European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.2581388 Volume 5 | Issue 6 | 2019

COMPARATIVE EFFICACY OF CLOSED AND OPEN KINETIC CHAIN EXERCISES ON DEVELOPMENT OF EXPLOSIVE STRENGTH IN LOWER EXTREMITY

Arijit Putatunda[1i],
Mahendra Singh Chundawat[2]
[1]Student Activity and Sports Officer,
National Institute of Technology Patna,
Bihar, India
[2]Retd. Professor,
Department of Physical Education,
University of Rajasthan,
Jaipur, India

Abstract:
The purpose of the study is to compare the efficacy of closed and open kinetic chain exercises on development of explosive strength in lower extremity and to determine which mode of training resulted in the greatest performance enhancement. The case study incorporated randomly a total of seventy five college level players of different games, each aged between 19 to 24 years. The total seventy five players were randomly divided into equal three groups. Among these groups, two different groups were gone through closed chain kinetic and open chain kinetic exercises respectively and one group kept as control group. Progressive weight training thrice a week for 7 weeks scheduled. Necessary data was collected by administering standing broad jump performance prior to training and at the completion of the training period. Statistical technique Analysis of covariance test was applied to compare the efficacy between closed chain and open chain kinetic exercise at 0.05 level of significance, while significant changes were seen in the open kinetic chain group and close chain kinetic group. The closed kinetic chain group improved in .16 meters which was significantly more than the .08 meters seen in the open kinetic chain group. The result reveals close chain kinetic exercise mode of training resulted in the greatest strength development in lower extremity.

Keywords: closed chain kinetic exercise, open chain kinetic exercise, explosive strength, squats, lunges, leg extension, leg curl and lower extremity

1. Introduction

The term "chain" refers to the kinetic chain of the body, which simply means that all our bones and muscles are connected in a "chain" and therefore the movements we make are also part of a that kinetic chain. Our hand or foot is free to move during an open chain exercise. These types of movements tend to isolate a single muscle group and a single joint. During closed chain exercises, our hands or feet are in a constant, fixed position. In closed chain exercises multiple joints and multiple muscle groups are involved at the same time.[12] Explosive power drills are often used by athletes who need to generate a quick burst of maximal effort, such as movements required in Football, Track and Field sports, Racket sports and even Cycling. The types of exercises used to build this quick, explosive power are movements that require a maximum or near maximum power output from the athlete in a short amount of time. The goal of explosive exercise training is to ultimately move heavy weights very quickly. But to get to that point safely, without risking injury, it's important to start with light weights and slow controlled movements. Over a matter of training session (several weeks),[16] There is a considerable debate regarding the relative efficacy of open and closed kinetic chain exercise for increased strength and control of the knee muscles. The knee joint joins the thigh with the lower leg and consists of two articulations, one between the femur and tibia, and one between the femur and patella. It is the largest joint in the human body and very complicated. Human's knee supports nearly the whole weight of the body, Knee joint is very vulnerable to stress and injury. The aim of the study is to point out the best (in this respect) among the alternatives that are being studied. The final aim perhaps is not only to find the best, but also to improve it or similar objects later on. Choosing exercise is a most important aspect to impart useful training to a trainee. In the basis of this study physical education teacher, coaches, players are come to a general conclusion regarding impact of closed chain and open kinetic exercises.

2. Methodology

2.1 Research Approach

Experimental research design was adopted for the fulfillment of research approach for the study.

2.2 Sampling Technique

Random Sampling technique was used for the study.

2.3 Selection of the Subjects

75 male players of different sports were selected as subjects for this present study, each aged between 19-24 years.

2.4 Independent Variables

Closed Kinetic Chain Exercises: Selected Closed Kinetic Chain Exercises were half squats and lunges for the study.

Open Kinetic Chain Exercises: Selected Open Kinetic Chain Exercises were sited leg raise and leg curl (Hamstring curl) for the study.

2.5 Dependent Variable

Explosive Strength in Lower Extremity was considered as dependent variable for the study.

2.6 Experimental Design

Seventy five (75) players playing in Lovely Professional University, Phagwara, Punjab were selected randomly as subject for this study. Their fitness was considered according to University medical report and their age was verified by the University register. The subjects will be divided into three (3) groups viz. (a) Close Kinetic Chain Exercise group, (b) Open Kinetic Chain Exercise group (c) Control Group. Each group consisted of twenty five (25) subjects. All groups were administered initial tests on explosive strength (lower extremity) by standing broad jump test score will be recorded in number. After the initial tests, the training programme was administered to the two experimental groups whereas no training will be provided to the control group. After 7 weeks of training program again the same test administered and compares the test result with initial one.

