

Hip Abductor Strength following Total Hip Arthroplasty: A Prospective Study of Lateral Approach in 38 Patients

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ABSTRACT

Objective: To assess the hip abductor strength and Trendelenburg test after total hip arthroplasty through a lateral approach.

Methodology: It was a prospective cohort study conducted at the Department of Orthopedic Surgery, Services Hospital, Lahore over a duration of 10 months from March to December 2020. Thirty-Eight patients with unilateral hip osteoarthritis undergoing total hip arthroplasty via lateral approach were selected by convenient sampling. Pre-operative assessment of patients was done and the patients were re-assessed post-operatively after 1, 4, and 24 weeks for muscle strength using the Medical Research Council (MRC) Scale and Trendelenburg test. Paired t-test was used to assess the difference between mean abductor muscle strength after 1 and 24 weeks for statistical, significance considering a p-value ≤ 0.05 as a significant value.

Results: Out of the 38 patients selected, 2 were lost during the follow-up. Pre-operatively 24 patients tested positive and 14 tested negative for the Trendelenburg test on the involved side. The average muscle strength on the involved side pre-operatively was 3.67 ± 0.43 . There was a marked difference in the Trendelenburg test and muscle power pre-operatively on the normal side. One week post-operatively, 15 patients tested positive for the Trendelenburg test in contrast to 24 pre-operatively, 7 tested positive at 4 weeks and 3 tested positive at 24 weeks subsequently. Muscle power improved to 4.21 ± 0.41 one week post-operatively in contrast to 3.67 ± 0.43 pre-operatively, 4.53 ± 0.51 at 4 weeks, and 4.95 ± 0.23 at 24 weeks. This trend was seen in both males and females.

Conclusion: There is a marked improvement in hip abductor strength following total hip arthroplasty using lateral approach provided timely rehabilitation is applied along with good patient compliance. The MRC method has proven to be a simpler yet effective method.

Keywords: *Abductor strength. Lateral approach. Osteoarthritis. Total hip arthroplasty. Trendelenburg test.*

INTRODUCTION

Total hip arthroplasty is the preferred modality of treatment in advanced osteoarthritis of the hip or when all other modalities are deemed ineffective. It is most commonly performed via the lateral or posterior approach each having its merits and demerits. The lateral Hardinge approach requires the dissection of the abductor muscle mass which can result in weakened abductor muscle strength and abductor insufficiency post-operatively.¹ Abductor insufficiency may be caused due to either injury to the superior gluteal nerve or failure to securely attach the muscle mass following dissection.² This can have a significant functional outcome on the patient's post-operative activities of daily living. Some may require more time and rehabilitation for the recovery of the hip abductor strength to normal.³

The most common pathologies affecting the hip joint are avascular necrosis of the head of the femur, fracture of the neck of the femur and osteoarthritis. These pathologies can also render the abductor musculature of the hip joint weak on the affected side.⁴ Patients with

osteoarthritis of the hip joint, on the other hand, may already have reduced abductor weakness as a result of a reduction in mass, disuse, and pain in the hip joint, as a result of which the joint is prone to further mechanical instability, decreased shock absorption, and worsening the disease.⁵

Abductor muscles of the hip also play a leading role during the normal gait of the patient. During the stance phase of the gait cycle, the ipsilateral hip abductors have to contract eccentrically to stabilize the pelvis and to avoid excessive shock impact on the contralateral hip joint.⁶ Weak abductors can result in a Trendelenburg gait where there is a drop or adduction of the opposite hip during walking. The primary muscles involved are the gluteus medius and gluteus maximus. Trendelenburg test was first described by Friedrich Trendelenburg in 1895 as a test for abductor muscle function.⁷

The Medical Research Council of Great Britain system is a method of manual muscle testing that has been in use since the early 1940's. It is simple to use and interpret using numbers between 0 and 5. This method of quantifying the strength of muscles has been used in several studies.⁸

Despite the increase in the number of total hip arthroplasties, much void in the literature needs to be filled in regard to how hip abductor strength is related to its function and which exercises yield the best functional outcome. Literature available in our country regarding the abductor strength post-operatively in patients of total hip arthroplasty is lacking. So, the aim

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of the current study was to investigate the hip abductor strength in patients undergoing total hip arthroplasty via lateral approach.

