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Electromyographycal Analysis of Vastus Lateralis, Vastus Medialis and Rectus Femoris Muscle during Toe Touch in Kabaddi

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Abstract

PURPOSE – The purpose of the study was to analyze the EMG activity of the quadriceps muscle group during the toe touch in Kabaddi.

SUBJECT - twelve male inter university/national level Kabaddi players were selected as subjects for the study. The age of subjects ranged from 18-25 years.

METHODOLOGY- To measures Quadriceps muscles EMG activities during toe touch in Kabaddi was measured by NEURO TRACK MYO PLUS 2/4. The data was recorded in micro volt (μv). The collected data was analyzed statistically using descriptive statistics.

RESULT - the mean and S.D of toe touch performance was 7.50 & .74. **In case of leading leg**: the mean and S.D of all muscles were following; Vastus Lateralis muscle have the highest muscle activation with mean and S.D 381.41 & 26.58 followed by Vastus medialis have 247.84 & 32.09, Rectus femoris have 328.16 & 40.80. **In case of trailing leg:** mean and S.D of all muscles were following; Vastus medialis muscle have the highest muscle activation with mean and S.D 446.65 & 61.54, Rectus femoris have 370.85 & 35.44 Vastus Lateralis have 410.31 & 56.18.

CONCLUSION:, the Vastus Lateralis muscle showed the highest activation In the leading leg, while the Vastus Medialis muscle showed lower EMG activation. This could indicate that in the leading leg, athletes may rely more on lateral stability of the knee during toe touch in Kabaddi.

In the trailing leg, which bears the body weight during the toe touch maneuver, the Vastus Medialis muscle showed the highest activation. This is not entirely surprising as the Vastus Medialis muscle is responsible for stabilizing the patella and medial stability of the knee joint, and therefore plays an important role in supporting the body weight in this position

Keywords: Electromyographical Analysis, EMG, Toe Touch, Kabaddi, Quadriceps Muscles

INTRODUCTION

Kabaddi is a highly competitive sport that originated in ancient India and has gained global recognition in recent years. It requires a combination of physical strength, agility, and quick movements to outmaneuver opponents and score points. One of the critical skills in Kabaddi is the toe touch maneuver, which involves players touching the ground with their toes and then quickly jumping back up while avoiding being tackled by the opposing team. The execution of this skill requires the coordinated effort of several muscle groups, including the quadriceps group, which plays a vital role in providing the necessary power and stability for the movement.[Yallappa, M. 2020]

To better understand the muscle activation patterns and recruitment strategies involved in the execution of the toe touch skill in Kabaddi, electromyographical (EMG) analysis of the quadriceps muscle group can be conducted. EMG analysis measures the electrical activity generated by muscle contractions and provides insights into the neuromuscular control of movement. To execute the toe touch skill effectively, various muscle groups must work in harmony, producing the necessary force and coordination to complete the movement.[Hubley-Kozey, C. L. 2000]

EMG analysis is a valuable tool in understanding the mechanics of the toe touch skill in Kabaddi. EMG analysis of the toe touch skill in Kabaddi has the potential to provide valuable information about muscle activation patterns and recruitment strategies used by Kabaddi players. This information can be used to develop training programs that target specific muscles, improve muscle activation patterns, and enhance overall performance. Additionally, EMG analysis can provide insights into the biomechanics of the toe touch maneuver, such as the optimal foot position, angles, and timing for maximum efficiency.[Kumaravelu,]

The quadriceps group comprises four muscles located in the anterior thigh: the rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius. These muscles are responsible for extending the knee joint and providing stability during weight-bearing activities such as running, jumping, and landing. In the toe touch maneuver, the quadriceps group is essential in generating the necessary power for the jump back up and maintaining balance during the landing. Several studies have examined the EMG activity of the quadriceps group during various movements in sports such as soccer, basketball, and volleyball. However, there is limited research on the EMG activity of the quadriceps muscle group during the toe touch maneuver in Kabaddi. Understanding the muscle activation patterns of the quadriceps group during the toe touch maneuver can provide insights into the effectiveness of the movement and identify specific areas for improvement in training. This information can be used to optimize training programs and enhance performance outcomes. [Gilbey, H., & Ackland, T. 2018]

Objective of the study

The objective of this research paper was to analyze the EMG activity of the quadriceps muscle group during the toe touch in Kabaddi.

