COMPARISON OF MUSCLE ACTIVATION LEVEL DURING PERFORMING MODIFIED RAZOR CURL AND NORDIC CURL EXERCISES IN STRENGTH TRAINING

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ABSTRACT

The aim of this study is to determine muscle activation level between two different exercise technique (modified RAZOR curl and Nordic curl) on biceps femoris, semitendinosus, erector spinae and lower rectus abdominis. Twenty-five recreationally active male university students had voluntarily participated to serve the purpose of this study. Muscle activities during both concentric and eccentric contractions were measured using electromyography (EMG). The raw data obtained were than normalized to determine the rate of maximum voluntary isometric contraction (MVIC). Analysis of the result indicated that there was significant difference between modified RAZOR curl and Nordic curl exercises, in term of muscle activation of biceps femoris during concentric and eccentric contraction. However no significant differences was found either on concentric or eccentric muscle contractions for both exercises in other muscle groups. Finding of the study also reveal that the RAZOR curl technique produced greater maximal voluntary isometric contraction. Based on the results, it was concludes that Nordic curl is a better exercise technique for the training of hamstring musculature, due to higher concentric and eccentric activation on biceps femoris and semitendinosus. However modified RAZOR curl was more appropriate to be used for training aiming at higher functionality, with better activation of supporting muscles such as the core muscles. For practical application both exercises are suggested to be used inter-changeably for better muscle adaptation and stimulus apart from avoiding overuse injury.

PERBANDINGAN TAHAP KONTRAKSI OTOT KETIKA SEDANG MELAKUKAN SENAMAN *MODIFIED RAZOR CURL* DAN *NORDIC CURL* KETIKA LATIHAN BEBANAN

ABSTRAK

Matlamat kajian ini adalah untuk menentukan tahap aktiviti otot di antara dua teknik senaman (*modified RAZOR curl*dan*Nordic curl*) ke atas otot *biceps femoris, semitendinosus, erector spinae dan abdominal* bawah. Dua puluh lima pelajar lelaki universiti yang aktif secara rekreasi telah terlibat secara sukarela bagi memenuhi matlamat kajian ini. Aktiviti otot sewaktu kedua-dua kontraksi konsentrik dan esentrik diukur rmenggunakan alat electromyography (EMG). Data mentah di normalisasikan bagi menentukan kadar kontraksi sukarela maksima isometrik (MVIC). Analisa dapatan menunjukkan terdapat perbezaan signifikan di antara senaman *modified RAZOR curl* dan *Nordic curl*, dari segi pengaktifan otot biceps femoris sewaktu kontraksi konsentrik dan esentrik. Walau bagaimanapun di dapati tiada perbezaan yang signifikan bagi akitiviti otot yang lain bagi kedua-dua teknik tersebut, sama ada bagi kontraksi konsentrik mahupun esentrik. Hasil dapatan kajian menunjukkan kontraksi sukarela maksim isometrik yang lebih besar dihasilkan oleh teknik senaman *modified RAZOR curl*. Melalui dapatan yang diperolehi, penyelidik merumuskan bahawa *Nordic curl* adalah teknik senaman yang lebih baik untuk latihan otot *hamstring* kerana aktiviti ototkon konsentrik dan essentrik yang tinggi di bahagian otot *biceps femoris* dan *semitendinosus*. Walaubagaimanapun, *modified RAZOR curl* yang mengaktifkan otot teras dengan lebih baik adalah lebih bersesuaian bagilatihan yang mensasarkan keboleh fungsian keseluruhan tubuh yang lebih tinggi. Untuk aplikasi praktikal, kedua-dua jenis teknik senaman dalah dicadangkan digunakan secara bergilir-gilir bagi adaptasi dan ransangan otot yang lebih baik, selain bagi mengelakkan kecederaan lebih guna.

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INTRODUCTION

1.1 Background of study

Physical training based on weight loading or resistance training has been widely used over decades ago among the athletes and it is not a new phenomenon among sports fraternity. This training method seems like a special tool among professional or non-professional athletes since it helping them to increase their performance. Acknowledged that, strength training is suited for everyone either male of female athletes even for recreational peoples. As our technology becoming more advanced and numerous

researches have been done to study the benefit of strength training, the approaches did by sports expertise also seem following the trend. The outcomes from the past study also make it getting more exciting which discover the training revolution method from time to time.

