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Case Study

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2-Year Follow up of Balance in Stroke Patients after Myofascial Release using a Tennis Ball
-Four Case Reports-

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| Abstract |

Purpose: Myofascial release (MFR) is an effective treatment for improving muscle stiffness and balance in neurological patients. This study examined long-term effects of MFR on the balance ability of stroke patients.
Methods: MFR using a tennis ball was applied to the lower extremity and sacroiliac joint of the affected side of four stroke patients. The four subjects performed the Berg balance scale (BBS) and Timed up and go (TUG) test at the beginning of an 8-week intervention, directly after the intervention, and 2 years later.
Results: The BBS scores indicated a trend toward maintenance of balance ($p=0.05$), but there was no difference in the TUG time ($p=0.47$).
Conclusion: MFR may be a clinically meaningful intervention to maintain balance in stroke patients over a long period. However, the sample size in this study was too small to draw general conclusions. A larger study with more participants is needed.

Key Words: Myofascial release, Balance, Stroke, Stiffness

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Ⅰ. INTRODUCTION

Movement disorder after stroke is a result of complex interaction which is involved in primary neural damage and secondary tenomuscular changes (Dietz & Sinkjaer, 2007; Meskers et al., 2009). Approximately 43% of stroke patients experience stiffness after their neurological injury (Wissel et al., 2013). Clinically this is called spastic muscle hypertonia after stroke (Sinkjaer & Magnussen, 1994; Thilmann et al., 1991). The joint stiffness results from increased spasticity of neural origin and from the altered viscoelastic properties of non-neural tissue (Dietz & Sinkjaer, 2007). This stiffness might cause permanent structural changes of muscles and connective tissues by the mechanical effects (Carey & Burghardt, 1993). Park and Hwang (2016) reported that muscle stiffness is important to increase the balance ability of stroke patients. Based on these results, the structural changes in muscles and connective tissues by muscle stiffness may lead to the balance problems in stroke patients.

Clinical approaches to balance of stroke patients can be divided into non-neural and neural perspectives. The non-neural components include the altered properties of connective tissue and joints, whereas the neural components are involved in paresis and spasticity (Knutsson et al., 1997). There are dysfunction and symptoms from fascial entrapments of neural structures, which are leaded fascial strain out of continuous traction and tension (Bruno & Emiliano, 2014; Myers, 2014). It has been hypothesized that a part of the body with fascial restriction could induce severe stress of other regions because a fasical structure is related to envelop, divide, or support the organization (Schleip, 2003). To improve balance in stroke patients, many researchers have adopted a neurological perspective (Orrella et al., 2006; Tankisheva et al., 2014; Wist et al., 2016), but, the changes in the biomechanical properties of connective tissues should not be ignored (Knutsson et al., 1997).

Myofascial release (MFR) is a clinical manipulation technique to release connective tissues such as muscles and fascia (Sherman et al., 2006). The majority of MFR has been applied to patients with musculoskeletal disorders (Ajimsha & Al-Mudahka, 2015). A few studies have investigated the effects of MFR in neurology patients (Park & Hwang, 2016; Whisler et al., 2012). Park and Hwang (2016) suggested that MFR could improve the balance of spastic chronic stroke patients. Although there are a few studies of the MFR to improve the balance of neurological patients, its long-term effect has not been proven. Therefore, present study was to examine the long-term effect of MFR on the balance in stroke patients.

Ⅱ. MATERIALS AND METHOD

1. PARTICIPANTS

Eight patients were treated at S hospital in Busan, South Korea at the beginning. All subjects complained of stiffness in the affected lower limb while walking. Four of them agreed to participate in this 2-year follow-up re-evaluation. This study was performed on 4 stroke patients, who aged 61.25±14.08 years (mean±SD); their post-onset, heights, weights, and position senses were 6.00±1.41 years, 159.88±3.84cm, 64.35±9.87kg, and 1.50±1.73 scores, respectively. All of them were in-patients. Table 2 summarises the patients' demographic characteristics. Position sense of the big toe was assessed according to the Stroke Impairment Assessment Set (Abe et al., 2009). When a patient obtained no position change, a score of 0 was given, whereas obvious movement was given a score of 3 points. Ethical approval of the study was granted by Kaya University (No. 2015039), South Korea.

2. INTERVENTION

The participants were subjected to MFR with a tennis ball for 30min to the sole (plantar fasciae), triceps surae, hamstring, and sacrotuberous ligament, all parts of the superficial back line (SBL) (Myers, 2014), as in a previous study (Park & Hwang, 2016). The intervention was performed on the affected side of all participants three times per week for 8 weeks (24 sessions in total). The balance of the four subjects was tested at the beginning, right after the 8-week intervention and 2 years later (Fig. 1). The physical therapists who performed the MFR with a tennis ball were trained in the program (Table 1).

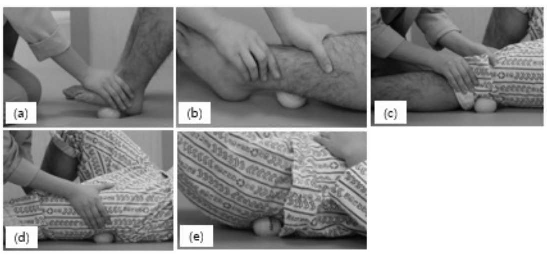

Fig. 1. Intervention of the myofascial release with a tennis ball (a~e).

