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Comparison of Effects Between Modified Vertical Roll Sling and Bobath Roll Sling in Hemiplegic Shoulder Subluxation

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Abstract

The purpose of this study was to compare the effectiveness of modified vertical roll sling and conventional Bobath roll sling in reducing hemiplegic shoulder subluxation. Radiography of 40° anterior oblique radiographic view were taken, before and immediately after wearing each sling in 13 hemiplegic patients. The vertical distance, horizontal distance, and joint distance were measured. Analysis of radiographically measured distances showed that both modified vertical roll sling and Bobath roll sling decreased vertical, horizontal, and joint distances. Reduction in vertical and joint distances were significantly greater in modified vertical roll sling compared to Bobath roll sling, while horizontal distance showed no significant difference between the two slings. Therefore it can be concluded that modified vertical roll sling is an effective orthosis in reducing hemiplegic shoulder subluxation.

Key Words: Bobath roll sling; Hemiplegia; Modified vertical roll sling; Subluxation.

Introduction

The subluxation of shoulder joint is the most common complication in hemiplegic patients. Ikai et al (1998) reported that 17~64% of hemiplegic patients were diagnosed with shoulder subluxation. The etiologic factors of shoulder subluxation during flaccid stage include impaired locking mechanism of rotator cuff muscles (Basmajian and Bazant, 1959; Cailliet, 1991; Davis, 1985). The clinical manifestations are pain, discomfort, contracture, joint movement dysfunction (Anderson, 1985; Antonio et al, 1977), delayed functional recovery, and reflex sympathetic dystrophy (Dursun et al, 2000; Smith et al, 1982). When this shoulder subluxation is not treated appropriately, secondary irreversible injuries in muscle, ligament, nerve, and blood vessels can be occurred (Moskowitz et al, 1969).

Clinically, to diagnose shoulder subluxation, therapists measure a distance between inferior acromion and humeral head using investigator's fingers, or plexiglass jig, or caliper. More objectively, radiographic measurement is performed using X-ray to determine the vertical distance and horizontal distance between acromion and humeral head. The vertical distance between acromion and humeral head is similar to clinical test and easily determined in 45 degree oblique view and dorsal view in X-ray (Keats et al, 1985). The horizontal distance is associated with lateral deviation of humeral head and is affected by roll position of sling rather than pathology itself in shoulder joint (Zoravitz et al, 1995).

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To treat subluxation in hemiplegic patients, various slings have been applied. Among these approaches, Bobath roll sling has been advocated by many researches. The advantages of wearing sling include protection of hemiplegic upper limb, maintenance of humeral head into glenoid fossa, and prevention of shoulder subluxation by blocking caudal sliding of humeral head. Bobath roll sling, especially, has been used widely because it is easy to wear and does not limit range of motion stimulating proprioception. However, there has been a controversy regarding the effect of sling so far. Zoravitz et al (1995) compared the wearing effects among single strap hemisling, Rolyan upper limb cuff sling, Bobath roll sling, and Cavalier shoulder support, and concluded that single strap hemisling reduced subluxation significantly and Bobath roll sling induced lateral deviation of humeral head. Cailliet (1980) and Hurd et al (1974) stated that single strap hemisling and Breuer-Kauper sling have limited correction effect because elbow can be lowered causing caudal movement of humeral head. Most slings induce flexion in elbow joint and flexor synergy pattern in hemiplegic upper limb, limit range of motion, and reinforce the movement of sound side. Brooke et al (1991) argued that single strap hemisling can cause shoulder contracture and asymmetric arm swing preventing normal arm pendular motion and learning normal gait pattern. Rajaram and Holtz (1985) and Zoravitz et al (1995) stressed that Bobath roll sling does not limit upper limb movement so that free upper limb movement is ensued receiving abundant proprioceptive input. However, he also indicated the shortcomings of Bobath sling; that is, lateral deviation of humeral head and compressing radial nerve. Claus and Godfrey (1985) described possible circulation disorder in hemiplegic upper limb after wearing Bobath roll sling. Sullivan and Rogers (1989) stated that distal upper limb edema can be aggravated from not supporting forearm and hand in hemiplegic side.

