Modified measurement of finger-floor distance —Self-assessment bending scale—

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Summary

Finger-floor distance (FFD), which represents trunk flexibility, is a reliable assessment of lumbar impairment. Although this measurement is easy to test, it is difficult to adopt in a large, epidemiological study because it requires examiners. As an alternative, we developed a simple self-assessment bending scale (SABS). The purpose of the present study was to investigate the validity and reliability of the SABS. The SABS has 7-point grading scheme: (1) Fingertips can not reach beyond the knees; (2) Fingertips can reach beyond the knees but the wrists can not; (3) Wrists can reach beyond the knees, but fingertips can not reach the ankles; (4) Fingertips can reach the ankles, but not the floor; (5) Fingertips can touch the floor; (6) All of the fingers can reach the floor; and (7) Palms can reach the floor. We measured the FFD and SABS in 55 healthy volunteers. SABS assessments were made and documented independently by the subject and examiner. The SABS highly correlated with the FFD ($r=0.95$). Kappa statistics for the SABS grades given independently by the subjects and the examiner were high at 0.98. These findings suggest that the SABS may be used as an alternative to FFD measurements in epidemiological studies.

Introduction

Finger-floor distance (FFD), which represents trunk flexibility, is commonly used to study lumbar impairment, including low

back pain. Although finger-to-floor is a composite movement of spine, hips and hamstring flexibility⁵⁾, true lumbar flexion and total lumbosacral/hip flexion are closely correlated and are equally relevant as a mea-

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Fig. 1 Definition of the self-assessment bending scale (SABS).

Grade 1: Fingertips can not reach beyond the knees; grade 2: Fingertips can reach beyond the knees but the wrists can not; grade 3: Wrists can reach beyond the knees but the fingertips can not reach the ankles; grade 4: Fingertips can reach the ankles but not the floor; grade 5: Fingertips can touch the floor; grade 6: All of the fingers can reach the floor; and grade 7: Palms can reach the floor.

surement of impairment⁴). Total flexion is also found to closely reflect self-reported disability in activities of daily living^{2,4,6}) and it is suggested to be the single most valid measure of lumbar impairment⁷). The FFD method has been shown to be reliable^{1,3}). Although the measurement is easy, it is difficult to use in a large, epidemiological study because it requires examiners. As an alternative, we developed a simple self-assessment bending scale (SABS), like the FFD, in which reference sites and reaching points on the body were defined. The purpose of the present study was to briefly investigate the validity and reliability of the SABS.

I. Materials and Methods

The study included 55 healthy volun-

teers without lower back pain (24 males and 31 females). Their age ranged from 21 to 60 years (mean $\pm$ SD: 33.1 ± 11.8 years; men, 34.9 ± 9.8 years; females, 31.7 ± 11.5 years). Their height ranged from 150 to 180 cm (164.6 ± 8.9 cm; males, 157 to 180 cm [172.6 ± 5.9 cm]; females, 150 to 169 cm [158.5 ± 5.1 cm]). They were informed of the purpose of the study, and informed written consent was obtained prior to participation.

1. Self-assessment bending scale (SABS)

According to the instructions described in the questionnaire, the subject stood with their feet together and bent forward slowly, with the knees extended, and measured the point to which the fingertips reached. The results were graded on a 7-point scale: (1) Fingertips can not reach beyond the knees;

Fig. 2 The questionnaire of the self-assessment bending scale (SABS)

Please put both legs together and bent forward without momentum, with the knees extended, and measure the point to which the fingertips reached. Please attach a badge to the item to apply in fact. beyond knees but wrists can not; (3) Wrists can reach beyond knees, but fingertips can reach the ankles; (4) Fingertips can reach ankles, but not the floor; (5) Fingertips can touch the floor; (6) All of the fingers can reach the floor; and (7) Palms can reach the floor.

(2) Fingertips can reach beyond the knees but wrists can not; (3) Wrists can reach beyond the knees, but fingertips can not reach the ankles; (4) Fingertips can reach the ankles, but not the floor; (5) Fingertips can touch the floor; (6) All of the fingers can reach the floor; and (7) Palms can reach the floor (**Fig 1**). The definition of knees and wrists is illustrated in the questionnaire. The SABS questionnaire is shown in **Fig. 2**.

