Observation of arm behaviour in healthy elderly people: Implications for contracture prevention after stroke

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The purpose of this study was to observe normal arm movement in healthy older adults to determine the duration, frequency, and purpose of arm elevation and external rotation to guide clinical practice in the prevention of contracture. An observational study was undertaken in the homes and local community of 21 older people mean age 73 (SD 7) years. Participants' arm movements were observed for a median time of 254 (IQR 85) min during the day. The duration (min/hr) and frequency (movements/hr) which the arm spent in positions of 45 degrees to 90 degrees elevation, > 90 degrees elevation, and external rotation, as well as the purpose (manipulating, holding, reaching, pulling/pushing, or gesturing) for which these positions were adopted, were recorded. Participants' arms spent little time (3.6 min/hr) at 45 to 90 degrees elevation and almost no time (0.6 min/hr) at > 90 degrees elevation or external rotation (0.6 min/hr). Participants' arms moved to > 90 degrees elevation 13 times/hr and into external rotation 18 times/hr. Participants moved momentarily to elevation > 45 degrees and external rotation in order to reach for objects, while holding objects was the primary reason for maintaining positions for > 2 s. It may be possible to minimise the incidence of shoulder contracture in those patients with stroke who have regained some shoulder muscle activity by placing at-risk muscles in lengthened positions while replicating these features of everyday activities. [Schurr K and Ada L (2006): Observation of arm behaviour in healthy elderly: Implications for contracture prevention after stroke. Australian Journal of Physiotherapy 52: 129–133]

Key words: Arm, Shoulder, Movement, Aging, Contracture, Stroke

Introduction


Weakness or paralysis is reported in up to 80% of people three months after stroke (Bruton 1985, Dean and Mackey 1992, Goldstein 1996). Consequently, the tissues of the shoulder are at risk of developing the structural changes associated with immobilisation which lead to contracture (Herbert 1995, Goldspink and Williams 1990, Williams 1990). The resulting loss of range and consequent loss of function in the affected arm compounds the neurological deficit of the stroke. Current intervention to prevent contracture is to place the at-risk muscles in lengthened positions for about 30 min per day (Ada and Canning 1990, Ada and Canning 2002, Carr and Shepherd 1998). This intervention assumes that the muscles of the shoulder normally spend about 30 minutes each day in lengthened positions. However, clinical trials investigating this intervention have found it to be largely ineffective (Ada et al 2005, Dean et al 2000, Harvey et al 2000, Harvey et al 2003) suggesting that this duration of stretch may not be sufficient. The purpose of the present study was to observe arm movement in healthy older people to determine the daily duration and frequency of arm elevation and external rotation. This information may then be used to establish the duration of stretch required to prevent contracture.

Method

Participants Healthy older people were recruited from the local community by advertisement and personal contact. Participants were included if they were older than 60 years, the age of people with a similar musculoskeletal profile to those after stroke. Participants were excluded if they had musculoskeletal or medical problems that prevented them from carrying out their preferred daily activities. Twenty-one volunteers living in their own homes, 11 male and 10 female, mean age 73 (SD 7) years, participated in this study. Their mean level of daily activity was 3 (SD 1) on a custom-made scale of 0–5, where 0 represents a lifestyle with sedentary hobbies (eg reading, watching TV) and 5 represents an active lifestyle with exercise for at least two hours four times a week. Mean maximum passive shoulder flexion was 160 (SD 14) degrees and mean maximum passive external rotation was 72 (SD 13) degrees, which can be considered within normal limits. Ethical approval was gained from the relevant institutional ethics committee and written consent was gained from participants before data collection commenced.
Measurement of arm movements Each participant was observed continuously for a four to five hour period between 8 am and 5 pm, except during toileting. Participants were assigned randomly to observation during the morning (n = 12) or afternoon (n = 9). They went about their normal daily activities while the observer recorded the movements of their arm (Kilbreath and Heard 2005). It is generally assumed that the dominant arm is used more than the non-dominant one and recently this has been shown to be true (Kilbreath and Heard 2005). Therefore, the non-dominant arm was chosen for observation so as not to overestimate arm movements. A checklist was used to record information about the duration, frequency, and purpose of arm movements. A tick was placed in a box corresponding to the arm position observed: 45 to 90 degrees elevation or > 90 degrees elevation, as well as whether the arm was in external rotation. The time spent in that position was classified as either momentary (< 2 s), short duration (2–10 s) or prolonged (> 10 s), allowing duration to be determined. Each new movement was recorded on the subsequent row of the checklist allowing frequency to be determined. The purpose of the arm movements was classified as manipulating, holding, reaching, pulling/pushing, or gesturing. If a participant disappeared from view, that time was recorded as unobserved and provided breaks from observation. There were 88% agreement when the duration of arm movements from the observation checklist were compared to a simultaneous videotape of the same person, suggesting that the observation procedure was valid. All data were collected by the same person (KS).

To avoid participants changing the nature of their daily activities no comment was made about arm use. Instead, participants were told that they were being observed to determine the daily activities in people of a similar age to those after stroke. Participants were asked to behave as if the researcher was not present during the observation, and during recruitment were asked specifically not to change their routine or plans for the day of observation. At the completion of data collection, participants were asked what they thought had been observed, whether their daily pattern had changed because they had been observed, and in what positions they slept. No participants were aware that their arm had been observed, or felt that their daily activities had changed markedly. No-one reported sleeping with their arm(s) above their heads.

