A critical appraisal of "Effects of closed versus open kinetic chain knee extensor resistance training on knee laxity and leg function in patients during the 8- to 14-week post-operative period after anterior cruciate ligament reconstruction"

By

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Abstract

Closed kinetic chain exercises interventions have been thought to increase function outcomes as they seem to resemble daily activities more than open kinetic chain exercises. In this appraisal I look at a study comparing closed and open chain intervention in ACL rehabilitation patients with my focus being on the objective functional outcomes of the study. This appraisal investigates why I chose this question and the applications of that question to clinical practice. I detail the research process that led me to choose this article as well as the clinical significance of the article for future patients. The strengths and weakness of introduction, methods, results, and discussion will be analyzed to show what the study performed well and how the study can be improved upon for further trials. Lastly the clinical implications of this article will be addressed to demonstrate how this article can be used as evidence when treating ACL reconstruction. In this section I look into the potential risk and reward of using closed chain exercises to treat patients and the confidence that this intervention can be practically applied.

Key words

Closed chain, ACL, Function

Introduction

Closed kinetic chain (CKC) training and open kinetic chain (OKC) training has been debated as to what is the superior method to rehabbing post-surgical ACL repair. CKC has been the preferred method as OKC safety has come into question and as CKC, in theory, should relate more to function as it greatly resembles everyday tasks. Due to this idea, I wanted to explore if an intervention consisting of CKC training would in fact lead to greater functional performance than OKC training. The potential differences between the interventions could change the approaches therapists take on the most effective way for post operative ACL repair patients in returning to prior function. Due to this, I posed the question, is an intervention of CKC exercises more effective in increasing function when compared to OKC exercises in post operative ACL reconstruction patients?

Methods

To find an article that applied to this question, I began searching the US National Library of Medicine database. This database was used due to their large collection of medical trials. I used the keywords “ACL” and “closed chain” and limited my search results to only include trials. I did these two things to filter out review articles and find specific articles that would highly relate to my clinical question. Inclusions used during the search process were post operative patients and comparing CKC and OKC interventions. These were used to further relate the articles specifically to the question posed above. With the criteria used, nineteen articles were reviewed until I decided on this one.

This article was published in the journal of *Knee Surgery, Sports Traumatology, Arthroscopy* in 2005. Research for this study was performed in London, United Kingdom. Authors M. Perry, M.

Morrissey, and D. Morrissey are from the Division of Applied Biomedical Research at King's College London. The author J. King is from the Department of Sports Medicine from Queens Mary College in London and P. Earnshaw is from Guy's and St Thomas' NHS Trust. I decided to choose to critically appraise this article instead of the others I reviewed as I felt this one most closely related to my clinical question. This article not only looks at functional mobility with a questionnaire like many other studies, but also tested single leg jumping as a way seen to correlate to function of the knee. This testable component, along with the comparison of CKC and OKC interventions made me this article seem the most closely related to my clinical question.

Results

Summary of the study

This research experiment set out to compare the effects of closed chain exercises versus open chain exercises on ACL reconstruction. Specifically, the study was testing how the graft held in the two scenarios and the function of the knee between the two exercises. The study was single blinded and based out of London, published in 2005, and consisted of49 patients recovering from ACL surgery. Knee laxity was measured using a ligament arthrometer and knee function was assessed using the Hughston Clinic knee self-assessment questionnaire and from single leg max jump testing. During the experiment the two groups underwent pretesting post-surgery which included the self-questionnaire, joint angle measurements, knee laxity measurements, and knee circumference. The subjects then underwent 6 weeks of intervention with their closed or open chain exercises and a common set of exercises set by clinicians. The results of the

study showed no significant differences between open and closed chain exercises on knee laxity or function. In the discussion at the end of the research article the researchers suggest there does not seem to be an advantage to using one exercise set over the other but that it may still be safer to use closed chain exercises post operatively as some data has not been refuted on the safeness of open chain exercises.

Appraisal of the study introduction

Looking to the introduction of this study, the authors clearly presented the history of controversy as to whether OKC is a safe treatment method and why CKC has been more common practice for ACL rehabilitation patients. Based on the comparisons between the two interventions, the authors showed the need for research during the second crucial timing of graft susceptibility.

