

Impact of Proprioceptive Exercises Post ACL – Reconstructive Surgery

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Abstract- An increasing prevalence of injury to the knee joint leading to ACL reconstruction surgery (ACL-R) a common procedure getting done. Irrespective of the ages, rehabilitation post ACL-R needs more focus for early functional return of the subjects. **Aims and objective** of this original research report was to analyse proprioceptive exercises among ACL-R, impact of exercises on obesity, and their combined effects on womac score in 1 year follow up. **Materials and Methods:** 5 subjects with mean age of 34 years of both sex who had ACL-R with mean BMI of 42 kg/m² were treated with proprioceptive exercises and weight reduction exercises in a one year follow-up from 2015-2016, with weekly twice frequency at Chennai. **Results:** pre and post womac score $p < .01$ and BMI $p < .05$ were analysed statistically and recorded. **Conclusion:** Than regular exercises among post ACL-R, subject, focus on obesity, angular correction exercises, core strengthening, graft specific exercises along with continued follow-up are key focus of this monograph presentation.

Index Terms- ACL – R – Anterior Cruciate Ligament Reconstruction, BMI, Womac Score

I. INTRODUCTION

Anterior Cruciate Ligament (ACL) is a anterior stabilizer of knee, restricting anterior tibial translation and rotational forces at the tibio femoral joint

Injury:

ACL deficiency results in pain increased instability and altered function (Heringston et al 2006). ACL injury is the most common injuries of knee joint and accounts for 50% of total injuries occur in knee joint (Allan et al 2013)

Prevalence:

In New Zealand 80% of all knee LG injured (ACL –R) Anterior Cruciate Ligament Reconstruction (Gianotti 2009) more than 2,50,000 ACL injuries occur yearly in US (Chapman et al 2001) and more than 50% of them under goes ACL - R(AAOS 2007)

Economy with ACL – R

- With an average cost of an ACL – R surgery is \$10, 32 US dollars in 2011 (Lubowitz & Appleby 2011). Total costs including diagnosis, surgical reconstruction and post operative rehabilitation of ACL injuries accounts to 13 billions in united states annually (Brophy et al 2009)

- ACL – R life time cost for a patient was \$38, 121 and \$7.6 million annually in US who were projected to develop radiographic osteoarthritis life time, would need total knee replacement (TKR) (Scott et al 2000)
- Wright et al 2012 have in a systematic review post ACL –R reported with increasing health care cost, increased psychological distress and re injury

Keywords:

ACL – R: Anterior Cruciate Ligament Reconstructive Surgery, ACL, Womac Score, TKR, CKC – Closed Kinematic Exercise Proprioception, BPTB, EMG, QOL

Role and Need for Surgery in ACL Injury :

- ACL –R may aid patients in regaining proper joint kinematics, minimising poor joint kinematics are abnormal stresses that could occur with ACL – D (Losina et al 2009)
- ACL – R surgery is aimed at restoring joint stability, minimizing further damage to the menisci and articular cartilage (Gold Blatt et al 2005) and (Lynch et al 2013)
- Have identified criterions such as absence of giving way, absence of joint effusion symmetry of quadriceps strength, patient reported outcomes, return to sports, as successful outcome of the post ACL –R surgery.
- A Cochrane review by smith et al 2014 analysed ACL injured subjects with ACLR and conservatively managed with exercises, recorded no difference with regard to knee function, health status and return to pre injury level.

Aims & Objective of this monograph was to analyse Proprioceptive exercises on obesity and womac among post ACL- R subjects

II. MATERIALS & METHODOLOGY

5 subjects with mean age of 3 who underwent ACL-R following RTA were included in this research in a one year follow up study. Their mean BMI was 42 Kg/m² all the subjects were regularly treated with weekly twice frequency at Chennai where this study was conducted during the period of Feb 2016 to march 2017 with good adherence for exercises, all the subjects have continued their daily routine activities.

All the subjects were treated by the author from the first .Post operative day of surgery, but PTB grafts were used on 3 subjects and hamstring Grafts on 2 subjects.

