Effects of Shoe Lift on Weight Bearing in Stroke Patients

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Objectives: *To determine the effect of shoe lift, cueing and cueing with shoe lift on weight bearing in paretic leg of stroke hemiparetic patients and compare the effect between each condition*
Design: *Cross-sectional experimental study*
Setting: *Department of Rehabilitation Medicine and Department of Ear, Nose and Throat, Faculty of Medicine, King Chulalongkorn Memorial Hospital, Chulalongkorn University*
Subject: *Ten hemiparetic patients as a result of unilateral stroke*
Material and Method: *Weight symmetry of each patient was measured by posturography during quiet stance and in conditions of compelled weight shift. Each patient was started with quiet standing, standing with shoe lift under the sound leg; cueing and cueing with shoe lift under the sound leg respectively. Weight symmetry scores were recorded for comparing the weight distribution between each foot.*
Results: *There were 10 hemiparetic patients. Seven were male. The average age was 53.4 ± 8.45 years. There were 5 right hemiparesis and 5 left hemiparesis. The average onset was 12.3 ± 15.73 months. In the right hemiparetic patients, weight bearing in the paretic leg was significantly improved when cueing with shoe lift compared with quiet standing and with shoe lift (Backward p = 0.012, Forward p = 0.011 and Backward p = 0.001, Forward p = 0.036 respectively). In the left hemiparetic patients, weight bearing in the paretic leg was significantly improved when cueing compared with quiet standing (Backward p = 0.046), and when using the shoe lift (Backward p = 0.016). Cueing with shoe lift could significantly improve weight bearing in the paretic leg when compared with shoe lift alone (Backward p = 0.015). Shoe lift alone could improve weight bearing in the paretic leg of the right and left hemiparetic patients but was not statistically significant (p > 0.05).*
Conclusion: *Cueing with shoe lift under the sound leg can significantly improve weight bearing of the paretic leg of the right and left stroke hemiparetic patients.*

Keywords: *Stroke rehabilitation, Hemiparesis, Weight bearing, Shoe lift*

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Eighty-eight percent of acute stroke patients have hemiplegia or hemiparesis with poor motor control. They usually bear weight on the sound leg[1]. An asymmetrical weight distribution correlated with abnormal gait and postural control. It is an obstacle for standing and walking[2-6]. Poor dynamic control during walking can increase the falling risk and 2 – 4 times femoral fracture[7]. Etiology of asymmetrical weight bearing are weakness, impaired sensation, spastic, contracture, and visuospatial deficit. From the observation, some patients who had good recovery may have had poor weight bearing on the sound side for a long time. This was hypothesized by a learned non-use theory[8-10]. Conventional weight bearing training by a physical therapist can increase weight symmetry and improve gait pattern. Visual feedback combined with conventional training did not significantly improve the gait than conventional training alone[11,12]. Another method is the forced use technique that was introduced by Professor E. Taub[13, 14]. The sound limb was constrained 6 hours a day to force the patient to use their paretic limb. The motor scale score of the paretic hand was significantly improved after 2 weeks[14]. It is difficult to constraint in cases of lower limb. Using a shoe

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lift under the sound leg may solve this problem. While the patient was wearing a shoe lift, compelled weight shift to a paretic leg with more symmetrical weight distribution was shown[1, 9, 10]. A 9 – 10 mm-thick shoe lift compelled symmetrical weight distribution more than others[10]. Walking speed, stride length and weight distribution were improved in selected cases after a 6 weeks ambulation training program with shoe lift[9].

The present study sought to determine the effect of shoe lift, cueing and cueing with shoe lift on weight bearing in the paretic side and comparing the effect between each condition.

Material and Method

Study design

Cross-sectional experimental study.

Setting

Outpatient clinic, Department of Rehabilitation Medicine and Posturographic section, Department of Ear, Nose and Throat, King Chulalongkorn Memorial Hospital, Chulalongkorn University.

Subjects

Patients with hemiparesis as a result of a stroke were recruited. The inclusion criteria were unilateral stroke and standing safely without assistance or gait aid for at least 2 minutes. The exclusion criteria were as follows: severe illness, unstable vital signs and/or neurological signs, bilateral hemiparesis, inability to follow commands, orthopedic conditions disturbing weight bearing, vestibular disorders, and severe neglect.

Apparatus

1. The EquiTest posturography device model 5.08 (DT2801) – A
2. A 1-centimeter high density polyurethane foam shoe lift

Method

After informed consent, the demographic data of each patient was recorded. Subjects stood on a force platform and were secured with a harness to prevent a fall during perturbation. The head was in the neutral position, arm alongside the body and the medial malleolus centered over the marker line of the forceplate. The force platform was translated backward then forward in 3 grades (small, medium, and large translation). Each translation was repeated 3 times. Weight symmetry score was measured by posturography data processor during quiet standing and in the condition of compelled weight shift. Each patient was measured in sequence: quiet standing, standing with shoe lift under the sound leg, verbal and tactile cueing [15] without shoe lift, and cueing with shoe lift under the sound leg. The patients had a two minute-rest period between each condition. If weight distribution was equal, the weight symmetry score would be 100. If more weight was distributed on the right leg, the score was more than 100. If more weight was distributed on the left leg, the score was less than 100.

