Effect of mobilization on ankle mobility and balance performance in diabetic patients

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ABSTRACT

Introduction and Aim: Diabetic Cheiroarthropathy is defined as the condition of restriction joint mobility due to pseudo-sclerodermatous hand, the fibrosis of the elastin connective tissues over the skin. It limits joint mobility especially around Tibia fibular mobility that are interrelated with the flexibility of ankle motion that results in the balance disorder in diabetic population. The aim of the study was to determine the effects of the tibia fibular mobilization technique on ankle joint in diabetes mellitus patients.

Materials and Methods: 60 diabetic subjects were randomly assigned into experimental group and control, in which experimental group received Tibia fibular mobilization technique and conventional treatment whereas control group received only conventional treatment 1 time a week for 3 weeks. **Results:** There is no significant difference in Ankle dorsi flexion range of motion in both extremities but there is significant difference in ankle plantar flexion range of motion in both extremities and functional reach test in both extremities.

Conclusion: There is a significant difference in the ankle plantar flexion range of motion and functional reach test, Hence, mobilization of Tibiofibular joint will be beneficial in improving the ankle range of motion and balance factor in the diabetic population.

Keywords: Diabetic cheiroarthropathy; diabetes; tibia fibular mobilization technique; functional reach test.

INTRODUCTION

Diabetic cheiroarthropathy is defined as the condition of restriction joint mobility due to pseudo-sclerodermatous hand, the fibrosis of the elastin connective tissues over the skin. Basically pain-free restricted proximal meta-carpo-phalangeal or interphalangeal joints extension right after the full bend of fingers can be seen in diabetic cheiroarthropathy (DCA). In severer condition, tight waxy skin surface, unbearable pain and stiffness might incorporate. There were several clinical features are commonly observed in DCA, such as tight waxy skin over the extremities because of the replacement of fibro tissues with collagen tissues. Basic cause of rheumatic complications in DM is obesity and low physical activity, more incidence of OA in DM is due to adipocytes. According to British Cohort poor blood glucose control leads to rheumatic complications. Many of the scientific studies showed that there was a large amount of the diabetes population having a high risk of fall because of the restricted range of motion and poor foot sensation feedback. This threatening problem shall be paid attention and resolved. Even though diabetic population did have a high awareness for preventing the vital complication, but ankle mobility and balance were often left out. In case of mobilization, physician or therapist are likely to study regarding the subtalar and talocrural joint, but less attention paid over tibia fibular joint (1).

Apart from that, the majority of the research excessively focused on studies of modalities, and manual or hands-on technique was getting less attention. So, by the intention to turn out the effects of manual technique, research regarding Maitland mobilization had chosen. The purpose of this study is to rule out the effect of the mobilization technique on ankle mobility and balance performance in diabetes patients. Maitland joint mobilization technique used to mobilize the tibiofibular joint to a diagnosed case of the diabetic patient for more than 5 years. Studies had found out the mobility of tibiofibular joint are significantly interconnected i.e. ankle mobility as the gear and wheel mechanism. In addition, the mobility of the ankle joint is directly affecting the quality of the ankle strategy as fall prevention. There are many studies performed to prove the stretching exercise of calf muscle to improve ankle range of motion, the patients were given during 3 squat tasks, static and dynamic postural control, strength of the ankle musculature, joint position sense, and self-reported function with the Foot and Ankle Ability Measure subscales, the patient were improved (2). But still, there is less attention over the tibiofibular joint mobilization. Hence the aimed objective of our study was focusing on a diagnosed diabetic patient group that more than 5 years is because the diabetic population has a high risk of developing DCA and LJM. Hypothesis: Controlled motion of the Achilles tendon, during the optimal healing condition, is achieved by early controlled motion of the ankle joint. This will result in a strong tendon with a shorter length than for immobilized ankle joints. The patient-allowed motion of the ankle will experience a better functional outcome and a better patient-reported health in comparison with immobilization (3).

Accumulation of glycosylated end products on collagen and other connective tissues which is said to be responsible for LJMS. In the course of disease small joints of hands and feet will be impaired with the advanced stages ankle, shoulder, spine, hip will involve and will lead to risks of fall. LJMS is a broad term under which Achilles tendon pathologies, trigger finger, Dupyterns contractures, carpal tunnel syndrome, frozen shoulder plant arfacities occurs more in diabetics than non-diabetics. LJMS is associated with micro and macro vascular complications, daily stretching exercises will reduce the risk of fall and maintains the quality of life (8).