Data analysis The total time each participant’s arm spent in 45 to 90 degrees elevation, > 90 degrees elevation and external rotation (that is between the anatomical neutral position and the position of maximal rotation) was determined. The time spent in < 45 degrees elevation and internal rotation less than neutral was calculated as the time remaining. Each participant’s data were then expressed as the number of seconds spent in that position per hour of observation. The frequency with which the shoulder moved into 45 to 90 degrees elevation, > 90 degrees elevation and external rotation was expressed as the number of movements per hour of observation. Participant 2 was excluded from further analysis because the duration of his arm movements

<table>
<thead>
<tr>
<th>Subject</th>
<th>Observation time (min)</th>
<th>Time in arm positions (min)</th>
<th>Number of arm movements</th>
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<tr>
<td></td>
<td>Total</td>
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<tr>
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| Med     | 290                    | 254                         | 18                       | 5              | 3                | 130                  | 53                | 88                |
| IQR     | 120                    | 85                          | 15                       | 4              | 3                | 94                   | 49                | 74                |
was over 5 SD from the mean and therefore well outside the predicted normal distribution. Median and interquartile range were used to describe the data as they were not normally distributed. Table 1 provides data for individual participants.

**Results**

Participants were observed for a median of 254 (IQR 85) min doing a variety of activities such as making beds, doing house work, gardening, and driving cars. Thirty-six min were unobserved. Of the observed time, participants spent 240 (IQR 66) min at < 45 degrees elevation, 18 (IQR 14) min between 45 and 90 degrees elevation, and 5 (IQR 3) min at > 90 degrees elevation and 3 (IQR 3) min in external rotation. This means that participants’ arms spent very little time (3.6 min/hr) between 45 and 90 degrees elevation and minimal time (0.6 min/hr) at > 90 degrees elevation (Figure 1a). Participants’ arms also spent minimal time (0.6 min/hr) in external rotation (Figure 1b).

Participants’ arms moved 34 (IQR 23) times/hr into 45 to 90 degrees elevation, and 13 (IQR 12) times/hr into > 90 degrees elevation. They moved 18 (IQR 11) times/hr into external rotation.

Examination of frequency and duration together showed that shoulder movements to 45 to 90 degrees elevation occurred 23 (IQR 22) times momentarily (ie < 2 s), 10 (IQR 5) times for short durations (ie 2–10 s) and two (IQR 3) times for prolonged periods (ie > 10 s) each hour. Movements to > 90 degrees elevation occurred five (IQR 7) times momentarily, five (IQR 4) times for short durations and once (IQR 1) for prolonged periods per hour. Movements into external rotation occurred 13 (IQR 7) times momentarily, three (IQR 2) times for short durations, and 0.3 (IQR 0.3) times for prolonged periods.

Examination of frequency and duration together with the purpose of shoulder movements showed that most participants moved momentarily to elevation > 45 degrees and external rotation in order to reach for objects, while holding objects was the primary reason for maintaining positions for > 2 s.

**Discussion**

Even the least active people in this study were seen performing a broad spectrum of activities. Given the relatively active nature of the people observed, it is possible that the time the arm spent in elevation and external rotation is an overestimation of the time spent in these positions by more sedentary elderly people. Even so, participants’ arms spent only 1% of the observation time either above shoulder height or in external rotation. A study of arm use in older people found that ‘high reach’ and ‘extra high reach’ positions comprised 5% and 2.5% respectively of the positions used during the day (Clark et al 1990). While this is more than found in the current study, it supports the observation that the arm spends little time in elevation above shoulder height. This finding contrasts significantly with the lower limb where ankles spend more than 50% of the day at plantargrade or greater (Barrett 1997). In the lower limb, common daily tasks demand greater than plantargrade positions of the ankle. For example, standing up from a chair requires up to 30 degrees of dorsiflexion (Rodosky et al 1989), walking requires 10 degrees dorsiflexion (Sutherland et al 1980), and stair descent requires 27 degrees dorsiflexion (McFadyen and Winter 1988). In contrast, common daily tasks such as eating, drinking, and hair combing are performed with the arm between 10 and 45 degrees elevation (Cooper et al 1993, Dol’n’ikov cited in Buckley et al 1996, Safaee-Rad et al 1990) which is nowhere near maximum arm elevation. Why the tissues around the shoulder maintain length with less time in lengthened positions than those of the lower limb is not obvious.
It is difficult to use the findings of this study for the clinical problem of preventing contracture after stroke. Even extrapolating the observation that the arm spent 0.6 min/hr in elevation > 90 degrees or external rotation to a 24 hour period only translates to about 15 min per day. However, clinical trials of about 30 min positioning per day have not been totally effective in preventing shoulder contracture after stroke (Ada et al 2005, Dean et al 2002). This may be because other complications besides weakness (eg spasticity) could be influential in developing and maintaining contracture. For example, it is known that electrical stimulation to muscles positioned in shortened lengths potentiates contracture (Goldspink and Williams 1990). This may be why it appears necessary to position muscles in lengthened positions for longer durations after a stroke than in people with normal function.

The findings of this study may have more significance for those people who have regained some shoulder muscle activity. A good start may be to mimic the everyday movements of the arm in the healthy elderly. Extrapolating from the present study, intervention for shoulder retraining could consist of 10–15 min of brief arm movements involving reaching for objects both above shoulder height and to the side as well as sustained arm movements involving holding objects. If intervention strategies for this group combine the need for muscles to lengthen as well as replicate the features of everyday activities, it may be possible to maintain the 160 degrees flexion and 70 degrees external rotation which is normal for this age group.

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**References**


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