

ORIGINAL ARTICLE

IJPHY

Preliminary Study About The Application Of Gravicorder For Weight-Shifting and-Bearing Exercise As a New Educational Device of Physiotherapists

¹Shinichi DAIKUYA²Masakazu MATSUOKA¹Yumi OKAYAMA

ABSTRACT

Background: To establish an objective evaluation of basic physiotherapy technique, we recorded a mechanical aspect during a lateral weight-shifting (WS) using gravicorder.

Methods: Subjects were 18 physiotherapists divided into three groups based on experience year. Our originally developed software converted center of gravity data during WS to 3-dimensional mechanical value.

Results: All direction data showed significantly lower in the long experience year group ($p < 0.05$). The coefficient of variation was high vertical for all three groups.

Conclusion: In the group with more years of experience, it was confirmed that it was compactly implemented. In the vertical direction, it is thought to be implemented by empirical rules because there is no constant normal pattern or common recognition among physiotherapists.

Keywords: physiotherapy, education, weight-shifting guidance, weight-bearing exercise, physiotherapy education, years of experience.

Received 30th November 2022, accepted 25th April 2023, published 09th June 2023



www.ijphy.org

10.15621/ijphy/2023/v10i2/1321

CORRESPONDING AUTHOR

^{*}Shinichi DAIKUYA

Professor, Hokuriku University.
Taiyogaoka, Kanazawa, Ishikawa 920-1181
Japan.
e-mail: sh_daikuya@hokuriku-u.ac.jp

²Director, REHASTAGE Co., Ltd. 2-7-3-202
Nipponbashi-Nishi, Naniwa, Osaka 556-0004 Japan.
e-mail: matsuoka@reastage-c.com
¹Assistant Professor, Hokuriku University.
Taiyogaoka, Kanazawa, Ishikawa 920-1181 Japan.
e-mail: y-okayama@hokuriku-u.ac.jp



INTRODUCTION

In Japan's current clinical physiotherapy situation, staff education has become insufficient by a rapid increase in the number of new physiotherapists and a 365-day rehabilitation providing system initiative. Therefore, it is challenging to evaluate physiotherapy techniques objectively, and the student and staff instruction is often carried out based on the experience and subjectivity of the individual teacher or senior physiotherapist. And in recent years, there have been an increasing number of situations in which teachers and department administrators with little clinical experience are required to provide technical guidance. On the other hand, because physiotherapy services provide under the public insurance system by the same fee in Japan, it has become an issue to ensure the quality of basic physiotherapy services at a minimum level since a wide range of physiotherapists, from those with considerable clinical experience to new graduates, in clinical practice. Therefore, it is needed to establish a method for objective evaluation and instruction of physiotherapy techniques in school and clinical physiotherapy education.

In this study, as a preliminary step to the quantification of basic physiotherapy skills, which will contribute to the objective evaluation and guidance of basic physiotherapy techniques and provide a basis for ensuring the quality of physical therapy, we aimed to clarify a mechanical aspect during the guidance of lateral weight-shifting (Figure 1) as one of the basic physiotherapy techniques using gravicorder.

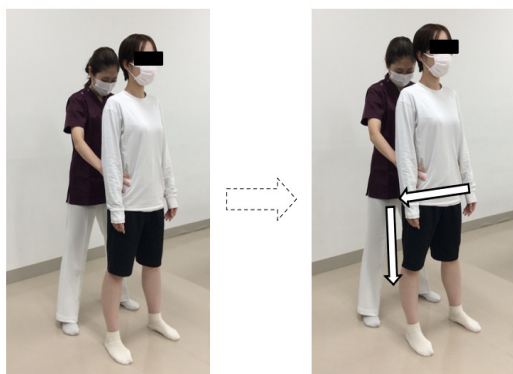


Figure 1. Weight-shifting and weight-bearing exercises as basic physiotherapy techniques.

These are the exemplification scene the weight-shifting from natural standing (left figure) to right leg dominant weight-bearing (right figure).

METHODS

Subjects were 18 physiotherapists: average age and years of therapists' experience of 25.9 ± 3.4 and 2.4 ± 1.6 years, respectively. They were divided into three groups (A, B, C) of 6 people, each based on years of therapists' experience. The experience year of groups A, B, and C was one year only, two years only, and more than 3 (mean: 4.2 (3-7)) years, respectively (Table 1).

Table 1. Mean age and years of experience in each group.

