

BioRescue의 측정자내와 측정자간 신뢰도

Intra- and Inter-rater Reliability of BioRescue

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요약

BioRescue(RMIngénierie, Marseille, France)는 대상자가 일어서거나 앉을 때 동적과 정적인 균형을 평가하기 위해 사용하는 장비이다. 이전부터 다양하게 사용되고 있지만 이 장비에 대한 명확한 신뢰도에 대한 연구는 아직 부족한 상태이다. 본 논문은 균형 능력 측정을 위한 BioRescue의 측정자내와 측정자간 신뢰도를 측정했다. 이 연구의 대상자는 34명의 건강한 대상자들과 2명의 물리치료사 평가자들로 구성되었다. BioRescue는 발지표(면적과 압력), 롬버그 검사, 안정성 검사로 구성되어 있다. 발지표의 면적과 안정성 검사는 모든 방향에서 ICC값이 0.60 이상으로 나왔다. 하지만 발지표의 압력과 롬버그 검사는 모든 방향에서 ICC값이 0.60 이하로 나왔다. BioRescue는 균형검사 시 발지표의 면적과 안정성 검사에서 높은 신뢰도를 나타냈다. 하지만, 발지표의 압력과 롬버그 검사의 수치에서 숙련자와 비숙련자의 차이를 보이기 때문에 장비의 정확성을 위해 숙련이 필요하다.

■ 중심어 : | 균형 | 바이오레스큐 | 안정성범위 | 롬버그검사 |

Abstract

BioRescue (RMIngénierie, Marseille, France) is able to assess dynamic and static balance when a test subject stands or sits over the platform. Although previous studies have examined the reliability of other balance measurement methods, little research has been conducted on the reliability of equipment such as BioRescue. This study examined the intra-rater and inter-rater reliability of BioRescue during balance assessment. Thirty-four healthy adults participated as subjects and two physical therapists participated as examiners to determine intra- and inter-rater reliability. BioRescue was used to conduct measurements during footprint (area and pressure), Romberg, and limit of stability tests. The footprint area and limit of stability tests yielded intra- and inter-rater reliability ICC values above 0.60 in all directions. However, the footprint pressure and Romberg tests yielded values below 0.60 in all directions. BioRescue showed good inter-rater and intra-rater reliability in measurements during footprint area and limit of stability tests. However, because the values of limits of stability show the difference between experienced and unskilled, skill is required for the accuracy of the equipment.

■ keyword : | Balance | BioRescue | Limits of Stability | Romberg Test |

I. Introduction

Balance is the ability to maintain the center of gravity on the surface through interaction with sight, vestibular system, somatic sense, muscular strength, and coordination ability[1]. Clinically, general balance is assessed using functional movement assessments (e.g., timed up and go test, functional reach, and Romberg tests), evaluation tools (e.g., the Berg Balance Scale and Activity-specific Balance Confidence Scale), and balance measurement equipment. Of these, the latter is expensive and applicable to only a limited number of test subjects, but is considered the most objective method and thus is widely applied in clinical settings[2]. BioRescue (RM Ingénierie, Marseille, France) is a platform with built-in sensors able to respond to any fine motion. This device is able to assess dynamic and static balance when a test subject stands or sits over the platform; it has been applied in many studies[3][4]. Although previous studies have examined the reliability of other balance measurement methods, little research has been conducted on the reliability of equipment such as BioRescue. In previous studies, BioRescue has been used to assess and train the balance ability to stroke patients and cognitive impairment patients[5][6]. However, there was no mention of examiner's proficiency. Because the result of assessment and training may vary depending on the proficiency of examiner, to support the results of previous studies, the reliability of the BioRescue instrument itself is required. Therefore, we examined the intra-rater and inter-rater reliability of this device.

II. Method

Thirty-four healthy adults, aged 20-30 years,

participated in this study (sex: 16 males, 18 females; mean age: 22.65 ± 1.59 years; height: 167.55 ± 8.95 cm; weight: 64.35 ± 15.57 kg). No participants had injuries or diseases of the musculoskeletal or nervous system. Participants provided informed consent, and all procedures were approved by the Silla University Institutional Review Board (1041449 - 201805 - HR - 002). Two physical therapists participated as examiners. Examiners 1 and 2 had been physical therapists for 1 year and 11 years, respectively. The examiners tested all subjects during two separate sessions. Two measurements were performed on the same day to assess inter-rater reliability. After 1 week, main examiner repeated measurements at the same time of day to assess intra-rater reliability. BioRescue (RM Ingénierie, Marseille, France) is a platform ($610 \times 580 \times 10 \text{ mm}^3$) with 1,600 built-in sensors, a 55-inch monitor (distance: 1-1.5m), and a safety bar [Fig. 1]. We conducted a footprint test to determine the frequency (%) of pressure levels imposed on four measurement areas and to quantify

