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Research Article

EFFECT OF RESISTANCE BAND TREADMILL WALKING ON LOWER LIMB MUSCLE STRENGTH, BALANCE, GAIT PARAMETERS AND FUNCTIONAL PERFORMANCE: A CASE STUDY

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Treadmill walking, ipsilateral neck and shaft of femur fracture, long proximal femoral nail, Muscle Strength Dynamometer, gait.

A B S T R A C T

Purpose: The purpose of this study was to assess the effect of Resistance band treadmill walking and weight-bearing exercises on strength, balance, gait parameters and functional performance in a patient following ipsilateral neck and shaft of femur fracture managed with Long Proximal Femoral Nail (LPFN): Follow-up Two Years After Surgery.

Methodology: A 27-year-old male patient volunteered for a 4-week intervention (6 days in a week) where he performed 10 minutes of treadmill walking, 3 times per week, while wearing a Thera Loop band placed at distal end of femur bone that provided bidirectional resistance to the lower limb muscles. Strength, balance, gait parameters and functional performance were assessed before and after the 4-week intervention.

Conclusion: Results obtained Pre and Post – intervention showed a notable improvement in strength, balance and functional performance of the affected leg and thus depicted gait symmetry.

INTRODUCTION

Combined femoral neck and shaft fractures are an unusual kind of fractures. However, associated ipsilateral femoral neck fractures had been stated to arise in as high as 9% of all femoral shaft fractures (Tornetta P III *et al*, 2007). Hip fracture is considered to be an important public health issue as outcome after the same is often poor (Sherrington C *et al*, 2003). Current quality management in hip fracture involves little delay to surgical repair and subsequent mobilisations. However, the best kind and intensity of mobilisation stays unclear. Researchers have determined that, among people after hip fracture, an exercise programme conducted whilst standing resulted in reduced need for gait aids in inpatient rehabilitation and greater improvements in balance, proprioception and functional abilities when compared to an exercise programme conducted in seated or supine position (Lee KJ *et al*, 2020). There is evidence from the stroke literature that a higher dose of exercise leads to greater improvements in physical functioning, and exercises which involves weight-bearing functional task activities and walking on treadmill with some body weight support can be particularly effective (Hwang YI *et al*, 2013).

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Using resistance bands is a great way to build strength as they add an extra challenge to body weight exercises, but they don't put the same sort of pressure on the joints that external weights (like kettlebells or dumbbells) do. They are also great for targeting smaller, stabilizing muscles that help throughout to achieve the full range of motion. Resistance bands being light and portable, makes them easy to use anywhere. Muscular strength obtained from resistance exercise programs are account for developing velocity and movement coordination thus promoting balance and functionality (Lee SY *et al*, 2017). Reciprocal application and informal back up controlled liable research have been showed resistance exercise is an efficient training technique for improving muscular strength and power (Lee SY *et al*, 2017). Conversely, along with strength training an ordinary endurance training program progress aerobic capacity and has various beneficial influences. We drew on these pieces of evidence to develop a 'best-practice' exercise programme for a patient which involved a higher dose of exercise with use of Resistance bands and Thera Loop with an emphasis on exercises conducted whilst standing (i.e. weight bearing) and walking on a Treadmill with Thera Loop to improve his strength, balance and physical functioning.

Case Description

An adolescent male patient (age 27 years; BMI – 29.55 Kg/m^2) presented with2 years old Post- operated Ipsilateral Neck of

femur and shaft of femur fracture managed with Long Proximal Femoral Nailing and Dynamic Compression Plating done in Right (dominant) leg. The injury occurred 2 years ago in a road accident while riding his bike when a truck dashed him from behind and he fell directly on his Right Hip Joint. He was diagnosed with a Right sided neck of femur and shaft of femur fracture and was managed accordingly on 26/12/2018. The participant was taught ambulation using walker with Non-weight bearing of involved side in inpatient rehabilitation. He was then made to do Partial to Full weight bearing of the involved side by the end of 5 weeks and was then shifted to a cane support while ambulating which he used for almost a year. The participant is in CRPF (Central Reserve Police Force) and his occupational background activities consisted of heavy physical training exercises, heavy weight lifting, running, etc., which the participant is experiencing difficulty in returning to his daily routine activity schedule as he was not able to undergo a proper Physiotherapy Rehabilitation programme just after the Hip surgery due to lack of facilities.