Statistical analysis

The data was analyzed using the SPSS statistical program version 10.0. The demographic data was shown as mean ± SD. Repeated measured ANOVA was used for analyzing the effects of shoe lift and cueing on weight symmetry. Significant level was $p < .05$.

Results

Ten hemiparetic patients participated in the present study. Seven were male. Five had right hemiparesis. The average age was 53.4 ± 8.45 years (range 39-66). The average onset was 12.3 ± 15.73 months (range 1-48). The average rehabilitation period till the study day was 4.9 ± 5.61 months (range 1-19). The demographic data is shown in Table 1.

Weight bearing had a tendency to shift to the paretic leg in all experimental conditions. In the

Table 1. Demographic data

Characteristics	Right hemiparesis	Left hemiparesis	Total
Age(yr)	52.2 ± 6.14	54.6 ± 10.92	53.4 ± 8.45
Male	4	3	7
Female	1	2	3
Ischemic stroke	3	3	6
Hemorrhagic stroke	2	2	4
Onset (month)	13.0 ± 11.8	11.6 ± 20.40	12.3 ± 15.73
Rehabilitation period (month)	17.9 ± 6.90	1.9 ± 0.89	4.9 ± 5.61

right hemiparetic patients, weight bearing in the paretic leg was significantly increased when cueing with shoe lift under the sound leg was compared with quiet standing (backward translation $p = 0.012$, forward translation $p = 0.011$) and with shoe lift alone (backward translation $p = 0.001$, forward translation $p = 0.036$). In the left hemiparetic patients, weight bearing had a tendency to increase in the paretic leg when backward and forward translation, but was statistically significant only in backward translation. Weight bearing in the paretic leg was significantly increased when cueing was compared with quiet standing ($p = 0.046$) and when compared with the shoe lift ($p = 0.016$). Cueing with shoe lift significantly increased the weight bearing in the paretic leg when compared to shoe lift alone ($p = 0.015$). Shoe lift alone could improve weight bearing in the paretic leg of the right and left hemiparetic patients but did not reach statistical significance ($p > 0.05$). Weight symmetry score is shown in Table 2.

Weight symmetry score was increased toward more than 100 in the right hemiparetic patients when using the shoe lift, cueing and cueing with shoe lift as shown in Fig. 1. Weight symmetry score of the left hemiparetic patients was decreased toward 100 when cueing and cueing with shoe lift as shown in Fig. 2.

Discussion

An asymmetrical weight distribution while standing was the common problem in stroke patients with hemiparesis[2-6]. Physical therapy helped improvement of the symmetry stance[16,17]. A conventional standing balance training technique can improve balance but in some patients asymmetry may persist. The results of the present study showed some improvement of weight distribution. Subjects stood with the sound leg positioned on a shoe lift had a tendency to increase more weight bearing onto the paretic leg but it was not statistically significant. The results were the same as the Chaudhuri G and Aruin AS report [10] that used the same shoe lift thickness. During shoe lift condition, the right hemiparetic patients tended to increase more weight bearing in the paretic leg than the left hemiparetic patients. This may be caused by hypoesthesia and neglect syndrome that was found more in the left hemiparetic group. During cueing and cueing with shoe lift, the patients shifted more weight to the paretic leg. This effect was not found when

Table 2. Weight symmetry score of the hemiparesis patients

Hemiparesis	Translation	Weight symmetry score (mean ± SD)			
		Quiet standing	Shoe lift	Cueing	Cueing with shoe lift
Right	Backward	96.2 ± 32.75	101.9 ± 36.50	117.3 ± 41.31	118.2 ± 38.70
	Forward	103.1 ± 31.67	113.4 ± 31.31	117.3 ± 27.18	128.2 ± 24.21
Left	Backward	125.3 ± 16.47	125.7 ± 17.98	104.6 ± 18.66	103.3 ± 25.72
	Forward	119.0 ± 23.06	122.5 ± 23.31	105.2 ± 27.08	99.7 ± 25.0