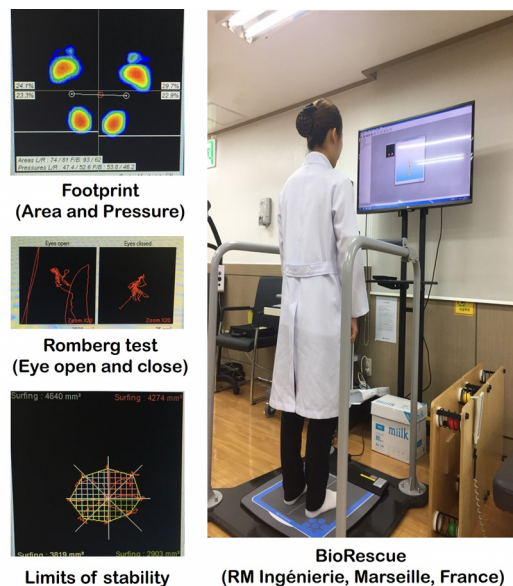


Fig. 1. BioRescue

each area(mm²). We also performed a Romberg test to measure the subjects' stable balance ability for 30s with eyes open and closed, and a limits of stability test to measure the basal area(mm²) of stable swaying in each of eight directions. Before each of these tests, the subject stood on both feet over a platform, stretched out one foot forward by 30°, and kept one eye on the front monitor. Inter- and intra-rater reliability were expressed using the intraclass correlation coefficient (ICC) (3.1) and 95% confidence intervals (CI). The equipment was deemed reliable when ICC values were good (0.60 - 0.80) or excellent (>0.80)[7]. Statistical analyses were performed using the SPSS Statistics 21.0 software (IBM SPSS Inc., USA), and significance was determined at P < 0.05.

III. Results

In the footprint area test, the inter-rater reliability ICCs were 0.91 (left), 0.91 (right), 0.79 (front), and 0.77 (back); the intra-rater reliability ICCs were 0.93 (left), 0.90 (right), 0.81 (front), and 0.84 (back). In the limits of stability test, the inter-rater reliability ICCs were 0.66 (left), 0.72 (right), 0.60 (front), and 0.77 (back); the intra-rater reliability ICCs were 0.78 (left), 0.76 (right), 0.69 (front), and 0.84 (back). In the footprint pressure and Romberg tests, inter- and intra-rater reliability ICCs were below 0.60 in all directions[Table 1][Table 2].

Table 1. Inter-rater reliability of two examiners

			Examiner 1	Examiner 2	ICC (95%CI)	p
Foot prints	Area	Left	138.20 (29.53)	135.79 (27.45)	0.91 (0.82 to 0.95)	0.001
		Right	138.67 (27.54)	137.64 (26.42)	0.91 (0.83 to 0.95)	0.001
		Front	138.44 (30.92)	137.73 (26.23)	0.79 (0.62 to 0.89)	0.001
		Back	138.44 (35.39)	132.76 (31.73)	0.77 (0.59 to 0.88)	0.001
	Pressure	Left	50.70 (2.54)	49.75 (2.50)	0.20 (-0.14 to 0.50)	0.123
		Right	49.30 (2.54)	50.24 (2.50)	0.20 (-0.14 to 0.50)	0.123
		Front	44.89 (7.91)	44.96 (7.28)	0.59 (0.31 to 0.77)	0.001
		Back	55.10 (7.91)	55.02 (7.29)	0.59 (0.32 to 0.77)	0.001
Romberg test	Eye open	Surface area ellipse	24.20 (22.40)	15.94 (13.79)	0.20 (-0.13 to 0.50)	0.117
		Length	8.70 (1.51)	8.80 (1.46)	0.37 (0.04 to 0.63)	0.013
	Eye close	Surface area ellipse	31.55 (32.73)	28.85 (25.99)	0.57 (0.30 to 0.76)	0.001
		Length	10.43 (3.05)	10.90 (2.87)	0.59 (0.32 to 0.77)	0.001
Limits of stability	Left	5506.38 (1881.36)	6030.61 (2524.46)	0.66 (0.42 to 0.81)	0.001	
		5726.32 (2156.96)	5908.91 (2268.45)	0.72 (0.51 to 0.85)	0.001	
	Front	6907.88 (2241.74)	7411.55 (3005.12)	0.59 (0.32 to 0.77)	0.001	
		4324.67 (1969.54)	4527.91 (1993.14)	0.77 (0.59 to 0.88)	0.001	

