

# 3D motion analysis comparison of left handers' wrist flexion and cutting accuracy according to scissors type

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**Abstract.** [Purpose] The purpose of this study was to research the difference in wrist flexion and accuracy of left-handers when using regular scissors made for right-handed persons versus scissors made for left-handers. [Subjects and Methods] Eighteen left-handers participated in the experiment. There were ten males and eight females subjects. The degree of wrist flexion of 18 left-handers was analyzed when using scissors designed for left-handers and when using scissors designed for right-handers. [Results] When left-handers used left-handed scissors, they carried out the task while extending the wrist at  $4.67 \pm 14.60^\circ$ , but when they used right-handed scissors, they carried out the task while flexing the wrist at  $1.19 \pm 12.41^\circ$ . When left-handers used left-handed scissors, the error rate was  $1.39 \pm 1.29$  times on average, but when they used right-handed scissors, the rate was  $0.72 \pm 0.67$  times on average. [Conclusion] When left-hand dominant persons used left-handed scissors rather than right-handed scissors, the degree of wrist flexion decreased, which created more functionality, and the accuracy of the cutting increased. For improved cutting accuracy and wrist stability and to protect the wrist from extensive flexion, it is necessary for left-handers to use scissors that are made for left-handed people.

**Keywords:** Ergonomics design, Hand function, Left-hander

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## INTRODUCTION

Human beings do various activities by using their hands<sup>1)</sup>. Most people have a dominant hand, meaning the hand which is used for specific activities<sup>2)</sup>. Hands are a part of the body which we by necessity use in our daily life, and likewise the majority of objects which we use in daily life were also produced by hands<sup>3)</sup>.

The activities which clearly show a dominant hand include writing, using utensils, and using scissors<sup>4)</sup>. Dominance is measured through a demonstrated preference for or performance using a single hand<sup>5)</sup>. In addition, the hand which is used to carry out tasks requiring special motor techniques or complex tasks is also used to classify the dominant hand<sup>6)</sup>. It is not difficult to find a dominant hand through clinical means; for example, the hand which is used for writing, tooth-brushing, eating meals, and throwing a ball is the dominant hand<sup>7)</sup>. However, in some cultures, due to environmental factors, the use of the left hand when writing and eating meals is suppressed and the right hand is used<sup>8)</sup>.

Among the activities related to one's dominant hand, next to writing and eating meals, the activity which shows the

most clear lateralization is the use of scissors<sup>9)</sup>. When using scissors, left-handers' pattern of twisting the body or excessively flexing the wrist appears in contrast to right handers<sup>10)</sup>. There has been little research on the use of scissors until now, though recently there have been studies of precision and error of left-handed physicians who use scissors when performing operations<sup>11)</sup>.

The purpose of this study was to investigate wrist flexing when a left-hander uses left-handed scissors versus right-handed scissors, and was conducted using 3-dimensional motion analysis. This study aims to further the understanding of the kinematic function of left-handers' upper limbs in work performance and whether it is related to risks of musculoskeletal disorders. Through this investigation, this study aims to lay an ergonomic foundation for left-handers.

## SUBJECTS AND METHODS

The study subjects were healthy adults who had no problem carrying out the prescribed tasks and who agreed to the study's parameters. According to the study's criteria, those who did not have a history of neurological diseases or musculoskeletal disorders were included. Left-handers whose dominant hand was the right and those left handers who did not use scissors using their left hand were excluded. Eighteen left-handers participated in 3-dimensional motion analysis of the scissor-using task. There were 10 male subjects (55.6%), and eight female subjects (44.4%), and their average age was  $21.39 \pm 1.38$  years (Table 1). This study was conducted in accordance with the ethical principles of the Declaration of Helsinki regarding experiments with human subjects.

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## RESULTS

When left-handers used left-handed scissors, they carried out the task while extending the wrist at  $4.67 \pm 14.60^\circ$ , but when they used right-handed scissors, they carried out the task while flexing the wrist at  $1.19 \pm 12.41^\circ$ . The results were significantly different. The time taken by left-handers was  $37.81 \pm 8.14$  seconds on average to conduct the task using left-handed scissors, and the time taken to conduct the task using right-handed scissors was  $35.84 \pm 5.70$  seconds on average. These results were not significantly different. When left-handers used left-handed scissors, the error rate was  $1.39 \pm 1.29$  times on average, but when they used right-handed scissors, the rate was  $0.72 \pm 0.67$  times on average. These results showed statistically significant differences, with the number of errors when using the left-handed scissors being higher (Table 2).

## DISCUSSION

This study was conducted to lay a scientific foundation for intervention for left-handers through quantified analysis of the function of the upper extremities of left-handers when conducting work-related tasks. Everyone wants to use their dominant hand when carrying out tasks<sup>12)</sup>. However, if only about 10% of the population uses the left hand, the left hander number is great. And they added that there are cases where left-handers use their right hand for a particular task because of the difference in an absolute ration as 90% are right-hander. Most research conducted until now has focused on right-handers and insufficient attention has been paid to left-handers<sup>13, 14)</sup>.

There have long been reports that left-handers are less skillful than right handers<sup>15)</sup>. In addition, left-handers are much more likely than right-handers to suffer accidents or injuries when using tools and equipment designed for right-handers<sup>16)</sup>. However, despite these aforementioned reports, systematic and scientific research on left-handers has not been consistently conducted and much research on the use of the left hand has focused on relations with other diseases, language or brain function. Accordingly, there is insufficient research on the lowering of work performance and the onset of musculoskeletal disorders as a result of using the left hand.

The results of this study suggest that, when using left-handed scissors, left-handers extend the wrist more than when they use the right-handed scissors, and that they make more errors. When using the left-handed scissors, it was possible to reduce flexion of the wrist more than when using the right-handed scissors. Left-handed scissors have blades in the opposite direction from those of right-handed scissors. In other words, as the general scissors for right-handers face the center from the right side, left-handers have to change the intended direction to the opposite side when using right-handed scissors. For that reason, when using left-handed scissors, which have the blades in the opposite direction, it was possible to reduce flexion of the wrist.

If enough research is done on the function of the upper extremities of left-handers, it will be possible to prevent musculoskeletal disorders, and make ergonomic designs for

**Table 1.** General characteristics (N=18)

		Left hander (n=18)
Gender	Male	10 (55.6%)
	Female	8 (44.4%)
Age (years)		21.4 ( $\pm 1.4$ )

**Table 2.** Results of scissors type (N=18)

	Left handed scissors	Right handed scissors
	M $\pm$ SD	M $\pm$ SD
Flexion ( $^\circ$ )	$-4.7 \pm 14.6^{**}$	$1.2 \pm 12.4$
Time (sec)	$37.8 \pm 8.1$	$35.8 \pm 5.7$
Error	$1.4 \pm 1.3^{**}$	$0.7 \pm 0.7$

\*\*Significant difference  $p < 0.05$

left-handers, thereby increasing their work efficiency. There is a need to continuously conduct research on left-handers and to establish an environment for their success.

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