

Reliability study of spring weighing scale for measurement of hip abductor muscle strength

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Abstract

Background: Hip abductor muscle strength can be measured by repetition maximum (1RM). For object based assessment hand held dynamometers can be used for strength measurement of upper limb muscles. But it is very difficult to measure strength of lower limb muscle by using hand held dynamometer and reliability for the same is also not established yet. Spring weighing scale can be used as an alternative to measure the strength of muscles. There is no evidence available for use of spring weighing scale to measure muscle strength. So, this study has been designed to establish reliability of spring weighing scale for measurement of hip abductor strength.

Objective: To establish reliability of spring weighing scale for measurement of hip abductor muscle strength.

Intervention: Reliability of spring weigh scale for hip abductor strength was checked by Cross sectional study. 15 normal individuals aged 18 to 25 were included. Informed consent was taken prior to study. Study was conducted at the physiotherapy OPD, Lokhat hospital. First measurement of Hip abductor strength was taken on day-1 and the second reading was taken after 24 hours of the first reading that means on day-2. Consistency of the results was checked to establish the reliability of instrument prior conducting the main study.

Results: Reading of 15 subjects were taken at the interval of 24hours to check the consistency of the readings Cronbach's Alpha test has to be performed as the data are in form of scale. As the result of Cronbach's Alpha test (0.998) – Indicates highly reliable

Conclusion: As the result of Cronbach's Alpha test (0.998) – Indicates highly reliable for measuring hip abductor strength.

Keywords: weighing scale, hip abductor strength

Introduction

Hip muscle weakness occurs as consequence of OA knee and mechanism behind it is same as quadriceps weakness. i.e. because of pain functionality is reduced that lead to less activation of muscle causing atrophy of muscle fibers leading to muscle weakness [3]. People with knee OA demonstrate significant weakness of the hip musculature. Hip abductor muscle weakness leads to impaired control of pelvis in frontal plane which results in drop of pelvis towards opposite side which ultimately results into shifting

of center of mass away from the stance limb towards swing side. That causes excessive loading at medial knee joint of stance limb which results in pain and functional abnormality [2, 4]. Weaker hip abductors associated with lower external hip rotation moment on the osteoarthritis stance limb would result in additional pelvic drop of the contralateral swing limb, shifting the body's COG towards swing limb. This would lengthen the lever arm at the osteoarthritic knee, thus increasing medial knee load provoking the disease progression [5].

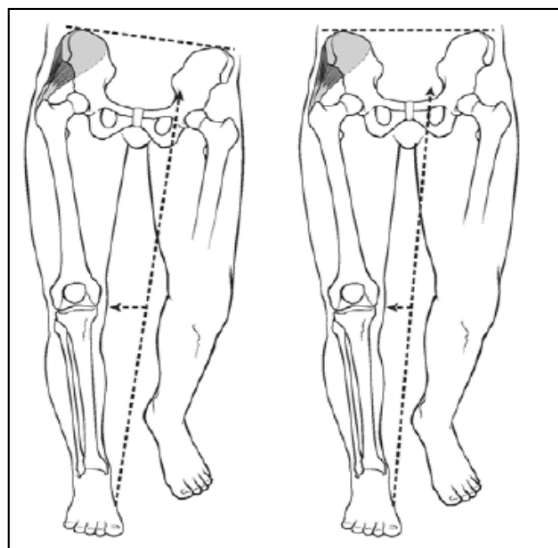


Fig 1: Hip abductor weakness leading to increase stress at medial compartment of knee joint [2]

Hinman *et al* concluded that People with knee OA demonstrate significant weakness of the hip musculature. Findings from this study support the inclusion of hip strengthening exercises in rehabilitation programs [3]. Chang *et al* concluded that weakness of hip abductor in OA knee leading to shifting of pelvis on contralateral side. That causes more loading of medial knee joint causing provocation of the condition [5]. K.L. Bennell *et al* concluded that isolated strengthening of the hip muscles improves symptoms and functionality in the patients with OA knee [6]. Shakoor N. *et al* concluded that significant improvements in knee pain and functionality in the patients with OA knee following the standard quadriceps strengthening exercise. Khalil Khayambashi *et al* concluded that hip abductor strengthening is effective in improving pain and health status compare to quadriceps strengthening in female with PFPS. So the incorporation of hip abductor strengthening should be considered while designing a rehabilitation protocol [7].

So, Hip abductor strength measurement is necessary before and after treatment in order to take the follow-up of the patient. There are several evidences available for measurement of muscle strength by hand held dynamometer. Hand held dynamometer is reliable and valid tool for strength measurement of upper limb muscles. But, its reliability and validity for strength measurement of muscles of lower limb is not established. As an alternative to hand held dynamometer spring weighing scale can be used for strength measurement of muscles of lower limb. This study has been designed to establish the reliability of weighing scale for measurement of hip abductor strength.

Methodology

Reliability of spring weighing scale for hip abductor strength was checked by Cross-sectional study. 15 normal individuals aged 18 to 25 were included. Informed consent was taken prior to study. Study was conducted at the physiotherapy OPD, Lokhat hospital. First measurement of Hip abductor strength was taken on day-1 and the second reading was taken after 24 hours of the first reading that means on day-2. Consistency of the results was checked to establish the reliability of instrument prior conducting the main study.