Table 2. Intra-rater reliability of examiner 1

			Day 1	Day 2	ICC (95%CI)	p
Foot prints	Area	Left	138.20 (29.53)	140.26 (29.30)	0.93 (0.86 to 0.96)	0.001
		Right	138.67 (27.54)	140.67 (27.05)	0.90 (0.82 to 0.95)	0.001
		Front	138.44 (30.92)	138.26 (26.27)	0.81 (0.65 to 0.90)	0.001
		Back	138.44 (35.39)	142.67 (39.71)	0.84 (0.71 to 0.92)	0.001
	Pressure	Left	50.70 (2.54)	50.05 (2.37)	0.46 (0.15 to 0.68)	0.003
		Right	49.30 (2.54)	49.94 (2.37)	0.46 (0.15 to 0.68)	0.003
		Front	44.89 (7.91)	46.15 (6.93)	0.75 (0.56 to 0.86)	0.001
		Back	55.10 (7.91)	53.84 (6.93)	0.75 (0.56 to 0.86)	0.001
Romberg test	Eye open	Surface area ellipse	24.20 (22.40)	18.23 (15.25)	0.47 (0.17 to 0.70)	0.002
		Length	8.70 (1.51)	8.84 (1.53)	0.79 (0.62 to 0.89)	0.001
	Eye close	Surface area ellipse	31.55 (32.73)	29.26 (26.55)	0.60 (0.34 to 0.78)	0.001
		Length	10.43 (3.05)	10.15 (2.02)	0.55 (0.27 to 0.74)	0.001
Limits of stability	Left	5506.38 (1881.36)	6275.23 (2179.30)	0.78 (0.61 to 0.88)	0.001	
		5726.32 (2156.96)	6276.61 (2387.71)	0.76 (0.57 to 0.87)	0.001	
	Front	6907.88 (2241.74)	7816.38 (3023.44)	0.69 (0.46 to 0.83)	0.001	
		4324.67 (1969.54)	4703.11 (1911.97)	0.84 (0.70 to 0.91)	0.001	

IV. Discussion

In the footprint test, left and right movement had excellent inter-rater reliability and front and back movement had good inter-rater reliability; intra-rater reliability was excellent in all directions. In the limits of stability test, intra-rater reliability was good in all directions. Similar results have been obtained in similar studies on balance-measuring equipment. In Nintendo Wii balance board study, the inter-rater reliability (ICC: 0.89-0.79), intra-rater reliability (ICC: 0.92-0.70) were high in terms of COP length and velocity[8][9]. Therefore, we consider our results objective data for a clinical setting. However, reliability was poor in the foot print pressure and Romberg tests, likely because the variables used for balance measurement were specified in greater detail by this equipment, compared to the general equipment assessed in previous studies[9][10] and because the technical edge of the measuring platform sensors permitted greater influence by the surroundings during measurement. Because the number of the study subjects was small, it is difficult to generalize our results. Future studies should increase the number of study subjects and include subjects with balance impairment.

Although functional and performance are important, measurement equipment must be accurate and reliability to use trust measured data. In order to verify the accuracy and reliability of equipment in previous studies, the study is conducted by comparing novice and experienced examiners. If there is no difference between the results of novice and experienced examiners, it can be suggested that anyone can easily use this equipment and that it is reliable[11][12]. The results of this study showed that in the inter-examiner reliability of the two examiners, the confidence between the two inspectors was

moderate and different. This is reliable but represents a difference in accuracy. Future studies should demonstrate equipment accuracy by studying the differences between experienced and novice examiners. In addition, novice examiner of intra-examiner reliability showed different levels of limits of stability. Therefore, it can be seen that the accuracy of the equipment requires experience.

V. Conclusion

BioRescue showed good inter-rater and intra-rater reliability in measurements during footprint area and limit of stability tests. However, because the values of limits of stability show the difference between experienced and unskilled, skill is required for the accuracy of the equipment.

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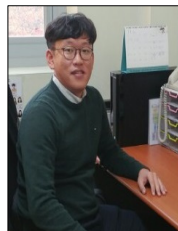
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