



EFFECTIVENESS OF CONCENTRIC VERSUS ECCENTRIC EXERCISES ON PATIENTS WITH JUMPER'S KNEE

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Abstract:

Background and Purpose: Effectiveness of Eccentric and Concentric quadriceps Training in patients of jumpers knee. The objective of this study is to address the effectiveness of concentric versus eccentric exercises on pain and function in patients with. (Jumper's Knee)

Study design: A pre-post experimental design was used in this study

Subjects: Thirty patellar tendons from 30 patients with a long duration of pain from the proximal patellar tendon and referred to the physiotherapy and Orthopaedic Department were included in the study

Methods: visual analogue scale, which deals with pain and is a good functional rating system for active persons by Noyes FR et.al

Results: There are total 30 patients out of them there are 11 male and 4 female in group A and group B each. The Chi square test shows there is no significant gender wise distribution of patients in two groups. The mean age of patients in group A is 23.20 with SD 3.46 while the mean age of patients in group B is 23.33 with SD 3.83. The student's t-test shows that there is no significance difference in mean age of patients in two groups.

Conclusion: This study has shown that eccentric Quadriceps training is more beneficial than concentric training. But there is no satisfactory physiological explanation for this. This study was performed on a small group. To establish the effectiveness of Eccentric exercises on Jumper's knee this should be done on a large group. Generalization of the study is very less because all the subjects are from same area. To increase the generalization, this study should be done on a wide range of patients.

In the present study, the effectiveness of eccentric Quadriceps training in jumper's knee was established till the end of the study. However there is a need of follow up further.

Key words: -concentric exercise, eccentric exercise, jumpers knee, quadriceps training. ROM, VAS

Introduction

Strengthening and correcting biomechanics improves the energy absorbing capacity of the limb both at the affected musculotendinous unit and at the hip and ankle. The ankle and calf are critical in absorbing the initial landing load transmitted to the knee.⁵ Biomechanical studies reveal that about 40% of landing energy is transmitted proximally.⁶ Thus, the calf complex must function well to prevent more load than necessary transferring to the patellar tendon. Better landing techniques can decrease patellar tendon load. Compared with flat foot landing, forefoot landing generates lower ground reaction forces and, if this technique is combined with a large range of hip or knee flexion, vertical ground reaction forces can be reduced by a further

25%.⁶ The success of a pain based eccentric exercise program has been demonstrated in the treatment of Achilles tendinopathy⁷ but the effect of painful eccentric training during the rehabilitation of patellar tendinopathy is unknown. Furthermore, recent investigations have shown that squats performed on a 25° decline board target the knee extensor mechanism more specifically than the standard squat, and it has been suggested that this may be relevant in the management of patellar tendinopathy. Given these findings, a combination of squatting on a decline board and into tendon pain would theoretically provide an effective conservative treatment protocol for patellar tendinopathy.⁴

The eccentric exercise commonly recommended for the patellar tendon is the squat.⁸ However, when a subject performs a squat, several mechanisms may unload the knee extensors and potentially reduce the eccentric load through the patellar tendon. Trunk flexion, side-to-side load sparing, and calf tension may all reduce the load placed on the knee.⁸ Passive and active calf tension has the potential to reduce demand on the knee extensors in the squat by limiting forward angulation of the tibia approaching the limit of ankle dorsiflexion. Purdam et al have suggested that this effect can be minimised, and load on the patellar tendon maximised, by performing a squat on a decline.

Eccentric moves recruit most fast twitch fibres. A new piece of research has investigated the differences in activation patterns between concentric and eccentric quadriceps contractions. In particular, the researchers were concerned with measuring the amount of muscle activity as revealed by electromyography (EMG) and the mean frequency of the EMG signal. As a rule, the larger the EMG signal recorded the more muscle fibres are being recruited, while the frequency of the signal is an indication of how fast they are being recruited. Research has shown that higher frequency EMG is consistent with greater fast twitch fibre recruitment.

