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The Effect of Copenhagen Adduction Exercise on Groin pain in amateur Foot Ball Players: Randomized Controlled Trial

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Abstract:

Background and Purpose: Groin strain is an injury to the muscle- tendon junction unit that produces pain on palpation of adductor tendons and on resistance testing of the adductor muscle group. Groin strain results from putting to much stress on muscles of groin. If these muscles are tensed forcefully they can get over-stretched or torn. Groin pull are common in people who play sports such as running and jumping where Sudden jumping or changing direction is a likely cause. The aim of this study was to evaluate the effect of Copenhagen adduction exercise in amateur football players with longstanding groin pain.

Design: Randomized pretest, post-test control group design.

Methods: 56 subjects with longstanding groin pain who fulfilled the inclusion and exclusion criteria were selected for the study and 28 subjects were randomly assigned to each of the two groups. Group A received Copenhagen adduction exercise and group B received Conventional training along with Copenhagen adduction exercise the duration of the Treatment is for a period of 8 weeks. Pre-test and post- test evaluation included HAGOS, OSLO, McGill questionnaire and Dynamometer.

Results: HAGOS- when comparing between groups the post-test mean of HAGOS for Group A showed increment from 56.24 to 74.97 and group B was 48.23 to 52.16 which was statistically significant i.e. $p<0.001$.

Keywords: Groin pain, Copenhagen adduction exercise, conventional training.

1. INTRODUCTION

An adductor strain is defined as an injury to the muscle-tendon unit that produces pain on palpation of the adductor tendons or its insertion on the pubic bone with or without pain during resisted adduction.

Adductor related groin pain is the most common groin injury among soccer players and low hip adduction strength represent a risk factor for groin injury in soccer. Low-level of adductor muscle strength has been linked to the possibility of suffering an injury where the muscle strength ratio between adduction and abduction has been reported as important intrinsic risk factor that cause groin injuries.

Adductor muscle strains can result in missed playing time for athletes in many sports. Adductor muscle strains are frequently encountered in ice hockey and soccer. These sports require a strong eccentric contraction of the adductor musculature. The adductor longus is the most commonly injured muscle and accounts for 62%to 90%of cases. It is hypothesized that this occurs due to its low tendon to muscle ratio at the origin.

The Risk factors include previous hip or groin injury, which is likely the greatest risk, as well as age, weak adductors, muscle fatigue, decreased range of motion, and inadequate stretching of the adductor muscle complex. The ratios between Eccentric hip adduction (EHAD) and eccentrichipabduction (EHAB)

also impact on injury risk. An EHAD: EHAB ratio between 1.25 and 1.6 is thought to reduce injury risk to foot ballers.

Players with weak core stability are also at an increased risk of suffering from groin strain, if the "core" is weak its influence can be seen on the lower extremity mechanics and its performance. The lumbar, pelvis, and hip region together are considered to be the core of the body and are collectively called the lumbo pelvic hip complex (LPHC). In foot ball this "core" is responsible for preventing stretch or tear of adductor muscles as well as abdominal muscles

Football is a sport characterized by a continuous increase in athletic commitment and intensity where pelvis and hip are subjected to considerable biomechanical stresses. Therefore acute and chronic groin and hip injuries are very common among soccer players.

The groin pain is classified into 3- adductor related, iliopsoas related, inguinal related, pubic related, hip related and other causes.6 Muscle injury can represent more than 40% of total injuries in football. Hip adductor muscle injuries are the second most frequent acute groin injuries in athletes. Adductor related injuries constitute 64-69% of all groin injuries.