MATERIALS AND METHODS

Patients with both genders aged 40 to 70 years who had chronic diabetes diagnosed more than 5 years were included. Patients with pain around the lower extremities, recent surgery around knee and ankle, tumor, non-cooperative patient and patients having neuropathy were excluded from study.

The subjects from various physiotherapy center and any volunteers from the patient family who fulfilled the inclusion criteria of the study were selected. Informed consent was taken from the patients before starting the study. This study was a simple randomized single-blind controlled study. The subject who got the odd number in sequences were allocated in the treatment group and for those who were the even numbers were assigned the control group. The data analysis was done using SPSS version 22. The descriptive data were expressed as mean ± standard deviation (SD).The data has a normally distributed pattern and the parametric paired "t" test was used to measure statistically with the value of $P < 0.05$ is considered statistically significant. Experimental group was given hot pack for 10 minutes over the calf, self-stretching of calf muscle-hold for 15 sec; 10 reps per set for 2 sets, strengthening exercise with calf raises of10 repetitions, 3 set, proximal and distal tibiofibular Grade 4, 1 minute per set, 5 sets of mobilization. Control group was given -Hot pack for 10 minutes over the calf ,self-stretching of calf muscle; hold for 15 sec; 10 reps per set for 2 sets, Strengthening exercise – calf raises; 10 repetitions, 3 sets. Both of the groups were given approximately 45 minutes to complete for a single

session of the treatment. The participation duration for each subject is 3 weeks.

RESULTS

Table 1: Comparison of dorsiflexion of the control group and experimental group

Groups	Left Dorsiflexion				Right Dorsiflexion			
	Number	Median	SD	P value	Number	Median	SD	P value
Control	30	26.3667	5.98552	.960	30	26.1667	6.17606	.922
Experimental	30	26.3000	4.08656	.960	30	26.3000	4.08656	.922

Inf: There is no significant difference in left and right dorsiflexion among experimental group and control group.

Table 2: Comparison of plantarflexion of the control group and experimental group

Groups	Left Plantarflexion				Right Plantarflexion			
	Number	Median	SD	P value	Number	Median	SD	P value
Control	30	60.8333	4.92764	.000	30	61.1667	4.67630	.000
Experimental	30	35.5667	6.53734	.000	30	335.5667	6.53734	.000

Inf: There is significant difference in the left and right dorsiflexion among experimental group and control group.

Table 3: Comparison of functional reach test of the control group and experimental group

Groups	Number	Median	SD	P value
Control	30	39.4000	8.13507	.000
Experimental	30	32.0800	5.90847	.000

Inf: There is a significant difference between functional reach test among the experimental group and the control group. As mean and standard deviation of Control and Experimental group are 39.4000 and 3,20,800. And 8.13507 and 5.90847. The Experimental group shows significant improvement in functional reach test.

DISCUSSION

Many studies observed that the Maitland joint mobilization technique on diabetic's population. Cherqaoui *et al.,* stated that the diabetic population tended to suffer limited joint mobility syndrome over the ankle joint which will directly lead to poor balancing ability. Thus, by application of joint mobilization were intended to prevent the LJMS and improvise better balancing mechanism.

The current study was conducted to evaluate the effects of mobilization technique on ankle mobility and balance performance in diabetes patients. Combination of Maitland mobilization technique on distal and proximal tibia fibular with standard treatment statistically significantly improved ankle dorsiflexion, plantarflexion, and functional reach test and the hypothesis was accepted tibia-fibula (proximal and distal) mobilization is effective to increase the ankle joint mobility in the group of chronic DM patient.

Rheumatic complications with DM Associated formation of glycosylated end products which leads to vasculopathy and neuropathy. More the duration of DM more will be the rheumatic complications in DM. Especially if diagnosed early systematic rheumatologic exam to screen any musculoskeletal complications, which can be potentially treatable.

