Eccentric Quadriceps Training In Post Operative Fracture Patella To Achieve Normal Gait Cycle

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ABSTRACT

To know the effect of Eccentric quadriceps training in post-operative fracture patella for achieving normal gait cycle in selected patients, in the Department of Physio Occupational Therapy unit Under Department of Orthopaedics. Under inclusion criteria patients were selected those who are facing difficulties during ambulation. The Rancho Los Amigos, OGA (Observational Gait Analysis) method is selected for each pattern of body segment use in gait cycle.

The Biomechanical gait assessment in complete gait cycle is important to analyse gait pattern. In this study focus on knee joint specially during stance phase in which heel strike to foot flat later on foot flat to mid stance where quadriceps muscle action takes place eccentrically in 0-15o and 15- 5o. knee extension respectively.

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INTRODUCTION:
Patella is triangular and largest sesamoid bone, having dimension 4-4.5 cm in Length, 5-5.5 cm in width, 2-2.5 cm in thick \(^{(1)}\). Functionally it works an anatomically pulley for quadriceps muscle. Patella fracture is just 1% of fractures out of all fractures in the body \(^{(2)}\). Such fractures managed conservatively as well as operatively. Dynamically the contractile structure of the quadriceps pes anserine muscle group and biceps femoris muscle helps to maintain patellar alignment. The important of the vastus medialis oblique (VMO) has been discussed extensively in the literature. The VMO attaches to the mid portion of patella, the medial patello femoral ligament (MPFL) and adductor magnus tendon. Its more oblique alignment (as compared to the vastus medialis longus) provides mechanical advantage to promote medial stabilisation force to the patella. The vastus intermedius inserts posteriorly at the base of patella. The vastus lateralis provides lateral dynamic reinforcement in conjunction with the Iliotibial band (ITB) and the superficially oblique retinaculum. Tightness in the ITB can cause the patella to glide and tilt laterally. Inferiorly the patella is secured via the patellar tendon and its attachment to the tibial tubercle \(^{(3)}\).

In this study utilization of quadriceps muscle in eccentric type of strengthening programme in which total length of muscle increases a tension is produced, in short it is a lengthening contraction under which require fewer recruitment of motor unit than concentric muscle contraction to control load of joint \(^{(4)}\).

In Post immobilization period, routine rehabilitation process under which knee range of motion (ROM), strengthening of hamstring and quadriceps muscle, ankle toe mobilization in initial stages, strait leg raising (SLR), and finally a routine gait training. One important missing part would like to mention is normal gait cycle. Despite of good surgery as well as routine rehabilitation protocol, unable to achieve normal gait pattern of walking hence we plan this study, the eccentric quadriceps training programme which plays vital role to minimise locomotor disability in this study.

MATERIALS AND METHODS:
Work undertaken in Physio-occupational therapy unit under the department of orthopedics at our hospital. Total 10 no participants evaluated and managed through this technique. Material required for this procedure 8 inches height stool with 12 x 12 inches top, Tripod stick, Mirror with parallel bar. Activity like eccentric training programme for affected side carried out by asking patient to keep unaffected limb on 8 inches heightened stool with the help of tripod stick and stay there for 10 sec. simultaneously ask to lunch (bend) affected limb 10 to 15° flexion and go back to original position for period of 10 repetition with 15 sec. rest for next cycle , all this programme carried out for 5 minutes twice in a day followed by gait training in front of mirror with the help of parallel bar initially (As shown in fig. no.1 and fig no.2)

**Fig no.1 Using stool and Tripod stick**
**INCLUSION CRITERIA:**

1) Fracture patella operated by Tension Band Wiring (TBW) or circumferential cerclage wire fixation in transvers patella fracture.
2) Close fracture patella
3) Knee range of motion 60° to 90°.
4) Quadriceps muscle power grade 2 onwards
5) No extensor mechanism rupture

**EXCLUSION CRITERIA:**

1) Another associate fracture of lower limb Ipsilateral.
2) Infection around knee joint
3) Neurological deficit
4) Patella Alta or baja.

**PHYSICAL EXAMINATION:**

Above evaluation done after 2 ½ months post operatively. By using OGA gait analysis method all the patients were using gait pattern of hyperextension knee with excessive trunk flexion. (as shown in fig. no. 3) also to check no pain and tenderness around the knee joint, pain free knee flexion, Quadriceps muscle power, Gait analysis by using scale of Rancho Los Amigos Observational Gait Analysis (OMG) method. In the present following study total 10 participants fulfilling inclusion and exclusion criteria were selected. These were evaluated for the functional outcome total duration of 3 months with regular interval of follow up every 15 days.
RESULTS:

Age wise Distribution;
In total participants majority of patients were belonging to 45-55 years age group. Followed by 35-44 years age group and ≥ 65 years of age group.