Selection of subject

For the purpose of the study twelve male inter university/national level Kabaddi players were selected as subjects for the study. The age of subjects ranged from 18-25 years. All subjects were selected from Uttar Pradesh for the study.

Procedure

Proper time was given to the subjects for general warm-up as well as for specific warm up. Each subject was repeatedly performed the toe touch. Site preparation for the Electrode– Interface included shaving of the area, and cleaned by an isopropyl alcohol soaked pad. The skin preparation was elicit a slight histochemical effect.

After the placement of surface electrode (Ag/AgCl) on selected muscle, subjects were get the brief and explanation and demonstration of skill, electrode points were marked in the presence of specialized person and then subject were allowed to take practice trail in order to get familiar with the test. During the execution of toe touch technique, the body weight was on the rear leg for easy extension of the attacking leg. Raider's shoulder was towards sideline or midline. The momentum was towards the midline, to maintain balance; the body was in a crouch position, leaning toward the midline. The knee joints and ankle joint was extended to cover more distance and touch the anti with inner portion of the toe. The hand was kept free with flexed elbows aside the chest to maintain balance and for the raider to defend himself from the antis in the cover position. After execution this skill raider was withdraw his leg immediately to avoid an ankle hold by the antis.

Method: In Criterion measures Quadriceps muscles, muscles activities during toe touch in Kabaddi was measured by NEURO TRACK MYO PLUS 2/4 operated by the investigator during

the performance of toe touch. The data was recorded in micro volt (μv). After making all entries of the subject pertaining to his profile on the software, the subject was performed the skill. All the selected subjects were performed toe touch three times for each muscle. Best trail result of each participant's recorded by the EMG system.

Statistical analysis of data: The spss 20.0 version software was utilized to compute the mean and standard deviation.

TABLE -1 DISCRIPTIVE STATISTICS OF THE ELECTROMYOGRAPHY MUSCULAR CONTRACTION OF LOWER LEG (LEADING LEG) WITH THE PERFORMANCE OF TOE TOUCH

	MIN.	MAX.	MEAN	STD. ERROR	S.D.	VARIANCE	SKEWNESS	KURTOSIS
Rectus femoris	278.00	380.40	328.16	11.78	40.80	1664.28	.222	-1.923
Vastus medialis	190.00	296.60	247.84	9.26	32.09	1029.48	-.881	-.215
Vastus lateralis	343.20	433.20	381.41	7.67	26.58	706.38	-.183	.063

RESULT OF THE STUDY

Table 1 reveals that the description of electromyography muscular contraction of selected muscles during toe touch in Kabaddi and the performance of toe touch, the mean and standard deviation of toe touch performance was 7.50 & .74 and the mean and standard deviation of all muscles were following; Vastus Lateralis muscle have the highest muscle activation with mean and standard deviation 381.41 & 26.58 followed by Vastus medialis have 247.84 & 32.09, Rectus femoris have 328.16 & 40.80