According to NCAA sports during the 2009-2010 through 2013-2014 academic years 1984 hip/groin injuries were reported, where overall hip injury rate resulted of 53.06 per 100,000 AEs. The annual incidence of hip/groin injuries increased every academic year, starting at315 injuries in 2009-2010 and rising to 495 injuries in 2013-2014. The most commonly reported injuries were an adductor/groin tear (n = 486), hip flexor tear (n = 365), iliopsoas/sartorius tear (n = 252), and internal rotator/groin tear (n = 185). The sports with the highest rates of hip injuries per 100,000 AEs were men‟s soccer (110.84), mens ice hockey (104.90), and women's ice hockey (76.88). Although most hip injuries occurred during practices (66.83%) versus games (33.17%), the overall rate of injuries during games was significantly higher (RR, 2.18 [95% CI, 1.99-2.39]). In sex-comparable sports (basketball, cross-country, lacrosse, ice hockey, indoor track, outdoor track, soccer, swimming and diving, and tennis), hip injury rates per 100,000 AEs differed greatly, with men being affected more than women (59.53 vs 42.27, respectively; RR, 1.41 [95% CI, 1.28-1.55]).Additionally, women had a similar rate of hip injuries per100,000 AEs in competition versus practice (42.17 vs 42.30, respectively; RR, 1.00 [95% CI, 0.82-1.21]), whereas men were much more likely to get injured in competition than during practice (138.91 vs 44.22, respectively; RR, 3.14 [95% CI, 2.82-3.50]).

Flexibilitydeficit has been identified as a relevant factor in the occurrence of muscle injuries. It has also been observed that adductor ruptures or tendinopathies are related to a decreased hip abduction range for these athletes.

The Copenhagen adduction (CA) exercise is a non-equipment eccentric training exercise designed to strengthen both the hip abductors and adductor muscles and to optimize asymmetries between these muscles. The Copenhagen Adduction exercise (CA) has demonstrated high activation of the adductor longus muscle, as well as considerable eccentric adduction strength. In terms of prevention programs that are performed on adductors, there are studies that point to the Copenhagen adduction exercise (CAE) as an important exercisein injury prevention. CAE is a non-equipment eccentric exercise proposed for strengthening the adductor and abductor hip muscles to optimize the control of asymmetries.

OBJECTIVE OF THE STUDY:

To evaluate the significant difference in effectiveness between Copenhagen adduction exercise and Conventional therapy on chronic groin injuries among amateur football players.

MATERIALSANDMETHODS:

MATERIALS: Stopwatch, Wobble board, Soccer ball, Dynamometer, Pen, McGill Pain Questionnaire Chart, HAGOS Scale Chart, OSLO chart.

Source of Data:

For the purpose of data collection 56 male football players within the age group of 15-25 years with longstanding groin pain since 3 months in the Department of Physiotherapy or referred to the Department of Physiotherapy in Navodaya Medical College, Hospital and Research Center, Raichur were selected.

Research design: Randomized pre-test-post-test Control group design

Setting of the study: Navodaya Medical College, Hospital and Research Centre, Raichur, which is 1200 bedded Multispecialty Hospital with fully equipped Orthopaedic Physiotherapy Department.

Variables

Independent variables: Copenhagen adduction exercise, Conventional training

Dependent variables: The Hip and Groin Outcome Score Scale, McGill Questionnaire, Dynamometer, Oslo sports trauma research centre overuse sports injury questionnaire.

Sample and sampling Techniques:

Men (15 to 25 years) with clinical diagnosis of Groin Strain attending the physio therapy department were selected for the study.

These subjects were allocated in to two groups using simple random sampling technique. Total sample consists of 56 subjects with Groin strain.

Group A: Copenhagen Adduction exercise with conventional training. Group B: Conventional training.

INCLUSION CRITERIA: Athletes aged between 15 to 25 years, Gender- Male athletes, Athletes who have had longstanding groin pain since 3 months, Athletes who didn't include Copenhagen adduction exercise in their training protocol.

METHOD OF COLLECTION OF DATA: Study consists of 56 subjects within the age group of 15-25 years. The subjects were screened for inclusion and exclusion criteria and those who fulfilled the criteria were considered for the study.

MeasurementTools:

Pain was assessed by MC Gill Pain Questionnaire , Strength of the adductors muscles was assessed using a hand-held dynamo meter, Symptoms, pain, activities of daily living & participation in activities, quality of life, physical function in sports and recreation was assessed by HAGOS,OSLO was used to record the magnitude, symptoms and consequences of overuse injury in sport.