Concentric contraction involves force created when the muscle fibres shorten, while eccentric contraction involves force created when they lengthen. For example, when you land on two feet from a jump and bend your knees the quadriceps are lengthening, but also creating a force to control the landing. As you spring back from the landing, extending your knees and jumping back up in the air, the quadriceps is shortening as they create force to push you off. In this experiment the subjects performed maximal concentric and eccentric contractions of the quadriceps, while the

researchers measured the EMG activity and frequency of signals. They found that the total EMG signal was greater during the concentric phase – suggesting more muscle fibres are active at this time – while the mean frequency of the EMG signal was greater during the eccentric phase – suggesting faster twitch fibres are being recruited at this time. They concluded that during a maximal eccentric contraction there is less total muscle fibre recruitment; with fast twitch fibres recruited in preference to slow twitch ones, whereas during a maximal concentric contraction all the muscles fibres are used.¹⁰

Method

Participants

Thirty patellar tendons from 30 patients with a long duration of pain from the proximal patellar tendon and referred to the physiotherapy and Orthopaedic Department were included in the study.

Variables:

The Independent variables concentric versus eccentric exercises on patients with Jumper's Knee and the dependent variables were pain and ROM.

Outcome measures:

Primary outcome measures were pain (measured using numeric pain rating scale) and knee rom measured by universal goniometer

Study Protocol

There were two treatment protocol, eccentric quadriceps training while standing on a decline board and concentric quadriceps training. Both training groups were given careful instructions by the same physiotherapist on how to perform the training. Both practical and hand written instructions were given. The training program consisted of three sets of fifteen repetitions each, performed twice a day, 7 days a week for 12 weeks.

Results

Table 5.1 Distribution of study subjects according to the personal characteristics.

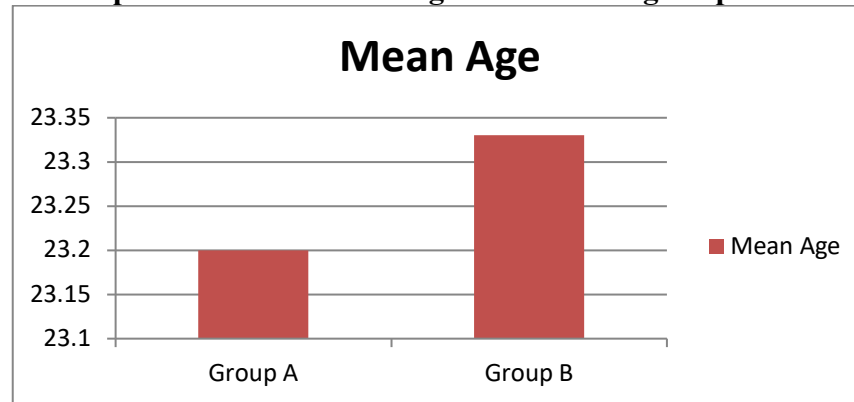
Characteristics	Group A (N=15)	Group B (N=15)	P-value
Gender(Male/Female)	11/4	11/4	0.659
Age(Mean± SD)	23.20±3.46	23.33±3.83	0.921

p^aassociated with chi square & p^b is associated with unpaired test.

Table 5.1 shows the distribution of patients according to personal characteristics. There are total 30 patients out of them there are 11 male and 4 female in group A and group B. The Chi square test shows there is no significant gender wise distribution of patients in two groups. The mean age of patients in group A is 23.20

with SD 3.46 while the mean age of patients in group B is 23.33 with SD 3.83. The student's t-test shows that there is no significance difference in mean age of patients in two groups.

Graph 5.1: The column diagram of mean age of patients



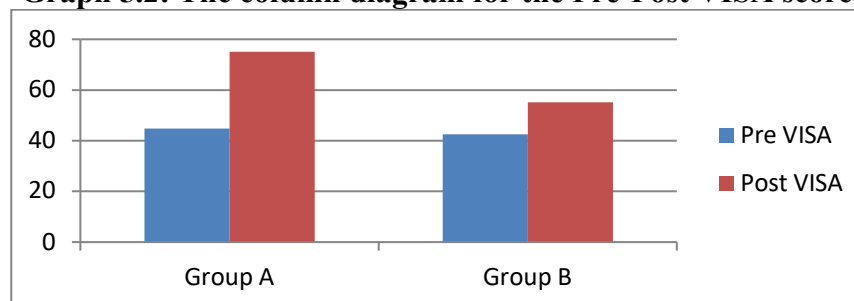
The Graph 5.1 shows the column diagram of mean age of patients in group A and group B. The mean age of patients in group A is 23.20 while the mean age of patients in group B is 23.33.