Recently, a newly-modified vertical roll sling has been designed to treat and prevent further shoulder subluxation by achieving glenohumeral stability in hemiplegic shoulder. The development of modified vertical roll sling was for meeting the needs of hemiplegic shoulder; maintenance of humeral head in the glenoid fossa, unlimited shoulder abduction and external rotation, comfortability, easy donning and doffing, protection from trauma, and proper upper limb weight distribution (Smith and Okamoto, 1981). From the design and manufacturing mechanism of modified vertical roll sling, it was hypothesized that vertical distance, horizontal distance, and joint distance measured in hemiplegic shoulder with radiography would be different compared with conventional Bobath roll sling. Thus, this study was aimed at comparing the immediate correction effects between modified vertical roll sling and Bobath roll sling in hemiplegic shoulder using X-ray.

Methods

Subjects

Thirteen hemiplegic subjects who were inpatients or outpatients in rehabilitation hospital in Daejeon in Korea voluntarily participated in this study. The inclusion criteria was as follows: 1) six months after the stroke onset, 2) no previous history of shoulder dislocation or subluxation prior to stroke onset, 3) hemiplegic shoulder subluxation confirmed by positive sulcus sign less than 2 fingers width, 4) 0~1 grade upper limb spasticity determined by modified Ashworth scale, 5) less than poor grade determined by manual muscle strength. Table 1 shows subjects' characteristics, and Table 2 depicts physical examination data.

Modified Vertical Roll Sling

The pad was positioned in acromion on hemiplegic shoulder, and the roll was secured in axilla. The strap was connected vertically between acromion and roll in hemiplegic upper limb. This strap was designed to modify applied pressure in axilla. Another strap was secured from acromion anteriorly and connected to acromion posteriorly (Figure 1).

Table 1. Characteristics of subjects (N=13)

Parameters	Subjects
Gender (men/women)	7/6 (54%/46%)
Age (year)	61.5
Onset (month)	6.9
Diagnosis (cerebral infarct/hemorrhage)	11/2 (85%/15%)
Hemiplegic side (right/left)	10/3 (77%/23%)

Table 2. Physical examination data of subjects (N=13)

Parameters		Subjects (%)
Sulcus sign (number of fingers)	1.0	8 (62)
	1.5	5 (38)
Upper limb spasticity (modified Ashworth scale)	Grade 0	11 (85)
	Grade 1	2 (15)
Muscle strength of hemiplegic shoulder (flexors and abductors)	Poor	5 (38)
	Trace	1 (8)
	Zero	7 (54)

Figure 1. Anterior and posterior views of modified vertical roll sling.

Figure 2. Anterior and posterior views of Bobath roll sling.

The pad was positioned in the middle of cervicothoracic junction area, and rolls were secured in bilateral axillae. The straps connected each roll obliquely at posterior aspect, and vertically at anterior aspect (Figure 2).

Radiographic Measurement

Each subject was asked to sit with bilateral shoulders relaxed before wearing each sling. Modified vertical roll sling and Bobath roll sling were applied randomly in hemiplegic shoulder. X-ray was taken by 40 degree anteromedial to posterolateral view with 40 inch film focus distance. The principle investigator inserted the index finger between the roll and patient's axilla while the strap was fastened to confirm the same fastening level of strap in hemiplegic shoulder. The vertical distance was determined by the length between the inferolateral aspect of acromion and the superior aspect of humeral head. The horizontal distance between the center of glenoid fossa and the medial aspect of humeral head, joint space between the superior aspect of glenoid fossa and humeral head; that is, the perpendicular distance from tangential line contacting humeral head (Figure 3).

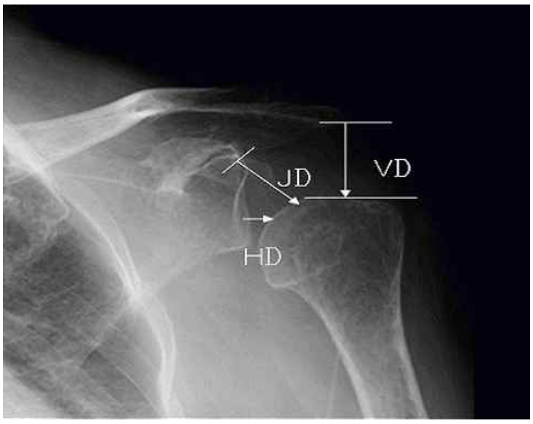

Figure 3. Radiographic measurement. VD: Vertical distance, HD: horizontal distance, JD: joint distance.