PROCEDURE:

GROUP A: 28 subjects received Copenhagen adduction exercise along with Conventional Therapy. Treatment protocol include:

Warmup-Usingstationarybicyclefor10min at25kmph,

Forward jumping – Subject stood with his feet together and his knees slightly bent. He jumped forward, landed with his both feet together and his legs in a slightly squat position.

He springs back, landing on the spot he started on. It was made sure that he landed lightly on the balls of his feet, controlling the landing between jumps.

Running with the pushing leg forward- Subject stood with his feet hip-width apart. Engaging his core, he took a big step forward with his right leg. Starts to shift this weight forward so that the heel hits the floor first. Subject then lowers his body until right thigh is parallel to the floor and right shin is vertical. It's been made sure that the knee doesn't go past the right toe. Subject then pressed into his right heel to drive back up to starting position. It was repeated on the other side.

Static stretching for 5 mins

Quadriceps stretching: Subject grabbed hold of one ankle with his hand from the same side. Tightened his stomach muscles to prevent his back from arching. Then he extended his thigh backwards, bend his knee and bring his ankle up towards his butt. It was made sure that he keeps his knee aligned with his hip by keeping his ankle in the same line as his hip, rather than angled outward or inward towards his body. He should feel the stretch in the front of his thigh.

Hamstring stretching: Subject placed his one leg on a low stool with his hips and feet facing forward. Then he leaned forward from his hips, keeping his back flat and knee straight until he feels a stretch in the back of his thigh.

Neck stretching: Subject bends his head forward and slightly to the right. With his right hand, gently pulled his head downward. Till a stretch is felt on the back side of his neck. Hold for about 30 seconds. The stretch was repeated on the opposite side.

Torso stretching: Patient stood with his feet facing forward, as wide as his shoulders, and his arms by the side with a 90-degree bent in the elbows. Then he kept his feet in the same position and in a controlled manner, twists his torso from one side to the other. It was made sure that he does not force the movement.

Dynamic stretching for 10 mins-

Walking knee hugs: Subject stood tall with his legs straight and arms hanging by the side. Then he kicked one knee up as high as possible. Then grasped it with both hands and gently pulled the knee slightly higher hugging it to the body. Slowly he lowered to repeat with the opposite side and with each step subject moved forward slightly.

Lateral lunges: Subject stood with his feet hip- width apart. Then he took a big step with his left leg, then bent his left knee and pushed hips back and lowered until his knee was bent to 90*. Then he pushed back to start again.

Copenhagen adduction exercise: This exercise was performed in the side- lying position, the lower forearm was used as support on the ground while the other arm was placed along the body. The upper leg was held in approximately the height of the hip of the partner, who held the leg with one hand supporting the ankle and the other supporting the knee. One repetition was performed as the subject lifts the body in a 3-s concentric hip adduction movement until the body reaches a straight line, while simultaneously adducting the lower leg so that the feet touch each other. This was followed by a 3-s eccentric adduction where the body was lowered halfway to the ground while the foot of the lower leg was lowered until it just touches the ground without using it for support.

Cool down exercises: Similar hamstring, quadriceps, torso and neck stretching as mentioned in Warm-up were performed. Frequency and Duration: 4 days per week for 8 weeks

CONVENTIONAL THERAPY: GROUP B: 28 subjects received Copenhagen adduction exercise along with Conventional Therapy.

Treatment protocol include: As the above mentioned Group A the group B also includes same Warm-up &Cool-down exercises,

Regular training protocol -Adductionfor30secagainst soccer ball placed between feet lying supine with knee extended.

Adduction for 30 sec against soccer ball placed between feet lying supine with hip flexed45*.

Wobble board for 5 min.

Adductor lateral slide, Forward slide, Side lying adductor, Prone on couch hips at edge at 90* flexion and feet's on floor both hips are slowly extended, Standing adduction with ankle pulley, 100m run with 10m acceleration and deceleration phases with 6-8 reps, Lateral running.

