Development and Standardization of the Hand Function Test

Tasuku Kaneko and Toshiaki Muraki

A simple test battery was developed and standardized to evaluate hand functions. The battery consisting of ten subtests was designed on the basis of various hand activities. To establish the norms of 16 age groups, the tests were administered to 1388 normal subjects (629 males and 759 females) ranging in age from 4 to 90 years. These data will enable occupational therepists and other clinicians to objectively compare a patient's score with those at same age group of him. Test-retest reliability at one week interval with 20 subjects was evaluated. To evaluate its practical usability, 185 patients with various hand disabilities were tested by many occupational therapists. A case report presented here illustrates the possible use of this test in clinical stuations to provide objective evidence of changes in hand functions after occupational therapy.

Key Words
Hand function test,
Standardization,
Occupational therapy.

INTRODUCTION

In numerous clinical situations, assessment of hand function is indispensable for occupational therapists; various hand function tests have been developed so far today. However, no function test gives any normative data for the very young up to the aged (1–5).

A comprehensive and simply administered assessment is of importance in planning an intervention of occupational therapy. In addition, a test battery is needed that provides normative data with the large sample size, with which occupational therapists can estimate patient's functional restoration of the hand.

School of Allied Medical Sciences, Kobe University, Kobe, Japan

A simple test battery designed by us were administered to 1388 normal subjects ranging in age from 4 to 90 years to establish the norms of 16 age groups.

MATERIALS AND METHODS

1. Equiptment and Test procedure

The test board (Fig.1) was placed along the nearest edge of a table. Each subject was seated on a chair facing the board. Midline of the test board was placed in a line vertical to subject's midline. The examiner sat side by side with the subject for easy demonstrability. Before starting each subtest, the subject was given instruction and demonstration. The subtests are always performed first with a dominant hand or sound hand. Time to complete each subtest is measured in seconds using a stop watch. Administration time is approximately 20 minutes, because each subtest is limited in time.

The following instruction is given to the subject: I want to see how quickly you can manage this test with your hand. I want you to work as quickly as you can. Before you start a subtest, I will show you how to do it. When it is time to start, I will say

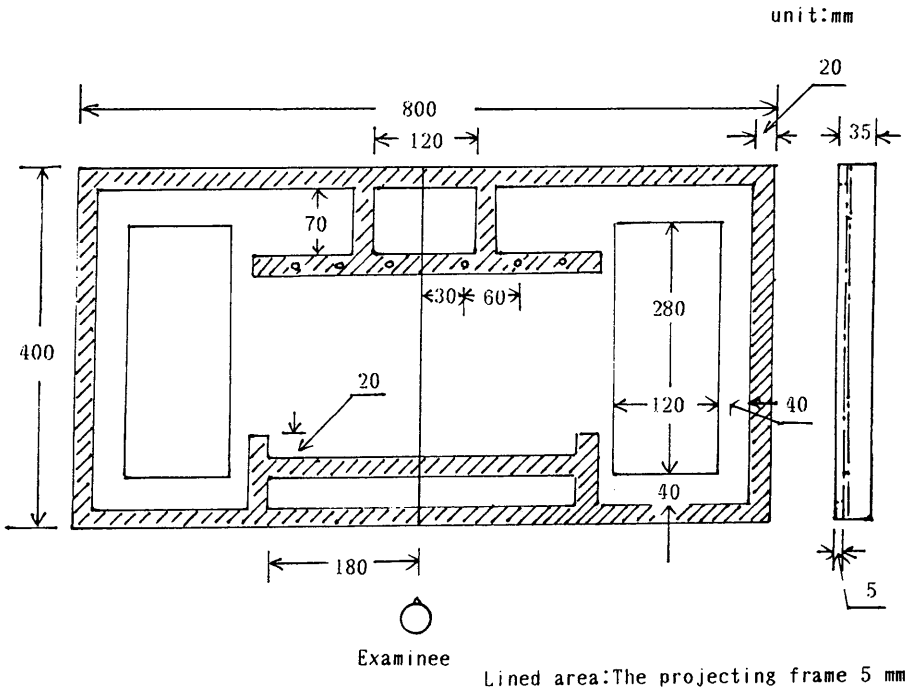

Figure 1. Test board

"ready?" and then "go". Place your hand on the front edge of the test board.

Subtest 1

Equipment: Five soft balls of diameter 6.8cm, 80g in weight.

Instruction: "Pick up these five balls one at a time, and place them here like this." (Fig. 2)

Subtest 2

Equipment: Six wooden balls of diameter 4.0cm, 15g in weight.

