Metanalysis of Qualitative and Quantitative improvement in Active Rehabilitation of Post ACL Repair or Reconstruction

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Abstract

Background: Physiotherapy regimen is important in both Pre-Surgery and Post-Surgery phases. However, Despite its widespread knowledge of importance of physiotherapy in both pre and post operation phases and during conventional therapy, the efficacy of early active intervention of physiotherapy in post-operative ACL repair/reconstruction is limited on the basis of quantitative and qualitative analysis.

Purpose: The aim of this meta-analysis was to analyze the randomized controlled trials having quantitative and qualitative improvement in parameters after active rehabilitation in subjects with post-repair/ reconstruction of Anterior Cruciate Ligament.

Methods: The authors searched Google Scholar and PubMed from 2014 to 2019. Only downloadable randomized controlled trials were included in the study.

Main results: Twelve trials were included in the study with. The schedule of treatments varied greatly from certain days to 6 weeks or even follow up of 12 weeks. Subgroup analysis performed on Qualitative and quantitative assessment of pre-operative and post-operative active physiotherapy regimen showed significant statistical difference.

Conclusion: The result of the present study shows strong evidence to support the active physiotherapeutic treatment pre-operative as well as post-operative in subjects with ACL repair/reconstruction, which helps in improving both qualitative and quantitative parameters.

Key words: *Meta-analysis, Qualitative, Quantitative parameters, Active rehabilitation, ACL repair, reconstruction*

Introduction

Anterior Cruciate Ligament injury is common in knee joint injuries. Maximum injury of ACL occurs at sudden twisting and turning of flexed knee at the range 30 degrees.[1] According to grading system given by Hopkin's[2] Usually grade III: is opted for surgical reconstruction and grade I and II: for repair/conservative management.[3]

Most of the musculoskeletal operations require both pre- and post- Physiotherapy regimen. Pre-operative physiotherapy regimen helps in easy future rehabilitation of the subject as the surgery causes definite reduction of the strength within the local muscles. [4] Post-operative physiotherapy regimen helps in increasing the strength as well as range of motion, reducing pain, early recouping of the daily activities, and functionally improving the subject. [5] Various recent therapies used during Physiotherapy pre-operative and post-operative regimen which are known to be significant are; Whole body vibration, cross education, eccentric cycling, Delaware-Oslo, MOON, FES, Jump training with Body weight support. [6-17]

There are very few randomised controlled trials defining both the qualitative and quantitative improvement in post-operative ACL. Further, information about qualitative and quantitative assessment of the change in parameters with active rehabilitation of ACL post-repair/ reconstruction is limited. Hence it is necessary to know the improvement both qualitatively and quantitatively in cases with post-ACL repair/reconstruction after active rehabilitation. Hence this meta analysis is undertaken.

Method

Literature Search:

The reviewer searched the following computerized bibliographic English language databases: Google Scholar and PubMed from 2014 to 2019. The highly sensitive Cochrane collaboration strategy was used which targeted only randomized controlled trails.

Literature selection:

Studies were included if they met inclusion criteria and excluded if they didn't. Inclusion criteria: 1) Randomised Controlled trial of Physiotherapy following post-ACL reconstruction/repair, 2) RCT's having Immediate physiotherapy referral, 3) RCT's having Active physiotherapy intervention, 4) RCT's having EMG analysis of quadriceps, hamstring, gastrocnemius (any or all of the muscles) or any other qualitative analysis, 5) RCT's having any one of the disability scales as quantitative analysis relating to knee and 6) RCT's which can be downloaded 7) RCT's published after 2014 Exclusion Criteria: 1) Inclusion of any other trauma except ACL injury, 2) Irregular physiotherapeutic regimen, 3) Passive physiotherapeutic regimen, 4) Bilateral ACL injury.

Quality assessment:

Quality of the studies recruited in this study was assessed by quality list from Cochrane Back Review Group[18]. Data were extracted Independently and checked for accuracy for the purpose of methodological quality.

Ethical Clearance: Ethical clearance obtained from institutional ethical committee Krishna Institute of Medical Sciences Deemed to Be University Karad.

Statistical Analysis

Randomized controlled trials in this study are classified by the year of publication, type of active rehabilitation, follow up time, outcome measure and improvement seen or not. Effect size was calculated of the changes in outcome measure between the control group and active rehabilitation part of the experimental group of various studies. Also, comparison was done between active therapy of each study to analyze the most effective therapeutic approach improving both qualitative and quantitative parameters post ACL repair/ reconstruction using SPSS version 16.0.

Results

Search strategy identified 1250 potential abstracts among which 150 randomized controlled trials were extracted out of which only 12 fit into the criteria of the study- Appendix 1. Table 2 depicts the key clinical and methodological characteristics of each included study.