RESULTS:

Table 1: Age distribution between two groups

Group		N	Mean	Std deviation	Std error Mean	T test	P value
AGE	Treatment group	28	21.3571	2.32879	0.44010	0.593	0.555
	Conventional group	28	20.9286	3.02983	0.57258		

Above table shows mean and standard deviation of age in treatment group which is 21.36□2.33. Mean and standard deviation of age in conventional group is 20.93 3.03. There is no statistical significance foundbetweenthetreatmentgroupandcontrolgroupinagei.e.pvalue=0.55whichis p>0.005.

Table 2: Intra group comparison of Pre test and Post test scores of HAGOS, OSLO, McGill Questionnaire and Dynamometer in treatment group.

Treatment group		Mean	N	Std deviation	Std error Mean	T test	P-value
HAGOS	PRETEST	56.24	28	10.064	1.90193	22.553	<0.001
	POST TEST	74.97	28	10.331	1.95238		
OSLO	PRETEST	71.88	28	10.962	2.07169	27.271	<0.001
	POST TEST	31.32	28	9.876	1.86460		

MC GILL questionnaire	PRETEST	73.89	28	9.726	1.83810	30.478	<0.001
	POST TEST	38.04	28	11.644	2.20056		
Dynamometer	PRETEST	16.39	28	1.499	0.28331	25.117	<0.001
	POST TEST	19.57	28	1.501	0.28372		

Above table shows pre- test mean of HAGOS which is 56.24± 10.06 and post- test is 74.97□10.33 in treatment group which is statistically significant i.e. p<0.001.Pre- test mean of OSLO is 71.88±10.96 and post- test is 31.32□9.87 which is statistically significant i.e. p<0.001, Pre- test mean of McGill Questionnaires 73.89 ± 9.73 and post-test is 38.04 11.64 which is found to be statistically significant i.e. p<0.001. Pertest mean of Dynamo meteris 16.39 ± 1.50 and post testis 19.57 1.50 which is found to be statistically significant i.e. p<0.001.

Table 3: Intra group comparison of pretest and post test scores of HAGOS, OSLO, McGill Questionnaire and Dynamometer in conventional group.

Conventional group		Mean	N	Std deviation	Std error Mean	T test	P-value
HAGOS	PRETEST	52.23	56	11.39988	1.52337	10.358	<0.001
	POST TEST	63.57	56	15.47612	2.06808		
OSLO	PRETEST	65.21	56	12.13140	1.62113	8.070	<0.001
	POST TEST	43.66	56	15.58541	2.08269		
MC GILL questionnaire	PRETEST	63.48	56	14.57529	1.94770	8.324	<0.001
	POST TEST	44.22	56	12.61082	1.68519		
Dynamometer	PRETEST	15.25	56	1.97484	0.26390	14.483	<0.001
	POST TEST	17.45	56	2.72310	0.36389		

Above table shows pre test mean of HAGOS which is 52.23 ± 11.40 and post test is 63.57 15.48 which is found to be statistically significant i.e. p<0.001. Pre test mean of OSLO is 65.21 ± 12.13 and post test is 43.66□15.58 which is found to be statistically significant i.e. p=0.001. Pre test mean of McGill Questionnaire is 63.48 ± 14.57 and post test is 44.22□12.61 which is found to be statistically significant i.e. p<0.001.Pre test mean of Dynamometer is 15.25 ± 1.97 and post- test is 17.45 □2.72 which is found to be statistically significant i.e. p<0.001

Table 4: inter group comparison of pre test and post-test scores of HAGOS in treatment and conventional group.

Group			N	Mean	Std deviation	Std error Mean	T test	P-value
HAGOS	PRETEST	Treatment Group	28	56.24	10.06409	1.90193	2.789	0.007
		Conventional Group	28	48.23	11.40664	2.15565		
	POST TEST	Treatment Group	28	74.97	10.33100	1.95238	8.168	<0.001
		Conventional Group	28	52.16	10.56079	1.99580		

Above table shows the pre test mean of treatment group which is 56.24 □10.06 with a standard error of 1.90 and conventional group is 48.23 11.41 with a standard error of 2.16.The post test mean of treatment group showed an increment to 74.97 10.33 with a standard error of 1.95 and control group to 52.16 □10.56 with a standard error of 1.99 which is found to be statistically significant i.e. p<0.05 for HAGOS scale between the treatment and conventional group.

