

Research Article

# Comparison of Modified RAZOR Curl and Nordic Hamstring Curl Exercises in improving Hamstring Muscle Performance among Male Volleyball Players

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## I N F O

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## A B S T R A C T

**Background:** Volleyball players' lower extremity strength, power, and flexibility are more significant, and hamstrings, in particular, affect their performance. Concentric hamstring performance-enhancing methods are the most common. They may reduce hamstring flexibility and raise the risk of strain. In this study, we focused on enhancing hamstring muscle performance in volleyball players using particular hamstring eccentric training regimens that increase lower extremity performance.

**Method:** A total of 40 volleyball players were sorted into two groups using a suitable sampling procedure based on inclusion and exclusion criteria. For 12 weeks, Group A (n = 20) received modified RAZOR curl while Group B (n = 20) received Nordic hamstring curl.

**Results:** The mean values for the 1 Repetition Maximum and 40 Yard Dash Tests were 11.6 and 1.24, respectively, with standard deviations of 1.63 and 0.31, and paired 't' values of 12.86 and 3.26, indicating that Group B (Nordic hamstring curl) showed substantial gains in strength and power. However, Group A (modified RAZOR curl) improved significantly in the Superman Exercise Test from baseline, with a mean of 12.1 and a standard deviation of 1.74. In the 1 Repetition Maximum, 40 Yard Dash Test, and Superman Exercise Test, both groups had unpaired 't' values of 12.86, 3.26, and 16.69.

**Conclusion:** Both groups improved in strength and power, according to the findings of this study. Although Group B trained volleyball players improved more, modified RAZOR curl (Group A) was more pertinent to be used for functional training and increased activation of supporting muscles, especially the core muscles.

**Keywords:** Volleyball Player, Modified RAZOR Curl, Nordic Hamstring Curl, Strength, Power, 40-yard Dash Test, One Repetition Maximum

## Introduction

William Morgan, an American, created volleyball 100 years ago in 1895. It was first supposed to be a leisure or athletic training sport. It is now widely regarded as the world's largest sport in terms of active players, with an estimated 200 million participants. The International Volleyball Federation (IVBF) was founded in 1947 and had 210 National Federations as members in 1994. Since 1964, male and female volleyball players have been contesting in the Olympic Games, with Olympians from all four continents. And also, the physical demands of the game are gradually increasing along with its popularity. Challenging and taxing practices and the presence of a competitive atmosphere can lead to a hostile environment.<sup>1,2</sup>

Interscholastic volleyball is played by about 460,000 high school students each year, including over 410,000 girls. Volleyball-related injuries have grown as the involvement has risen over the last couple of decades. Volleyball injuries are the lowest among the major sports, yet volleyball players are susceptible to both acute and repetitive injuries.

Volleyball is a team sport that demands powerful moves such as leaping, spikes, and ball blocking. Aside from these technical aspects, muscle strength and power are two important characteristics that influence an athlete's performance in competitive sports. Sports that need a high level of motor characteristics in the hamstring and quadriceps muscles of the lower limb, such as jumping, necessitate a high level of motor characteristics in these muscles.

Volleyball has become a fast-paced game played primarily by young players as a result of recent technological improvements. In comparison to other sports such as football, basketball, or soccer, volleyball has comparatively low injury rates, but, according to recent research, the rates of injury are gradually increasing.<sup>3</sup>

Volleyball players had frequent injuries because of differences in muscle power and ratio between agonist and antagonist, according to the American College of Sports Medicine 2017. Most of these injuries occurred during the preseason, while a few of them occurred in the regular season and postseason.<sup>4</sup>

Volleyball, in particular, requires motions that need diverse muscle strength at varying speeds. This power-generating capacity has a direct impact on a volleyball player's performance.<sup>5</sup> Muscle strength and power are also important factors in sporting success. They are critical components in sports for accomplishing goals and avoiding injuries.<sup>3</sup>

For players to improve functional agility, speed, and performance, they must first improve muscular strength

and power. There are numerous forms of training available in this method, such as isometric or isotonic, otherwise concentric or eccentric.<sup>6</sup>

Currently, most studies show that eccentric training is more advantageous than concentric training for improving power, strength, cardiovascular fitness, adaptation, and conditioning.