Statistical Analysis

SPSS program for Window version 10.0 was used for data analysis. To determine the statistical differences in measured distances between sling types and before and after sling wearing, paired t-test was used with the level of significance of .05.

Table 3. Statistical analysis for slings application (N=13)

Sling type	Parameters	Before (㎜)	After (㎜)	t	p
Bobath roll sling (n_1=13)	VD	25.16±1.80*	23.06±3.22	3.445	.005
	HD	10.62±.85	9.47±1.14	6.168	.000
	JD	24.60±2.96	22.59±3.96	5.880	.000
Modified vertical roll sling (n_2=13)	VD	25.16±1.80	21.93±3.59	4.144	.001
	HD	10.62±.85	9.27±1.04	8.527	.000
	JD	24.60±2.96	21.27±3.86	9.438	.000

*Mean±SD.
VD: vertical distance.
HD: horizontal distance.
JD: joint distance.

Table 4. Statistical analysis after wearing slings

Parameters	Modified vertical roll sling (㎜)	Bobath roll sling (㎜)	t	p
VD	21.93±3.59*	23.06±3.22	5.113	.000
HD	9.27±1.04	9.47±1.14	6.373	.000
JD	21.27±3.86	22.59±3.96	1.935	.077

*Mean±SD.

Results

Radiographic Measurements

Table 3 shows radiographic data for both slings. After wearing Bobath roll sling, vertical, horizontal, and joint distances decreased significantly. After wearing modified vertical roll sling, vertical, horizontal, and joint distances decreased significantly. In comparison for decrement in all distances after wearing each sling, vertical and joint distance of modified vertical roll sling decreased significantly compared with Bobath roll sling. There was no significant difference in horizontal distance between modified vertical roll sling and Bobath roll sling (Table 4).

Discussion

This study investigated the effect of modified vertical roll sling on radiographic measurement in hemiplegic patients, and the findings of this study partially supported the research hypotheses. The vertical and joint distances reduced significantly in modified vertical roll sling compared with those of Bobath roll sling. These results are consistent with those of Cheong (2001) and Cho et al, (2007) who reported that Bobath roll sling was effective in limiting depression of humeral head by finding decreased vertical distance. The joint distance was stated as a sensitive measure reflecting both the vertical and lateral movement of humeral head (Han et al, 1993; Han et al, 1994). Even though the roll of modified vertical roll sling placed in hemiplegic axilla was manufactured by two different textures to minimize the pressure on axilla and to decrease lateral movement of humeral head, it was determined that modified vertical roll sling fails to decrease horizontal distance compared with Bobath sling in this study. This result is thought to be caused by lateral deviation of humeral head.

The results of this study can be interpreted that modified vertical roll sling is superior to conventional Bobath sling for stabilizing the glenohumeral joint in hemiplegic side. The possible explanations for improved stability in modified vertical roll sling are summarized as follows. First, the pad secured on superior aspect of acromion in hemiplegic side was designed in relation with hemiplegic shoulder contour. Second, by encompassing anterior and posterior humeral head using shoulder pad, glenohumeral stability was promoted. Third, the strap is aligned vertically connecting the pad and the roll supporting both glenoid fossa and humeral head. The subjective comfortability of modified vertical roll sling was not reported in this study, however, most subjects reported that a donning and doffing and adjusting a strap in a modified vertical roll sling was much easier compared with Bobath roll sling.

There are some limitations in the present study. First, the vertical, horizontal, and joint distances of sound shoulder of subjects were not compared with those of affected shoulder. Second, the number of subject was small. Third, the effect of modified vertical roll sling was assessed with only radiographic test rather than functional measures. Fourth, only the immediate effect of modified vertical roll sling was studied. Further researches are required to investigate the long term effect of modified vertical roll sling using a functional measure with a large sample group. Additionally, the effect of roll size and texture material to affect horizontal distance should be investigated.

Conclusion

The modified vertical roll sling reduced vertical and joint distances significantly in radiographic test, whereas no significant difference in horizontal distance was observed between the two slings. Therefore, based on the findings of the present study, modified vertical roll sling is effective in improving glenohumeral joint stability in hemiplegic shoulder subluxation by decreasing vertical and joint distances between glenoid fossa and humeral head.

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