Instruction: "Pick up these six balls one at a time, and place them here like this." (Fig. 3)

Subtest 3

Equipment: Five wooden rectangular prisms of 10.0cm long, 10.0cm wide and 5.0cm high, 200g in weight.

Instruction: "Pick up these five prisms one at a time, and place them here like this." (Fig 4)

Subtest 4

Equipment: Six wooden cubes of 3.5cm square, 15g in weight.

Instruction: "Pick up these six cubes one at a time , and place them here like this."(Fig. 5)

Subtest 5

Equipment: Six wooden circular plates of diameter 3.0cm, and 1.0cm thichness, 5g in weight.

Instruction: "Pick up these six plates one at atime, and place them here like this." (Fig. 6)

Subtest 6

Equipment: Six wooden cubes of 1.5cm square, 2g in weight.

Instruction: "Pick up these six cubes one at a time , and place them here like this."(Fig. 7)

Subtest 7

Equipment: Six 9.0–by–7.0cm vinyl

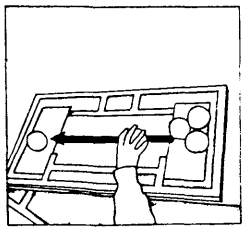

Figure 2. Subtest 1

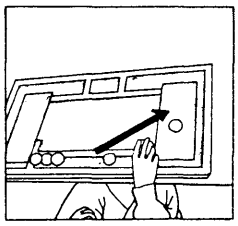

Figure 3. Subtest 2

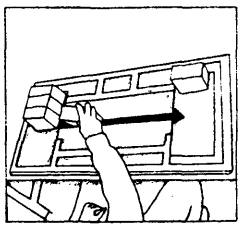

Figure 4. Subtest 3

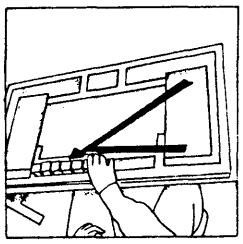

Figure 5. Subtest 4

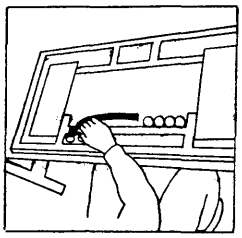

Figure 6. Subtest 5

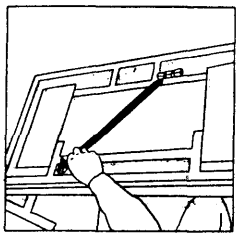

Figure 7. Subtest 6

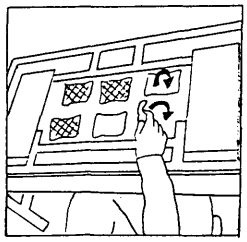

Figure 8. Subtest 7

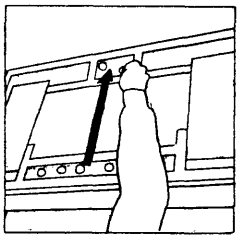

Figure 9. Subtest 8

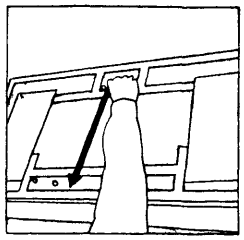

Figure 10. Subtest 9

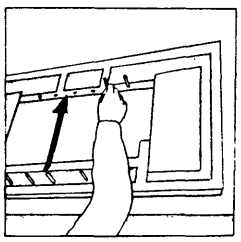

Figure 11. Subtest 10

sheets.
Instruction: "Turn these sheets over one at a time like this." (Fig. 8)
Subtest 8
Equipment: Six iron circular plates of diameter 2.0cm and 0.2cm thichness, 3g in weight.
Instruction: "Pick up these six plates one at a time, and place them here like this." (Fig. 9)
Subtest 9
Equipment: Six iron balls of diameter 0.6cm, 2g in weight.
Instruction: "Pick up these six balls one at a time, and place them here like this." (Fig. 10)
Subtest 10
Equipment: Six iron pins of diameter 0.3cm and 4.0cm long, 2g in weight.
Instruction: "Pick up these six pins one at a time, and put into these holes like this." (Fig. 11)

All ten subtests were administered to 100 normal subjects (50 males and 50 females) ranging in age from 18 to 25. All subject were right-handed. The mean times in taken for completion of each subtests and standard deviations were calculated. Ten grades (1～10 point) of each subtests were established with right and left hand separately (Fig. 12). 10 point of each subtest were within the mean times plus 3 standard deviations. 9 point were within the mean times plus 6 SD. 8 point were within the mean times plus 9 SD. 7 point were within the mean times plus 12 SD. 6 point were within the mean times plus 15 SD. 5 point were within the mean times plus 18 SD. 4 point were within the mean times plus 21 SD. 4 point were the mean times plus 24 SD. 3 point were within the mean times plus 27 SD. 2 point were the mean times plus 30 SD, and 1 point were within the mean times plus