2.7 Statistical Technique

Analysis of co-variance (ANCOVA) was applied to find out the difference among the selected training programme. For testing the hypothesis the level of significance will be set at 0.05.

Table 1: Load distribution throughout the training session [3]

1RM (one repetition maximum) check 1st time										
Flat Pyramid (2 Weeks)										
		Warm up				**Target Sets**				**Down Sets**
Load (kg)										
Repetition		5	5	5	5	5	5	5	5	5
Percentage of 1RM		30	50	60	70	80	84	84	84	80
Ascending Pyramid (3 Weeks)										
		Warm up				**Target Sets**				
Load (kg)										
Repetition		6	6	6	6	6	6	4	2	1
Percentage of 1RM		30	50	60	70	80	85	90	95	100
1RM check 2nd time										
Double Pyramid (2 Weeks)										
Double Pyramid (Version 1)										
	Warm up	**Target Sets**								
Load (kg)										

Repetition	3*15/5	4	3	2	1	1	2	3	4	
Percentage of 1RM	30	80	85	90	95	95	90	85	80	
Double Pyramid (Version 2)										
	Warm up	**Target Sets**								
Load (kg)										
Repetition	3*15/5	2	2	2	2	2	2	2	2	
Percentage of 1RM	30	80	85	90	95	95	90	85	80	

3. Discussions of Findings

The data was analyzed and compared with the help of statistical procedure ANCOVA and finding reflected in the form of following tables.

Table 1: Mean and SD of different groups measured in post testing

Treatment Group	Mean	Std. Deviation	N
Close Chain Kinetic Exercise group	2.4380	.17452	25
Open Chain Kinetic Exercise group	2.3908	.14765	25
Control Group	2.2740	.16281	25
Total	2.3676	.17425	75

Descriptive statistics of the data measured in the post testing shown in table 1, the mean and standard deviation of the different treatment group during post testing which going to be used in writing the final results of this study.

Table 2: Adjusted mean and standard error of different groups in post testing

Treatment Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Close Chain Kinetic Exercise group	2.448[a]	.011	2.426	2.470
Open Chain Kinetic Exercise group	2.367[a]	.011	2.345	2.389
Control Group	2.288[a]	.011	2.265	2.310

Descriptive statistics of the data measured in the post testing after adjustment with the initial difference. The mean and standard deviation showed in table 2 which going to be used for writing the final result using SPSS outputs.

Table 3: ANCOVA table for the post test data on standing broad jump performance

Source	Type I Sum of Squares	df	Mean Square	F	Sig. (p-value)
Pre Test	1.704	1	1.704	546.590	.000
Treatment Group	.322	2	.161	51.657	.000
Error	.221	71	.003		
Corrected Total	2.247	74			

ANCOVA table for the post-test data on standing broad jump performance shown at table no 3. The main analysis of covariance table the significance value has been named as p-value is used instead of the term significant value. Post hoc comparison for the group means in post-measurement adjusted with the initial differences since the F-ratio

in the above mentioned table is significant. Table 3 clearly shows the F-value for comparing the adjusted means of the treatment groups (Closed chain kinetic exercise, open chain kinetic exercise and control) during post-testing. Since p value for the F-statistics is .000 which is less than 0.05, it is significant. Thus, the null hypothesis of no difference among the adjusted post- means for the data on standing broad jump performance in the treatment group may be rejected at 5% level.
Since F-statistics is significant, post hoc comparison has been made for the adjusted means of the three groups which shown table 4.

Table 4: Pair-wise comparisons

Dependent variable: Post-testing score of standing broad jump			
Treatment Group (I)	**Treatment Group (J)**	**Mean Difference (I-J)**	**Sig.[b]**
Close Chain Kinetic Exercise group	Open Chain Kinetic Exercise group	.081*	.000
	Control Group	.160*	.000
Open Chain Kinetic Exercise group	Close Chain Kinetic Exercise group	-.081*	.000
	Control Group	.079*	.000
Control Group	Close Chain Kinetic Exercise group	-.160*	.000
	Open Chain Kinetic Exercise group	-.079*	.000

Note: The mean difference is significant at the 0.05 level.

It may be noted here that p-value for the mean difference treatment between close chain kinetic exercise, open chain kinetic exercise and control group in all aspects is 0.000 which is less than0.05 and hence they are significant at 5% level.[6] Thus the following conclusion can be drawn:

1) There is a significant difference between the adjusted means of the closed chain kinetic exercise and control groups on the data of standing broad jump performance during post testing.
2) There is a significant difference between the adjusted means of the open chain kinetic exercise and control groups on the data of standing broad jump performance during post testing.
3) There is a significant difference between the adjusted means of the open chain kinetic exercise and closed chain kinetic exercise groups on the data of standing broad jump performance during post testing.

