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Abductor muscle weakness and the role of targeted physiotherapy in intertrochanteric fractures treated with PFN

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Abstract

Introduction: Intertrochanteric hip fractures are common with increasing age. Unstable intertrochanteric fractures are now commonly fixed using PFN, however it cannot engage greater trochanter on its own. Gluteus Medius and gluteus minimus (main abductors) attach to greater trochanter, hence abductor weakness is a likely consequence especially in comminuted fractures. In this study we measured the incidence of post-operative abductor weakness and result of targeted physiotherapy on it.

Materials and Methods: 135 patients with unstable intertrochanteric fractures underwent proximal femoral nailing at our hospital. The patients included in this study were more than 18 years of age with unstable fractures classified according to Modified Evans classification type 3, 4 and 5 with the duration of trauma less than 3 weeks. The functional assessment was made using Modified McKay criteria through analysis of abductor muscle strength. All patients underwent a pre-determined physiotherapy as per protocol.

Result: Immediate post-operative muscle power was Grade 1 (09 pt.), Grade 2 (39 pt.), Grade 3 (43 pt.) and Grade 4 (43 pt.). Most of the patient improved their muscle power grade at 12 weeks with only 09 patients with grade 2 and 23 patients with grade 3 power. At final months follow up only 08 patients had grade 3 power and only 6 patients had grade 4 power while the rest had muscle power grade 5. In our study excellent score was seen in 87 patients (83%), good in 12 patients (12%) and poor only 7 patients (5%) at 6 months, as per Modified McKay criteria.

Conclusion: Abductor weakness and Trendelenburg gait are surprisingly common in patients treated with PFN and this complaint is often overlooked. Correct surgical method and targeted physiotherapy can help alleviate this problem.

Keywords: Intertrochanteric fractures, proximal femoral nail, abductor muscle weakness

Introduction

In the hip, intertrochanteric fractures constitute approximately half of the fractures, with more than 50% of them being of unstable variety [1]. In this region, injury creates a spectrum of fractures especially to the proximal femoral metaphysis, with damage to the intersecting cancellous composite and lamellar networks. This results in displacement of the fracture fragments, hence affects the origin/insertion of muscle groups and alters the biomechanics of the hip joint [2].

Abductor musculature of the hip joint includes the gluteus medius, gluteus minimus (which attach to the tip of GT), and the tensor fascia lata (also an important abductor runs across the hip on the lateral aspect). These muscles acting on a lever arm, extend from lateral aspect of femoral head, must exert an equal moment to hold the pelvis level in a one legged stance and greater moment to tilt the pelvis while walking [3]. The longer the abductor lever (i.e., the more laterally placed insertion of the abductors), the less the ratio between the levers, the less the abduction force required to maintain balance, and the less the joint reaction force on the femoral head [4].

Intertrochanteric fractures are of high interest globally as they are the most frequently operated fractures, have the highest post-operative fatality rate among surgically treated fractures and are a serious health resource issue as well due to high cost of care required after injury,

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the reason is primarily related to poor recovery of functional independence after conventional fracture care [5].

It is important to know that the residual life time risk of proximal femoral fracture from age of 60 is 44% for women and 25% for men [6]; 30% of the patients die [7], 50% of survivors need assistance in walking and 90% need assistance to climb stairs after 1 year [8, 9].

One of the most common outcomes in hip fractures is mobility limitation due to deficits of lower limb muscular strength [10]. Studies in elderly adults have demonstrated that the muscle strength deficit is extremely large after Intertrochanteric fractures without good rehabilitation [11].

Looking at the poor functional outcome after hip fractures, the lack of targeted physiotherapy, the need to probably alter surgical techniques and the fact that very less research has been done on this complication, the authors felt compelled to study abductor muscle weakness in intertrochanteric fractures and the results of targeted physiotherapy on it.

Materials and Methods

This study on 135 patients was conducted between 2017 and 2018 in the Department of Orthopedics. All intertrochanteric fractures were treated with proximal femoral nail. A total of 106 cases were included in the study.

Inclusion Criteria

1. Unstable IT fractures – Modified Evan’s type 3, 4, 5
2. Age above 18 years
3. Duration of injury less than 3 weeks

Exclusion Criteria

1. IT fracture with sub trochanteric extension
2. Pathological fractures
3. Open fractures
4. Patients unable to bear weight on the same limb prior to injury
5. other associated fractures which would interfere with rehabilitation.

Physiotherapy Protocol

The early mobilization of hip and knee joint is one of the main advantages of fractures treated by internal fixation is

- Deep breathing manoeuvres to prevent chest infection
- Vigorous ankle and foot movements with static quadriceps and hamstring exercises
- Isometric exercises of the glutei are important and should be done to the maximum possible limit
- Isometric exercises for hip and knee extensors and

abductors should be started at the earliest

- Pressing the leg down on a pillow is a good exercise for isometric contraction of extensors of hip
- Isometric exercises for abductors are taught to the patient attenders and patient resists the effort to abduct the limb
- Assisted SLR started as soon as patient was comfortable

After suture removal or 7 days:

- Relaxed passive mobilization by physiotherapist started.
- Use CPM(Continuous Passive Motion Machine whenever available to gain maximum passive movements
- Progressive assisted range of movements by self dragging of heel to hip done
- Assisted abduction started by sling support and or putting sound leg under the affected leg

All patients underwent 30mins of rigorous physiotherapy from day 1 and were discharged after day 7. On day 1 patient was started with closed chain exercises for quadriceps strengthening and straight leg raising. Day 2 onwards patient was made to sit on the bed and extend and flex knee joint first with support and then without. Open chain exercises were started after one week.