<table>
<thead>
<tr>
<th>Age Group (yrs.)</th>
<th>No of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-55</td>
<td>6</td>
<td>60%</td>
</tr>
<tr>
<td>35-44</td>
<td>3</td>
<td>30%</td>
</tr>
<tr>
<td>≥ 65</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100%</td>
</tr>
</tbody>
</table>

Gender wise distribution

<table>
<thead>
<tr>
<th>Gender</th>
<th>No of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>06</td>
<td>60%</td>
</tr>
<tr>
<td>Female</td>
<td>04</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100%</td>
</tr>
</tbody>
</table>

Knee stance phase gait through observational gait analysis
Heel strike to foot flat of participants before and after training. Here examination of knee joint done in plane to observe knee flexion 0-15°. During stance phase whereas before training exercise planter flexion at ankle and forward trunk bending observed in few participants.

<table>
<thead>
<tr>
<th>Training</th>
<th>Flexion 0-15</th>
<th>Plantar flexion + forward trunk bending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>After</td>
<td>07</td>
<td>03</td>
</tr>
</tbody>
</table>

Foot flat through mid-stance total 10 participants observed this stage of gait before as well as after training in this phase extension of knee 15-5° observed.

<table>
<thead>
<tr>
<th>Training</th>
<th>Extension 15-5</th>
<th>No flexion at knee joint (Hyperextension gait)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>After</td>
<td>07</td>
<td>03</td>
</tr>
</tbody>
</table>
In above mention observation 3 participant were not able to achieve normal gait cycle out of which two were had hardware prominence(As shown in Fig no. 3) and one had patella femoral arthritis.

**Fig No. 3 Hardware Prominence**

In this follow up study eccentric quadriceps training programme achieved normal gait cycle during heel strike to mid stance phase through foot flat. As per Rancho los amigos, observational gait analysis system.

**DISCUSSION:**
Most resistance training programme involve a combination of eccentric and concentric exercise at various speed and with the patient or body segment in various position. Both concentric and eccentric exercise has distinct value. There use depends on strength capacity of muscle and functional need of the patient. Opinion and results of studies vary on whether or not the effect of training with concentric and eccentric contractions in the exercised muscle group are, mode specific. Although there is substantial evidence to support specificity of training (6). There is also some evidence to suggest that training in one mode leads to strength gain, although less significant, in the other mode. Because transfer of training is quite limited, selection of exercise that stimulate the functional movement needed by a patient is a prudent choice. In addition, because many functional activities require both concentric and eccentric strength, power and muscle endurance, incorporating concentric and eccentric training in the rehabilitation progression is advisable (7).

Relationship of patella and quadriceps muscle is very crucial during rehabilitation process it should have normal alignment of patella into trochlea. Patella glide inferior with knee flexion & superior with knee extension. Here patella femoral joint reaction force (PFJRF) varies during different activity, studies has demonstrated forces of 1.3 times body weight (BW) during ambulation, 3.3 times BW during stair case ambulation, 5.6 times BW during running and up to 7.8 times BW (8) during full knee bend or squat.

Intention of eccentric training programme for achieving normal gait pattern should carry out in a comfortable zone in relation to Biomechanics of quadriceps muscle action. But eccentric quadriceps training protocol to be start after 2 to 2 ½ month postoperatively. Here found visual analog scale (VAS) should be between 1-3 not only considering pain factor but due to loss of kinaesthetic as well as proprioception sensation matters, to get normal gait cycle in fracture patella.

The above mention protocol done for the period of 15 to 20 days in the department. Gait was evaluated through observational gait analysis (OGA) of Rancho los amigo scale. The pathological gait of
The patient was totally corrected now patient able to walk normal stance phase of total gait cycle, where utilizing quadriceps muscle to lock the joint. No hyperextension of knee as well as excessive trunk flexion seen. Due to number of repetition during eccentric quadriceps strengthening protocol helps to improve kinaesthetic as well as proprioception sensation which reflect in to normal gait cycle.

CONCLUSION:
Eccentric training programme of quadriceps muscle helps to improve gait cycle in post-operative fracture patella. In routing rehabilitation programme we are achieving Range of Motion, muscle power, abnormal gait here focus to achieve normal gait cycle which leads to reduce embarrassment during walking improve confidence in walking, minimising loss of disability. A little effort by modifying re-habitation programme going to give maximum to improve walking pattern.

LIMITATION OF STUDY:
Further study with increase number of sample size is required.

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