

Kinetic characteristics of the trunk and pelvis in young and elderly subjects and patients with low back pain while washing their face

Katsuyuki Shibata Ikuko Morita* Seiji Nishimura
Munehiro Ikuta Tetsuro Higashikawa**

ABSTRACT

A washing the face are performed in the anteverted position by bending the trunk forward, it is difficult for elderly people and patients with low back pain to perform such action due to large loads in the dorsolumbar region. Subjects : Six young and 6 elderly people, and 6 patients with low back pain. Methods : The movement of the neck, chest, lumbar regions and the pelvis recorded by a video camera were analyzed using a three-dimensional image analyzer. Results : In the young group, the pelvis was moved backward while bending the trunk forward, and the bending ratio of the lumbar region and pelvis was a significantly larger than other groups ($P<0.05$). In the elderly group, the backward movement of the pelvis was small, and the bending angle of the pelvis was large larger than young group ($P<0.05$). In the low back pain group, the trunk was bent while moving the pelvis backward. We determined the patterns of movement in the 3 groups.

KEY WORDS

washing the face, young subjects, lumbago subjects, elderly subjects

Introduction

Since washing the face and hands and brushing teeth are performed in the anteverted position by bending the trunk forward, it is difficult for elderly people and patients with low back pain to perform such actions due to large loads in the dorsolumbar region. Komori¹⁾ reported that many elderly people had low back pain while washing their face, and that the occurrence of low back pain was closely related with the anteverted position.

In the present study, we analyzed the movements of the neck, chest, lumbar regions and the pelvis recorded on videotapes while washing the face in the young, elderly and low back pain groups, and determined the patterns of movements.

Subjects

Six young subjects with a mean age of 24.0 ± 2.9 years, 6 elderly subjects with a mean age of 81.7 ± 3.3 years, and patients with low back pain with a mean age of 52.5 ± 9.5 years were examined.

Methods

Fig. 1 summarizes the methods. A conventional wash stand with a height of 72cm was used. The subjects bent the body forward from the standing position, washed their face using water from the faucet, and returned to the initial standing position.

The movements were recorded by a video camera placed on the left side of the subjects. Eight landmarks were set on the following sites ; the occiput,

Department of Occupational Therapy, School of Health Sciences, Faculty Of Medicine, Kanazawa University.

* Morita Hospital, Komatsu, Ishikawa.

** Allied Health Profession Kanazawa Rehabilitation Academy, Kanazawa, Ishikawa.

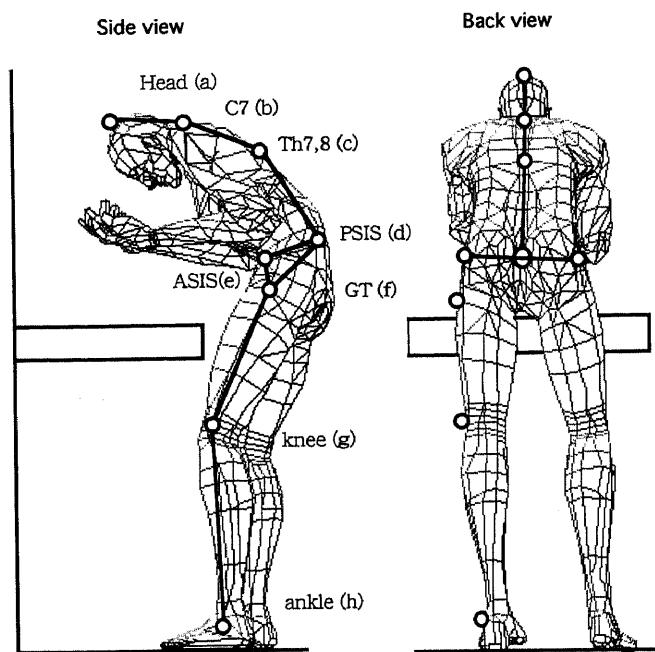


Figure 1. Illustration of marker placement and definition of joint angles. PSIS ; Posterior superior iliac spine, ASIS ; anterior superior iliac spine, GT ; greater trochanter.

seventh cervical spur, seventh and eighth thoracic vertebrae, fifth lumbar vertebra, anterior superior iliac spine in the pelvis, posterior superior iliac spine, greater trochanter, knee joints and lateral malleolus. As shown in Fig. 1, the angles of the body regions were determined by drawing lines between 3 landmarks. The inclination of the pelvis was expressed as the angle formed by the line between the anterior superior iliac spine and posterior superior iliac spine in the pelvis and the horizontal line.