Table 5: Post hoc comparison of adjusted means of the data on standing broad jump performance obtained in post measurement shown in graphics

Control Group	**Open chain kinetic exercise group**	**Close chain kinetic exercise**
2.288	2.367	2.448

" " "Representation on significant difference between means.

In order to find as to which treatment is the best, one can see the adjusted mean values of different treatment groups during post testing given in table 2. Clubbing these

adjusted means with the three conclusions mentioned above, one may get the answer. However, this task became much easier if table 5 is created. In this table, the adjusted post-means of different group have been written in descending order. If the difference between any two group means is significant (which can be seen from table 4), nothing is done if the mean difference is not significant, a line is drawn under the two groups. Thus, it may be concluded that the standing broad jump performance of the three different groups are not equal. Open chain kinetic exercise group have been performed better than control group and close chain kinetic exercise group have been performed better than open kinetic chain group.

Hence, it may be inferred that close chain kinetic and open chain kinetic exercise are not equally effective, closed chain exercise is much more effective in enhancement the standing broad jump performance among the subjects in comparison to that of the open chin exercise group. Open chain kinetic excise is also effective in enhancement of the standing broad jump performance among the subjects in comparison to that of the Control group.

4. Conclusions

This kind of a study is helpful in terms of practical application for coaches and sport researchers. In-season testing can provide coaches with useful information about the players workout ability and characteristics so that they could place them member in specific training for better performance as individual or as a team in a competition. The result shows a significant difference among these two training program in terms of close chain kinetic workout and open chain kinetic workout which improve proper training, reduce unnecessary workload, prevent from unwanted injury. In terms of injury prevention open chain exercises for the hamstrings produce a posterior shearing force and stress at PCL and quadriceps produces an anterior shearing force and stress at ACL, which increased ACL stress near full extension and PCL stress near 90 degrees knee flexion.[8] More specifically open kinetic chain means that the tibia is moving upon a fixed femur, such as in a leg extension or leg curl. There is no force being applied under the foot, therefore, the chain is “open”. closed kinetic chain means the femur is moving upon a fixed tibia, with the ground or other support (such as a step or leg press platform) under the foot, so the chain is closed.[7] When the chain is closed, the integrity of the joint is more stable. Joint compression forces between the femur and tibia are higher, which keeps the femoral condyles seated properly in relation to the medial and lateral meniscus. The quadriceps and hamstrings are co-contracting, decreasing the shearing forces on the meniscus and articulating cartilage, and with proper technique, shearing forces to the posterior patella are minimized.[10] Researcher can conclude that close chain kinetic exercise mode of training resulted in the greatest strength development in lower extremity and minimize the chances of unwanted injury.

References

McGinnis Peter, (2004). "Biomechanics of Sports and Exercise" 2nd ed.: Human Kinetics.

Hall Susan J., (1991). "Basic Biomechanics", 2nd ed.: California: McGraw Hill Companies.

Bompa O. Tudor, Gregory Haff G., (2015) "Periodization", Human Kinetics Publication, PP.279-281.

Barrow L.J. & Jack K.N., (1988) Practical Measurement for Evaluation in Physical Education. (3rd Edition) New Delhi Surjeet Publication.

Verma J.P., (2013). Data Analysis in Management with SPSS Software, Springer India.

Putatunda A., (2012). Impact of Close Chain and Open Chain Kinetic Exercise on Knee Joint: A Review Synthesis, Futuristic Trends in Physical Education, Twenty first century publication, Vol. 1, pp. 75-77.

Baruah; et al., (2016). A comparative study on effectiveness of open versus closed kinetic chain exercises to improve gait in spastic diplegic cerebral palsy, Int J Physiother. Vol 3(2), pp.193-196.

Verma S., (2012). Comparing open kinetic chain with closed kinetic chain exercise on quadriceps strength and functional status of women with osteoarthritic knees, Medicina Sportiva, vol VIII, no 4, pp. 1989-1996.

Shah & Raman, (2013). Influence of Closed Chain Vs Open Chain Exercises in Patients with Chronic Ankle Arthritis, Journal of Medical Thesis.

Bubanj et al., (2012). Difference in the explosive strength of lower extremities between athletes and non-athletes: a preliminary study, Physical Education and Sport Vol. 10, No 4, Special Issue, pp. 297 – 303.

Joseph M. Horrigan, D.C., Leg Extensions vs. Squats, http://www.ironmanmagazine.com/leg-extensions-vs-squats, Retrieved on 2.01.2019.