Physical Examination

Patient was conscious, co-operative, and well-oriented to time, place and person. Patient was experiencing difficulty in walking and did not have any complaints of Pain at the site of surgery. The strength of the lower limb muscles was quantified by measuring maximum voluntary isometric contraction using a handheld dynamometer (Thorborg K *et al*, 2010). The participant performed Y- Balance test that is used to assess lower extremity balance and neuromuscular control to predict lower extremity injury (Robinson RH *et al*, 2008). Also, Berg Balance Score (BBS) was calculated to assess the risk of fall. Self-perceived functional ability was assessed using the Lower Extremity Functional Scale (LEFS), a functional status evaluation tool that aims to investigate the degree of difficulty an individual experiences in performing everyday tasks. The Harris Hip Score (HHS) a widely used disease-specific measure of hip disability (domains of which include pain, functions of daily living, and gait) was taken pre and post – intervention. Gait parameters (Barefoot and with Corrected footwear) were assessed using BIOVAL motion analysis software system pre and post – intervention (Sacco G *et al*, 2015).

Intervention

Patient received 4 weeks (six days a week) of Physiotherapy (individualized, closely monitored) along with a structured home exercise program (low intensity,6 days a week). Exercise program started on a lower intensity, gradually increasing to goal intensity during the first two weeks. Gradually the intensity and duration of exercise was increased to a rate of exertion that the patient found somewhat challenging but not overly difficult. The exercise program focused mostly on training of muscle strength and joint flexibility in weight-bearing positions. All movements were done using Pelvis Stabilization Belt and Once isolated movement was achieved there was increase in number of repetitions or hold time. The participant also performed Resistance band Treadmill walking with Thera-loop placed just above the knee joint for 10 minutes three times a week with low grade speed (2 – 4 Km/hr) (Sloot LH *et al*, 2014). Most important was Limb Length Correction and hence Shoe modification with Equivalent raise at Right shoe sole.

RESULT

The isometric Hip Abductors, internal rotators and flexors strength of the operated leg increased (+19%, +11% and +6% respectively), also Knee extensors and flexors strength (+8% and +7% respectively), with Ankle Plantar-flexors and Dorsiflexors strength (+11% and +6% respectively) after the intervention (shown in Table 1). The results of the Y- Balance test showed improvement [Right LL (+6%) and Left LL (+3%)] Post-intervention (shown in Table 1).There was an improvement seen in the LEFS, HHS and BBS Scores by +27%, +14% and +6% respectivelyPost- Intervention (shown in Table 1).The Pre-and Post- Intervention gait analysis on BIOVAL Software system suggests that theBarefoot centre of pressure is almost located centrally Post- intervention (shown in Table 2 and 3). Also, equal weight distribution is noted bilaterally when compared to Pre- intervention baropodometric images (shown in Figure 1 – 4).

Table 1 Strength, Balance and Functional Parameters Preand Post-Intervention

Muscle group	**Pre- intervention (in Kg)**		**Post- intervention (in Kg)**	
	Right Side	**Left Side**	**Right Side**	**Left Side**
Hip flexors	5.3	6.3	5.6	6.3
Hip extensors	4	6.3	4	6.3
Hip abductors	3.6	5.3	4.3	5.6
Hip adductors	4	4.3	4	4.3
Hip internal rotators	3.6	5	4	5
Hip external rotators	4.3	5.3	4.3	5.3
Knee flexors	5.6	6.3	6	6.3
Knee extensors	8.6	9	9.3	9.3
Ankle dorsiflexors	5.3	6	5.6	6
Ankle plantar flexors	3.6	4.3	4	4.3
Y – Balance Test	**Pre – intervention (in cms)**		**Post – intervention (in cms)**	
	Right side	**Left side**	**Right side**	**Left side**
Anterior	80	82	81	82
Posterior-lateral	51	68	55	70
Posterior-medial	57	62	64	66
Reach distance (Total)	188	212	200	218
Balance % = (average reach distance/limb length ×100)	67	74	71	76
Functional evaluation scales	**Pre - intervention**		**Post - intervention**	
Lower Extremity Function Score	44/80		56/80	
Berg Balance Score	49/56		52/56	
Harris Hip Score	78/100		89/100	

