

APPENDIX:

Baseline assessment and test of function

Cervical flexibility (1.1; 1.2; 1.3) was tested in a seated position with the upper body 4-point belted and eyes closed as described by Rudolfsson et al. [1]. An electromagnetic tracking system (FASTRAK[®], Polhemus Inc.) was used to measure cervical sagittal extension and flexion from a neutral head position, axial rotation and a combined movement of axial rotation in a maximal forward neck flexion position (degrees). Range of motion (ROM) in the upper and lower cervical parts during extension and flexion were recorded separately [1].

Cervical muscle strength-endurance and functional strength (2.1; 2.2; 2.3) were tested in three different tasks. First, cranio-cervical flexor (CCF) isometric strength and endurance (2.1) were tested in a standing position with the body secured by wide strips around chest and waist. An application pad was positioned under the mandible and participants were instructed to push against the pad as if performing a “nod” with the head. Torque was recorded in newton-meters (Nm). The protocol was based on that of O’Leary et al [2] in conformity with Van Wyje et al [3]. Second, isometric strength of the cervical flexors and extensors (2.2) was tested according to Salo et al [4] with participants in a seated position with wide strips around chest and waist. A bar with a force cell was placed against the participant’s forehead for flexion strength and against the occiput for extension strength, providing values in Newton (N). Third, functional strength (2.3) was measured by a dynamic lifting task from waist to shoulder height, the Cervical Progressive Isoinertial Lifting Evaluation test (C-PILE) [5]. Maximal lifting capacity was measured in maximal lifted kilogram divided with participant weight. In order to minimize the effects of participant’s body under or over weights, a formula called “adjusted weight” according to Mayer et al [5] was used. In the subcategory 2.3, the participants also provided a subjective rating of their ability to carry and to lift.

Cervical sensorimotor control (3.1;3,2), the first subcategory 3,1 was evaluated by questions about dizziness, balance disturbances and difficulties to rotate the neck, due to neck problems [6], and neck related headache. The second subcategory 3,2 was a test of maximal speed of cervical axial rotation measured in degrees per second. This was performed in same setup as test of cervical flexibility and measured by FASTRAK[®] [7]. The subject was sitting with the head in a neutral position waiting for a sound that indicated a fast axial rotation to the right or left.

Trapezius myalgia (4.0) was diagnosed with the criteria neck pain, tightness of the trapezius muscle and palpable tender points in the trapezius muscle [8, 9]. Pressure pain thresholds (PPT) were measured using an algometer to quantify muscle tenderness (kPa).

Cervicogenic headache (5.0) diagnosis was based on the major criteria of Cervicogenic Headache International Study Group [10] combined with reduced ROM in the upper cervical spine and palpable upper cervical joint dysfunction [11].

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