Strength training typically used by the athlete as well as the normal population to maximizes their physical appearances, performance and as well as injury prevention approach. For most of the time, athletes were given strength training program that utilized free weight and machines. Appropriately arranged and all around composed preparing training design plan and activity determination was a vital element that may impact the result of the training (Grieco, Carmine, Cortes, Nelson, Greska and Eric et al, 2012).

From a physiological perspective, strength training helps to expand and strengthens our muscle groups either direct or indirect process. It likewise helps in expanding and strengthens ligament and tendon wisely if done appropriately and regularly. It helps our body preparing additionally builds solid force abilities, saves, and increasing bone compactness, expands autonomy, and essentialness for maturing body (Skelton, Young, Grieg and Malbut, 1995). Lifting weights likewise has been indicated to enhance mental well-being by expanding self-regard or self-esteem, decrease the potential danger of osteoporosis and the signs and manifestations of various ceaseless sicknesses, for example, coronary diseases, joint inflammation, and sort 2

diabetes. Additionally, it helps enhancing rest and quality sleep meanwhile decreasing discouragement or depression (Sequin and Nelson 2003)

Athletes lower limb performance may improve by applying resistant and force to stimulate the lower limb muscle groups such as quadriceps, hamstring and gastrocnemius to enhance strength and the dynamic balance (Holm, Inger ,Fosdahl, Aarsland, Friss, Astrid, Risberg, Arna, Mykelburst, Grethe, Steen and Harald 2004). The physical activities or exercise selection chosen by coach, exercises expertise and trainer definitely one of the major factor that determine the impact of athlete performance. As an alternative to utilizing traditional method and physical activity technique as a part of training preparation, it seems that functional training approach strategy appears to be as another choice for conditioning experts and coaches' or athlete to be used prescribing training program (Oliver and Dougherty 2009).

Hamstring muscles are one of the muscles groups located in the lower limbs and benefited by strength or resistance training approached. Hamstring muscles were categorized into three sections that are biceps femoris, semitendinosus, and semimembranosus. In numerous years, a mixture variety of methodology and training strategies has been done to reinforce this muscle to make it stiffer and stronger to protect it from serious injuries. In order to do that, the most widely recognized training approach utilized by numerous coaches, conditioning expert, educator and athletes before was a leg curl, seated leg curl, standing leg curl and hip thruster exercises. This exercises

selection was proven affectively and works very well in the selected muscles, but it is still lack of functionality since in real games the situation and condition were totally different. The major issue arises here was the real motion and athlete's movement requires during executed certain movement in the certain position during the games or activities. As we noted in the real game, the movement or body motion nature was entirely unexpected in real game or sports since it has a combination of fitness components such as speed, power, strength, endurance and etc. As a discretionary and option to numerous coaches and training experts, utilization of functional training was the better decision.

However, since functional training was applied in the training session, the muscle group's engagement turns out to be more dynamic and more useful. As reported in previous study by Oliver et al, 2012 was informed that, modified RAZOR curl does not only suitable exercise to train hamstring muscles, but it had wise capacity to firing and trigger others supportive muscles such as upper and lower rectus abdominis, oblique and gluteus maximus . As reported in his past study 2009, RAZOR curl was better choice compare to incline leg curl exercises since it has the better capacity to create more muscular activation on gluteus and core muscles. In reality, the type of muscle contraction of concentric-eccentric and isometric contraction must be met during strength training. The concentric-eccentric and isometric contraction typically happened when resistance was applied.

In order to develop muscular strength and enhancing better performance, force must be applied on specific muscles group to initiate either isotonic or isometric contraction. In gaining muscular strength, types of contraction activities on muscle filaments, the level of contractile and versatile structure of the muscle itself likewise impacted the result of the training preparation done by athletes and coaches. During the concentric stage in muscle contraction, it will remain the filament length but decrease muscle length opposed to eccentric contraction where muscle length expanded. The repetitions of this procedure during the workout were recruiting and enrolling more and more muscle fiber. The increasing number of muscle fiber will result increasing or decreasing of muscular strength and muscular endurance based on the number of repetition and type of training.