Fig. 2 shows the analytic method. The movements of the subjects recorded by a video camera were analyzed using a three-dimensional image analyzer. Images on videotapes were converted into fast image files via a video captureboard, and the coordinates of the landmarks were tracked.

Results

The washing movements were expressed as stick pictures drawn by connecting the coordinates of the landmarks. Ten-stick pictures were produced by dividing the total time of face washing into 10 parts. The characteristics in the young and low back pain groups were bending the body forward while moving the

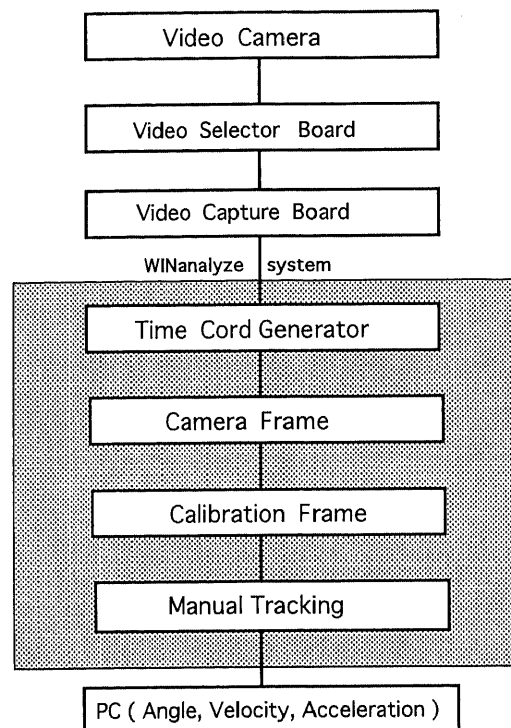


Figure 2. Schema of the image analytic system.

pelvis backward. In the elderly group, the movements were slow with a small backward movement of the pelvis and a low angular velocity of bending the body forward.

Fig. 3 shows the typical cases of the changes in the angle formed by the trunk and pelvis in the 3 groups. Since the time of face washing varied with the subjects, the figures were shown using the normalized time (% time). In the young group, the lumbar bending angle gradually increased from 70 degrees, was maintained at 110 degrees while washing the face, and returned to the initial standing position by extending the trunk. In the elderly group, the lumbar bending angle decreased from 80 degrees to 70 degrees, of which the changes were smaller than in the young group. In the low back pain group, the changes in the angle in the neck, chest and lumbar regions were smaller than in the young and elderly groups.

The joint angle ratio was determined using the following equation, each joint angle/ (neck angle + chest angle + low back angle + pelvis inclination angle) \times 100. In the young group, the neck was 10%, the lumbar region was 50%, and the pelvis inclination was