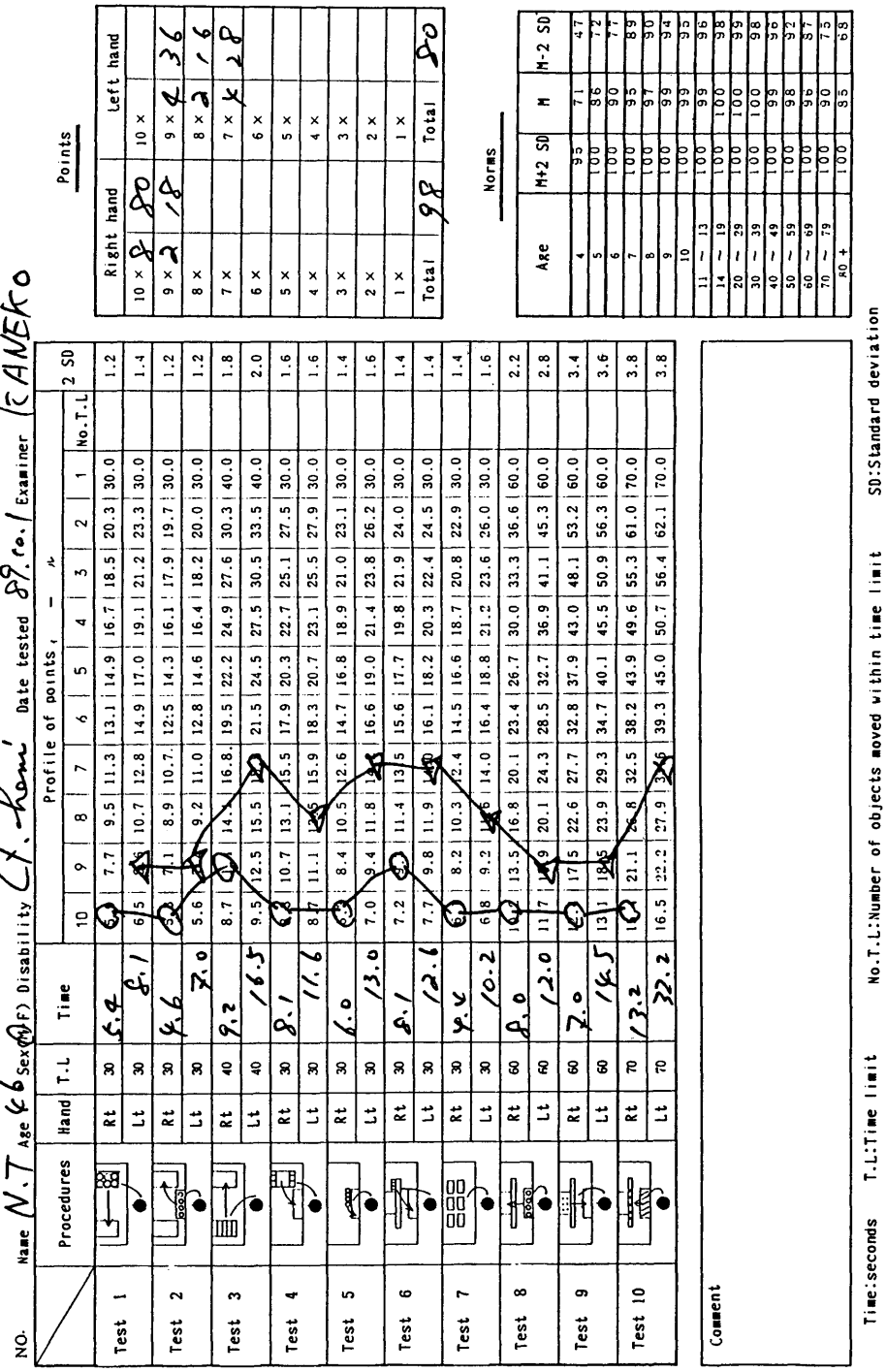

Figure 12. Evaluation form and a result of a hemiplegic patient

33 SD.

2. Subjects for Norms of Each Age Groups

To establish the norms of 16 age groups, the tests were administred to 629 males and 759 females ranging in age from 4 to 90 years (total 1388). Number of subjects in each age groups were as follows: 4 years, 64(37 males 27 females); 5 years, 57(30 males and 27 females); 6 years, 77(41 males and 36 females); 7 years, 47(24 males and 23 females); 8 years, 55(23 males and 32 females); 9 years, 55(34 males and 21 females); 10 years, 61(29 males and 32 females); 11–13 years, 115(45 males and 70 females); 14–19 years, 240(90 males and 150 females); 20–29 years, 152(92 males and 60 females); 30–39 years, 81(41 males and 40 females); 40–49 years, 91(34 males and 57 females); 50–59 years, 81(38 males and 43 females); 60–69 years, 65(20 males and 45 females); 70–79 years, 103(39 males and 64 females); and above 80 years, 44(12 males and 32 females).

RESULTS

Mean value and standard deviation including right and left hands of males and females in each age groups were calculated. Mean point, mean point plus 2 SD and mean point minmus 2 SD of each age groups were demonstrated in evaluation form(Fig. 12). These data will enable therapists to objectively evaluate a patient's hand dexterity in comparison with that of the normal at his age group.

Test-retest reliability at one week interval was performed to 20 subjects, which indicated a signigicant value($r = 0.907$) in Spearman's ranking correlation coefficient.

Moreover, in clinical situations, 185 patients with various hand disabilities due to cerebrovascular accident, cerebral palsy, peripheral nerve injury, and trumatic quadriplegia were examined by occupational therapists. As a result it reveals that this test battery will measure a broad spectum of hand disability and evaluate an effect of treatment.

We present one case to whom the hand function test was applied and show how it is clinically useful.

A 46-year-old man with left hemiplegia due to cerebrovascular accident had a difficulty in using his hand because of slight spasticity. Before receiving occupational therapy he was tested with this battery. His scores showed 80 points(involved hand) and 98 ones(sound hand). Scores of involved hand increased in 9 evaluate effect of occupational therapy. Scores of involred hand increased in 9 subtests and time taken to complete these tasks became shorter in all subtests(Table 1). It suggests that this test will be of value in occupational therapy intervention by providing objective data of improving disabled hand function.