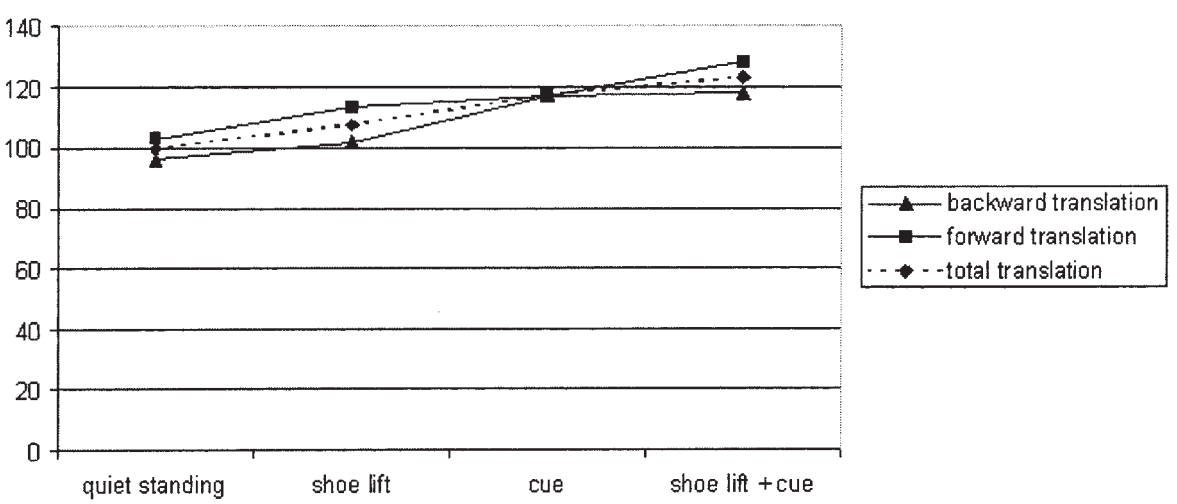

Fig. 1 Weight symmetry score of the right hemiparetic patients

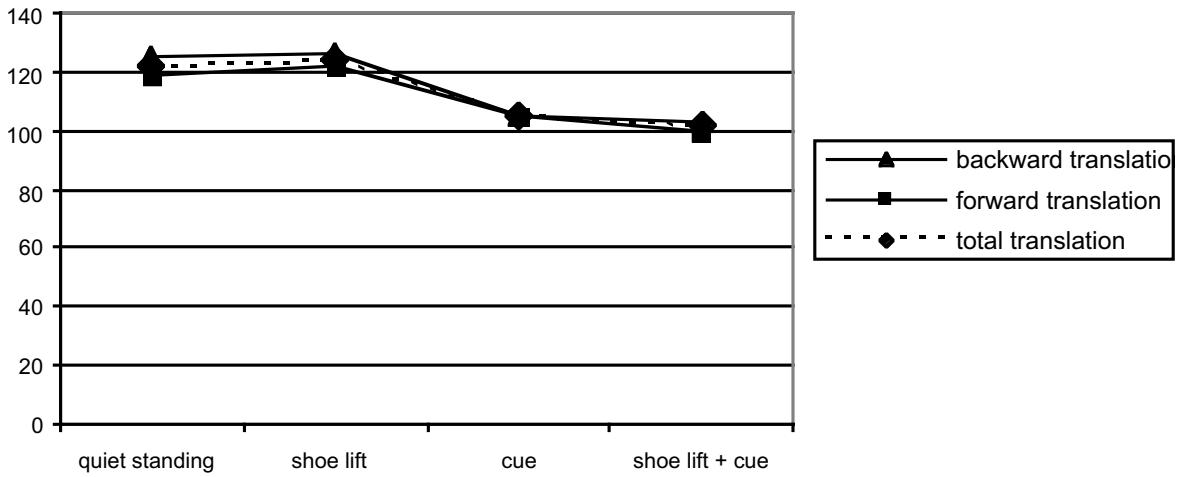

Fig. 2 Weight symmetry score of the left hemiparetic patients

using shoe lift alone in the left hemiparetic group. It is suggested that cueing was an important technique aiding left hemiparesis to shift weight. Cueing could improve weight bearing in both paretic groups but not as well as cueing cooperated with shoe lift. Shoe lift alone could improve weight bearing but did not reach statistical significance. So the shoe lift was a supplemental device; when used with cueing; to aid some patients who have not severe hypoesthesia/neglect to improve weight bearing. The weight symmetry score of the present study cannot be compared with other studies[1,9,10] because different shoe lift material and posturographic apparatus were used. A rest period between each condition was set for preventing carry-over effect[1].

The limitations of the present study are: small sample size, dynamic postural control parameters were not measured, and no long term study of the effect of shoe lift. Further studies are needed to prove the efficacy of cueing with shoe lift and its' benefit for improving standing balance and walking ambulation.

Conclusion

Cueing with shoe lift under the sound leg significantly improves weight bearing in the paretic leg of both right and left hemiparetic patients. Compelled weight distribution induced by cueing and shoe lift can help a stroke patient with hemiparesis to distribute weight more symmetrically. Shoe lift acts as a supplemental device aiding weight symmetry during standing.