Evidences:

1. Whole body vibration exercise protocol versus a standard exercise protocol after ACL Reconstruction: A clinical Randomized Controlled Trial with Short Term Follow-up by Berschin G. et al; 2014; quality score=5.1.1. Sample size was 20 in each group with outcome measure: Isometric and isokinetic muscle strength measurements, Lysholm score, neuromuscular functions. Improvement was seen in group with whole body vibration.[6]

2. Effects of early whole body vibration treatment on knee neuromuscular function and postural control after anterior Cruciate ligament reconstruction: a randomized controlled trial by Pistone et al;2016; Quality score=4.2.2. Sample size was 17 in each group. Pre physiotherapy intervention included whole body vibration therapy. Outcome measure were Maximum voluntary isometric strength during knee flexion and extension and Balance on force platform. Improvement was seen in whole body vibration technique at one month itself.[7]

3. Effect of targeted exercise on knee-muscle function in patients with persistent hamstring deficiency following ACL reconstruction- study protocol for a randomized controlled trial by Bregenhof; 2018; quality score= 6.2.2. 25 sample was included in each group with Maximal isometric knee flexor-extensor strength, KOOS, IKDC, Tegner activity score Rate of force development for knee flexion and extension, tendon regeneration and potential muscle hypertrophy evaluated by MRI, Postural control, kinetic/kinematic gait characteristics and knee related functional capacity. None of the result were mentioned.[8]

4. Cross education does not accelerate the rehabilitation of neuromuscular functions after ACL reconstruction: a randomized controlled trial by Zult et al; 2018; quality score=7.3.4. 22 sample was included in each group, with outcome measure: Isometric quadriceps maximal voluntary contraction, Voluntary quadriceps activation, quadriceps force accuracy and variability,

knee joint proprioception and single leg balance and improvement was seen in standard treatment protocol and cross education didn't show any improvement.[9]

5. A comparison between Modified Robert Jones Bandage and Intermittent Cold Pack in Arthroscopic Anterior Cruciate Ligament Reconstruction: A Prospective Randomized Controlled Trial by Kijkunasathian et al; 2017; quality score=3.2.2. sample size was 19 in each group with outcome measures were Functional outcomes: positive quadriceps set, active straight leg raise, active knee flexion and limited knee extension, Knee swelling and Overall patient satisfaction. Improvement was seen in intermittent cold packages.[10]