Patients were advised non weight bearing for 3 weeks followed by touch toe weight bearing for 3-6 weeks, partial weight bearing for 6-8 weeks and full weight bearing after 8 weeks.

The functionality was assessed by abductor muscle strength analysis and specific physiotherapy aimed at restoring abductor muscle power. The abductor muscle strength was evaluated at 6 week, 3 month, 6 month and finally after union using Modified Mckay criteria.

3. Observations and Results

Immediate post-operative muscle power was Grade 1-nine patients, Grade 2-thirty nine patients, Grade 3-forty three patients and Grade 4-fifteen patients, calculated as per the MRC criteria. Patients underwent the dedicated physiotherapy protocol and as seen in [Table 1], most of the patients, improved their muscle power grade at twelve weeks with only nine patients with grade 2 and twenty-three patients with grade 3 power. At final months follow up, only eight patients had grade 3 power and only six patients had grade 4 power (due to varus malunion) while rest all had muscle power grade 5.

In our study, Modified Mckay criteria showed excellent score in eighty seven patients (83%), good in twelve patients (12%) and poor only seven patients (5%) at 6 months. [Table 2]

Table 1: Abductor muscle strength at respective follow ups (per MRC criteria)

Grade Time	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
3 weeks	4	26	66	10	0
6 weeks	3	13	45	37	8
12 weeks	3	9	27	39	28
6 months	3	4	13	30	56
Final followup	3	3	8	6	86

Table 2: Modified Mckay Criteria at final follow up for functional assessment

Evans Classification	Excellent	Good	Fair	Poor	Total
Type 01	14	0	0	0	14
Type 02	21	2	0	0	23
Type 03	20	5	0	0	25
Type 04	24	3	0	2	29
Type 05	6	2	3	4	15
Total	85	12	3	6	106

Discussion

The lifespan of our population has increased globally in the recent decades. The sheer increase in age has led to an increase in the number of osteoporotic population and this has led to an increase in the amount of trauma^[13]. These fractures are the main cause of disability, functional impairment and death in elderly people^[14].

It is important to note that in proximal femoral fractures managed conservatively, particularly in IT fractures, less than half of the individuals regain the same level of physical function, that they exhibited before the fracture^[15]. Morbidity is very common and can be partially related to the lack of strength and muscle power. The fractured leg can be 20% weaker than non fractured leg between 3-36 months^[16]. This clearly emphasizes the importance of early mobilization and physiotherapy in surgically fixed intertrochanteric fracture.

PFN has both advantages and disadvantages which has been widely studied^[17]. However one of these complications is the abductor muscle weakness which has not been dealt with in much detail. It is established that abductor muscle weakness can occur due to many reasons such as mal-union, excessive collapse, wrong entry site and degree of comminution of greater trochanter^[18].

It is interesting to note that varus malunion brings about a change in biomechanics of the hip joint, decreases the abductor moment which will result in an abductor lurch^[19]. Similarly if the entry site is through piriformis fossa it may disturb the abductor musculature^[20]. Rudy Rendle *et al* found that those implants that require excessive reaming of the greater trochanter to proximal aspect of implant may cause abductor muscle wasting and Trendelenburg gait (10). Many studies have been done in which the PFN has been reinforced with GT fixation devices. This is the proof enough that abductor muscle weakness is a known complication of IT fracture and there is a need to study the effect of physiotherapy on it^[22].

In our study excellent score was observed in eighty seven patients (83%), good in twelve patients (12%) and poor only seven patients (5%), as per Modified Mckay criteria, at six months follow-up. These results are comparable to a study done by Wale *et al* who had similar results^[22]. In our study we found that two patients (4.4%) had initial abductor power grade 1, twenty nine patients (64.4%) had grade 2 power and rest had grade 3 muscle power. All patient regained grade 5 power at six months except two patient (grade 4 power) who had varus mal union. This is consistent with the observational studies done by N Ivanova *et al.*^[23]

In immediate post-operative period modified Mckays criteria is useful to assess the abductor weakness and should be routinely used

Strengthening exercises are the key to the functional improvement of patients along with gait or ADL training or proprioception and others like motor stimulation apparatuses and analgesia. Limitations of mobility are quite common and are partially related to the lack of strength and muscle power^[24]. The goal of physical therapy in postoperative treatment of patients with a proximal femoral fracture should be to increase muscle strength, and to improve ambulation and efficiency, thus enabling the elderly patient to become independent.

Most of the available implants like DHS and PFN do not fix greater trochanter. Some implants like Trochanteric Stabilization plate (TSP) and Tension Band Wiring of greater trochanter are used to fix greater trochanter but many a times it is so comminuted that these devices seldom help. Most of

the patients often describe a limp in their gait, which is often overlooked by the surgeon, or the lurch is so mild that it may go unnoticed and becomes apparent only on close observation. Each patient should receive individualized physiotherapy as some individuals may not tolerate certain exercises which may lead to variations in time to regain full abductor strength.

Conclusion

Abductor weakness and Trendelenburg gait are quite common in patients treated with PFN and this complaint is often overlooked. Proper assessment of abductor muscle power should be performed post-operatively and physiotherapy for abductor weakness is essential for complete rehabilitation of patients.

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