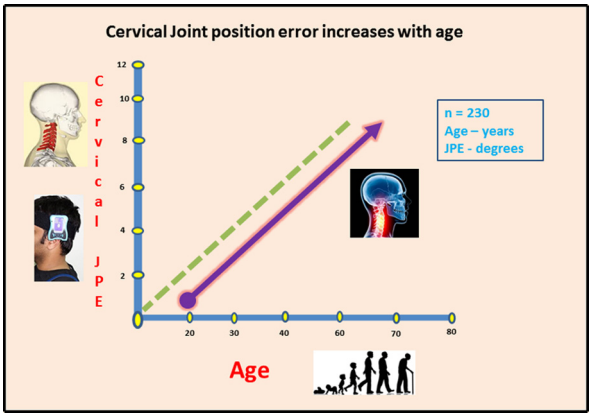
ORIGINAL ARTICLE

Association of age on cervical joint position error

Khalid A. Alahmari *, Ravi Shankar Reddy, Paul S. Silvian, Irshad Ahmad, Venkata Nagaraj Kakaraparthi, Mohammed Mehtab Alam

Department of Medical Rehabilitation Sciences, College of Applied Medical Sciences, King Khalid University, Abha, Saudi Arabia

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 2 August 2016
Received in revised form 19 December 2016
Accepted 1 January 2017
Available online 9 January 2017

ABSTRACT

This study quantitatively assesses the association between age and cervical joint position error (JPE) and compares JPE between young and older asymptomatic subjects. Subjects (n = 230) ranging in age from 17 to 70 years volunteered to participate in the study. Cervical JPE was measured for all subjects with the active movement angle reproduction test in degrees using a digital inclinometer; testing was done in all cervical movement directions (flexion, extension, side-bending right and left, rotation right and left). Subjects were divided into two groups: young (n = 169, mean age: 32.4 years; range 17–49 years) and older (n = 61, mean age: 61.9 years; range 50–70 years) and JPE was compared. Pearson's product-moment correlation

* Corresponding author. Fax: +966 172417744.
E-mail address: alahmarirt@gmail.com (K.A. Alahmari).

Peer review under responsibility of Cairo University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.jare.2017.01.001

Keywords:
Aging
Proprioception
Neck
Position sense
Kinesthesia
Somatic sensation

coefficients were significant and positive for the association of age on cervical JPE in flexion ($r = 0.71$), extension ($r = 0.81$), side-bending right ($r = 0.77$), side-bending left ($r = 0.84$), rotation right ($r = 0.84$), and rotation left ($r = 0.84$). JPE was significantly larger (for all movement directions) in the older subject group ($P < 0.001$). Advancing age was significantly associated with the increasing cervical JPE and older subjects showed greater errors when compared to younger subjects.

Introduction

Proprioception refers to information sent by afferent receptors from peripheral muscles, capsules, ligaments and joints to the central nervous system that contributes to efficient neuromuscular control of movement and joint stability [1–5]. Proprioception encompasses the sensation of joint position and joint movement (kinesthesia) [5,6].

Position sense of the head and neck is mediated by cervical proprioceptors, visual stimuli, and vestibular systems [7,8]. Sensory information from mechanoreceptors in structures in and around a joint plays an important role in joint stability [9]. Abnormal cervical afferent inputs result in an impaired cervical position sense, which is measured as cervical joint position error (JPE) [10–12]. Cervical position sense primarily reflects ascending inputs (afferent) from the neck muscle, capsule and ligament receptors of the cervical spine [13,14]. Head positioning tests are frequently adapted to assess cervical JPE [8,15–19]. Several methods exist to investigate cervical JPE, and the most commonly used is the active movement angle reproduction test, which requires the subject to relocate a neutral head position or a target head position selected by the investigator [8,15]. In head position sense measurement studies, the variable measured is the difference between the reference point position entrenched initially (either a neutral or target position) and the position produced by the subject when attempting to match the target position [8]. This difference is called JPE and has angular units of degrees (°). As humans age, the cervical spine undergoes degeneration, leading to decreased cervical range of motion (ROM), decreased cervical muscle strength and an altered length-tension relationship [20–22]. These changes may contribute to a reduced cervical joint position sense [22]. Age-related reduction of joint position sense in peripheral joints such as the hip [23], knee [24–26], ankle [27–29] and upper extremity joints [30,31] of asymptomatic subjects has been documented, and JPE is associated with injury, joint pain, muscle fatigue, and chronic pain [27,32–34]. However, literature on the effect of age on cervical joint position sense in asymptomatic subjects is lacking. A study on patients with whiplash injury (ages 18–66 years) suggests a positive correlation between age and cervical JPE [35]. This supports the idea that age can influence cervical JPE in cervical pathological conditions. This study hypothesizes that cervical joint position sense and cervical JPE correlate with age in asymptomatic subjects, and that cervical JPE is larger in older subjects compared to younger subjects. The objective of this study was to quantitatively assess the association of age on cervical JPE in asymptomatic individuals and to compare cervical JPE of younger and older subjects.

Subject and methods

Subjects

Volunteer participants were recruited through advertisements in the physical therapy department of the university and in the local city, in the form of posters and verbal announcements. A total of 230 asymptomatic subjects (age range: 17–70 years) were recruited to participate in the study. Subjects were divided into two groups: younger ($n = 169$, mean age = 32.4 years; range = 17–49 years) and older ($n = 61$, mean age = 64.9 years; range = 50–70 years). All subjects included in the study reported having no neck pain at the time of the study. Subjects were excluded if they had prior treatment for neck pain; any history of traumatic spinal injury; a whiplash-associated disorder; central nervous system impairment such as paresthesia; vestibular impairment such as vertigo, dizziness or motor imbalance; or neck pain elicited by cervical motion in the range used for the study. All subjects were required to attend two sessions. In the first session, subjects were familiarized with the equipment and re-positioning tasks and in the second session, cervical JPE was assessed. Demographic data (age, height, weight) were recorded. *Subjects were required to sign an informed consent prior to participating in the study. This study was approved by the university ethics review board committee (REC/2016-01-06).*

Instrumentation

Cervical JPE was measured using a Dualer IQ digital inclinometer (J-Tech Medical, Midvale, UT, USA; Fig. 1). The digital inclinometer is reliable, fast, and high in measurement precision [36,37]. Digital inclinometer spine evaluation protocols are well established and endorsed by the American Medical Association (AMA) [38]. The digital inclinometer allows clinicians to evaluate range of motion and proprioception using dynamic inclinometry similar to that used in other goniometric protocols [39]. The digital inclinometer has shown test-retest reliability for measuring spine range of motion [38,40].

Measurement of cervical joint position error

For the test, subjects sat upright in a chair with back support. An erect posture with hips and knees at approximately 90 degrees and feet placed firmly on the ground was maintained throughout the test. A strap secured the thoracic spine to the chair during cervical movements. The active movement angle reproduction test with target position reproduction was used to measure cervical JPE. The target head position to be