



Original Article

Does grip strength on the unaffected side of patients with hemiparetic stroke reflect the strength of other ipsilateral muscles?

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Abstract. [Purpose] Grip strength is used as an indicator of overall body muscular strength. However, most studies on grip strength have been performed in healthy people, and no study has evaluated it in the unaffected side of patients with hemiparetic stroke. The purpose of this study was to determine if grip strength on the unaffected side of patients with hemiparetic stroke correlates with the strength of other ipsilateral musculature. [Subjects and Methods] The maximal strengths of the muscles on the unaffected side of 31 patients with hemiparetic stroke were measured, and correlation coefficients were calculated. [Results] The results revealed significant positive correlations between grip strength on the unaffected side and the strength of the other ipsilateral muscle groups, with relatively high correlations being observed for the upper extremity muscle groups. [Conclusion] This suggests that grip strength on the unaffected side of patients with hemiparetic stroke can be used as a simple way to estimate overall strength on that side.

Key words: Grip strength, Muscle strength, Stroke

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INTRODUCTION

Muscular strength is functionally very important in daily life; therefore, this aspect is usually assessed in rehabilitation. In the assessment of muscular strength, grip strength is often examined because it is easy to measure. Normal values for grip strength, stratified by age and gender, have been reported—e.g., 29.7–37.7 kg for males and 22.3–23.8 kg for females in their seventies and 19.4–30.6 kg for men and 16.6–17.8 kg for women in their eighties^{1–3)}. Grip strength is affected by many factors, such as height, weight, age, gender, position of the hand during measurement, and bone mineral density^{4–8)}. Grip strength correlates with the strength of the erector spinae, quadriceps femoris, shoulder abductors, and total muscle strength^{9–11)}.

In a number of studies, grip strength has been measured on the affected side in patients with hemiparetic stroke and has been found to be related to bone density, muscle tone, muscle spasticity, and motor paresis^{12–15)}.

Muscle strength on the unaffected side is very important in patients with hemiparetic stroke to compensate for loss of function on the affected side. However, no study has evaluated grip strength in the unaffected side of patients with hemiparetic stroke or examined if it correlates with the strength of other ipsilateral muscle groups in these patients, as it does in healthy people.

The purpose of this study was therefore to investigate whether grip strength on the unaffected side can serve as an indicator of overall ipsilateral muscular strength in patients with hemiparetic strokes.

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SUBJECTS AND METHODS

We enrolled 31 inpatients with hemiparetic stroke. The patients comprised 12 males and 19 females, with a mean age of 73.6 ± 7.4 years. The inclusion criterion was ability to maintain a stable sitting position and communicate with others. Patient age, gender, and Brunnstrom stage (Br-stage) were gathered.

The data in this study were generated by measuring grip strength, as well as isometric strength of major muscle groups in the upper and lower extremities on the unaffected side of each patient. Grip strength was measured with a Smedley-type dynamometer (Tanita Corp.) and isometric muscle strengths were measured with a hand-held dynamometer (μ -tasF1, Anima Corp.). The strengths of seven muscle groups on the unaffected side were measured as isometric strength: shoulder flexion and extension, elbow flexion and extension, hip flexion, knee extension, and ankle dorsiflexion. Positions for the isometric measurements were in accordance with the method described by Bohannon¹⁶⁾, with the patient being strapped for stability while either supine or sitting. Grip strength was measured three times, and the maximum value (kg) was used for analysis. Isometric strength was determined by multiplying the maximum of three measurements (N) by the moment arm to yield joint torque (Nm).

For statistical analysis, Pearson product-moment correlation coefficients were calculated to examine the relationship of grip strength with each of the isometric muscle groups on the unaffected side. The level of significance was set at 0.05. Data were analyzed using SPSS Ver. 20.0 for Windows.

As an ethical consideration, matters concerning the study were explained to the patients both orally and in writing, and their consents were obtained before participation. In addition, the measurements were done after approval was received from the ethics committee at the hospital to which the patients were admitted.

RESULTS

The characteristics on the patients are shown in Table 1.

Their grip strength and isometric strengths are shown in Table 2, and the correlation coefficients in Table 3. The mean grip strength was 17.3 ± 6.5 kg (21.4 ± 6.2 kg for males and 14.6 ± 5.2 kg for females).

Grip strength correlated positively and significantly with the strengths of all of the other seven muscle groups ($p < 0.01$).

Table 1. Subject characteristics (N=31)

Variable	Value
Age (years)	73.6 ± 7.4
Gender (n)	Males:12 Females:19
Brunnstrom-stage (U/E) (n)	I:2 II:10 III:3 IV:2 V:7 VI:7
(L/E) (n)	I:1 II:5 III:5 IV:6 V:8 VI:6

Values are n or Mean \pm SD

Table 2. Muscle strength of unaffected side (N=31)

Variable	Strength
Grip strength (kg)	17.3 ± 6.5
Shoulder flexors (Nm)	20.0 ± 8.3
Shoulder extensors (Nm)	25.0 ± 8.7
Elbow flexors (Nm)	25.8 ± 11.0
Elbow extensors (Nm)	24.0 ± 9.2
Hip flexors (Nm)	34.5 ± 8.8
Knee extensors (Nm)	49.1 ± 18.3
Ankle dorsiflexors (Nm)	18.1 ± 6.4

Mean \pm SD

Table 3. Correlation between grip strength and muscle strength of unaffected side

	GS	SF	SE	EF	EE	HF	KE	AD
GS	-	0.68	0.75	0.77	0.78	0.51	0.55	0.71
SF		-	0.81	0.84	0.80	0.72	0.62	0.85
SE			-	0.75	0.80	0.59	0.50	0.78
EF				-	0.90	0.58	0.64	0.77
EE					-	0.56	0.51	0.74
HF						-	0.56	0.66
KE							-	0.57
AD								-

All of correlation were significant ($p < 0.01$)

GS: grip strength, SF: shoulder flexors, SE: shoulder extensors, EF: elbow flexors, EE: elbow extensors, HF: hip flexors, KE: knee extensors, AD: ankle dorsiflexors

The correlation of muscle strength with grip strength was 0.68 for the shoulder flexors, 0.75 for the shoulder extensors, 0.77 for the elbow flexors, 0.78 for the elbow extensors, 0.51 for the hip flexors, 0.55 for the knee extensors, and 0.71 for the ankle dorsiflexors.

DISCUSSION

The results of this study revealed moderate correlations between grip strength and the strengths of the other muscle groups, with stronger correlations seen in the upper extremity. The correlation coefficients were quite similar to those seen in healthy patients from previous studies^{9–11}). Thus, the presence of the disorder appears to have had no appreciable effect on correlations between grip strength and muscle strengths on the unaffected side.

The grip strengths recorded in this study were lower than those previously reported^{1–3}). Patients with hemiparetic stroke have decreased muscle strength due to disuse atrophy^{17–19}). However, even with the lower grip strength recorded in this study, the correlations between muscle strengths and grip strength on the unaffected side remained intact. Muscle strength is reportedly correlated with cross-sectional area of the muscle^{20, 21}), but since we did not measure muscle cross-sectional area, we could not determine the principal cause of the decreased strength. However, our results indicate that even if muscle strength decreases due to a disorder, the correlations can still stand.

In conclusion, our results suggest that measuring grip strength as a simple assessment of muscle strength on the unaffected side in patients with hemiparetic stroke can be an effective way to determine general strength on the unaffected side. In future studies, we hope to increase the number of patients and present more detailed data on patients with hemiparetic stroke, stratified by parameters such as age and gender.

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