A concentric and eccentric contraction activity is the common muscle contraction process occurred at our musculoskeletal system during the workout or any physical activities, but not in isometric contraction. Isometric contraction happened when our muscles condition generates force without changing the length but stimulates by forces. According to Oliver et al, 2012, to increase muscular strength by isometric contraction, the requirement percentage of maximum voluntary isometric contraction (MVIC) must be more than 60 percent onwards. Isometric contraction can be activated when the slippage of the contractile elements occurs and elastic strain arises during isometric contraction although there is no movement observed (Nordin and Frankel 2001).

As reported from various past studies, eccentric training methodology has been utilized as a part of numerous sorts of the training program and well planned by coaches, trainers and even conditioning specialist. A variety of eccentric loading training has been applied to improve athlete's performance and used for rehabbing injuries among the sports practitioners. Eccentric training also has been proving significantly reduces hamstring injuries among the athlete and sports fraternity. According to the previous study, the athlete will get the benefit of eccentric training if the training plan were done properly. Proske and Allen (2005) concluded that by performing eccentric training can providing muscle more protection from injuries. Malliaropolus et al, 2012 was inferred that, eccentric training may increase muscle stiffness and in the meantime, it can protect muscle from damage and indirectly increase the ability of elastic energy in stretch-shortening cycle during the eccentric phase.

Concentric training was opposite to the eccentric training. During the concentric activation process, muscle changes length and gets to be shorter when it was contracted. Basically, the typical exercises such as lying curl, standing leg curl, and seated leg curl emphasizes and activates more concentric compare to eccentric. The vitality of energy expenditure during performing concentric exercise also much greater compared to eccentric since the musculoskeletal need to execute force applied to gain more strength. However, when compared both contraction, eccentric seems have more ability to produce

more force by using less energy compare to concentric contraction (McHugh et al, 1999).

Another factor may influences muscular strength was individual muscle length and size. As mention by Nordin and Frankel (2001), the more extended muscle length and the greater size he/she has, the more powerful and stronger individual can be. Meaning that, by having greater and more muscles length and size, it may produce high drive and delivered the greatest intensity fluctuates between diverse muscles size and length. However, it does not change in the same muscle across different individuals since other factors such as genetic and experience level also influenced the outcomes. (Mohamed, Perry J. and Hislop 2002).

To enhance the athlete performance, adding a variation of training method is necessary to gain the maximum result. Moreover, by adding more variation in athlete training program, meaning that adding more functionality in athlete training program. Thusly, alternative approach such as functional training has now been a popular approach. Functional training such as body weight training seems very useful method compare to traditional weight training. Functional training was a functionally based exercise and it has been regarded as more practical and produce better muscle contraction. Functional training option likewise has been demonstrated proven more complex compare to traditional training method which is more isolated or focusing in one muscle area only (Oliver, Stone, Wyman and Blazquez, 2012).

More importantly, functional training also incorporated multi-joint movement compared to traditional exercise method. It has better joint involvement because it includes dynamic and entire body movement (Gambetta and Gray 2002). Additionally, functional training permitted or allowed more muscles activation on specific muscle groups depending on body position and based on the sporting skills mimic (Oliver et al, 2009). According to professional functional training handbook, functional training is a purpose training based on athlete's need (Michael Boyle 2004). He also clarified that functional training is more accurately represented as a general training sports base where it allowed and let the athlete handle their own body weight in certain position and movement. Precisely spoken, he also mentions that functional training does not only to prepare and reinforce hamstring muscles groups for improvement but also as a training tool for injury prevention.

Koulouris and Connell (2003) reported that, biceps femoris and semitendinosus of hamstring groups were one of the muscle areas which located in the lower limb was discovered to be prone to the injury among the athletes. Both of this hamstring muscle exceedingly presented to intense hamstring strain which is lead to serious injury during high tension contraction in hamstring. Eccentric process and muscle strain were played an important role an accumulated of muscle fiber damage contribute to this issue (David, Morgan, William, Anthony, and Shield 2012). Due to this matter, hamstring specific exercises was recommended to be more emphasis in any strength

training program, especially for individual's identified as having a weak hamstring muscle group. Modified RAZOR curl and Nordic curl were an example of functional based exercises that can be used to train hamstring muscle groups.