METHODOLOGY

It was a prospective cohort study conducted at the Department of Orthopedic Surgery, Services Hospital, Lahore after approval by the institutional ethical committee (Letter No. IRB/2020/468/SIMS, 04-01-2020) over a duration of 10 months from March to December 2020. Twenty female and eighteen male patients with unilateral primary or secondary osteoarthritis undergoing total hip arthroplasty were included in this study after written informed consent. Patients with bilateral hip osteoarthritis, previous surgery on the hip, previous hip fracture, hip dysplasia, diagnosis of congenital dislocation of the hip, Paget's disease, or rheumatoid were excluded from this study. Abductor strength of the patients was measured using the Medical Research Council Scale and Trendelenburg test pre-operatively & post-operatively. The surgery was performed by the two surgeons both using the lateral approach to minimize the bias of the technique. This approach involves splitting of the gluteus minimus and medius muscles following which these are retracted anteriorly and in continuity with the anterior portion of the vastus lateralis muscle. Standard physical therapy regime was started on the first post-operative day and continued daily until discharge at about 1 week after the surgery. Exercises carried out before the discharge by the physiotherapist included an active range of motion of hip, knee, and ankle, and functional activities. Patients were advised partial weight bearing with an assisted walking device for 6 months and weight bearing as tolerated following that. Upon discharge, the patients were given instructions regarding home exercises and were called for follow-up at 2 weekly intervals. The patients were assessed after 1, 4, and 24 weeks of surgery.

In our study we had one physiotherapist who performed Trendelenburg test to standardize our results. The patients were asked to perform one leg stance for 20 seconds. If the patient was unable to hold the one leg stance for 20 seconds, the test was deemed positive and negative if the patient held onto a single leg stance for more than 20 seconds. Measurement of abductor strength and Trendelenburg test was performed by the same physiotherapist with the patient in an erect position. This assessment was done at 1, 4, and 24 weeks post-operatively.

The Medical Research Council muscle strength scoring system consists of 5 scores (Table 1). This was measured pre-operatively and then post-operatively after 1, 4, and 24 weeks at follow-up.

STATISTICAL ANALYSIS

Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Paired t-test was used to assess the difference between mean abductor muscle strength pre-operatively & post-operatively after 1, 4, and 24 weeks. The results were considered statistically significant with a p-value ≤ 0.05 .

RESULTS

Out of the 38 patients selected, 20 were females and 18 were males. The mean age of patients was 71.96 ± 8.60 years, with a mean height of 1.69 ± 0.14 m and a mean weight of 77.05 ± 13.56 kg. The youngest patient was 54 years of age and the oldest was 88. Two patients were lost to the follow-up. Thus 36 patients were assessed up to the end of the study period. Patient demographics are tabulated in Table 2.

Pre-operatively, 24 patients tested positive and 14 tested negative for the Trendelenburg test on the involved side. The average muscle strength on the involved side pre-operatively was 3.67 ± 0.43 . There was a marked difference in the Trendelenburg test and muscle power pre-operatively on the normal side. One

Table 1: Medical Research Council Muscle Strength Scoring System

Score	Description
0	No contraction visible or palpable
1	Flicker of contraction visible or palpable, although no limb movement
2	Active movement with gravity eliminated with full range of motion
3	Active movement against gravity with full range of motion
4	Active movement against moderate resistance with a full range of motion
5	Normal power

Table 2: Descriptive Information of Patients

		Age (Years)	Height (m)	Weight (kg)	
Gender	Females (n=20)	66.80±7.78	1.65±0.07	78.40±11.45	
	Males (n=18)	77.11±8.60	1.73±0.08	75.56±10.75	
Mean±SD		38	71.96±8.60	1.69±0.14	77.05±13.56

Table 3: Trendelenburg Test and MRC Score of Study Subjects

Study Variables	Pre-operative	1-week Post-operative	4-week Post-operative	24-week Post-operative	Paired t-test statistics for Trendelenburg test & MRC score at 1 week and 24 weeks
Trendelenburg Test					
Positive	24	15	7	2	t=4.13 p-value=0.00
Negative	14	23	31	36	
MRC Score					
Mean±SD	3.67±0.43	4.21±0.41	4.53±0.51	4.95±0.23	t=-10.18 p-value=0.00
Minimum	3.00	4.00	4.00	4.00	
Maximum	4.00	5.00	5.00	5.00	

week post-operatively, 15 patients tested positive for the Trendelenburg test in contrast to 24 pre-operatively, 7 tested positive at 4 weeks and 3 tested positive at 24 weeks subsequently. Muscle power improved to 4.21±0.41 one week post-operatively in contrast to 3.67±0.43 pre-operatively, 4.53±0.51 at 4 weeks, and 4.95±0.23 at 24 weeks. This trend was seen in both males and females (Table 3).