Table 5.2: Pre and Post VISA score of patients

VISA	Group A	Group B
Pre Visa	44.80	42.60
Post Visa	75.00	55.27
MD(Post- Pre)	30.2	12.67

Table 5.2 shows pre and post VISA score of patients in two groups A & B. The mean Value of pre VISA for group A is 44.80 and group B is 42.60. The mean value of post VISA score for group A is 75.00 while for group B is 55.27. Tables shows the mean difference of pre- post VISA score for group A is 30.2 while for group B is 12.67.

Graph 5.2: The column diagram for the Pre-Post VISA score.



The Graph 5.2 shows the column diagram for the Pre-Post VISA score in group A and group B. Graph Shows the pre-post VISA difference in group A is more than the group B.

Table 5.3: Comparison of Pre-Post VISA score in two groups

VISA	Group A	Group B	t-value	p-value
Pre Visa	44.80±24.76	42.60±42.60	0.23	0.56
Post Visa	75.00±14.53	55.27±22.52	2.85	<0.01

Table 5.3 shows comparison of Pre-Post VISA score in two groups A & B. Table 5.3 shows there is no significance difference ($t=0.23, p=0.56$) in mean value of pre VISA score in group A and B while shows there is significance difference

($t=2.85, p<0.01$) in mean value of Post VISA score in group A and B. The table shows the mean value of VISA score in group A is higher than in group B which implies that the method used in group A is more effective than the method used in group B.

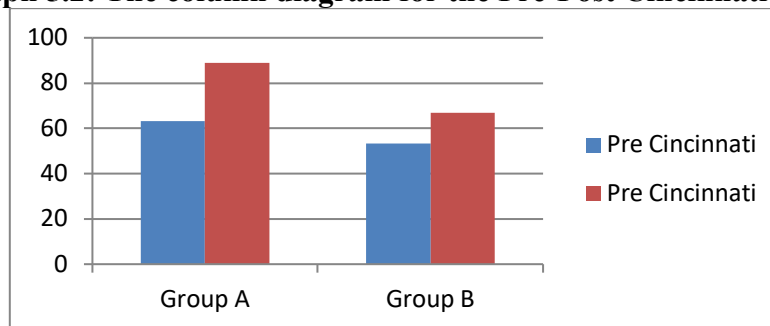
Table 5.4: Pre and Post Cincinnati score of patients

Cincinnati	Group A	Group B
Pre Cincinnati	63.27	53.40
Post Cincinnati	89.00	67.00
MD(Post- Pre)	27.53	13.56

Table 5.4 shows pre and post Cincinnati score of patients in two groups A & B. The mean Value of pre Cincinnati for group A is 63.27 and group B is 53.40. The mean value of post Cincinnati score for

group A is 89.00 while for group 67.00. Tables shows the mean difference of pre- post Cincinnati score for group A is 27.53 while for group B is 13.56.

Graph 5.2: The column diagram for the Pre-Post Cincinnati score



The Graph 5.2 shows the column diagram for the Pre-Post Cincinnati score in group A and group B. Shows the pre-post Cincinnati difference in group A is more than the group B.

Table 5.5: Comparison of Pre-Post Cincinnati score in two groups

Cincinnati	Group A	Group B	t-value	p-value
Pre Cincinnati	63.27±23.36	53.40±18.05	1.294	.206
Post Cincinnati	89.00±9.07	67.00±12.66	5.469	<0.01

Table 5.5 shows comparison of Pre-Post Cincinnati score in two groups A & B. Table 3 shows there is no significance difference ($t=1.294, p=0.206$) in mean value of pre Cincinnati score in group A and B while shows there is significance difference ($t=5.46, p<0.01$) in mean value of Post Cincinnati score in group A and B. The table shows the mean value of Cincinnati score in group A is higher than in group B which implies that the method used in group A is more effective than the method used in group B.

Discussion

The short term results of this prospective randomized study in athletes with chronic painful jumper's knee showed that treatment with painful eccentric quadriceps training, but not with painful concentric quadriceps training, both while standing on a decline board, significantly reduced tendon pain during activity and improved function. These findings support the results from a recent non-randomized pilot study by Purdam et al³⁵. Due to severe pain after 6 weeks of training, there was a

high frequency of drop outs (5/15 tendons) in the concentric group. This could possibly have impacted on the results, but because no patient in the concentric training group was satisfied with the result of the treatment, we considered it incorrect due to ethical reasons to recruit more patients into the study.