Table 5: inter group pre-test and post-test scores of OSLO in treatment and conventional group

Group			N	Mean	Std deviation	Std error Mean	T test	Pvalue
OSLO	PRETEST	Treatment Group	28	71.88	10.96233	2.07169	4.901	<0.001
		Conventional Group	28	58.54	9.34408	1.76587		
	POST TEST	Treatment Group	28	31.32	9.86651	1.86460	9.768	<0.001
		Conventional Group	28	56.00	9.02669	1.70588		

Above table shows the pre-test mean of treatment group which is 71.88 10.96 with standard error of 2.36 and conventional group is 58.54 9.34 with standard error of 1.77. The post- test mean of treatment group is 31.32 9.87 with a standard error of 1.86 and conventional group is 56 9.03 with standard error of 1.71 which was found to be statistically significant i.e. $p<0.005$ for OSLO between the treatment and conventional group.

Table 6: Inter group comparison of pre- test and post- test scores of McGill Questionnaire in treatment and conventional group

Group			N	Mean	Std deviation	Std error Mean	T test	P-value
MC Gill questionnaire	PRE TEST	Treatment Group	28	73.89	9.72630	1.83810	7.637	<0.001
		Conventional Group	28	53.07	10.65134	2.01291		
	POST TEST	Treatment Group	28	38.04	11.64425	2.20056	4.181	<0.001
		Conventional Group	28	50.40	10.44764	1.97442		

Above table shows the pre-test mean of treatment group which is 73.89 9.73 with standard error of 1.84 and conventional group is 53.07 10.65 with standard error of 2.01. The post- test mean of treatment group is 38.04 11.64 with a standard error of 2.20 and conventional group is 50. 40 10. 45 with standard error of 1.97 which was found to be statistically significant i.e. $p<0.005$ for Mc Gill Questionnaire between the treatment and conventional group.

Table 7: Inter group comparison of pre- test and post- test scores of Dynamometer in treatment and conventional group

Group			N	Mean	Std deviation	Std error Mean	T test	P-value
Dynamometer	PRE TEST	Treatment Group	28	16.39	1.49912	0.28331	5.286	<0.001
		Conventional Group	28	14.11	1.72861	0.32668		
	POST TEST	Treatment Group	28	19.57	1.50132	0.28372	9.387	<0.001
		Conventional Group	28	15.32	1.86694	0.35282		

Above table shows the pre-test mean of treatment group is 16.39 1.50 with standard error of 0.28 and conventional group is 14.11 1.73 with standard error of 0.33. The post- test mean of treatment group is 19.57 1.50 with a standard error of 0.28 and conventional group is 15.32 1.87 with standard error of 0.35

which was found to be statistically significant i.e. $p<0.005$ for Dynamometer score between treatment and conventional group.

DISCUSSION

The groin pain is classified into 3- adductor related, iliopsoas related, and inguinal related, pubic related, hip related and other causes. Groin strain results from 1 putting too much stress on muscles of groin. If these muscles are tensed forcefully they can get over-stretched or torn. Groin pull are common in people who play sports that require running and jumping. Sudden jumping or changing direction is a likely cause.

The principle aim of this randomized control trial was to evaluate the effect of Copenhagen adduction exercise on groin pain in amateur foot ball players. In this study 56 subjects with groin pain were included which were divided in 2 groups, Group A (Copenhagen adduction exercise + conventional physiotherapy exercises) and Group B (Conventional exercises).