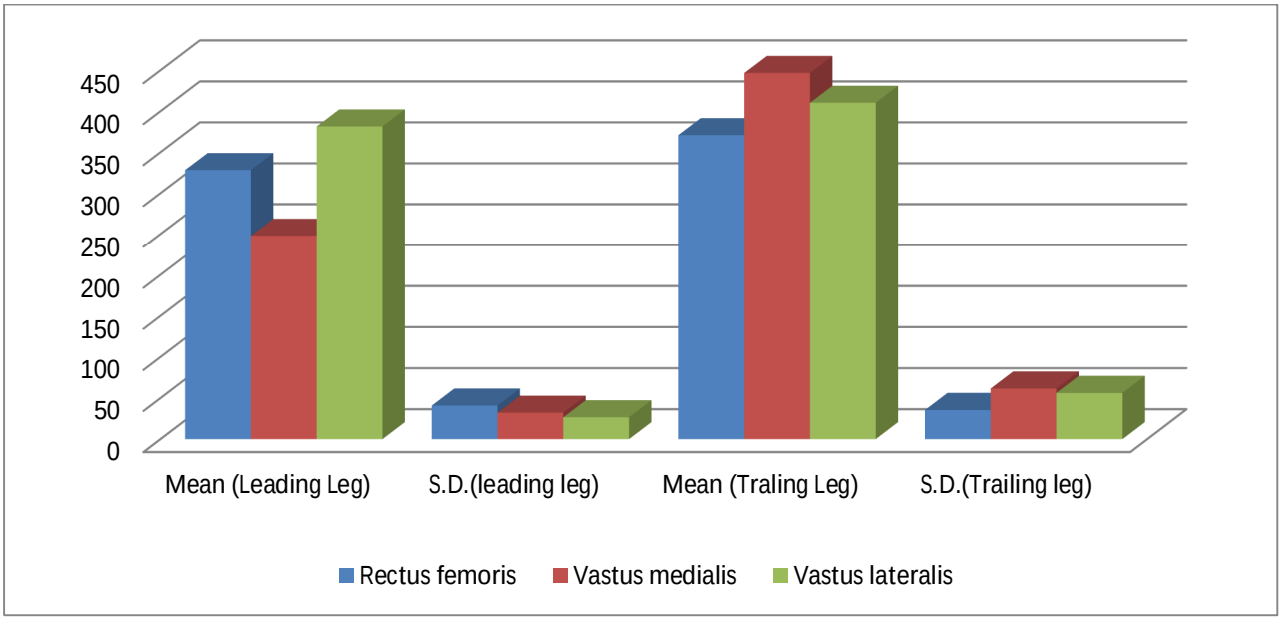
TABLE – 2 DISCRIPTIVE STATISTICS OF THE ELECTROMYOGRAPHY MUSCULAR CONTRACTION OF LOWER LEG (TRAILING LEG) WITH THE PERFORMANCE OF TOE TOUCH

	MIN.	MAX.	MEAN	STD. ERROR	S.D.	VARIANCE	SKEWNESS	KURTOSIS
Rectus femoris	313.00	415.10	370.85	10.23	35.44	1255.539	-.273	-1.459
Vastus medialis	316.40	548.00	446.65	17.77	61.54	3787.388	-.734	.864
Vastus lateralis	340.10	540.50	410.31	16.22	56.18	3156.635	1.061	1.472

RESULT OF THE STUDY

Table 2 reveals that the description of electromyography muscular contraction of selected muscles during toe touch in Kabaddi and the performance of toe touch, the mean and standard deviation of toe touch performance was 7.50& .74 and the mean and standard deviation of all muscles were following; Vastus medialis muscle have the highest muscle activation with mean and standard deviation 446.65 & 61.54, Rectus femoris have 370.85 & 35.44 Vastus Lateralis have 410.31 & 56.18.

GRAPHYCAL REPRESENTATION OF MEAN SCORE OF QUADRICEPS GROUP OF MUSCLES ACTIVATION OF LEADING LEG AND TRAILING LEGDURING TOE TOUCH IN KABADDI



DISCUSSION

VASTUS LATERALIS

The quadriceps muscle group is responsible for knee extension and stabilization of the knee joint during activities such as walking, running, jumping, and squatting. The vastus lateralis muscle originates from the lateral aspect of the femur, specifically the greater trochanter, a bony prominence at the top of the femur, and the lateral lip of the linea aspera, a bony ridge on the posterior (back) aspect of the femur. The muscle also has an indirect attachment to the iliotibial band, a fibrous band of tissue that runs down the lateral aspect of the thigh and inserts into the tibia bone just below the knee joint.

The vastus lateralis muscle inserts into the patella, a sesamoid bone located in the quadriceps tendon, which is a thick fibrous band of tissue that connects the quadriceps muscle group to the patella. The quadriceps tendon then continues distally, becoming the patellar ligament, which inserts into the tibial tuberosity, a bony prominence on the anterior surface of the tibia bone just below the knee joint. The patellar ligament is an important structure in the extensor mechanism of the knee, as it transmits the force generated by the quadriceps muscle group to the tibia bone, resulting in knee extension. When the muscle contracts, it generates a force that pulls on the quadriceps tendon, which in turn pulls on the patella, causing it to move anteriorly (forward) relative to the femur bone. This movement of the patella results in knee extension. The vastus lateralis muscle also works in concert with the other three muscles of the quadriceps muscle group to provide stability to the knee joint during Toe touch in Kabaddi.