In the current study, the diagnosis of jumper's knee was established from clinical examination. In recent studies, neovessels in the area with structural tendon changes, visualized with the colour Doppler technique, have been demonstrated to be related to tendon pain during activity.

The aim of our study was to compare eccentric with concentric quadriceps training. Therefore, we emphasized the use of exercises, which, as far as possible, included either eccentric or concentric muscle contraction. However, especially for the concentric exercise, there was a short period of eccentric muscle contraction in the initial phase of the exercise. To try to limit bias, the patients themselves evaluated treatment. The patients recorded the amount of patellar tendon pain during their sporting activity on a CINCINNATI Score and graded their tendon function on a VISA score. Patient satisfaction with treatment (satisfied/not satisfied) was also assessed.

Jumper's knee is a troublesome condition to treat and frequently brings athletic careers to an end. Kettunen²⁴ and coworkers found that 53% of patients with jumper's knee had to stop their sporting career due to knee pain. However, we cannot exclude that some of these patients also had other problems, such as cartilage defects. There is no treatment of choice for jumper's knee. Results of surgery vary and cannot be predicted⁴⁶, and no conservative method has been demonstrated to be outstanding. Eccentric calf muscle training has been shown to give very good clinical results in patients with chronic mid-portion Achilles tendinosis⁷, but similar good results have not been achieved with eccentric quadriceps training in patients with jumper's knee. However, it should be remembered that eccentric training does not produce good results in patients with Achilles tendon insertional problems, and jumper's knee is an insertional

patellar tendon problem. Consequently, there seem to be differences in the response to eccentric training depending on where in the tendon the injury is located.

There are relatively few studies evaluating conservative treatment of jumper's knee, and to our knowledge, only two randomized studies comparing different models and evaluating function. Studies by Stanish and Curwin and Jensen and Di Fabio⁴⁰ reported promising clinical results using 6–8 weeks of pain free drop squat training. Unfortunately, no patient material or functional data were reported, which makes comparison difficult. Karlsson et al.⁴⁷ showed that 70% of patients with a partial patellar tendon rupture had excellent results after a combined concentric and eccentric pain free rehabilitation protocol.

A randomized study by Cannell et al⁴¹, using a 12 week programme of pain free drop squat or leg extension/curl exercise in patients involved in a variety of sports, found that both groups had significant reduction in pain. Although most of the patients returned to sport, only six of 19 (32%) subjects were pain free after 12 weeks of training. In a recent prospective randomized controlled trial in basketball players, it was demonstrated that a protocol consisting of painful eccentric decline squat

exercises and a traditional pain free eccentric leg squat protocol were both effective in the treatment of tendon pain and sporting function⁴³. At the 3-month follow up, there were no differences in the results between the groups, which had significantly improved. In our prospective randomized study, only painful eccentric, but not painful concentric, quadriceps training showed a significant improvement in the CINCINNATI and VISA scores after 12 weeks of training. Based on the results of the above studies, it seems that eccentric quadriceps training produces good clinical results. However, it should be remembered that only short-term clinical results are reported; long term follow up studies are needed. The use of a decline board does not seem to significantly improve clinical outcome, but the groups of patients were small, and studies with

larger numbers of subjects are needed to evaluate these results.

We cannot explain why painful eccentric, but not painful concentric, quadriceps training is associated with good clinical results. If the beneficial mechanisms are related to interference with nerves, maybe the "nerve damage"⁴⁸ is caused more effectively during eccentric loading. Another possible explanation for the differences in the results might be that eccentric loading is associated with a better tissue response in terms of tissue repair mechanisms.

Limitations

A large sample size required to make the study more reliable. Our study is limited to two outcome measures other outcome measures can also be used. Only pain and knee range of motion was measured and analysed. The limiting factor is that no functional scale is used in this study.

Conclusion

This study has shown that eccentric Quadriceps training is more beneficial than concentric training. But there is no satisfactory physiological explanation for this. This study was performed on a small group. To establish the effectiveness of Eccentric exercises on Jumper's knee this should be done on a large group. Generalization of the study is very less because all the subjects are from same area. To increase the generalization, this study should be done on a wide range of patients. In the present study, the effectiveness of eccentric Quadriceps training in jumper's knee was established till the end of the study. However there is a need of follow up further.

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