Group	Age	Years of experience
A (n=6)	26.0±3.8	1
B (n=6)	24.5±0.8	2
C (n=6)	27.2±4.4	4.2±1.5 (3-7)

Incidentally, subjects were selected from only one hospital because our previous study concluded that weight-shifting pattern was affected by the institution they worked [1]. All study tasks were carried out in accordance with the Declaration of Helsinki. Before the experiment, according to the decision about the ethical review of the board meeting of the hospital belonged all subjects, we explained in advance the outline and invasion of this experiment and the presence/absence and form of publication and then conducted subjects who obtained written consent to the purpose of this experiment.

The experiment was performed following conditions (Figure 2).

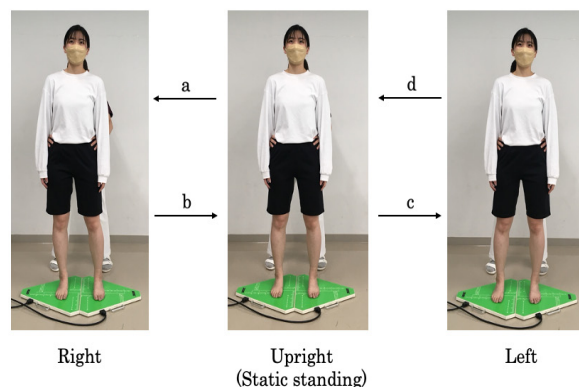


Figure 2. Experimental situation

Start position: upright position (static standing).
Shifting from upright standing to right direction (a) → to upright (b) → to left direction (c) → to upright (d).
Repeated for 1 minute with free velocity.

1. Equipment:

Gravicorder (JK-101II, UNIMEC Co.Ltd.)

2. Guidance of weight-shifting and -bearing

1) Maneuver:

Bilateral manual guidance from the posterior side at the lateral part of the pelvis. Maximal weight-bearing on lateral lower extremity without contralateral lower extremity getting off the floor

2) Procedure

Start position: upright position (static standing).

Shifting from upright standing to right direction → to upright → to left direction → upright, repeated for 1 minute with free velocity.

3. Recorded and analyzed data

X, Y, and Z values, indicating positional information, which changes depending on the weight shift, were calculated using the originally developed software. X, Y, and Z are numerical values calculated based on the values of a center

of pressure, a floor reaction force, and an acceleration obtained from the gravicorder in three dimensions (X is left and right, Y is front and back, and Z is up and down). In addition, a numerical value of the body's position of a healthy male during weight-shifting and -bearing was recorded as control sample data. An average value and coefficient of variation of the maximum value were compared among the three groups. The Tukey method was used to compare statistically, and a significance level was set at less than 5%. In addition, the value of voluntary lateral weight-shifting and -bearing by a healthy person was also calculated and compared with results for each group.

RESULTS

The mean of the maximum values of X, Y, and Z was significantly lower in group C than in groups A and B for all of X, Y, and Z. In particular, the value of X tended to be significant in groups A and B (Table 2). Compared with healthy person data, X showed a high value in all three groups, and there was no particular difference between Y and Z. However, the coefficient of variation was high in Z for all three groups (Table 3).

Table 2. Mean of the maximum values of X, Y, and Z

	X	Y	Z
Group A	377.3±35.0	93.5±7.5	45.3±21.7
Group B	371.0±31.5	94.4±8.7	55.2±23.5
Group C	249.7±46.7*	64.3±12.2*	37.0±18.4*
Active motion (Healthy, n=1)	180.5	87.8	15.1

*: p<0.05, Group C vs. Group A, B

Table 3. Coefficient of variation of X, Y, and Z

	X	Y	Z
Group A	9.3	8.0	48
Group B	8.4	9.2	42
Group C	18.7	19	50

DISCUSSION

Few studies have been conducted on differences in technology and thinking to years of healthcare experience. Studies in nursing have reported that newer faculty tended to have more positive attitudes toward the increased use and adoption of technology than more experienced faculty [2]. Fujino et al. [3] pointed out cases in which performance increases or does not increase with years of experience based on The Emotional Intelligence (EI) Scale and nursing performance. There, it was reported that there was a significant positive correlation between EI and nursing performance, that nurses with high EI actively improved their nursing skills and that their nursing performance improved with experience, and that nurses with low situational judgment skills showed no improvement in nursing performance with experience. A study in cardiac surgeons using mortality from reoperation as an indicator reported that as experience increased, outcomes improved through the first two career decades, then stabilized in the third decade before declining in the fourth decade [4].

There are even fewer reports on experience differences for physical therapists; Slade et al. [5] reported that the main characteristics of proficient physical therapists are high levels of skill, training, and experience and a broad scope of practice. A study examining differences in joint range of motion measurement results due to differences in examiner's experience and knowledge and differences in measuring instruments reported statistically significant differences in accuracy but not clinically meaningful differences [6].