Key emphasis on closed kinematic, proprioceptive exercises using air inflated, physioball, other weight bearing

means such as wobble board were used. Also core strengthening and resisted means of exercises to contra-lateral limb were used. A set of 5 specific proprioceptive exercises in various positions such as supine, sitting and standing were used, progression was done with increasing repetition and duration with isometric holds.

Also 5 core strengthening exercises using physioball were, where progression was done with more repetitions.

1. No undue pain were recorded with session but the subjects reported knee laxity with exertional activities such as long standing, prolonged sitting with travelling on both knee.
2. Also few articular changes such as crepitus and pain on movements with mild joint effusion was recorded
3. An interesting feature is with an quadriceps wasting of mean 2 cm but hypertrophy of gastrocnemius with 3 cm were recorded
4. Getting rid of brace usage post operatively depends on confidence pain, level of activities and strength of quadriceps post ACL-R was noted among participants

III. RESULTS

Table of results of all the subjects post ACL-R with womac score and BMI using paired t test:

MEAN	SD	SE	T	P
WOMAC SCORE				
PRE	8.95	3.99	8.52	0.01 XX
POST				
BMI PRE	2.19	.97	3.50	0.05
POST				

Note: X - Statistically Significant, XX - Highly Significant

IV. DISCUSSION

Rehabilitation of ACL:

- Strengthening of quadriceps and gastrocnemius are of greater important instead of hamstrings post ACL – R rehabilitation (Kvist and Gillquist 2001)
- Closed Kinematic Chain (CKC) exercises were widely used in the knee rehabilitation as they stimulate functional activities and similar daily activities (Heijne etal 2004) and increase tibiofemoral joint compression and emphasize co contraction between hamstring and quadriceps muscle, thus stabilizing the joint and minimize strain on the healing ACL (Escamila etal 1998)
- Also CKC exercises helps to correct neuro muscular imbalances for optimal biomechanics and reduction of knee injuries (Ford etal 2003)

Role of Proprioceptive Exercises in Post ACL – R:

- Proprioceptive deficits have been found beyond 1 year post ACL –R (Decker etal 2002) and proprioceptive exercises have been shown to enhance strength gains in the quadriceps and hamstring muscles post ACL –R (Zalter Storm 2000)
- Proprioceptive input and neuromuscular control are to be attended post ACL injury (Wojtys & Huston 1994) and proprioceptive exercises produces compensatory muscle activation patterns in the neuro muscular system that assist with joint stability (Cooper etal 2005)
- High intensity electrical stimulation to improve quadriceps strength and gait parameters were reported by many studies (Fitzgerald etal 2003)
- Evidence appears with contractile activity improved if this can be done during weight bearing, in an upright position, once the patient can tolerance placing the limb in a dependant position with at minimum partial weight bearing (Baratta etal 1988)
- With CKC position, decreased stress placed on the graft tissue as compressive forecast the tibiofemoral joint and co contraction of muscles surrounding the knee help control excessive motion at all joints in the closed chain (Oh Kohi etal 1991)
- If the patient has difficulty in performing supine knee extension, they can perform in prone position with hip extensor aiding achievement of full extension (Weber etal 2004)
- Hamstring activity is needed as they are synergistic to ACL, strengthening of the hamstring muscles may provide a primary dynamic restraint to anterior tibial translation (Gross etal 1993)
- Closed kinematic chain squats on a stable surface between 4-6 weeks post ACL – R, where knee flexed at 25⁰- 30⁰ and maintain that position as it will produce a co contraction of the hamstrings and quadriceps (Wilk etal 1996)
- Fitzgard etal 2000 have examined proprioceptive training in ACL deficient patients and recorded decreased frequency of giving way episodes following their ACL injury.
- Between 6 weeks to 3 months, where auto graft reaching nits weakest point structurally (Bulter etal 1989) as controlled loading will enhance ligament and tendon healing, while excessive stress loading to an ACL graft may cause graft elongation leading to excessive un wanted anterior posterior laxity (Beynnon eta 1994)
- Post ACL –R between 3 months period core trunk training and stability to maintain. Center of mass, balance and postural control, hence exercises for the trunk and hips are more desired (Myer etal 2008). Which can consists of sit-ups, bridging exercises, single leg bridges, straight leg dead lifts and planks (Hewett etal 2005) core exercises were part of this subjects therapy regime as supported by the above studies