Tools and Materials

- Spring Weighing Scale
- Non elastic belt
- Stop watch



Fig 2: Weighing scale and Belt loop



Fig 3: Stopwatch

Procedure of hip Abductor Strength measurement by spring weighing scale

Spring weighing scale is the machine which is used to measure the weight by placing the scale in vertical suspension. But in this study machine was used to measure hip abductor strength as an alternative of any strength measurement instrument (i.e.-Hand Held Dynamometer). This instrument can measure up to 50kgs of pulling weight. The pull exerted by hip abductor muscle measured in kilograms. That is the force generated by the muscle. That indicates the strength of the muscle.

Belt

Belt was used along with the machine to measure the hip abductor strength. Belt was made of non-elastic material. Loop of belt was made. The loop was hanged in the hook of weighing scale.

The instrument was kept horizontally over the floor. Top end of the instrument was kept fixed and bottom end containing hook was attached to the belt loop. Belt is of non-elastic material. Subject was asked to stand by keeping the loop at the lateral malleoli of affected lower extremity and then subject was asked to abduct the leg. Pulling weight in kilograms was measured. Both the feet were at equal horizontal level. Reading was taken thrice and average of those reading was considered. Patient was allowed to do a trial performance prior taking three final readings



Fig 4: Hip abductor strength measurement

Result

Using a spring weighing scale hip abductor strength was measured. Subject was made in standing position and was asked to pull the loop of belt which was attached to weighing scale by abducting hip; reading was taken through the position of scale. This measurement was taken twice at interval of 24 hours

Estimated torque was calculated with the equation

$$\text{Torque} = (\text{force} * \text{moment arm}) \div \text{Body Weight}^{[3, 4, 8]}.$$

Where Force is in newton, Moment-arm is in meter and body weight is in kilogram. Moment-arm length for torque calculation was based on taking limb length measurement. The moment arm was taken from ASIS to the medial malleolus minus 5 cm^[9].

Test- Retest Reliability

- Reading of 15 subjects were taken at the interval of 24hours.to check the consistency of the readings Cronbach's Alpha test has to be performed as the data are in form of scale.
- As the result of Cronbach's Alpha test (0.998)–Indicates highly reliable

Discussion

Test-retest reliability was done and internal consistency of the data was checked by Cronbach's Alpha test and the result obtained was 0.998. The obtained value is nearer to 1 that indicates the machine is highly reliable for measuring the strength of hip abductor muscle.

This study attempted to find out the reliability of the spring weighing scale for measurement of hip abductor muscle. Result reveals that it is highly reliable for measurement of hip abductor muscle strength. This instrument is cost effective and reliable compare to hand held dynamometer for measurement of hip abductor muscle strength.

Conclusion

This study reveals that spring weighing scale is highly reliable for measurement of hip abductor muscle strength compare to hand held dynamometer.

References

1. Sofat N, Ejindu V, Kiely P. What makes osteoarthritis painful? The evidence for local and central pain processing. *Rheumatology*, 2011.
2. Thorp L, Wimmer M, Foucher K, Sumner D, Shakoor N, Block J *et al*. The biomechanical effects of focused muscle training on medial knee loads in OA of the knee: a pilot, proof of concept study. *J Musculoskelet Neuronal Interact*. 2010; 10(2):166-73.
3. Hinman RS, Hunt MA, Creaby MW, Wrigley TV, McManus FJ, Bennell KL *et al*. Hip muscle weakness in individuals with medial knee osteoarthritis. *Arthritis care & research*. 2010; 62(8):1190-3.
4. Sled EA, Khoja L, Deluzio KJ, Olney SJ, Culham EG. Effect of a home program of hip abductor exercises on knee joint loading, strength, function, and pain in people with knee osteoarthritis: a clinical trial. *Physical Therapy*. 2010; 90(6):895-904.
5. Chang A, Hayes K, Dunlop D, Song J, Hurwitz D, Cahue S, *et al*. Hip abduction moment and protection

- against medial tibiofemoral osteoarthritis progression. *Arthritis and rheumatism*. 2005; 52(11):3515-9.
6. Bennell KL, Hunt MA, Wrigley TV, Hunter DJ, McManus FJ, Hodges PW *et al*. Hip strengthening reduces symptoms but not knee load in people with medial knee osteoarthritis and varus malalignment: a randomised controlled trial. *Osteoarthritis and Cartilage*. 18(5):621-8.
 7. Khayambashi K, Mohammadkhani Z, Ghaznavi K, Lyle MA, Powers CM. The Effects of Isolated Hip Abductor and External Rotator Muscle Strengthening on Pain, Health Status, and Hip Strength in Females With Patellofemoral Pain: A Randomized Controlled Trial. *Journal of Orthopaedic & Sports Physical Therapy*. 2012; 42(1):22-9.
 8. Bennell KL, Hunt MA, Wrigley TV, Hunter DJ, McManus FJ, Hodges PW *et al*. Hip strengthening reduces symptoms but not knee load in people with medial knee osteoarthritis and varus malalignment: a randomised controlled trial. *Osteoarthritis and cartilage /OARS, Osteoarthritis Research Society*. 2010; 18(5):621-8.
 9. Krause DA, Neuger MD, Lambert KA, Johnson AE, De Vinny HA, Hollman JH *et al*. Effects of examiner strength on reliability of hip-strength testing using a handheld dynamometer. *Journal of sport rehabilitation*. 2014; 23(1):56-64.