In physiotherapy, no research has revealed differences in physiotherapists' skills depending on their years of experience. Moreover, no research report quantitatively demonstrates basic physiotherapy techniques. Therefore, this study is thought to be highly novel in that it quantitatively demonstrates the basic technique of physiotherapy and attempts to clarify the differences in skills among physiotherapists with different years of experience. Therefore, it can be realizing effective instruction in the education of basic physiotherapy through an evaluation and a visualization of the physiotherapy technique using objective equipment. Furthermore, for an objective verification to clarify the weight-shifting and -bearing technique, which is one of the basic physiotherapy techniques, we tried to describe the mechanical aspect during weight-shifting and -bearing exercise using the gravicorder in this study. For the achievement of the purpose of this study, we use the original parameter recorded from a gravicorder, which was calculated from the location change of a center of foot pressure, and it is like a vector quantity, and the variation of its value compared in among the years of experience of a physiotherapist.

As a result of the mean of the maximum values of X, Y, and Z, depending on the years of experience of a physiotherapist, it was clear that there were differences in the lateral weight guiding on standing position, which is a relatively simple technique. As a result, in a longer group (Group C) with years of experience, it was clear that all indices became less than those of other groups in the lateral weight guiding on standing position, which is a relatively simple technique, as for the reason why this, it was thought that the longer years physiotherapist seeks the more compact method. On the other hand, compared with a weight-shifting and -bearing the pattern of a normal healthy subject as a control data, all indices in all groups become larger. This result led that, in the first place, physiotherapists tended to move larger in the therapeutic situation with an overdoing of an emphasis on a normal pattern.

As a result of the coefficient of variation of X, Y, and Z, the coefficient of variation of Z was tended to larger than other values in all groups. This result suggested that the method of vertical guidance, which was how to bear the weight to a lateral lower extremity and what distance was moved, were not commonly recognized by physiotherapists, and a method of a vertical guidance was especially dependent on their own experience and their post-graduate training. Our previous study¹⁾ has shown that there is not

necessarily a correlation between years of experience and skills as a physical therapist for those with more than six years of experience. However, in this study, differences in mechanical dynamics during weight-shifting and -bearing exercises were found between those with one or two years of experience and those with four or more years of experience. This result corroborates and further elaborates on the results of our previous study.

CONCLUSION

There was a difference in the guidance of lateral weight-shifting and -bearing depending on years of experience. The lateral value (X) was increased in all the groups because the lateral guidance was the task itself and was emphasized more than the pattern of a healthy person. In the vertical direction, it is thought to be implemented by empirical rules because there is no constant normal pattern or common recognition among physiotherapists. An important point, this study was performed in a single affiliation. Because subjects were thought to be instructed by the same concept, the influence of an experience year might become more precise.

REFERENCES

- [1] Okayama Y, Daikuya S. Physical therapy skills in the difference of years of experience -in the case of weight shifting-. Oral presentation at the World Confederation for Physical Therapy (WCPT) Congress 2021 (WCPT 2021), 2021, Dubai, Online, 9-11 April.
- [2] Kotcherlakota S, Kupzyk KA, Rejda P. Years of Experience as a Predictor of Nurse Faculty Technology Use. *J Nurs Educ.* 2017; 1; 56(2):115-119, doi: 10.3928/01484834-20170123-09
- [3] Fujino Y, Tanaka M, Yonemitsu Y, Kawamoto R. The relationship between characteristics of nursing performance and years of experience in nurses with high emotional intelligence. *Int J Nurs Pract.* 2015; 21(6):876-81. doi: 10.1111/ijn.12311.
- [4] Moon MR, Henn MC, Maniar HS, Pasque MK, Melby SJ, Kachroo P, et al. Impact of Surgical Experience on Operative Mortality After Reoperative Cardiac Surgery. *Ann Thorac Surg.* 2020; 110(6):1909-1916. doi: 10.1016/j.athoracsur.2020.04.077.
- [5] Slade SC, Hay-Smith J, Mastwyk S, Morris ME, Frawley H. Attributes of physiotherapy continence clinicians: a qualitative perspective. *Physiotherapy.* 2020; 106:119-127. doi: 10.1016/j.physio.2019.01.018.
- [6] Russo RR, Burn MB, Ismaily SK, Gerrie BJ, Han S, Alexander J, et al. How Does Level and Type of Experience Affect Measurement of Joint Range of Motion? *J Surg Educ.* 2018; 75(3):739-748. doi: 10.1016/j.jsurg.2017.09.009.