At first, RAZOR curl has been presented as a useful exercises method and alternative way to deal with train hamstring muscles in more practical position. However, some modification has been done to the original RAZOR curl in order to utilize some of the muscles at the lumbo-pelvic-hip complex can be activated. Originally, modified RAZOR curl is an exercise technique adapted from RAZOR Curl exercise, and this modification was clinically proven to have the appropriate level of effectiveness (Oliver et al, 2012). Modified RAZOR curl technique is more applicable and easier to perform compared to the original RAZOR curl. Due to lack of the equipment in the gym floor, Modified RAZOR curl seems to be the best alternative method to train hamstring muscle groups since there is no specific equipment needed. The ability of modified RAZOR curl to activate hip complex, torso, and oblique muscle make it more useful.

The Nordic curl exercise was, on the other hand, it has been presented as an exercises alternative method to train hamstring with better eccentric and concentric contraction approached without depending on gym equipment, more precisely known as weight training. As reported in previous study, functional training approach such as Nordic curl exercises often used in rehab

session among injured athletes and as a tool for injury prevention especially for biceps femoris and semitendinosus (Petersen J.and Holmich P. 2005). The similarity of both of these exercises can be done either assisted or unassisted by performing it on the sit-up bench or by having a partner holding the leg for assisted method.

As explained and clarify in this chapter, three type of muscular contraction must be met in order to gain strength and to improves athletes performance which is indirect as a basic step for injury prevention. However, there four major type of muscle contraction occurred on our skeletal muscle and they are concentric, eccentric, isometric and passive stretch and more familiar with the name muscle passively lengthening. Firstly, the eccentric contraction, an eccentric motion is one in which a muscle is lengthened during contraction. During that phase, the muscles in the legs are lengthening to slow the pace of the descent. As you eccentrically lower yourself during performing Nordic curl and modified RAZOR curl, your hips are eccentrically flexing. The gluteus maximus and hamstring muscles eccentrically control that motion. Also, the knee is eccentrically flexing, and the quadriceps muscles eccentrically control this movement. Lastly, the ankle joint is eccentrically dorsi flexing, as the calf muscles control your descent.

Secondly, the concentric contraction is one in which the muscle length decreases to perform a movement. During performing Nordic and modified RAZOR curl exercises, this would be the returning stage to the beginning

position of both activities. During performing Nordic and modified RAZOR curl, as subjects concentrically return to the starting position, the hips are concentrically extending. The gluteus maximus and hamstring muscles concentrically contract to shorten the muscles to pull your hips forward. Also, the knee is concentrically extending, and the quadriceps muscles shorten to pull the knee back to a straight position. And finally, the ankle joint is concentrically plantar flexing, as the calf muscles shorten to take your lower leg back to an upright position.

In the most effective way to restored and strengthen our skeletal muscles, concentric and eccentric was proven the best training approaches must be included in athletes training program. Ven Jonhagen, Gunnar Nemeth and Ejnar Eriksson (1994) were mention that both contraction types have it own advantages depending on athletes need and beneficial to human skeletal muscles. Therefore, almost of the exercises we have been done has the combination of these two contractions. However, it doesn't mean that isometric should be taken lightly or underestimated. Isometric was in different ways to make our muscles stronger.

Finally, the isometric contraction is the place there is no changing length on muscle filament during performing both activities. Isometric contraction wills triggers when subjects attempted to hold on into the certain position in any period of this activity when there is no concentric and eccentric contraction detected in hamstring, lower back, and rectus abdominis. The

review from the previous study was mentioned that by doing these three types of contraction most likely can increase athlete's performance and helps them to prevent the injury.