Surgical Techniques and Exercises:

- Patellofemoral complications are common especially following with patella tendon grafts (Sachs et al 1989) Tyler et al 2007 among 49 patients following Bone Patella Tendon – Bone (BPTB) – R with immediate weight bearing, have recorded decreased anterior knee and increased vastus medialis activity with EMG (Electrotherapy) but no difference in range of motion and articular cartilage among weight bearing group
- In BPTB- R as the extensor mechanism has undergone significant insult in the harvesting process, so early motor control with an active quadriceps contraction pulls tension through the patellar tendon, minimising the potential for entrapping scar tissue. Also it additionally squeezes scar tissue of the anterior knee helping to decrease swelling (Shelbourne 1990)
- **Hamstring Auto Graft** when used, maximal isometric exercises in 4-6 weeks period can be useful. The ACL mechano receptor reflex arc to the hamstrings may cause a loss of proprioception, as a latency of the hamstrings is almost twice that of the normal contra lateral uninjured knee (Lutz et al 1990) as at this time enough soft tissue healing of the hamstrings should allow tolerance to perform gentle hamstring, gastrocnemius and soleus flexibility exercises.

Procedures and Exercises:

- ACLR with a hamstring tendon graft has demonstrated better self reported function and decreased anterior knee pain when compared with a patellar tendon graft (Wipfler et al 2011)
- Frobell et al 2013 have demonstrated with patella tendon graft, have significant increase in patella femoral arthritis, not tibio femoral, when compared to hamstring graft.

Complications Post ACL – R

- Brittney et al 2014 have recorded that 44% of subjects who underwent developed osteoarthritis knee
- Oiestad et al 2009 in a 10 years follow up among ACL tear subjects reported the risk of developing arthritis was 13%
- As displayed in results table with reduction in BMI which statistically proven $P < .05$, hence complications post ACL – R, were less among this study subjects
- Barnius of osteoarthritis in a 14 year follow up post ACL –R prevalence of osteoarthritis in a 14 year follow up post ACL –R and increased knee laxity leading to meniscal chondral lesions (Loger Stedt et al 2010)
- Palmieri et al 2008 have in a systematic review post ACL –R recorded 20% subjects with quadriceps strength deficit with 2 year follow up and Øiestad et al 2009 link this to lower neural drive.

Quality of Life:

- As QOL and psychological health of the injured individual are often much lower than that of an uninjured individual (Schweer et al 2006) also major knee injuries like ACL can directly affect the ability to participate in sports, daily activities and employment

requirements (Lee et al 2008). An improved WOMAC score of this subject treated with Proprioceptive as main tool have improved functional mean as shown in table of results

Critical Analysis of the Topic:

1. Knee exercises alone sufficient post ACL – Right?
Total leg strengthening exercises of the operated knee as well trunk, contra lateral leg are important for better rehabilitation outcome from day one of Post ACL – R, are highly recommended

2. Does regular follow up favours functional outcome?
As reported 25% of patients post ACL – Right suffer a second tear in 10 years. Altered neuromuscular control of hip and knee during a dynamic landing task and postural stability deficits after ACL – R are predictors for second injury decreased muscular strength, joint position sense, postural stability are reported in 6 months – 2 years following post ACL – Right, hence regular therapy favours better functional outcomes is evident.