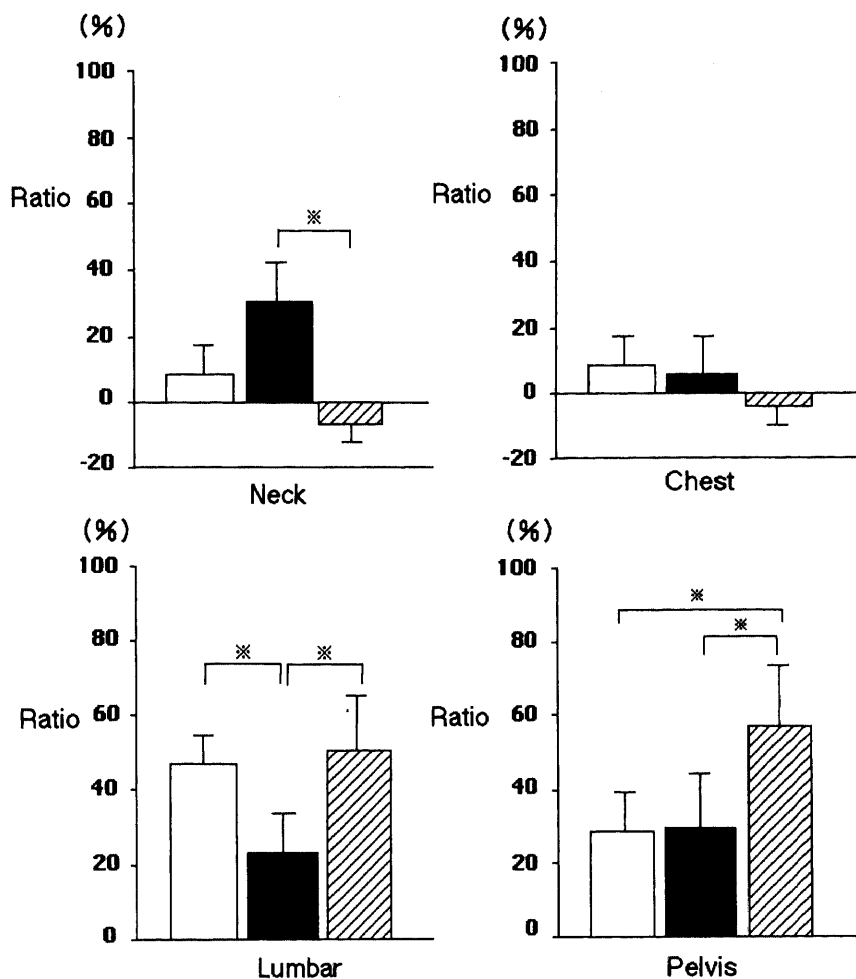


Figure 3. The ratio of each joint angle in body trunk bending.

40%, showing large movements of the lumbar region and pelvis. In the elderly group, the neck was 35%, the lumbar region was 25%, and the pelvis inclination was 40%, indicating that the ratio in the lumbar region was small compared to the young group. In the low back pain group, the neck was -10%, the chest was -10%, the lumbar region was 50%, and the pelvis inclination was 55%, indicating the largest pelvis inclination in the 3 groups.

Discussion

To wash the face, the face is brought close to the sink by bending the trunk forward, and the bending position is maintained until washing is completed. Mechanically, bending the trunk forward moves the weight of the upper trunk forward from the center line of gravity in the body, which causes torque in the dorsolumbar region of the trunk²¹.

In the young and low back pain groups, the pelvis was positioned behind the center line of gravity while bending the trunk forward. This was considered to minimize the load on the dorsolumbar region by bringing the gravity point of the upper trunk close to the center line of gravity.

In the elderly group, the subjects had kyphosis deformation in the thoracolumbar region, and an extreme bending position in the chest and lumbar regions was observed before washing. Therefore, the movements of the chest and lumbar regions while washing the face were smaller than in the 2 other groups.

In the low back pain group, rapid changes in the angular velocity of each joint did not generally occur while changing the position from standing to face washing and from face washing to standing, and excessive muscular activities in the dorsolumbar region

were controlled³⁾⁴⁾⁵⁾. The neck was excessively extended in the low back pain group compared to the 2 other groups. The weight of the head, which is generally 4.5-5.5kg, was brought close to the center line of gravity by extending and moving the head backward to reduce the load on the lumbar region⁶⁾⁷⁾⁸⁾. We will clarify the characteristics of face washing movements in the 3 groups and individuals by accumulating data from more subjects.

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若年者，高齢者，腰痛者の洗面動作における体幹と骨盤の運動学的な特徴

柴田 克之，森田 郁子，西村 誠次，生田 宗博，東川 哲郎

要 旨

洗面動作は，体幹を前屈した前傾姿勢となり，高齢者や腰痛者にとっては，腰背部に大きな負荷が生じる困難な動作である。対象者は若年者群6名，高齢者群6名，腰痛者群6名である。本研究は，3群の洗面動作中の頸部，胸部，腰部，骨盤の身体各部位の動きについて3次元画像解析装置を用いて解析した。若年者群は，体幹の前屈運動に伴い骨盤を後方へ移動しており，胸部と腰部の前傾角度は他の2群に比べ大きかった ($p<0.05$)。高齢者群の身体各部位の動きは小さく，骨盤の前傾角度が，若年群に比べ大きかった ($p<0.05$)。腰痛者群は，3群間で最も骨盤の前傾角度が大きかった ($P<0.05$)。洗面動作における3群の身体各部位の動作特徴について明示することができた。