The Nordic curl exercise, on the other hand, has been promoted as a non-gym alternative means of exercising hamstrings with stronger eccentric and concentric contractions without the use of exercise equipment, and weight training is a term used to describe a type of exercise that involves lifting weights.<sup>7</sup> Functional training approaches such as Nordic curl exercises are frequently utilised in rehab programmes among injured athletes and as a tool for injury prevention, as indicated in previous research, mainly for biceps femoris and semitendinosus muscles. Both of these workouts are similar and can be done with or without assistance.<sup>8</sup>

The RAZOR curl was an effective workout method for training hamstring muscles in a more precise position. The variation of the original RAZOR curl can be used to activate some of the muscles in the lumbopelvic-hip combination. It has been clinically confirmed to be effective at the appropriate level.<sup>9</sup> Since no special equipment is required on the gym floor, the modified RAZOR curl appears to be the greatest alternative strategy for training hamstring muscle groups. Modified RAZOR curls are more effective since they can activate the hip complex, torso, and oblique muscles.<sup>10</sup>

Hamstring muscles were situated in the posterior compartment of lowerlimbs and benefited from the resistance training approach. Biceps femoris, semitendinosus, and semimembranosus are the three components of the biceps femoris.<sup>11</sup>

Various methods of treatment strategies had been developed in these numerous years, for the strengthening of the hamstring muscle to prevent it from serious injuries. Leg curl, seated leg curl, standing leg curl, and hip thruster exercises were obtained from numerous training procedures employed by various coaches, conditioning professionals, educators, and athletes previously to achieve this.<sup>12</sup>

These selected exercises have been proven effective in the strengthening of hamstring muscle, but still, they are not applicable functionally because the situations of real games are different.

The main problem observed was regarding the real motion and athlete's motion required during executing certain movements in a certain position during the games or activities. The body movement of a player was completely unexpected in an actual sport. This was due to the reason

that playing a sport requires varying combinations of fitness components like power, speed, endurance, strength, etc.<sup>13-18</sup> Various coaches, as well as training experts, consider functional training as a better option.

## Method

### Participation

A total of 40 volleyball players were included in this study. The participants belonged to the age group of 18-25 years and did not have any recent injuries specifically in the knee and ankle. The inclusion criteria were as follows: male volleyball players with normal healthy conditions, active players, free of any hamstring injury since at least 6 months before, recreational athletes, following a regular exercise protocol, and at least 15 kg of 1 Repetition Maximum strength in the lower limb.

### Study Design

This study was planned as a case series. The participant's training procedure was handled by two physiotherapists. The participants were evaluated by the first physiotherapist both before and after the training regimen. The players were given the exercise routine by the second physiotherapist.

### Study Duration

This study lasted a year and 10 months, from February 2019 to November 2020.

### Study Setting

This study was done at the Out-Patient Department in Nandha College of Physiotherapy and Nandha Medical College and Hospital.

## Outcome Measures

### One Repetition Maximum

One Repetition Maximum (RM) is defined as the greatest amount of weight (load) a muscle can move through the available range of motion (ROM) a specific number of times. The players were instructed about the assessment protocol. Warm-up was done by performing several submaximal repetitions. 1-RM (or any multiple RM) was determined in four trials with 3 to 5-minute rest intervals in between the trials.<sup>19</sup> A starting weight was chosen that was within the subject's perceived capability (50-70% of maximum capacity). To maintain consistency between trials, resistance was gradually raised by 2.5 to 20 kg until the participant was unable to finish the designated repetition(s); all repeats were completed at the same pace and range of motion. The exact 1-RM or multiple RM was the final weight lifted successfully.

