

# Eccentric versus Concentric Contraction of Quadriceps Muscles in Treatment of Chondromalacia Patellae in Long Jumpers

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## ABSTRACT

**Background:** Chondromalacia patellae is a disorder that causes softening and degeneration of patellar cartilage, resulting in pain around the patella. It causes quadriceps muscular weakness, particularly in the vastus medialis. The aim of this study is to compare the effects of focused and eccentric contraction on chondromalacia and determine which is the most beneficial.

**Methodology:** RCT was done on 50 males of age 18-25 years, were randomly divided into 2 groups: 1 is concentric group and the other is eccentric group. In both groups, all the exercises were performed 4 times/week for 6 weeks; each exercise should be done for 2 sets with 10 repetitions. NPRS and WOMAC scale was used as outcome measures and the readings were noted pre- and post- intervention.

**Results:** The data was analyzed by JASP Software. The mean age value of eccentric group is  $22.240 \pm 2.107$  and concentric group is  $21.880 \pm 2.205$ . The data shows that there is significant improvement in eccentric group in NPRS as the post-intervention mean value is  $2.72 \pm 0.792$  while that of concentric group is  $3.680 \pm 0.802$ ; the p-value is  $<0.001$ . The data coins that there is significant improvement in all the parameters of WOMAC in eccentric group as mean value is  $30.640 \pm 3.451$  and of concentric value is  $34.6 \pm 3.594$  and the p-value is  $<0.001$ .

**Conclusion:** Study concluded that eccentric group is more effective than concentric group for management of chondromalacia. This suggests that exercises that emphasize eccentric contraction of the quadriceps, could be valuable addition to rehabilitation programs for individuals with chondromalacia. This coins that eccentric exercises can be effective intervention and can be considered as a primary component of treatment for chondromalacia.

**Keywords:** Chondromalacia, Eccentric contraction exercises, concentric contraction exercises

## INTRODUCTION

Chondromalacia patellae is a condition characterized by the softening and degeneration of the cartilage beneath the patella, induced by overuse (microtrauma), retinacular tightness, aberrant patellar posture, irregular Q-angle, quadriceps weakness or imbalance, or a combination of these factors leading to knee pain, discomfort, and potential

instability during movement.<sup>[1]</sup> The articular cartilage beneath the patella is normally smooth and shiny so that it can glide down the groove of the femur as the knee bends. However, softening of this cartilage can cause damage to the patella's undersurface, resulting in Chondromalacia Patellae.<sup>[2]</sup>

Studies coin that the patient complaints continuous pain around Patella which may

radiate to behind the patella (particularly in sitting with the knees flexed for an extended amount of time), frequently alleviated by slight movement. The discomfort is more persistent in advanced cases and is exacerbated by vigorous action, mainly when the knee is loaded in a flexed position. [2,3]

As per previous study, vastus medialis oblique (VMO) are the most important muscle in patellar mechanics. The imbalance between the vastus medialis and lateralis muscles is usually regarded as the main cause of this. Therefore, the main target of rehabilitation protocols for CMP is the vastus medialis muscle. [4]

According to previous literature, CMP can be managed by medical management and physiotherapy rehabilitation, and also coined that there is no need to do surgical procedure. A knee brace can be prescribed to patients who want to continue in sports activity which is known as a patella stabilizing brace consisting of a knee sleeve with a patella cutout and horse shoe pad laterally to keep out the patella tracking from laterally. [5]

Physiotherapy management includes stretching of vastus lateralis muscle, strengthening of Quadriceps and Hamstring muscle. Along with conventional physiotherapy, manual therapy and electrical therapy can be used such as Tens and IFT. Studies suggest that patella taping technique can be helpful for the management of Chondromalacia patellae as this will help to keep the patella from tracking laterally. [6] A study suggests that strengthening the quadriceps femoris muscle is beneficial for enhancing functional abilities, QOL, and alleviates pain, and may be of particular importance for people who wish to get back into high-demand hobbies like Running or other sports. [7]

Very few literatures shows that along with the strengthening of quadriceps muscles, eccentric and concentric contraction of quadriceps are also beneficial. A number of researchers

endorse few exercises as a newer category of training sessions in CMP rehabilitation because they can produce maximal VMO activity, particularly from 0 to 60 degrees of knee flexion. Furthermore, these exercises are safer than open chain exercises and place less stress on the patellofemoral joint, whereas others reported that open chain exercises at low flexion angles (from 0 to 20 degrees of flexion) are recommended because they are particularly effective and the quadriceps effort is greatest in this range. [2] But there are no studies till now, which compare the effect of eccentric contraction and concentric contraction on younger athlete population. So, there is dire need for further investigation to compare the effect of both type of exercises in rehabilitation of CMP.