There should be multidisciplinary collaboration between the rheumatologist, endocrinologist, and physiotherapist (1). A similar review observed by Gerrits, stated that the limited joint mobility syndrome is mainly caused by the long term of macro/microvascular complication and LJMS are unlikely reversible and lack of curable treatment option. Gerrits further mentioned the best way to cure the LJMS is to prevent it before the development of cheiroarthropathy. Hence, active joint exercise along with sustained stretching and good glycemic control was suggested to the diabetic population to maintain their healthy

joints. A related study conducted by Zimny *et al.,* stated that the limited ankle mobility was one of the factors that leads to elevated forefoot peak plantar pressure which will leads to foot ulceration, therefore plantar pressure measurement is recommended to include in future study to evaluate the application of joint mobilization in order to maintain or improve the ankle range of motion and to control the elevated plantar pressure in advance.

Another experimental study performed by Beazell *et al.,* found to be similar to the current study which is stated that proximal and distal manipulation of the tibia fibular joint would be altered and improve ankle range of motion (4). According to some authors (1, 2, 15), treadmill walk with ankle stretching orthosis (ASO) will significantly improve ankle dorsiflexion range (5). Study done by Cockayne *et al.,* the falls in elderly was the incidence rate of falls per participant in the 12 months following randomization. The secondary outcomes included the proportion of fallers and multiple fallers, time to first fall, fear of falling, fracture rate, health-related quality of life (HRQoL) and cost-effectiveness. They found that the interventions were potentially effective (6). Deussen and Alfuth studied the effect of sensorimotor training on balance strength, joint function on and planter foot sensitivity in chronic ankle sprain in athletes found there would be no difference in experimental and control group(7). Daily range of motion exercises and maintenance of good glycemic control are the frame work for prevention of LJMS (8). Hoch *et al.,* studied two-week joint mobilization intervention on dynamic balance and range of motion in adults with (CAI) concluded that joint mobilization targeted to talar glide improves the overall functional independence in adults with (CAI) within 1 week (9). Hoch and McKeon studied the effect of grade III mobilization of talar would improve dorsiflexion range of motion (10).

Jeon *et al.,* studied to compare the effects of 2 ankle-stretching techniques on ankle DFROM and concluded that as the talus was stabilized with a strap and the anterior glide of distal tibia at talocrual joint was facilitated, it would to improve the ankle dorsiflexion range, the active dorsiflexion and planter would improve with 3 weeks of self-stretching intervention (11).

Scaddan *et al.,* studied that joint mobilization is the way of treating joint arthritis (12). Apart from that, Kalten born *et al.,* mentioned that range of motion of the affected joint will improve after a joint mobilization session because of greater extensibility of the ligament structures and non-contractile capsular and the increased activity of the joint sensation and conduction of afferent impulses (13). The study carried out by Grindstaff *et al.,* found to be similar to the current study stating that there was a presence of facilitation spinal excitability of the calf muscle group while manipulating distal tibiofibular joint in CAI patients (14). Hence the presence of the stimulation of sensory receptors during the joint mobilization and facilitation of the afferent activity combine with the amplification of neuromuscular activation of the muscles structure that stabilized the joint, eventually resulting in the improvement of dynamic postural control during the functional reach test among the diabetic subjects. So the study concludes that there is a significant difference in the ankle range of motion and functional reach test in the diabetic population (15). Terada *et al.,* studied static stretching which would improve ankle dorsiflexion after acute ankle sprain, they perform various interventions such as stretching, manual therapy, electrotherapy, ultrasound, and exercises, to increase ankle dorsiflexion but the combined interventions are more effective than one intervention (16). Cheiroarthopathy is common in people with type 1 diabetes and related to high level of glycaemia. A routine examination of musculoskeletal system examination is required to rule out arthritic complications with type 1 diabetes (17).

CONCLUSION

Mobilization of tibiofibular joint will be beneficial in improving the ankle range of motion and balance factor in the diabetic population.