DISCUSSION

Total hip arthroplasty is most commonly performed via the lateral Hardinge approach.⁹ This was also the approach used for this study as it is commonly performed in our unit. There were 20 female and 18 male patients and the mean age of the patients was 71.96±8.60 years. Other studies also reported that osteoarthritis occurs more commonly in females, and in patients aged above 60 years.¹⁰

Pre-operatively, we assessed the abductor muscle strength and Trendelenburg test of both the affected and the unaffected side. The abductor muscle strength on the unaffected side was 5 out of 5 according to the MRC

grading. This was mainly due to our selection of patients with unilateral hip osteoarthritis. This trend was seen in patients of all age groups. The affected side, however, revealed the mean abductor strength of 3.67±0.43 out of 5 pre-operatively. This was a result of pain in the affected hip due to osteoarthritis. Post-operatively the abductor strength was seen to be 4.21±0.41 out of 5 at the first week following the physiotherapy. This jumped to 4.53±0.51 out of 5 at 4 weeks and finally to 4.95±0.23 out of 5 at 24 weeks post-operatively. This was seen because the source of pain in the affected hip joint had been removed and the patients were better able to cope with abductor strengthening exercises as a result of which this improvement in abductor strength was observed post-operatively.

A systematic review and meta-analysis were conducted to evaluate abductor muscle strength deficit in patients having total hip arthroplasty. According to this review, the strength of abductor muscle is reduced as compared to the unaffected contralateral side but it is improved post-operatively after hip arthroplasty.¹¹

The results revealed 2 patients testing positive on the unaffected side and 36 testing negative. This was an unusual finding since both of these patients had abductor strength of 5 out of 5 on the unaffected side. This discrepancy may be explained by poor understanding of the patients of the test pre-operatively since the investigator was the same pre and post-operatively. The affected side pre-operatively showed the test to be positive in 24 patients and negative in 14. This was in correlation to the fact that 27 patients had abductor muscle strength of less than 5 pre-operatively. Post-operatively, as the abductor strength improved, the patients testing negative for the Trendelenburg also increased. At one week post-operatively 15 patients tested positive and 23 negative in contrast to 24 testing positive and 14 negative pre-operatively. Those patients testing positive went from 7 at 4 weeks and 3 at 24 weeks post-operatively whereas those testing negative went from 31 at 4 weeks and 35 at 24 weeks post-operatively. We found patients with total hip arthroplasty had improved abductor muscle strength following physiotherapy by 24 weeks post-operatively. None of the patients was limited by pain during muscle strengthening exercises. In another study, 88 patients who underwent total hip arthroplasty through lateral approach were included in the study. They assessed abductor strength and Trendelenburg test post-operatively and found improved Trendelenburg test result after surgery (p -value <0.001).¹²

In this study, we used the MRC method of grading the abductor muscle power. This system of grading does, however, have its limitations which can lead to bias in the result. Large joint motor muscles such as deltoid around the shoulder joint and hip abductors may recover enough strength against resistance but may not be able to provide the full range of motion against gravity. This can lead to confusion between grades three and four. Recent studies used devices such as Kin-Com isokinetic dynamometer to evaluate muscle strength and it reduces the limitations faced when using the MRC system. Measurement with such devices is not without limitations, in the performance and accuracy of measurement of muscle strength.¹³

Another prospective study measured the abductor muscle strength of patients after total hip arthroplasty by using 1 Repetition Maximum (1RM) test. The study showed marked improvement in the abductor muscle strength following total hip replacement using the lateral approach. Although abductor strength post-operatively using the direct anterior or posterior approach was higher than the abductor strength using a direct lateral approach, the abductor strength using direct lateral approach reached 100% at 6 weeks and 112% at 3 months of the pre-operative value.¹⁴ These findings are consistent with the results of our study.

Another study conducted by Tantithawornwat et al., reported that abductor muscle strength increased after total hip arthroplasty. It has no significant correlation with preoperative limb length discrepancy. Total hip arthroplasty is an effective modality to decrease pain & improve functional outcomes of the patients.¹⁵

CONCLUSION

Hip abductor strength improves markedly, following total hip arthroplasty using lateral approach provided timely rehabilitation is applied along with good patient compliance. Although multiple methods of measuring hip abductor muscle strength following total hip arthroplasty using lateral approach are available, the MRC method has proven to be a simpler yet effective method.

LIMITATIONS & RECOMMENDATIONS

The MRC system of grading does however have its limitations which can lead to bias in the result. Large joint motor muscles such as deltoid around the shoulder joint and hip abductors may recover enough strength against resistance but may not be able to provide the full range of motion against gravity. This can lead to confusion between grades three and four. Another limitation of the study is the need to standardize the pathologies leading to a decrease in hip abductor strength pre-operatively, as this can help us understand how already weakened abductor musculature of the hip due to underlying pathology can respond functionally following traumatizing lateral approach to the hip.

A larger sample size needs to be evaluated to further understand the functional outcome of abductors and to validate the efficacy of the MRC grading of muscle strength over newer devices used for measuring abductor strength.

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