This current study aims to evaluate the effect of eccentric and concentric exercises of quadriceps on chondromalacia patellae and compare both whether the eccentric is better or concentric is better.

## **MATERIAL AND METHODOLOGY**

An Experimental study was conducted on 50 Long jumpers male having Chondromalacia patellae after receiving the ethical approval. In this study, 18 to 25 years old long jumpers were considered which were randomly divided into 2 groups. These groups were Group A which consists of eccentric group and Group B which consist of concentric group. Players who are having symptoms from less than 1 month, any other knee pathology, previous history of surgery of knee, history of fracture of patella and any previous history of physiotherapy were excluded from this study. The data was collected from 2 academies of Gurugram.

Group A subjects have to perform eccentric exercises of quadriceps such as (i) active strengthening exercises of quadriceps with minimal resistance, (ii) stand to sit on chair (up to 90 degrees), and (iii) stand on a board of 25 degrees with the entire body weight on affected leg and then flex the knee slowly to 70 degrees

which then return to normal position by using the unaffected leg along with the conventional physiotherapy.

In Group B subjects have to perform concentric exercises of quadriceps such as (i) active strengthening exercises for quadriceps with minimal resistance, (ii) dynamic quads, and (iii) stand on 25 degrees board with entire body weight on affected leg with the knee in 70 degrees flexion and then slowly straighten to full extension along with the conventional exercises.

All the exercises were performed 4 times/week for 6 weeks and each exercise should be done for 2 sets with 10 repetitions in both groups.

After explaining all the protocol to the subjects, a formal informed consent was taken from them. And NPRS scale for Pain and WOMAC was used as outcome measures. Both the pre- and post- readings were noted.

### DATA ANALYSIS

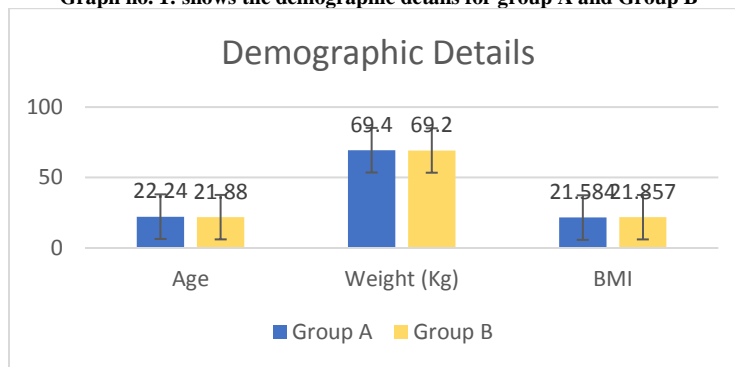
Data was entered in MS Excel, and were analyzed using JASP. Data was assessed for normal distribution by using Shapiro Wilk test. Results shows that data was normally distributed as the p-value was  $>0.05$ . Then descriptive statistics, and paired t-test was used on both the groups individually. After that paired t-test was used over the post values of both groups to compare which group is better.

### RESULTS:

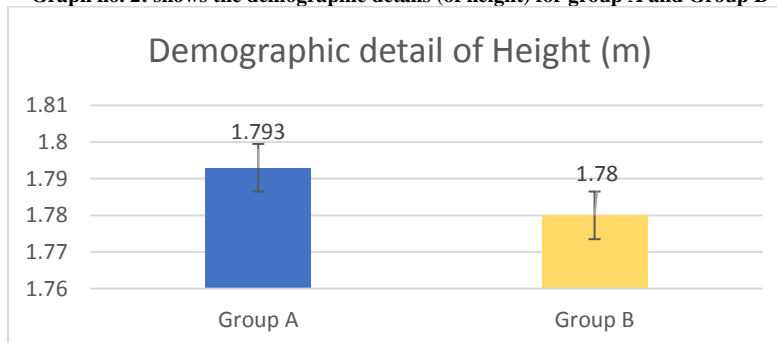
Table no. 1: Shows the descriptive statistics for demographic details of Group A and Group B.