Table 2 Gait Analysis (Pre- Intervention) done using Bioval Software System

	Gait Analysis (Pre- Intervention) (01/03/2021)			
Spatiotemporal Parameters	**Lateralised Walking (Left Side) Barefoot**	**Lateralised Walking (Right Side) Barefoot**	**Lateralised Walking (Left Side) Corrected)**	**Lateralised Walking (Right Side) Corrected)**
Walking speed (m/s)	0.65	0.74	0.71	0.70
Walking speed (km/h)	2.34	2.66	2.56	2.52
Walking rhythm (steps/mins)	85.11	86.83	88.89	88.63
Length of the cycle (m)	0.91	1.02	0.96	0.99
Length of the step left (m)	0.46	0.54	0.51	0.56
Length of the step right (m)	0.45	0.48	0.45	0.43
Bipedal support/cycle (%)	17.86	14.82	18.50	19.35
On one leg support left (s)	0.52	0.53	0.42	0.43
On one leg support right (s)	0.37	0.43	0.42	0.43

The Post- intervention gait analysis suggests of improvement in the Spatiotemporal parameters as well as Kinetics and

Kinematics of the phases of Gait cycle. The Bipedal support is improved on Right side (+21%) as compared to Pre-intervention stage. Also, Gait analysis with corrected footwear suggest significant improvement.

Table 3 Gait Analysis (Post- Intervention) done using Bioval Software System

	Gait Analysis (Post- Intervention) (27/03/2021)			
Spatiotemporal parameters	Lateralised Walking (Left Side) Barefoot	Lateralised Walking (Right Side) Barefoot	Lateralised Walking (Left Side) Corrected)	Lateralised Walking (Right Side) Corrected)
Walking speed (m/s)	0.89	0.79	0.72	0.70
Walking speed (km/h)	3.21	2.84	2.59	2.51
Walking rhythm (steps/mins)	98.68	92.45	91.19	92.45
Length of the cycle (m)	1.09	1.02	0.95	0.91
Length of the step left (m)	0.56	0.51	0.50	0.50
Length of the step right (m)	0.52	0.52	0.45	0.41
Bipedal support / cycle (%)	15.05	17.94	20.21	23.09
On one leg support left (s)	0.55	0.57	0.42	0.43
On one leg support right (s)	0.40	0.38	0.37	0.42

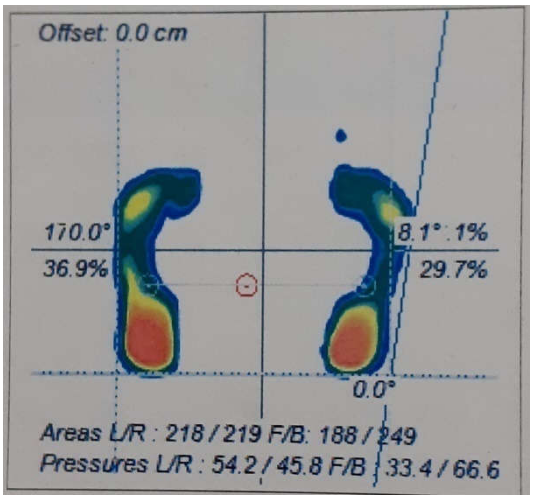

Fig 1 Barefoot baropodometric image Pre- intervention

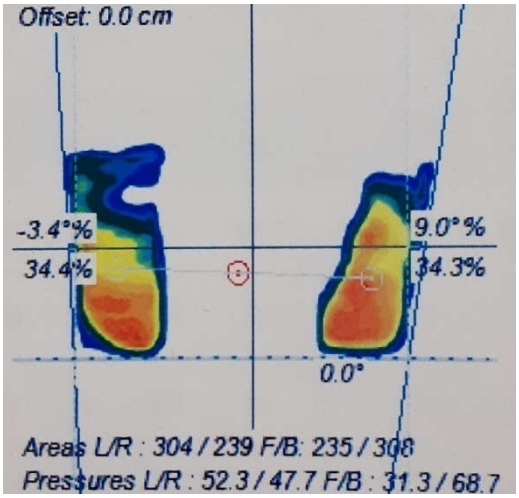

Fig 2 Corrected footwear baropodometric image Pre- intervention

The baropodometric image with corrected footwear suggests equal weight- bearing under bilateral feet as the area of contact is improved on Right side after correction. Centre of pressure is located centrally as compared to barefoot standing images. Corrected footwear Gait analysis suggests that Right knee hyperextension is reduced during stance phase of gait and ankle plantarflexion range is improved on Right side during Push- off phase as compared to Pre- intervention stage.