### 40 Yard Dash Test

A distance of 40 yards (36.6 meters) was marked on the ground with the help of cones. Smartphones were fixed

at the starting point and endpoint for recording the test. The players started running from a comfortable stationary 3-point stance position. They were instructed to keep the front foot on or behind the starting line and to hold the starting position for 3 seconds. Trick movements were restricted and the players had to start running with counts.<sup>20</sup> The players were motivated to maximise speed with the help of maximum power. Pre and post-training durations were noted.

### Superman Exercise Test

The players were instructed to lie in the prone position. At the same time, they had to extend the arms overhead and legs straight out or lift their arms and hip with the leg against the floor (Figure 1). Pre and post-holding durations were noted.

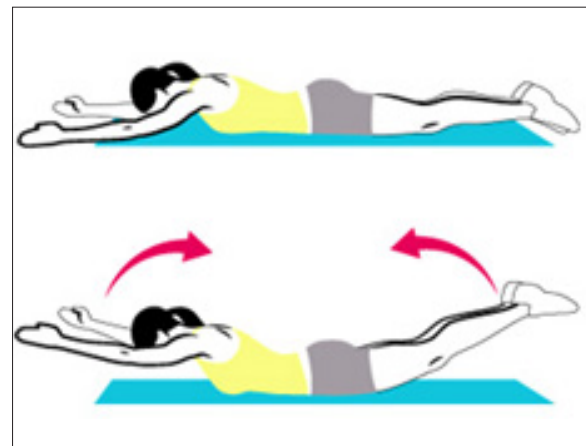


Figure 1. Superman Exercise Test

## Intervention

Each participant participated in a 12-week performance development programme. Modified RAZOR curl and Nordic hamstring curl were performed for a maximum of one hour per session with three sessions per week for 12 weeks including warm-up and warm-down. Based on the principles of DAPRE, players received progression in their protocols.

## Training Programme

The subjects were chosen using a practical sampling strategy. An efficient screening strategy was utilised to choose 40 patients who met the inclusion and exclusion criteria, with 20 patients being allocated to group A and the remaining 20 to group B. The study was explained to the subjects in detail, and signed informed consent was obtained from those who met the requirements. Individuals from both groups were assessed before and after the test. Both modified RAZOR curl and Nordic hamstring curl programmes were done in three sessions per week for 30 minutes along with a warm-up for 20 minutes and cool down for 10 minutes. The total duration was 60 minutes. Repetitions and sets were increased based on DAPRE.

## Group A (Modified RAZOR Curl)

### Exercise Protocol for Group A

Kneeling in the beginning posture with both knees flexed at 110 degrees and hip extended was required of the participants. To prevent friction between the knee and the surface, both knees were supported using an exercise mat. The therapist made sure that the players' feet were in contact with the ground or the sofa during the activities. Subjects leaned forward at a 90-degree angle with their upper body (Figure 2). They were instructed to hold their position for four seconds and then return to normal. They had to repeat this exercise without fail.



Figure 2. Modified Razor Hamstring



Figure 3. Nordic Hamstring Curl

## Group B (Nordic Hamstring Curl)

### Exercise Protocol for Group B

Subjects must kneel in the beginning posture with their torso up, stiff, and straight from their knees. By making the players sit on their knees and exert pressure on their heel/ lower legs, the therapist ensured that the players' feet were in touch with the ground or cot throughout the activity (Figure 3). The participants were told to descend

their upper bodies to the ground as gently as possible to maximise loading during the eccentric phase. To decrease loading in the concentric phase, hands and arms were employed to halt the forward fall of players and lift their back after their chest had reached the ground.

### Statistical Analysis

The data were evaluated by using the paired 't' test that was used to find out the statistical significance between pre and post-test values of 1 Repetition Maximum Test, 40 Yard Dash Test, and Superman Exercise Test for groups A and B.

Unpaired t-test was utilised for the comparison of both groups using the values of mean difference in 1 Repetition Maximum Test, 40 Yard Dash Test, and Superman Exercise Test. The arithmetic mean was calculated for all to assess the outcome measures pre and post-training in both groups. Standard deviation and mean difference were calculated to analyse the variation from means and the variation within the group.