Demographic Details				
	Group A		Group B	
	n	Mean $\pm$ SD	n	Mean $\pm$ SD
Age	25	22.240 $\pm$ 2.107	25	21.880 $\pm$ 2.205
Weight (Kg)	25	69.4 $\pm$ 1.323	25	69.200 $\pm$ 1.528
Height (m)	25	1.793 $\pm$ 0.013	25	1.78 $\pm$ 0.015
BMI	25	21.584 $\pm$ 0.451	25	21.857 $\pm$ 0.693

Graph no. 1: shows the demographic details for group A and Group B



Graph no. 2: shows the demographic details (of height) for group A and Group B



**Table no. 2: Shows the descriptive statistics and t-stat value for group A (Eccentric Group)**

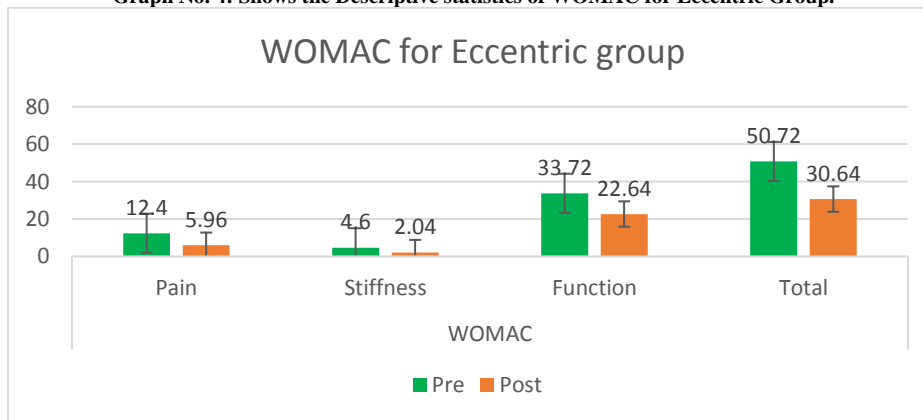
			Mean ± SD	t-Value	df	p-value
	NPRS	Pre	6.68 ± 0.748	36.768	24	< .001
		Post	2.72 ± 0.792			
W O M A C	Pain	Pre	12.4 ± 1.155	29.727	24	< .001
		Post	5.96 ± 1.369			
	Stiffness	Pre	4.6 ± 0.707	25.265	24	< .001
		Post	2.04 ± 0.790			
	Function	Pre	33.72 ± 2.590	25.437	24	< .001
		Post	22.64 ± 2.271			
	Total	Pre	50.72 ± 4.047	49.225	24	< .001
		Post	30.64 ± 3.451			

According to Table No. 2:

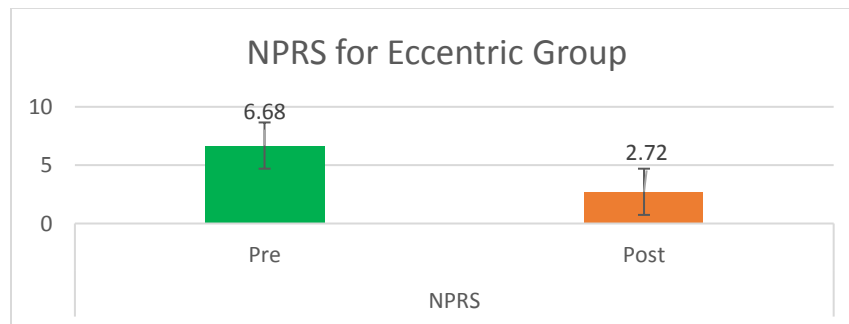
The mean value of NPRS for pre-value is 6.68 ± 0.748 while that of post value is 2.72 ± 0.792 and the t-stat value is 36.768 with the p-value <0.001. Mean value of Pain (WOMAC) for pre- value is 12.4 ± 1.155 and that of post value is 5.96 ± 1.369 and the t-stat value is 29.727 with the p-value <0.001. Mean value of Stiffness (WOMAC) for pre- value is 4.6 ± 0.707 with the post value 2.04 ± 0.790 with the

t-stat value 25.265 and p-value <0.001. The mean value of Function (WOMAC) for pre-value is 33.72 ± 2.590 whereas post value for the same is 22.64 ± 2.271 and the t-stat value is 25.437 with the significance value <0.001. Mean value of Total (WOMAC) for pre-value is 50.72 ± 4.047 while that of post value is 30.64 ± 3.451 and the t-stat value is 49.225 with the significance value <0.001.