2. Measurement of the FFD and SABS grading

Subjects standing on a 20-cm-high stool bent forward, and an examiner who was a skilled physical therapist measured the distance from the top of the stool to the fingertips. The top of the stool was considered zero. The distance was expressed as a positive value when the fingertips reached be-

yond the top of the stool and expressed as a negative value when the fingertips did not reach the top.

The SABS was graded in parallel with the measurement of the FFD in the same condition. When the fingertips reached beyond the top of the stool during forward flexion, the assessment was made on the basis of the part of the hands in contact with the top of the stool (fingertips, all of the fingers, or the whole palms). When the fingertips did not reach beyond the top of the stool, the subjects were instructed to place their hands on the front of their legs to examine the position of the fingertips or wrists relative to the body part (knees and ankles) (**Fig 3**). Assessments were made and documented independently by the subject and the examiner.

Fig. 3 A: When the fingertips reached beyond the top of the stool during forward flexion, the assessment was made on the basis of the part of the hands in contact with the top of the stool (fingertips, all of the fingers, or the whole palms).
B: When the fingertips did not reach beyond the top of the stool, the subject was instructed to place their hands on the front of their legs to assess the position of the fingertips or wrists relative to the body (knees and ankles).

3. Statistical Analysis

For validity, Spearman's correlation coefficient was used to examine the relationship between the FFD and SABS. Kappa statistics for the SABS grades given by the subjects and the examiner was calculated for reliability.

II. Results

The correlation between the FFD and SABS is shown in Fig 4. In the SABS assessment, no subject had grade 1 (the fingertips did

not reach beyond the knees), and only one subject had grade 2 (the fingertips reached beyond the knees but the wrists did not reach beyond the knees), probably because the present study included healthy volunteers without low back pain. There was a significant and strong correlation between the FFD and SABS ($r = 0.95$, $p < 0.0001$); however, some subjects with the same FFD measurement had different SABS grades. The FFD overlap was 1 cm between grades 2 and 3, 2 cm between grades 5 and 6, and

FFD: Finger-floor distance SABS: Self-assessment bending scale

Fig. 4 The correlation between finger-floor distance (FFD) and the self-assessment bending scale (SABS). There was a significant and strong correlation between the FFD and SABS (Spearman's correlation coefficient: $r=0.95$, $p<0.0001$). In the SABS assessment, disagreement between subjects and the skilled physical therapist occurred in only one subject, who misinterpreted grade 5 as grade 6 (arrow).

1 cm between grades 6 and 7.

In the SABS assessment, disagreement between the subject and examiner occurred in only one subject, who misinterpreted grade 5 as grade 6, and the kappa statistics were 0.98.

III. Discussion

SABS grades were highly correlated with FFD measurements with a correlation coefficient of 0.95. Kappa statistics for grades given independently by subjects and a skilled physical therapist were very high at 0.98, demonstrating that the SABS grading system is reliable. These findings suggest that this assessment method may be used as an alternative to FFD measurements in large, epidemiological studies.

Only one subject was assigned the wrong

grade. The subject misinterpreted the fingertips reaching the floor as "all of the fingers reaching the floor." This was probably attributed to misunderstanding "all of the fingers." Such misunderstanding can be avoided by illustrating the definition of knees and wrists and schematically showing the entire fingers in contact with the floor.

As described in the results, there was FFD overlap of up to 2 cm between two adjacent grades in SABS. This may be attributed to differences in the length of the extremities, such as the arms, palms, and fingers. When the fingertips do not reach the floor, individuals with longer arms are more likely to reach the distal parts of the legs because the radius of rotation is longer when the fingers and hands are placed on the front legs after measuring FFD. Thus, in-

dividuals with the same FFD may receive higher grades. The possibility that different grades (one-step higher) may be given to individuals with the same FFD may be a limitation of this method; however, the overlap was found to be 2 cm or less.

Conclusions

- 1) We developed a simple self-assessment bending scale (SABS) like the finger-floor distance (FFD), in which reference sites and reaching points on the body were defined.
- 2) SABS grades were highly correlated with FFD measurements with a correlation coefficient of 0.95, indicating validity. Kappa statistics for grades given independently by subjects and a skilled physical therapist were very high at 0.98, demonstrating that the SABS grading system is reliable. These findings suggest that the SABS may be used as an alternative to FFD measurements in large, epidemiological studies.
- 3) This method has the limitation that different grades (one-step higher) may be given

to individuals with the same FFD, although the overlapping range was 2 cm or less.

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