3. Other than Proprioceptive (Closed kinematic chain exercises) what specific exercises can be beneficial post ACL – R

Evidence suggests Cryotherapy post arthroscopic surgery decreases pain and disinhibition effect on the quadriceps muscle. Electrical stimulation to quadriceps core strengthening exercises (Hewett et al 2005) in a 6 week plyometric have recorded an increase in strength and function post ACL – R

4. Any muscles to focus specifically post ACL – R?
While quadriceps muscle strengthening is key post ACL – R, Hamstring, Gastrocnemius also to be strengthened. Also Vastus medialis of the operated knee to be given more attention

5. Major factors influencing post ACL – R rehabilitation?
Obesity, strength of quadriceps, type of grafts used, proper rehabilitation injury to associated structures of knee such as meniscus, medical LG, age of the subject, cost involved, type of exercises adopted all of which influences on the prognosis post ACL – R

6. Is Proprioceptive exercises alone enough?
Through Proprioceptive exercises are key area to be focussed in post ACL – R, other exercises to mobilise knee joint, strengthening of various muscles in different angles in line with the protocol, core strengthening and resisted means of exercises to contra lateral leg have to be added along with Proprioceptive exercises for good functional Proprioceptive clinical result

7. Range of motion of knee how much to expect and what are the factors influencing?

Pre operative loss of knee extension (In comparison to Contra lateral Knee) were likely to have limited knee extension after surgery but the good of knee flexion is 90° at week one and by 4th week 120° post ACL – R (Maske et al 2012) but combined with meniscectomy or medical LG repair influences post ACL – R range of motion of knee.

8. Is there chances of (Other) contra lateral knee getting affected post ACL – R?

With neuromuscular imbalances post ACL – R, contra level knee and ipsilateral lumbar spine, hip ankle, will undergo altered

biomechanical changes as inferred by Ford et al 2003. Also with an abnormal alignment with varus or varus deformity along with obesity can cause further degenerative changes of the contralateral uninjured knee hip and lumbar spine.

9. Quadriceps deficit mainly Vastus Medialis weakness persists?

Many studies evidenced quadriceps deficit mainly Vastus medial's in post ACL – R subjects even 2 years post surgery mainly in post BPTB graft is used

10. Changes in articular cartilage occurs?

Effects of early weight bearing post ACL – R, on articular cartilage is known, but altered biomechanics with decreased muscle strength, lack of range of motion, decreased joint position sense, abnormal leg alignment, neuromuscular deficit post ACL – R can lead to articular cartilage degenerative changes is evident

Critical Appraisal of this Presentation:

1. Further studies where larger sample with long-term follow-up post ACL – R are recommended along with analysing quality of life parameters
2. Limitations of this study includes smaller sample size, isolated Proprioceptive exercises were not experimented in this study no such parent study was available and should not be detrimental to the subject hence such effort was not made, however more focus on Proprioceptive means were given among the selection of exercises
3. No qualitative parameters such as NMRI, were used in this study to validate the results
4. Also reduction in BMI should be sustainable to correlate functional improvement of womac
5. Sample of population represents one metro city of India and multi centre trial with the same topic are recommended further.

V. EXECUTIVE SUMMARY

Post injury to knee joint resulting in ACL lesion are getting common also its management with ACL-R. This original monograph mainly focus on impact of proprioceptive exercises among post ACL-R subjects, proprioception exercises not only prevent damage to grafts but facilitates joint stability with co-contraction, which is similar to many daily activities with 5 subjects treated with proprioceptive exercises as major component along with core strengthening and strengthening of lateral limb post ACL-R in a one year follow up this research report strives to analyse the role of proprioceptive exercises in the rehabilitation of post ACL-R patients. Also obesity and womac score were evaluated with due statistical means. Critical analysis on the effect of core exercises, contra-lateral limb exercises, graft specific exercises were analysed, with strong conclusion on emphasis of patient specific, graft specific exercises and long term follow-up required among post ACL-R for sustained benefits and prevention of complications associated with it were presented in this monograph.

VI. CONCLUSION

As evidenced with various complications associated with post ACL-R, care should be taken while choosing exercises for example keeping an eye on obesity holds a key for better recovery. Also continued follow up for knee laxity, quadriceps strength and regular check on contra-lateral knee and lumbar spine are highly recommended with altered biomechanics. The role of physiotherapist gets highlighted with increases prevalence of ACL injury and subsequent ACL-R, hence pattern of prognosis should be patient centric and functional based one are the major outcome of this original monograph presentation.

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