**Graph No. 4: Shows the Descriptive statistics of WOMAC for Eccentric Group.**



**Graph no. 5: Shows descriptive Statistics of NPRS for Eccentric Group (Group A)**



**Table no. 3: shows descriptive statistics and t-value for group B (Concentric group)**

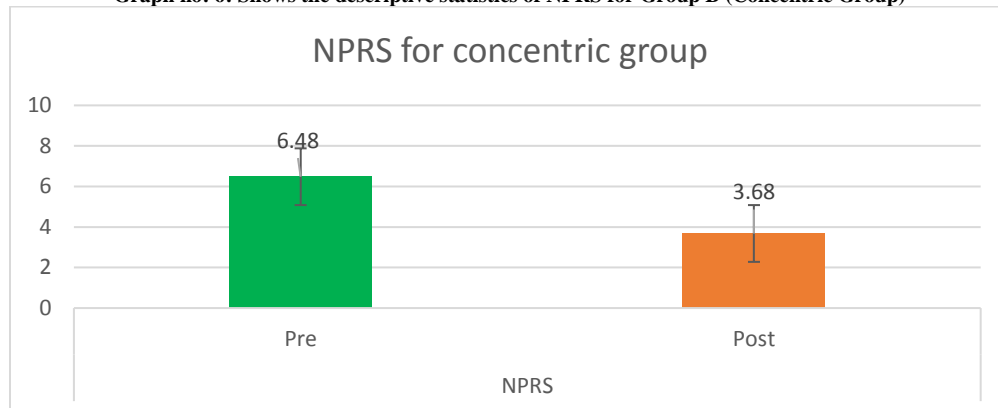
			Mean ± SD	t-Value	df	p-value
	NPRS	Pre	6.480±0.872	17.146	24	< .001
		Post	3.680 ± 0.802			
W	Pain	Pre	12.360 ± 1.469	26.626	24	< .001
		Post	7.280 ± 1.1			
O	Stiffness	Pre	4.440 ± 0.768	16.0	24	< .001
		Post	2.840 ± 0.800			
M	Function	Pre	30.440 ± 2.142	29.221	24	< .001
		Post	24.480 ± 2.201			
A	Total	Pre	47.240 ± 4.096	44.801	24	< .001
		Post	34.6 ± 3.594			

According to Table No. 3:

The mean value of NPRS for pre-value is 6.480±0.872 while that of post value is 3.680 ± 0.802 and the t-stat value is 17.146 with the p-value <0.001. Mean value of Pain (WOMAC) for pre- value is 12.360 ± 1.469 and that of post value is 7.280 ± 1.1 and the t-stat value is 26.626 with the p-value <0.001. Mean value of Stiffness (WOMAC) for pre-value is 4.440 ± 0.768 with the post value

2.840 ± 0.8 with the t-stat value 16 and p-value <0.001. The mean value of Function (WOMAC) for pre- value is 30.440 ± 2.142 whereas post value for the same is 24.480 ± 2.201 and the t-stat value is 29.221 with the significance value <0.001. Mean value of Total (WOMAC) for pre-value is 47.240 ± 4.096 while that of post value is 34.6 ± 3.594 and the t-stat value is 44.801 with the significance value <0.001.

**Graph no: 6: Shows the descriptive statistics of NPRS for Group B (Concentric Group)**



**Graph no. 7: shows descriptive statistics of WOMAC for the concentric group**

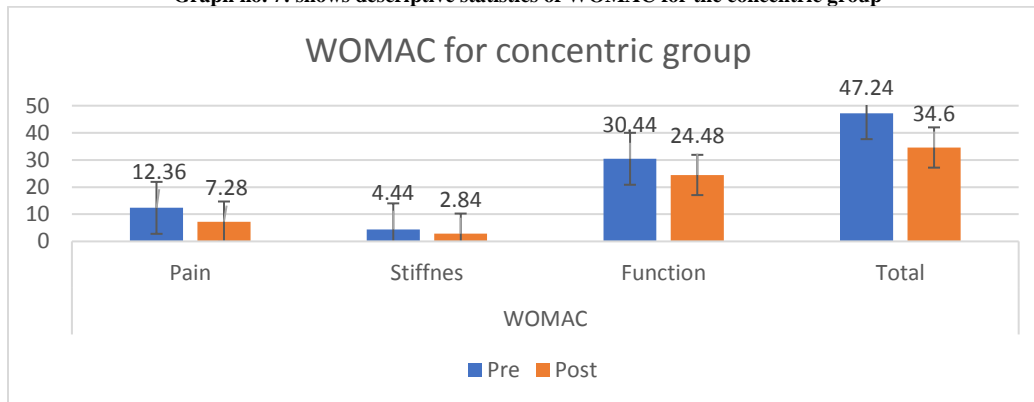


Table no. 4: Shows the descriptive statistics and t-value for Group A (Eccentric Group) and Group B (Concentric Group)