The introduction however fails to comment on the differing operation methods and any impact they might have on graft strength and function. Due to the three differing methods, I feel the authors should have mentioned data that would support their decision not to split the groups and account for the differing procedures.

Appraisal of the study methods

The authors presented the procedure for pre and post testing clearly and have a detailed intervention plan that would make this experiment easily replicable. The testing methods were also shown to be valid and reliable, and the experiment was kept consistent by having the same therapist perform both pre and post testing.

The methods section did have some glaring weaknesses as alluded to above, the groups did not account for the differing operation procedures. Due to this, the CKC group had many more hamstring grafts while the OKC group had many more patella tendon grafts. Another area of concern with this experiment is the bias that the article mentions the therapists could show towards one intervention method over the other. While it is not possible to blind a therapist to open versus closed chain exercise, it should be noted that the therapists did have a preconceived preference to treating with CKC exercises. The functional jump test can be seen as another weakness due to the inability for all subjects to complete the test after one subject sustained an injury from it and testing was halted for the rest of the subjects. This test might have been too intense to complete at this stage of rehabilitation, limiting the objective measure of function that this research was trying compare. Perhaps the biggest weakness in the intervention applied was the minor differences in intervention. Both subjects performed the same twelve core exercises with just three separate CKC and OKC exercises separating the subjects' intervention. This minimal difference between interventions might not allow for adequate training outcomes to occur.

Appraisal of the study results

The results of the study were shown clearly in the tables and analyzed to show no statistical differences. The researchers were also open with any concurrent knee pathologies, acknowledging the potential impact that might have had on the experiment.

One weakness which the authors mentioned in the results section was the different performance outcomes based on which facility the subject participated in the study at. Another weakness was the significantly different times spent on the bike between the two groups.

Appraisal of the study discussion

During the discussion, clear comparisons were done to tie in the researchers' findings to prior studies. This tie in helped strengthen their case that the two training programs do not differ significantly. The authors also addressed their limitations of bias well and presented solutions that could counter those biases in the future. The authors also addressed a previous weakness of the results section as they discussed the intensity differences at the different sites as possible explanations for different results between them.

Areas not addressed in the discussion were the potential impact of the differing grafts, the inability of their subjects to all perform the jump test, and how concurrent pathologies might have also impacted the subjects.

Discussion

This study could be used in a clinic to expand the number of exercises safely available when rehabilitating the ACL. This allows for more ways to work the muscles in the leg while maintaining patient safety. Regarding my clinical question, this article would argue that focusing on CKC exercises will not improve function, despite the exercise more closely resembling everyday activities. However, based on the limitations on exercise intensity, the article still

suggests that until further research is performed to compare increasing intensities, CKC exercises might still be the safer option.

Despite there being no significant differences between intervention methods, I think this article supports the use of CKC intervention over OKC for post operative ACL patients. While this study did not see increased function with CKC exercises, prior studies mentioned pointed out the increased similarities of CKC exercises with daily weight bearing activities. However, with growing evidence that OKC exercises are safe for ACL reconstruction patients, limiting the exercises to only CKC could deprive the patient of exercises that could help them in the recovery process. Considering this, I think the benefits of only using CKC exercises do not outweigh the potential risks of closing off an entire subset of exercises that have growing evidence of safety. Further research comparing the functional benefits of long term CKC regarding functional improvements would either strengthen or weaken the argument for CKC exercises over OKC exercises.

CKC exercises are supported as viable exercises for ACL rehabilitation and this paper gives me confidence that it is as effective as OKC exercises for an intervention. By focusing on CKC to the patient, I can be confident that I am not putting the recent graft under any unnecessary stress during exercises as tibial translation also did not differ between the two exercises. In future clinical setting, CKC exercises will be easily implemented safely with skills I am learning now and in the future. The thing I would change though with this intervention is the outcome testing as depending on patient progress, the testing might put the patient at an unnecessary risk of

injury. Through further research, other objective functional testing can be found that can allow for both patient safety and effectiveness of testing.

In conclusion the article reviewed provides clinically meaningful applications comparing CKC and OKC exercises with both providing similar improvements. Further research could explore more intense intervention protocols and their safety and effectiveness as well as exploring the use of only CKC and OKC interventions.