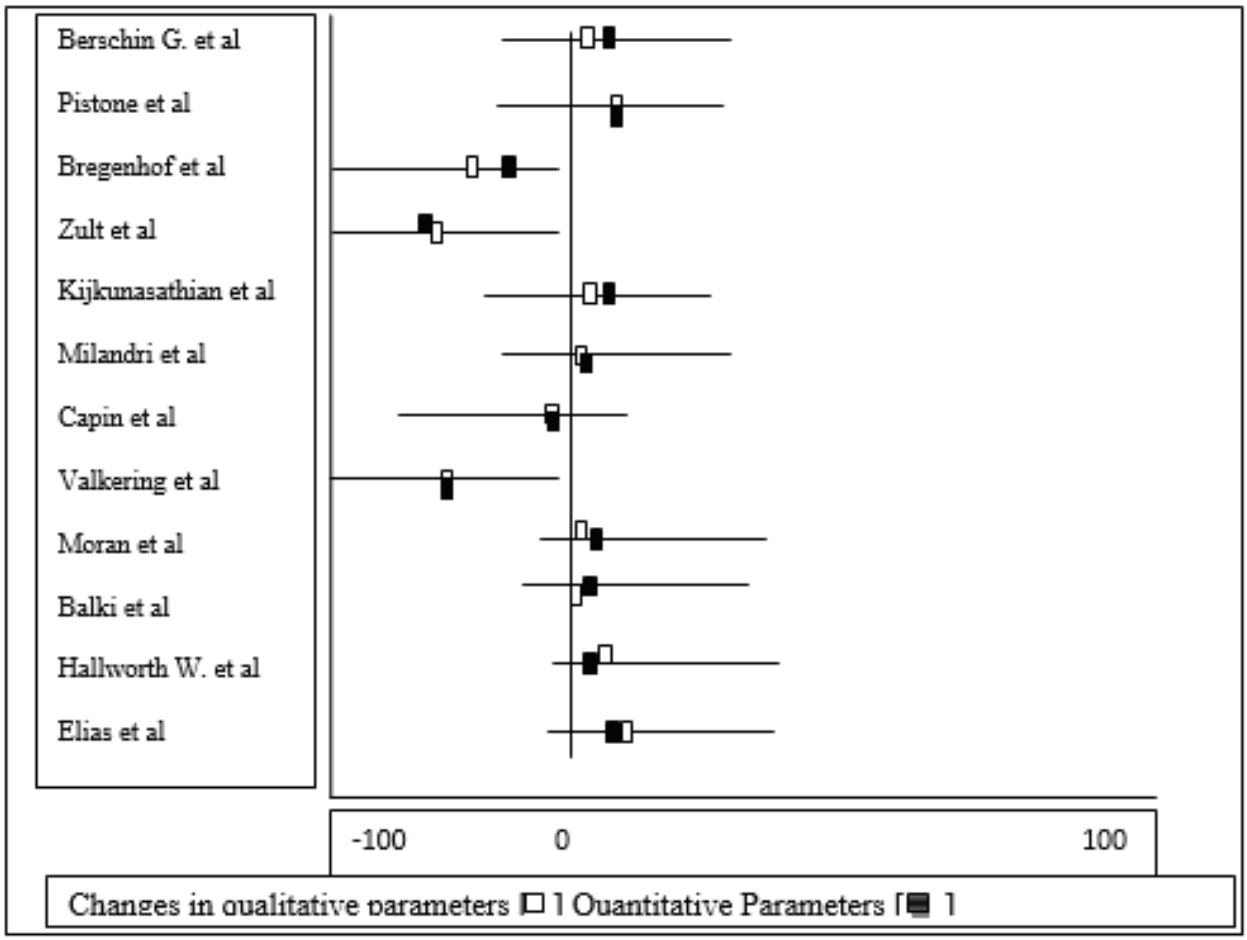
6. Eccentric cycling rehabilitation in anterior cruciate ligament reconstruction: a randomised controlled trial of strength and biomechanical outcomes by Milandri G. et al; 2017; quality score=1.1.1. outcome measure were: Maximal load rate, Initial load rate, Average load rate, Impact force, Hip-knee angle during gait and hip- knee moments and Frontal knee valgus angle. Improvement in all qualitative parameters except average loading rate and impact force.[11]
7. Comparison of ACL-SPORTS Randomized Controlled Trial With Delaware-Oslo and MOON Cohorts by Capin et al; 2019 with quality score= 5.2.4. sample size was 20 per group. Outcome measures were Quadriceps strength, Hop test, Functional outcomes (IKDC, KOOS pain, KOOS symptoms, KOOS ADL, KOOS Sports, KOOS QoL) Return to sport rates. Addition of perturbation did not add any benefit to the therapy. [12]
8. Pain experience and functional outcome of inpatient versus outpatient anterior Cruciate ligament reconstruction, an equivalence randomized controlled trial with 12 months follow up by Valkering et al;2015; quality score=6.2.2. Sample size was 23 per group with outcome measure: Functional outcomes: Lysholm, Tegner and IKDC Other: Pain experience and readmission rate. No significant difference were found between groups.[13]
9. Functional electrical stimulation following anterior cruciate ligament reconstruction: a randomized controlled pilot study by moran et al; 2019; quality score= 3.2.2. Sample size was 10 per group with outcome measures were Gait speed, single limb stance gait symmetry, Quadriceps isometric peak strength ration, peak strength inter-limb symmetry. FES was more better option to improve outcome measure.[14]
10. Kinesiotaping as a treatment method in the acute phase of ACL reconstruction: A double-blind, placebo-controlled study by Balki et al; 2016; quality score= 7.3.4. Sample size was 15 in each group with outcome measure: Lysholm, modified Cincinatti and Tegner scores on first and third post-operative months. KT therapy showed better improvement in all the outcome measures.[15]
11. A Randomized Control Trial of Acute Post Operative Care Following Anterior Cruciate Ligament Reconstruction: A Comparison of Two Protocols by Hallworth W. et al; 2014; quality score=3.2.2. sample size were different in both groups i.e. 20 in one group and 17 in another. Outcome measures were: International Knee Documentation Committee (IKDC) Subject Knee Evaluation Form, Numeric Rating Scale for Pain (NRSP), Circumferential measure, Range Of Motion and improvement was shown significant in group given with DVD for performance of exercise.[16]
12. Clinical Efficacy of Jump Training Augmented With Body Weight Support After ACL Reconstruction: A randomized controlled trial by Elias et al; 2016; quality score= 6.3.3. Sample size was 15 in each group with outcome measure= International Knee Documentation Committee (IKDC) questionnaire, leg landing mechanics via motion analysis, knee joint effusion using a stroke test, surface electromyography–generated co-contraction index during a single-legged landing. Jump training with augmented boody weight showed good improvement than without.[17]

The studies included 2458 patients; study sample size ranged from 10 to 409. Quality varied but tended to be higher in recent studies.