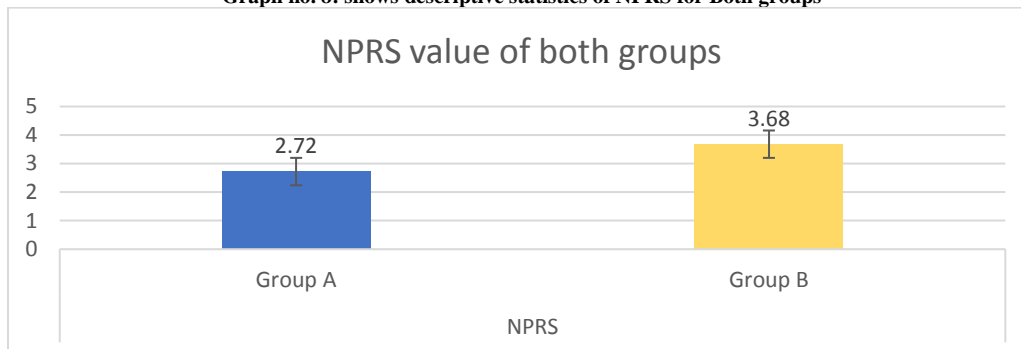
			Mean ± SD	t-Value	df	p-value
	NPRS	Group A	2.720±0.792	-3.977	24	< .001
		Group B	3.680 ± 0.802			
W O M A C	Pain	Group A	5.960± 1.369	-4.194	24	< .001
		Group B	7.280 ± 1.1			
	Stiffness	Group A	2.040± 0.790	-3.266	24	0.003
		Group B	2.840 ± 0.800			
Function	Group A	22.640± 2.271	-3.526	24	0.002	
	Group B	24.480 ± 2.201				
Total	Group A	30.640± 3.451	-4.906	24	< .001	

According to Table no. 4:

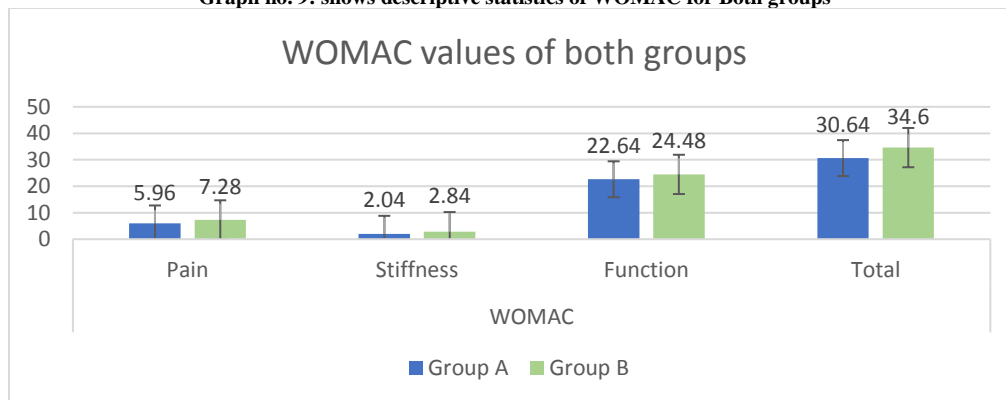
The mean value of NPRS for Group A is 2.720±0.792 while that of Group B is 3.680 ± 0.802 and the t-stat value is -3.977 with the p-value <0.001. Mean value of Pain (WOMAC) for Group A is 5.960± 1.369 and that of Group B is 7.280 ± 1.1 and the t-stat value is -4.194 with the p-value <0.001. Mean value of Stiffness (WOMAC) for Group A is 2.040± 0.790 with the value of Group B is 2.840 ± 0.8

with the t-stat value -3.266 and p-value 0.003. The mean value of Function (WOMAC) for Group A is 22.640± 2.271 whereas Group B for the same is 24.480 ± 2.201 and the t-stat value is -3.526 with the significance value 0.002. Mean value of Total (WOMAC) for Group A is 30.640± 3.451 while that of Group B is 34.6 ± 3.594 and the t-stat value is -4.906 with the significance value <0.001.