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ผลของการเสริมรองเท้าต่อการลงน้ำหนักในผู้ป่วยโรคหลอดเลือดสมอง

วสุวัฒน์ กิติสมประยูรกุล, ศศิยา เชี่ยวชาญวัฒนา, ศิริพร จันทร์ฉาย, เพิ่มทรัพย์ อิสีประดิษย์

วัตถุประสงค์: *เพื่อศึกษาผลของการเสริมรองเท้าต่อการลงน้ำหนักขาข้างที่อ่อนแรงในผู้ป่วยโรคหลอดเลือดสมองชนิดอ่อนแรงครึ่งซีกเปรียบเทียบกับการชี้นำและการเสริมรองเท้าร่วมกับการชี้นำ*

รูปแบบการวิจัย: *การศึกษาทดลอง ณ ช่วงเวลาใดเวลาหนึ่ง*

สถานที่ทำการวิจัย: *ห้องตรวจผู้ป่วยนอก ฝ่ายเวชศาสตร์ฟื้นฟู และห้องตรวจการทรงตัว ฝ่ายโสต นาสิก และลาริงซ์ โรงพยาบาลจุฬาลงกรณ์*

กลุ่มที่ทำวิจัย: *ผู้ป่วยโรคหลอดเลือดสมองที่มีอาการอ่อนแรงครึ่งซีกจำนวน 10 ราย*

วัสดุและวิธีการ: *วัดการลงน้ำหนักด้วยเครื่อง Posturography โดยให้ผู้ป่วยยืนบนแผ่นรับน้ำหนักและวัดการลงน้ำหนัก 4 ครั้งตามลำดับ ครั้งที่ 1 ให้ผู้ป่วยยืนตรง ครั้งที่ 2 ยืนโดยมีแผ่นเสริมรองเท้า (Shoe lift) วางใต้เท้าข้างปกติ ครั้งที่ 3 ยืนโดยได้รับการชี้นำให้ลงน้ำหนักขาข้างอ่อนแรง และครั้งที่ 4 ยืนโดยได้รับการชี้นำให้ลงน้ำหนักขาข้างอ่อนแรงโดยมีแผ่นเสริมรองเท้าวางใต้เท้าข้างปกติ การลงน้ำหนักแสดงเป็น Weight symmetry score*

ผลการศึกษา: *ผู้ป่วยโรคหลอดเลือดสมอง 10 ราย เป็นชาย 7 ราย หญิง 3 ราย อายุเฉลี่ย 53.4 $\pm$ 8.45 ปี อ่อนแรงซีกขวาและซีกซ้ายอย่างละ 5 ราย ระยะเวลาหลังเกิดโรคเฉลี่ย 12.3 $\pm$ 15.73 เดือน จากการวิเคราะห์ทางสถิติด้วย Repeated ANOVA ในผู้ป่วยโรคหลอดเลือดสมองชนิดอ่อนแรงซีกขวา พบว่าการเสริมรองเท้าร่วมกับการชี้นำช่วยเพิ่มการลงน้ำหนักขาข้างที่อ่อนแรงได้มากกว่าการยืนตรงและการเสริมรองเท้าเพียงอย่างเดียวอย่างมีนัยสำคัญทางสถิติ (Backward p = 0.012, Forward p = 0.011 และ Backward p = 0.001, Forward p = 0.036 ตามลำดับ) ในผู้ป่วยโรคหลอดเลือดสมองชนิดอ่อนแรงซีกซ้าย พบว่าการชี้นำช่วยเพิ่มการลงน้ำหนักขาข้างที่อ่อนแรงได้มากกว่าการยืนตรงและการเสริมรองเท้า อย่างมีนัยสำคัญทางสถิติ (Backward p = 0.046 และ p = 0.016 ตามลำดับ) และการเสริมรองเท้าร่วมกับการชี้นำช่วยการลงน้ำหนักขาข้างที่อ่อนแรงได้มากกว่าการเสริมรองเท้าเพียงอย่างเดียวอย่างมีนัยสำคัญทางสถิติ (Backward p = 0.015) การเสริมรองเท้าเพียงอย่างเดียวช่วยเพิ่มการลงน้ำหนักขาข้างอ่อนแรงในผู้ป่วยที่อ่อนแรงทั้งซีกขวาและซีกซ้ายเมื่อเปรียบเทียบกับการยืนปกติ แต่ไม่มีนัยสำคัญทางสถิติ (p > 0.05)*

สรุป: *การเสริมรองเท้าร่วมกับการชี้นำ ทำให้ผู้ป่วยโรคหลอดเลือดสมองชนิดอ่อนแรงครึ่งซีกลงน้ำหนักขาข้างที่อ่อนแรงมากขึ้นอย่างมีนัยสำคัญทางสถิติ*