REFERENCES

1. Abourazzak, F. E., Akasbi, N., Houssaini, G. S., Bazouti, S., Bensbaa, S., Hachimi., *et al.* . Articular and abarticular manifestations in type 2 diabetes mellitus. European Journal of Rheumatology, 2014; 1(4): 132-134.
2. Bagherian, S., Rahnama, N., and Wikstrom, E. A. Corrective Exercises Improve Movement Efficiency and Sensorimotor Function but Not Fatigue Sensitivity in Chronic Ankle Instability Patients: A Randomized Controlled Trial. Clinical Journal of Sports Medicine. 2017; 0(1): 1-10.
3. Barfod, K. W., Hansen, M. S., Holmich, P., Troelsen, A., and Kristensen, M. T. Efficacy of early controlled motion of the ankle compared with no motion after non-operative treatment of an acute Achilles tendon rupture: Study protocol for a randomized controlled trial. Trials, 2016; 17(1): 1-10.
4. Beazell, J. R., Grindstaff, T. L., Sauer, L. D., Magrum, E. M., Ingersoll, C. D., & Hertel, J. Effects of a Proximal or Distal Tibiofibular Joint Manipulation on Ankle Range of Motion and Functional Outcomes in Individuals with Chronic Ankle Instability. Journal of Orthopedic & Sports Physical Therapy. 2012; 42(2): 125-134.
5. Cho, Y. K., Kim, S. H., Jeon, I. C., Ahn, S. H., Kwon, O. Y. Effect of treadmill walking with ankle stretching orthosis on ankle flexibility and gait. Journal of Physical Therapy Science. 2015; 27(4): 1257-1260.
6. Cockayne, S., Rodgers, S., Green, L., Fairhurst, C., Adamson, J., Scantlebury *et al*., Clinical effectiveness and cost-effectiveness of a multifaceted podiatry intervention for falls prevention in older people: A multicenter cohort randomized controlled trial (the reducing falls with orthoses and a multifaceted podiatry intervention trial). Health Technology Assessment. 2017; 21(24): 1-198.
7. Deussen, S., Alfuth, M. The Influence of Sensorimotor Training Modalities on Balance, Strength, Joint Function, and Plantar Foot Sensitivity in Recreational Athletes with a History of Ankle Sprain: a Randomized Controlled Pilot Study. International Journal of Sports Physical Therapy, 2018; 13(6): 993-1007.
8. Gerrits, E. G. Limited joint mobility syndrome in diabetes mellitus: A minire view. World Journal of Diabetes. 2015; 6(9): 1108-1112.
9. Hoch, M. C., Andreatta, R. D., Mulleneaux, D. R., English, R. A., Medina Mckeon, J. M., Mattacola, C. G., *et al.,* Two-week joint mobilization intervention improves self-reported function, the range of motion, and dynamic balance in those with chronic ankle instability. Journal of Orthopedic Research, 2012; 30(11): 1798-1804.
10. Hoch, M. C., and McKeon, P. O. Joint mobilization improves spatiotemporal postural control and range of motion in those with chronic ankle instability. Journal of Orthopedic Research. 2011; 29(3): 326-332.
11. Jeon, I. C., Kwon, O. Y., Yi, C. H., Cynn, H. S., Hwang, U. J. The ankle-dorsiflexion range of motion after ankle self-stretching using a strap. Journal of Athletic Training. 2015; 50(12): 1226-1232.
12. Scaddan, E., Rowell, J., and O'Leary, S. A preliminary case series evaluating the safety and immediate to short-term clinical benefits of joint mobilization in hemophilic arthritis of the lower limb. Journal of Manual and Manipulative Therapy. 2017; 25(4): 208-214.
13. Kaltenborn, F., Evjenth, O., Kaltenborn, T., Manual therapy of the extremity joints, Vol 1: The Extremitis. 7th ed. Oslo, Norway: Orthopedic Physical Therapy Products; 2011.
14. Carolyn., K. Therapeutic Exercise: Foundations and Techniques, F. A. Davis Company, 2012.
15. Beazell, J. R., Grindstaff, T. L., Sauer, L., Magrum, E. M., Ingersoll, C. D., Hertel, J. Effects of a proximal or distal tibiofibular joint manipulation on ankle range of motion and functional outcomes in individuals with chronic ankle instability. J Orthop Sports Phys Ther. 2012; 42(2): 125-134.
16. Terada, M., Pietrosimone, B. G., and Gribble, P. A. Therapeutic interventions for increasing ankle dorsiflexion after ankle sprain: A systematic review. Journal of Athletic Training. 2013; 48(5): 696-709.
17. Larkin, M. E., Barnie, A., Braffett, B. H., Cleary, P. A., Dominick, L., Harth, J *et al.* Musculoskeletal complications in type 1 diabetes. Diabetes Care. 2014; 37(7): 1863-1869.