The force generated during a toe touch in kabaddi is dependent on several factors, including muscle size, fiber type composition, muscle length, and activation level. The vastus lateralis muscle is a large muscle that contributes significantly to force generation during a toe touch.

Muscle length also plays a role in force generation. The force-generating capacity of a muscle is greatest when it is at its optimal length, which is typically near its resting length. When a muscle is stretched or shortened beyond its optimal length, the force-generating capacity decreases. During a toe touch in kabaddi, the vastus lateralis muscle is stretched as the body bends forward, which decreases its force-generating capacity. However, the muscle is able to generate a strong force during the forceful extension of the leading leg as the body lifts off the ground.

VASTUS MEDIALIS

The force generated by the vastus medialis muscle is dependent on a variety of factors, including muscle activation, muscle architecture, and joint position. Studies have shown that the vastus medialis muscle generates the most force when the knee joint is flexed to 60 degrees. This is likely due to the optimal overlap between the actin and myosin filaments, allowing for maximal cross-bridge formation. Muscle activation is another crucial factor in force generation. The vastus medialis muscle is activated through the motor neuron, which sends an electrical signal to the muscle fibers. The amplitude and frequency of this signal can influence the amount of force generated by the muscle. High-frequency stimulation has been shown to increase force output in the vastus medialis muscle, indicating that motor unit recruitment plays a significant role in force generation.

The muscle architecture of the vastus medialis also plays a role in force generation. The muscle fibers are oriented in a pennate fashion, which allows for a greater number of muscle fibers to be packed into a smaller area. This increases the force-generating capacity of the muscle, as more cross-bridges can form between the myosin.

RECTUS FEMORIS

The rectus femoris muscle is located in the middle of the front of the thigh and is fusiform in shape, with its superficial fibers arranged in a bipenniform manner. Rectus femoris muscle is only quadriceps muscle which is crosses the hip joint. The rectus femoris functions as a prime mover for hip flexion and knee extension, and during walking and running, it pulls the femur forward while kicking out the lower leg. This helps position the foot to contact the ground and support the body weight. The rectus femoris muscle is stronger in knee extension than hip flexion, but it still assists other muscles such as the psoas, iliacus, sartorius, and tensor fasciae latae in moving the hip.

Because of its origin at the anterior inferior iliac spine, the rectus femoris has the ability to tilt the pelvis anteriorly. Together with the vastus lateralis, vastus intermedius, and vastus medialis, the rectus femoris forms the quadriceps group and is responsible for straightening the knee during standing and lifting with the legs. Although the vastus muscles are more powerful than the rectus femoris in this action, the rectus femoris still plays an important role. The strength of the vastus muscles is generated by their large cross-sectional area, increased leverage created by the patella, and single purpose of extending the knee.

The literature suggests that the Quadriceps muscle is primarily responsible for extending the knee, but the rectus femoris also acts as a strong hip joint flexor. In kabaddi, the toe touch is a fundamental move that requires quick and explosive movements. It is an essential move that helps the attacker to score points by touching the defenders and then returning back to their side of the court. The toe touch requires a significant amount of lower body strength, and the quadriceps muscles play a vital role in executing this move.

CONCLUSION

In the leading leg, the Vastus Lateralis muscle showed the highest activation, while the Vastus Medialis muscle showed lower EMG activation. This is an interesting finding as the Vastus Lateralis muscle is responsible for extending the leg at the knee joint and is also a major contributor to lateral stability of the knee. This could indicate that in the leading leg, athletes may rely more on lateral stability of the knee during toe touch in Kabaddi.

In the trailing leg, which bears the body weight during the toe touch maneuver, the Vastus Medialis muscle showed the highest activation. This is not entirely surprising as the Vastus Medialis muscle is responsible for stabilizing the patella and medial stability of the knee joint, and therefore plays an important role in supporting the body weight in this position.

These findings provide insight into the specific muscle activation patterns involved in toe touch in Kabaddi, which could be useful for coaches and trainers in developing effective training programs for athletes. For example, the findings could suggest that training programs should focus on strengthening the Vastus Lateralis muscle in the leading leg to improve lateral stability of the knee during toe touch, while also emphasizing the importance of the Vastus Medialis muscle in the trailing leg for supporting body weight.

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