Table 1. Changes in points and times

	Involved hand		Sound hand	
	Before OT	After OT	Before OT	After OT
	Point(Time)	Point(Time)	Point(Time)	Point(Time)
Subtest 1	9(8.1)	10(6.3)	10(5.4)	10(4.4)
Subtest 2	9(7.0)	9(6.5)	10(4.6)	10(4.4)
Subtest 3	7(16.5)	10(9.4)	9(9.2)	10(8.3)
Subtest 4	8(11.6)	9(10.7)	10(8.1)	10(8.2)
Subtest 5	7(13.0)	9(8.9)	10(6.0)	10(6.2)
Subtest 6	7(12.6)	8(11.2)	9(8.1)	9(7.6)
Subtest 7	8(10.2)	9(7.3)	10(4.4)	10(4.2)
Subtest 8	9(12.0)	10(10.0)	10(8.0)	10(7.8)
Sbutest 9	9(14.5)	10(13.4)	10(7.0)	10(6.3)
Subtest 10	7(32.2)	10(17.7)	10(13.2)	10(11.2)
Total	80(137.7)	94(101.4)	98(74.0)	99(68.6)

Time:seconds

DISCUSSION

Many hand function tests have appeared in the literature. Some of them had normative data for comparison a patient's score with normal subject's score.

Jebsen et al developed and tested a nondisabled sample of 360 adults ranging in age from 20 to 94 years(1). Smith used a population of 91 nondisabled males and females(age 21 to 62 years) to establish a standardized baseline for comparison(2). The Box and Block Test had normative data for children (7,8 and 9 years)(3), and also had data on 310 males and 318 females ranging in age from 20 to 94 years(4). Mathiowetz, Weber, et al reported normative data of Nine Hole Peg Test from 618 subjects(age 20 to 94)(5).

There are many other hand function tests. But some of them lack normative data for children and the others lack nomative data for adult. No function test have normative data for all age groups with large sample size. The lagest sample size is 628 subjects by Mathiowetz et al for Box and Block Test.

Our test battery was developed and standardized to evaluate hand function of all age groups. To establish norms of 16 age groups, the test was administered to 1388 normal children and adults(629 males and 759 females) ranging in age from 4 to 90 years. To evaluate its practical usability, 185 patients with various hand disabilities were tested by many occupational therapists. It was suggested that this test battery could measure a broard spectrum of hand disability and evaluate the effectiveness of treatment.

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