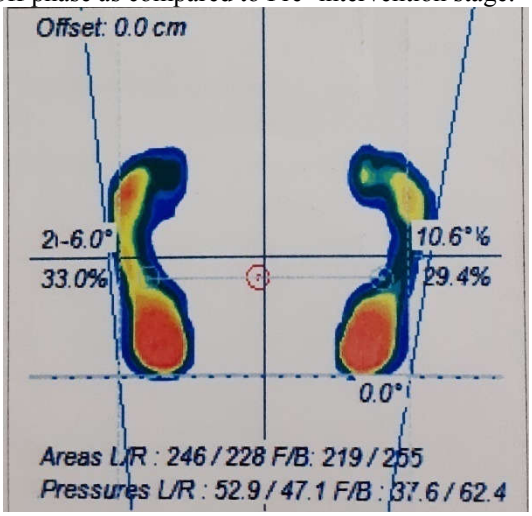

Fig 3 Barefoot baropodometric image Post- intervention

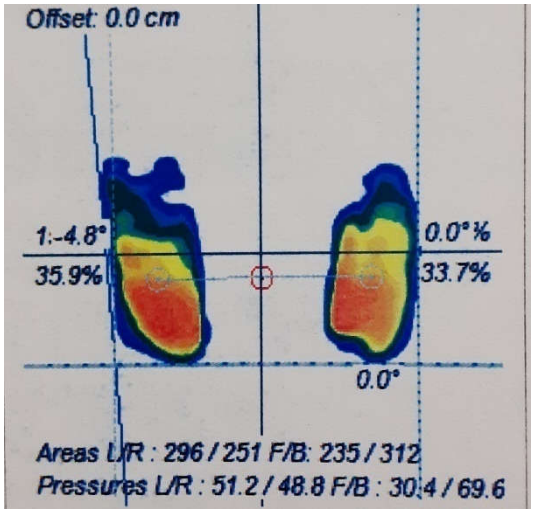

Fig 4 Corrected footwear baropodometric image Post- intervention

DISCUSSION

The LPFN is available in 130-135° and has a 6° proximal mediolateral angle that facilitates easy insertion from the trochanter (Gadegone W *et al*, 2013). The nail and screw support proximal head or the neck fragment. LPFN allows the temporary mechanically incompetent but biologically viable fragments to heal around the nail (Gadegone WM *et al*, 2007). Intramedullary implant itself acts as a buttress to prevent excessive fracture collapse and shaft medialization. The long PFN rigidly stabilizes both the factures adequately which leads to osseous healing (Gadegone W *et al*, 2013). It also offers advantage of a reamed and unreamed implantation technique, high rotational stability of the head-neck fragment and the possibility of static or dynamic distal locking (Gadegone WM *et al*, 2007). Approximately all the load is transferred to the nail and negligible portion to the medial femoral cortex. The two major complications are non-union and osteonecrosis (Gadegone W *et al*, 2013). Osteonecrosis represents perhaps the most serious complication, especially in a young adult. Wiss and co-workers reported a 6% incidence of osteonecrosis at an average follow-up of 32 months (Wiss DA *et al*, 1992). Though numerous authors report a union rate of 100% for both fractures, non-union of the femoral neck and shaft remains a potential serious complication. Wiss and co-workers reported