Graph no. 8: shows descriptive statistics of NPRS for Both groups



Graph no. 9: shows descriptive statistics of WOMAC for Both groups



## DISCUSSION

The aim of this study was to evaluate the effect of eccentric and concentric contraction of the

quadriceps muscle on the chondromalacia patellae and to compare the effect of both contractions so as to diagnose which type of

exercises is better for the treatment of chondromalacia patellae.

In this study, NPRS and WOMAC scale were used as outcome measures to evaluate the effect of both contraction exercises. As per this current study, there is a significant improvement in all the parameters due to eccentric type of contraction of quadriceps.

According to previous study, both eccentric and concentric contraction training sessions are helpful for building stronger quadriceps muscles, although eccentric contraction activities are more successful.<sup>[8]</sup>

As per the current census, the mean and standard value of the NPRS scale for the Eccentric group is  $2.720 \pm 0.792$  while that of the concentric group is  $3.680 \pm 0.802$  and the t-stat value is  $-3.977$  with a significance value of  $<0.001$ . So, this shows that there is a significant improvement in pain with the eccentric group of exercises.

As per the previous study, Athletes with chronic painful jumper's knee were treated with painful eccentric quadriceps training while standing on a decline board, but not with painful concentric quadriceps training. This greatly reduced tendon pain during activity and improved function.<sup>[9]</sup>

Now, considering all parameters of WOMAC scale shows a significant improvement in eccentric group compared to concentric group. The mean and standard deviation of Pain (WOMAC) for eccentric group is  $5.960 \pm 1.369$  and that of concentric group is  $7.280 \pm 1.1$  with the t-stat value  $-4.194$  and the significance value is  $<0.001$ . This shows that there is a great improvement in eccentric group of contraction as compared to concentric group.

Mean and standard deviation of Stiffness (WOMAC) for the eccentric group is  $2.040 \pm 0.790$  whereas that of concentric group is  $2.840 \pm 0.800$  and the t-stat value is  $-3.266$  and the p-value is  $0.003$ , this shows that there is a significant effect of Eccentric exercises on stiffness in chondromalacia as compared to concentric exercises.

As per previous census, eccentric and concentric contraction exercises and stretching of tight muscles (hamstrings muscles) are very important to be included in the program of treatment of chondromalacia patellae patients but there is significant improvement in eccentric group.<sup>[2]</sup>

Mean and standard deviation of function (WOMAC) for eccentric group is  $22.640 \pm 2.271$  while that of concentric group is  $24.480 \pm 2.201$  whereas the t-stat value is  $-3.526$  and the p-value is  $0.002$  which shows that there is a significant improvement in functional component of WOMAC due to eccentric contraction of quadriceps as compared to concentric contraction of quadriceps.

Previous researches show that there is great improvement in stability and function but upto a degree due to eccentric exercises. Only perform eccentric and concentric physical activity between  $0$  and  $90$  degrees of range of motion, and not more than  $90\%$ , as the patella's stability declines after  $90$  degrees and joint response force and degeneration also increase.<sup>[10]</sup>

The mean and standard deviation of Total (WOMAC) for the eccentric group is  $30.640 \pm 3.451$  whereas for the concentric group is  $34.6 \pm 3.594$  and the t-stat value is  $-4.906$  with the p-value  $<0.001$  which shows that there is a significant improvement due to eccentric group as compared to the concentric group.

According to the current study, there is a significant improvement in WOMAC and significant decrease in pain due to both types of the regime but eccentric exercises show greater improvement as compared to concentric exercises.

### Limitations

This study is subject to a small sample size, potentially limiting the generalizability of findings. Furthermore, the utilization of a limited number of outcome measures may restrict the comprehensiveness of the investigation.

### Future Recommendations

To enhance the research's comprehensiveness, it is recommended to incorporate a broader range of outcome measures. Additionally, expanding data collection to include academics from diverse regions would contribute to a more representative sample and facilitate generalizability.

### CONCLUSION

The current study concluded that both eccentric and concentric regime protocol can be added for the management of patient with chondromalacia. But eccentric regime shows results better than the concentric regime. So, we should incorporate these eccentric regimes in prescribing the exercises protocol to patients with chondromalacia.

#### Declaration by Authors:

**Ethical Approval:** Approved

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**Source of Funding:** None

**Conflict of Interest:** Authors declare no conflicts of Interest.

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