Active physiotherapeutic regimen versus improvement in outcome measure

Forest plots for qualitative measures and quantitative measures:

Effectiveness of various Active Physical therapy on Quantitative measure:



Compared with sham therapy, patients receiving treatment that included various Active Physical therapy intervention were definitely better except for one study which showed no better improvement than control group. On analyzing all the studies the maximum improvement was seen in disability index which one of the inclusion criteria of the study with 95% CI. Most significant effect was seen in study by Capin et al[12] and Hallworth et al[16] who used therapies like ACL SPORT- Protocol and A standardized protocol with DVD given to subjects respectively. Kinetic gait parameter was significant in the study by Elias et al including vertical ground reaction force as well by Moran U et al. Present showed significant effectiveness in quantitative parameters like kinetic gait parameters, any one disability scale, by Elias et al[17] and Capin et al[12] with p value 0.05 and 0.002 respectively.

Effectiveness of various Active Physical therapy on Qualitative measure:

Most significant effect was seen in study by Zult et al[9] and Elias et al[17] who used therapies like standardized treatment regimen and Jump training with body weight support respectively. Isometric maximal voluntary muscle contraction balance control and muscle strength of hamstring and quadriceps were also highly significant. The present study showed significant effectiveness in quantitative parameters like kinematic gait parameters and maximum activation of quadriceps and hamstring by Zult et al[9] and Elias et al[17] and with p value 0.015 and 0.001 respectively.

Discussion

All the therapies provided maximum benefit in improvement of both qualitative and quantitative parameters in subjects with post-ACL repair or reconstruction after Active physiotherapy regimen. Our comparison of various active physiotherapy regimen with control group stated that various physiotherapy protocols act differently on different parameters, which are both qualitative as well as quantitative, Most significant protocols were given in the studies by Capin

et al[12], Elias et al[17] and Zult et al[9].

Capin et al; the study compared three different protocol with one control group that is pure training of strength, agility, plyometric and secondary prevention, when compared to SAPP + perturbation training showed no statistical significance, but on comparison of this control group to MOON and Delaware-Oslo cohort study; ACL-SPORT [ACL-Return to SPORT protocol] group that is the control group showed more significant changes.[12]

Elias et al; jump training is very important part of rehabilitation of subjects with ACL repair or reconstruction, because it activates the muscle in sudden weight bearing position, and also during landing on uneven surfaces. But, jump training done directly would harm the operative procedure done on the fresh graft of ACL. The graft of ACL is fixed with screws which on sudden landing me cause damage. Also, ACL operated subjects are more prone to early development of osteoarthritis, hence usage of body weight support system will definitely help the rehabilitation process. Initially weight bearing exercises and walking are very painful to the subjects who have undergone ACL repair or reconstruction. Body weight support system, grades the amount of weight borne by the individual while performing weight bearing exercises and also during walking. Hence in this study both qualitative as well as quantitative parameters were seen to improve. Vertical jump training is specifically given to improve the co-contraction of musculature along the knee; both quadriceps as well as hamstrings. But as the loading is painful in knee disorders and vertical jump being dynamic loading if done in ACL injured cases which is therapy followed for attaining dynamic stability in the knee between 6-48 months.[17]

Zult et al; the study stipulated that the usage of cross education is not beneficial in the regimen of ACL repair/reconstruction. The study compared two groups, one with cross education and one without. At the end both of them were equally significant hence, between group significancy was not seen. Though, it is known that training the good leg in any of the operated cases, in lower extremity was helpful in early weight bearing activities like walking and transfer, this study had a negative impact on that and remarkably it had a negative effect of central activation ratio of quadriceps which was calculated and also decreased limb symmetry index of quadriceps muscle strength by the end of the session. Hence, cross education wouldn't be beneficial in treatment regimen followed for treating subjects who have undergone ACL reconstruction or repair.[9]

Conclusion

Every active therapy deals with improvement of various outcome measures. This meta analysis have gathered twelve such randomised controlled trials passing the quality test by Cochrane. On statistical analysis the significant improvement among all the studies with respect to disability scale, strength training and muscle performance was ACL- Return to SPORT Protocol along with closed kinetic training by jump training along with augmented body weight support system.

Summary

This study will used randomized controlled design to investigate the effect active physiotherapy rehabilitation on qualitative and quantitative parameters in subjects with ACL repair or reconstruction compared with controls, on knee-joint function in. The trial results helped to determine which active protocol or active physiotherapy regimen helped in improving both qualitative as well as quantitative parameters.

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Conflicts of Interest : None

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