1.2 Problem Statement

Modified RAZOR curl considered as body weight training and more specifically known as a functional training among the practitioners. Recently, it has been introduced as a part of hamstring exercise method. Modified RAZOR curls exercise is suggested to be more useful compared to traditional leg curl as it was done in a more functional position and more ability to activate other muscles group. Oliver et al, 2012 had examined muscle activation on gluteus Medius, gluteus Maximus, Multifidus, Longissimus, upper abdominal and external oblique while performing modified RAZOR curl. However their finding seems not conclusive enough due to the fact that they have not assessed eccentric and concentric contraction on selected muscles. Their study also did not investigate the muscle activities on biceps femoris, semitendinosus, erector spinae and lower rectus abdominis muscles. All of these variables and muscles activities are important in order to determine the actual benefits of this exercise technique. More importantly, as they claimed modified RAZOR curl an exercise for hamstrings, it is very important to know how effective this exercise able to firing, engage and recruiting muscles activities on hamstring. In addition, the engagement and involvement of the others supporter muscle groups such as lower rectus abdominis and erector spinae groups also be measured in this study.

Nordic curl is a functional training that does not result in uniform response stimulus, neither on dominant or non-dominant leg but it was concluded that Nordic curl was suitable method at every level of athlete (Jordan, Arcos, Mirian, Gregory, Asier Javier and Fernando (2013). Mostly the data collected from the previous study using Nordic curl exercise was focusing in eccentric contraction on hamstring muscle (Massimo Ditroillio et al, 2010). From the previous finding revealed that it works well on biceps femoris and semitendinosus with significantly high during eccentric compared to concentric, but it is still unknown for isometric contraction. Mjolnes, Anrson, Osthagen, Rasstard and Bahr (2003) assessed concentric and eccentric activation between leg curl and Nordic curl and they found that Nordic curl show a significant improvement of eccentric activation compares to concentric. However, they did not mention which part of hamstring muscles. Up to this point, the percentage of maximum voluntary isometric contraction (MVIC) and eccentric-concentric (Isotonic) contraction on biceps femoris, semitendinosus, lower abdominal and erector spinae still remain unknown between these two exercises.

Previously, many research reported that semitendinosus and biceps femoris was exposed to great injury during high-intensity training but not semimembranosus (Peterson J and Holmisch P, 2008). As respond to this problem, researcher decided to examine biceps femoris and semitendinosus for hamstring muscles followed by, erector spinae and lower abdominis for core

muscles to determine maximum voluntary isometric contraction (MVIC) and concentric-eccentric (isotonic) contraction between these two exercises method. In order to find out specific outcomes from this study, wireless electromyography (EMG) was used to measure the selected muscles variables.

1.3 Significant of study

This study was conducted by researcher to help teachers, sport practitioners', sport institutions, personal trainers, instructors, co-curriculum unit, department of education district and state level and others relevant agencies planning to develop a training program related to fitness, rehabilitation and strength training in every level of athletes. The result from this study will be used to extend the knowledge of the training method specifically on hamstring muscle groups. The findings from this study can be used to help in improving the quality of training methods, especially related to lower limb performance and injury prevention to all athletes and sports practitioners.

Other than that, the researcher hopes that the outcomes from this study will help to promote this exercise method to all sports fraternity. It helps them to train their hamstring muscle group and share new input or knowledge regarding exercise that could help to improve strength, endurance and indirectly reduce the risk percentage of hamstring muscle groups in the future for better performance.

Data from this study will be useful for the coaches and the athletes. They will know the importance and benefit of functional training method in order to enhance or improve hamstring performance and injury prevention as they rely more on the traditional exercises method before. Coachers, practitioners, athletes and other peoples who engaged with physical activities will be able to use the data as guidelines for them to plan and designed better training programs to improve the athlete's performance level with better approaches. Meanwhile, the data will help the athletes to show them their hamstring and core strength levels or performance in a certain period of time.

1.4 Purpose of the study

1.4.1 To determine the muscle activation level of concentric contractions between modified razor curl and Nordic curl.

1.4.1 To determine the muscle activation level of eccentric contractions between modified razor curl and Nordic curl.

1.4.3 To investigate the percentage different of the maximum voluntary isometric contraction (MVIC) between modified razor curl and Nordic curl.

1.5 Research Question

1.5.1 Will there be any significant differences on concentric contraction between modified RAZOR curl and Nordic curl?

1.5.2 Will there be any significant differences on eccentric contraction between modified RAZOR curl and Nordic curl?