an 18% incidence in his patients (Wiss DA *et al*, 1992).Dousa*et al*. reported good results of ipsilateral fractures of the proximal femur and the femoral shaft treated by the long PFN in 147 cases (Douša P *et al*, 2010).Thus, many studies suggest that ipsilateral fractures of the proximal femur and femoral shaft if diagnosed early and treated aggressively by LPFN gives a better functional result by a single implant (Gadegone W *et al*, 2013). In patients with hip pathologies, atrophy of the lower Gluteus Maximus and of the Gluteus Medius on the affected side and hypertrophy of the contralateral upper gluteus maximus have been observed. These results support the hypothesis that appropriate muscle strength of the hip extensor muscles including the gluteus maximus and of the hip abductor muscles is important for adequate physical function after hip surgery (Grimaldi A *et al*, 2009).The results of this study showed that hip muscle strength and endurance are associated with postoperative limping severity and that this association is stronger for the hip extensors and flexors than for the hip adductors and abductors. These results are particularly important because limping or asymmetric gait may contribute to the risk for secondary damages in other joints of the lower extremity. Exercises aimed at improving hip extensor and flexor strength and endurance to improve gait function should be considered for rehabilitation programs. The participant walked on the treadmill with bidirectional resistance Thera Loop band placed at distal end of femur bone. The slower than normal walking speed was used to allow the subject more time to learn the skill, promote a more symmetrical gait pattern, and allow greater loading on lower limb muscles. At every training session, close attention was paid to appropriately cue the participant in order to match the target-match template as close as possible. The cue involved bending the leg after toe-off by focusing on hamstring muscles and extending the leg fully during terminal swing phase by focusing on the quadriceps muscles.

CONCLUSION

The results obtained supports our hypothesis of clinical implication of Treadmill walking with resistance bands in routine Physiotherapy rehabilitation for managing Post-operated ipsilateral neck and shaft of femur fracture**,** as it helps to increase weight bearing status of the involved limb and thus improve gait symmetry.

References

Douša P, Bartoníek J, Pavelka T, Lunácek L. (2010) Ipsilateral fractures of the proximal femur and the femoral shaft. Acta ChirOrthopTraumatol Cech. 77:378 88.

Gadegone W, Lokhande V, Salphale Y, Ramteke A. (2013) Long proximal femoral nail in ipsilateral fractures proximal femur and shaft of femur. Indian J Orthop. 47(3):272-277.

Gadegone WM, Salphale YS. (2007) Proximal femoral nail an analysis of 100 cases of proximal femoral fractures with an average followup of 1 year. Int Orthop. 31:403 8.

Grimaldi A, Richardson C, Durbridge G, *et al*. (2009) The association between degenerative hip joint pathology and size of the gluteus maximus and tensor fascia lata muscles. Man Ther 14:611Y7.

Hwang YI, Yoo WG, An DH. (2013) Effects of the Elastic Walking Band on gait in stroke patients. NeuroRehabilitation. 32(2):317-322.

Jones CB, Walker JB. (2018) Diagnosis and Management of Ipsilateral Femoral Neck and Shaft Fractures. J Am AcadOrthop Surg. 21: e448-e454.

Lee KJ, Um SH, Kim YH. (2020) Postoperative Rehabilitation after Hip Fracture: A Literature Review. *Hip Pelvis* 32(3):125-131.

Lee SY, Yoon BH, Beom J, Ha YC, Lim JY. (2017) Effect of Lower-Limb Progressive Resistance Exercise After Hip Fracture Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Studies. J Am Med Dir Assoc. 18(12): 1096.e19-1096.e26.

Robinson RH, Gribble PA. (2008) Support for a reduction in the number of trials needed for the star excursion balance test. Arch Phys Med Rehabil. 89: 364–70.

Sacco G, Turpin JM, Marteu A, *et al*. (2015) Inertial sensors as measurement tools of elbow range of motion in gerontology. *Clin Interv Aging*. 10:491-497.

Sherrington C, Lord SR and Herbert RD (2003) A randomised trial of weight-bearing versus non-weightbearing exercise for improving physical ability in inpatients after hip fracture. Australian Journal of Physiotherapy, 49: 15-22.

Sloot LH, van der Krogt MM, Harlaar J. (2014) Self-paced versus fixed speed treadmill walking. *Gait Posture*. 39(1):478-484.

Thorborg K, Petersen J, Magnusson SP, Hölmich P. (2010) Clinical assessment of hip strength using a hand-held dynamometer is reliable. Scand J Med Sci Sports. 20(3):493-501.

Tornetta P III, Kain MS, Creevy WR. (2007) Diagnosis of femoral neck fractures in patients with a femoral shaft fracture. Improvement with a standard protocol. J Bone Joint Surg Am. 89(1):39-43.

Wiss DA, Sima W, Brien WW. (1992) Ipsilateral fractures of the femoral neck and shaft. J Orthop Trauma. 6;159-66.

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