HAGOS was used to measure the ability to participate in physical activity affected by groin problems, OSLO was used to measure the symptoms and consequences of overuse injuries, McGill Questionnaire was used to measure the pain intensity and hand-held dynamometer was used to measure the strength of adductor muscles treatment was given 4 times a week for 45 mins for a period of 8 weeks. The collected data was analysed by means of various statistical tool via mean, standard deviation and unpaired t test. 8 weeks of Copenhagen adduction exercise led to a significant improvement in HAGOS, OSLO, McGill questionnaire and hand-held dynamometer.

In the present study the results indicate that Copenhagen Adduction exercise is a viable option for groin pain in football players. Subjects who received Copenhagen adduction exercise showed an increment in HAGOS to a mean of 74.97 post training which was 56.24 before training. The OSLO score decreased to a mean of 31.32 which was 71.88 before training. Also, the McGill Questionnaire showed a decrement in mean to 38.04 from 73.89 in the treatment group. Hand-held dynamometer values increased to mean of 16.39 to 19.57 post- test.

The Copenhagen adduction (CA) exercise is a non equipment eccentric training exercise designed to strengthen both the hip abductors and adductor muscles and to optimize asymmetries between these muscles. The Copenhagen Adduction exercise (CA) has demonstrated high activation of the adductor long us muscle, as well as consider able eccentric adduction strength. Interms of prevention programs that are performed on adductors, there are studies that point to the Copenhagen adduction exercise (CAE) as an important exercise in injury prevention. The reason why CA exercises are more effective than resistance exercises is because they are done in a side plank position which directly involves the core muscles. This gradually increases the core stability and strength which is inversely related to groin strains, thus decreasing the intensity of groin pain along with increasing the eccentric hip adductor strength.

Control group which received conventional management for groin pain also showed an improvement in HAGOS scores from pre-test mean of 52.23 to 63.57. OSLO score showed a reduction in mean from 65.21 to 43.66. The McGill Questionnaire showed a decrement in mean from 63.48 to 44.22 in the conventional group. The conventional group also showed a significant difference in the mean results. The result of the study correlates with a systematic review done by David Sadigursky, Juliana Almeida Braid, Diogo Neiva Lemos De Lira et al (2017): To evaluate the efficacy of the FIFA 11+ injury prevention program for soccer players. It was a meta- analysis based on 6 studies which were all randomized control trial. It was concluded in the study that FIFA 11+ program reduced the risk of injuries in soccer players. In this study, the inter group comparison between the treatment group and conventional group showed a significant difference in all the four scales, however when the mean of both the groups were compared, treatment group was found to be more effective.

The results showed a higher significant difference in all the four scales. The result of this study correlates with a randomized control trial done by Hardy J, Thorborg K, Hölmich P, et al (2017): To investigate the effect on eccentric hip adduction strength of the FIFA 11+ warm-up programme with or without the Copenhagen Adduction exercise. After 8 weeks of intervention, study concluded that including the Copenhagen Adduction exercise to the FIFA 11+ programme increases eccentric hip adduction strength, while the standard FIFA 11+ programme does not.

Another randomized control trial conducted by L. Ishoi, C.N. Sorensen et al (2015): To examine the eccentric strength gain using Copenhagen Adduction exercise in- season. After 8 weeks of progressive training in addition to usual training intervention, there sults of the study concluded that Copenhagen adduction program shows significant increase in EHAD, EHAB and EHAD/EHAB ratio.

This result indicates significance between group differences for conventional training and treatment group favouring the treatment group over conventional training for subjects with groin pain. Hence, the result

of this study showed that both Copenhagen adduction exercise and conventional training exercises given to both the groups showed improvement in HAGOS, OSLO, MPQ, and Dynamometer which revealed that the applied exercises had a positive effect on improving groin pain in subjects with long standing groin pain in amateur football players. However, Copenhagen adduction exercise when combined with conventional training showed better results in improving groin pain in amateur football players.

CONCLUSION

This study concluded that both Treatment group and Conventional group showed improvement in pain in patients with longstanding groin pain. However, when the mean values were compared at the end of 8 weeks, Copenhagen adduction exercise with conventional therapy had shown highly significant results in improving the groin pain in subjects with groin injury in amateur foot ball players.

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