Table 1. Myofascial release program with a tennis ball

Order	Procedure	Time
1	Held the affected ankle of the individual and rolled a tennis ball under the sole form the toes back to the front edge of the heel (Fig. 1a, 1b)	10 minutes
2	Rolled the tennis ball back and forth transversely under the calf and thigh of each participant (Fig. 1c, 1d, 1e)	20 minutes

(Park & Hwang, 2016)

3. MEASUREMENTS

The four subjects were assessed using the Berg balance scale (BBS), which is a 14-item functional balanced measurement (Berg et al., 1995). Each of these items is scored from 0 to 4, which are summed to make a total score between 0 and 56, with a higher score indicating better balance. Previous meta-analysis study reported that the BBS has high intra and inter-rater reliability (Downs et al., 2013). The timed up & go test (TUG) is a clinical measure for assessing the functional mobility and balance. The TUG test measures the time taken for a subject to rise form a chair, walk 3m, turn, walk back, and sit down on the chair (Podsiadlo & Richardson, 1991). Recent study has shown that the TUG has excellent intra and iner-rater reliability in stroke survivors (Chan et al., 2017). Based on results, the TUG was also used for the follow-up in present study.

4. STATISTICAL ANALYSIS

The data were processed using SPSS ver. 18.0 for Windows (SPSS, Chicago, IL) for Frideman`s test. The level of statistical significance was set at 0.05.

Ⅲ. RESULTS

The BBS scores did not significantly differed ($p=0.05$), and there was no difference in the TUG time ($p=0.47$). Between the 8-week and 2-year follow ups, total BBS scores remained roughly constant or increased in 3 out of 4 subjects. In subject 1, the score decreased by 1 point for item 5. The score for subject 2 decreased by 1 point for items 4, 5, 8, 10, and 12; by 2 points for items 7 and 13; and by 3 points for item 9. In subject 3, the score increased by 1 point for item 11 and by 3 points for item 13. In subject 4, the score increased by 1 point for item 14 (Fig. 2).

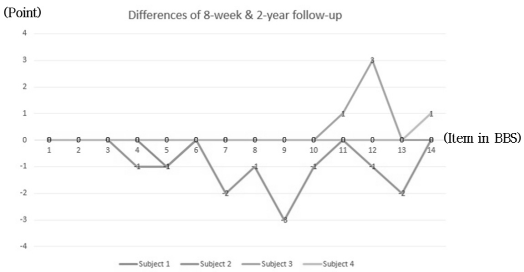

Fig. 2. Differences of the each item on the berg balance scale.

Ⅳ. DISCUSSION

This study examined the long-term effectiveness of the 8-week MFR program in four post-stroke patients. The BBS scores indicated to trend maintenance of balance, but not significantly differed (p=0.05), and there was no difference in the TUG time (p=0.47). Overall, the BBS score remained roughly constant or increased in three subjects, whereas it decreased markedly in subject 2.

Maintaining balance could be related to the release of passive muscle stiffness (such as resting tension, passive muscle tone, etc.) with applying MFR, which might continually influence active muscular contraction over a long period (Schleip et al., 2006). Some researchers have hypothesised that the major cause of this muscle stiffness is the presence of titin filaments (high elasticity), which could induce stiffness of the intramuscular filaments (Magid & Law, 1985; Schleip et al., 2006). The intramuscular connective tissue is in the perimysium. The function of the perimysium is to responding to the mechanical stiffness (Schleip et al., 2006). The reasons for the 2-year effect might be that it results from relaxing the stiffness of intramuscular connective tissue, which, in turn, is responsible for the increase of activities for which the summation of practices happen.

The cause of the decreased balance in subject 2 (items 4, 5, 7, 8, 9, 10, 12, and 13) seems to be the decreased activity because of the increased time to use the wheelchair instead of walking due to falling-down and the 5.4-kg weight gain over the 2 years, which the strength of the muscles could not control. On the other hand, the oldest subject was over 80 years old (subject 3) and still showed improvement in balance (Fig. 2). It means that the effect of MFR on the muscular stiffness can be maintained even in old patient. We carefully asserted that the 8-week MFR program had indirect long-term effects on the balance. However, in the cases of subject 2 and 3, to obtain the

Table 2. The characteristics of the stroke patients (N=4)

Subjects	Gender	Age (yr)	Dx	Post-onset (yrs)	Affected side	Height (cm)	Weight (Kg)	Assistive Device	Position sense
1	M	53	ICH	4	R	163.20	71.20	SC	0
2	F	58	ICH	6	L	156.50	68.30	SC	0
3	M	82	INF	7	L	156.60	68.20	SC	3
4	M	52	CVA	7	R	163.20	49.70	NA	3

ICH: intracranial hemorrhage, INF: cerebral infarction, L: left, R: right, SC: single-cane NA: non-applicable

Table 3. Results of the BBS and TUG

	Pre-test	8-week test	2-year follow up test	p
BBS (score)	37.50±9.67	45.50±6.35	43.50±10.75	0.05
TUG (second)	40.80±28.54	36.41±31.63	33.94±22.30	0.47

BBS: berg balance scale, TUG: timed up & go test long-term effect of MFR on muscle stiffness, activity ability is very important for stroke patients. Fascia is densely innervated by machanoreceptors, and stimulation such as MFR for these sensory endings leads to tonus changes in motor units (Schleip, 2003). Additionally, fascia has active movement, but muscle inactivity result in increased passive muscle stiffness (Schleip et al., 2006). These findings were shown that effect of constant MFR may influence activity ability of stroke patient. It is recommended to combine management that can increase the activity of stroke patients for clinical application of MFR.

Limitations in this study were that there were a small sample size and other factors which were not controlled.

Ⅴ. CONCLUSION

Balance of four stroke patients during the 2-year follow up showed maintenance with the 8-week MFR program. Despite the limited size of this study, clinicians can try using MFR to conserve the long-term balance of stroke patients. To obtain the desired results, we consider to apply MFR combined with management, which can facilitate physical activity of stroke patients. Further studies should evaluate the effects of MFR intervention on the functional abilities of stroke patients.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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