### Result

In both groups, the pre-and post-values were tested using the 1 Repetition Maximum, 40 Yard Dash Test, and Superman Exercise Test. The mean difference values for group A were 5.3, 0.93 and 12.1 and the standard deviations were 1.17, 0.29, and 1.74 respectively. The paired 't' values were 21.3, 14.3, and 31.1. For a 5% level of significance, the paired 't' test results were more than the table value (2.15) (Table 1).

Table 1. Data Analysis and Presentation for Group A

Data Values	Group A (Modified RAZOR Curl)		
	1 RM	40 Yard Dash Test	Superman Exercise Test
Mean difference	5.3	0.93	12.1
Standard deviation	1.17	0.29	1.74
Paired 't' test	21.3	14.3	31.1
Table value	2.15	2.15	2.15

1 RM: 1 Repetition Maximum

The mean difference values in group B were 11.6, 1.24, and 4.3, and the standard deviations were 1.63, 0.31, and 1.08 respectively. The corresponding 't' values were 33.5, 17.9, and 17.8. For a 5% level of significance, the paired 't' test results were more than the table value (2.15) (Table 2).

The calculated 't' values by unpaired 't' test assessed by 1 Repetition Maximum, 40 Yard Dash Test, Superman Exercise Test were 12.86, 3.26, and 16.89. The calculated 't' values were found to be higher than the table value (2.05) for a 5% level of significance at 38% of freedom (Table 3).

**Table 2. Data Analysis and Presentation for Group B**

Data Values	Group B (Nordic Hamstring Curl)		
	1 RM	40 Yard Dash Test	Superman Exercise Test
Mean difference	11.6	1.24	4.3
Standard deviation	1.63	0.31	1.08
Paired 't' test	33.5	17.9	17.8
Table value	2.15	2.15	2.15

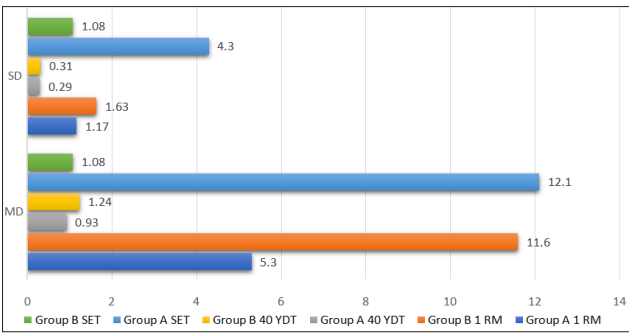
1 RM: 1 Repetition Maximum

**Table 3. Unpaired 't' Test Analysis and Presentation between Groups**

Data Values	Calculated Unpaired 't' Value	Table Value	Significance
1 RM	12.86	2.05	Significant
40 Yard Dash Test	3.26	2.05	Significant
Superman Exercise Test	16.89	2.05	Significant

1 RM: 1 Repetition Maximum

Figure 4 shows a comparative analysis between the mean difference and standard deviation values of the various tests in both groups.



**Figure 4. Mean and Standard Deviation between Outcome Measures for Group A and Group B**

MD: Mean Difference, SD: Standard Deviation, 1 RM: 1 Repetition Maximum, 40 YDT: 40 Yard Dash Test, SET: Superman Exercise Test

**Discussion**

While thinking about how to improve volleyball players' hamstring muscle strength and power,<sup>21</sup> a significant and positive improvement in volleyball players was discovered.

McHugh MP et al. explained that eccentric contraction takes less energy than a concentric contraction. When research participants have problems returning to their

starting position after completing each repeat, it's easy to understand why.<sup>22</sup>

Koulouris G et al. thought more strength was required to perform these exercises' full range of motion, particularly the modified RAZOR curl. So, if our skeletal muscle is required to produce more strength, then more energy uptake is required.<sup>23</sup>

According to Petersen J et al., soccer players who did the NH exercise reported a good level of hamstring strength growth and minimal risk of a hamstring injury. As a consequence of this research, they stressed the need for eccentric hamstring muscle training to avoid hamstring injury.<sup>8</sup> Given how simple it is to execute and how little time it takes, NH activity should be included as a general exercise in most athletics training programmes. It also doesn't require any special materials.<sup>24</sup>

In a study by Leszczak TJ et al., it was shown that Nordic hamstring exercise, when performed for 13 weeks, reduced the risk of a hamstring injury but did not lessen the degree of the injury, and that it primarily involved hamstring strength and power as well as conditioning with neuromuscular adaptation. As a result, the Nordic hamstring has been reported to be a crucial hamstring strain prevention strategy.<sup>25</sup>

Ebben WP et al. said that exercising hamstring curls boosts concentric strength by up to 29% in just six weeks, but Nordic curl wowed press. Once again, neither the Nordic curl nor the modified RAZOR curl was the best workout for increasing concentric activation. When workouts are needed to improve concentric activation, this approach is also recommended.<sup>26</sup>

Joint involvements are also one of the most important aspects to consider for any activity, according to Wright GA et al. Once any movement or motion is being performed, it needs the involvement of more than one joint and primarily it'll hold a fixed position based on the selected exercise. While performing Nordic curl and modified RAZOR curl, more than one joint was involved throughout the hip extension flexion and knee extension angle. This might happen if two joint muscles contract to move just one of them, and the muscular tension is sustained for a longer period.<sup>27</sup>

In their study, Onishi H et al. evaluated the activity of the long head of the BF (biceps femoris) while performing Nordic Hamstring Exercise (NHE) training for the strengthening of hamstring muscles or for the rehabilitation sessions of hamstrings that were strained earlier. The administration of an optimal training load could be an interesting subject for research in the future, given the high inter-individual differences in the involvement of BF while performing NHE.<sup>28</sup> Dankaerts W et al. also revealed a similar opinion in their study.<sup>29</sup>

According to McAllister MJ et al., it is critical to build muscular strength whilst reducing muscle mass gains in the sport that blends running and leaping activities. This may be further explained by the fact that when muscle size grows, strength grows at a slower pace than muscle mass.<sup>30</sup>

McGill SM found that this might be because eccentric activities improve neuromuscular control and muscle endurance, whereas concentric workouts improve neuromuscular control and muscle endurance.<sup>31</sup>

According to Sayers AL et al., the EMG amplitude of eccentric contraction was found to be smaller than that of concentric contraction due to a reduced number of motor units activated and a slower discharge rate.<sup>32</sup>

Brughelli M et al. revealed in their study that when there are dynamic and explosive motions, type II fibres are preferentially acquired. As the rate of contraction rises, the muscle can create a large amount of force.<sup>33</sup>

The final stage of the present research showed that besides improving functional abilities, Nordic hamstring curl also improves the performance of volleyball players without activation of core muscles.

Thus, this study has proved that Nordic hamstring curl is more effective than modified RAZOR curl for increasing the strength and power of hamstring muscles, whereas, modified RAZOR curl is more effective than Nordic hamstring curl in dynamic contraction, core, and whole-body activation.

## Conclusion

Based on the results, it was concluded that there is a significant difference between Nordic hamstring curl and modified RAZOR curl. Analysis of the significant effect of 1 Repetition Maximum and 40 Yard Dash Test shows improvement of strength and power in Nordic hamstring curl and analysis of the significant effect of the Superman test shows improvement in the activation of Longissimus and multifidus muscle.

Finally, it can be concluded that if players need to improve strength as well as support muscles such as longissimus and multifidus, modified RAZOR curl was highly recommended. In the case of players who wanted specific power and strength training, Nordic hamstring curl was the perfect option.

## Consent

Written informed consent was obtained from the parents of the students.

## Ethical Approval

This study was conducted after getting permission from the Institutional Ethics Committee and well-informed consent

was obtained from the patients for conducting this study and for the publication of this research work.

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