

EFFECT OF REVERSE NORDIC CURLS TRAINING ON SPORTS PERFORMANCE IN RECREATIONAL FOOTBALL PLAYERS

Shiwali Raiwad¹, Dr. Smita Patil²

¹Postgraduate student, Department of Sports Physiotherapy, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, Pin: 415539

²Associate Professor, Department of Sports Physiotherapy, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, Pin: 415539

Abstract: The present research paper focuses on the relevance of an eccentric exercise of the quadriceps to improve sports performance of amateur footballers. The game of football requires explosiveness, skill, and dexterity which can only be achieved through strong quadriceps muscles. In the experiment that was carried out, there were 38 male participants who were divided into two groups: the control group and the experimental group. The control group received ordinary training while the experimental group performed the Reverse Nordic Curl exercise for six weeks, thrice a week. The measurement parameters used before and after the intervention were strength of the quadriceps muscle through a hand-held dynamometer, core stability with Pressure Biofeedback and short passing test for task performance. However, there were no differences between the core strength of the two groups. The results of this study demonstrate the importance of using eccentric quadriceps training in reaching the optimal effect for particular sports disciplines, including football, where it is essential to develop the strength and precision of movements of the lower limbs. The use of RNC training as an integral element of the exercise regime will be useful not only for injury prevention but also for the development of athletes' skills. It is possible to draw several conclusions from the results obtained.

Keywords: Reverse Nordic Curls, Quadriceps Strength, Eccentric Training, Recreational Football, Sports Performance, Short Passing Test, Core Stability, Functional Outcomes, Injury Prevention, Conditioning Programs

1. Introduction

Football is the most played game in the world, which involves very fast, strong and coordinated movements by the participants. The quadriceps muscle plays a very important role in activities like running, jumping, kicking, and change of directions in football. The football player has a much higher risk of getting injured compared to any other athlete playing most sports. Injuries that occur because of muscles constitute about one third of all injuries recorded in professional football researches. It is due to the fact that it covers both the hip joint and the knee joint. This makes this muscle vulnerable to injuries related to running, kicking, and rapid decelerations. Traditional strength training includes concentric exercises only. Training of the quadriceps muscles using eccentric approach has been largely ignored. Research has shown that eccentric strength training can improve muscle length-tension characteristics and prevent the strain from occurring. Recreational athletes are more injury-prone than professional ones, since they usually do not take part in any structured and professional training program (Marcelino et al., 2020). Contrary to professionals, eccentric strength training is not included into their training routine as injury prevention. The Reverse Nordic Curl is the exercise including eccentric training and targeting quadriceps through knee extension. This exercise works all four quadriceps muscles, including rectus femoris. While there is a wide body of literature on Nordic hamstrings exercises, the situation with eccentric quadriceps exercises is different.



2. Methods

In this study, the use of pre and post testing for one year period was the type of experimental design used. In this study, 38 young male recreational football players were selected (Castagna, Krstrup & Póvoas, 2020). To qualify for the study, participants had to be training for seven to eight hours in a week. Participants having knee pain, history of injuries, or pathological conditions of their lower limbs were disqualified from the study. Prior to randomization of the subjects into two groups, ethical permission was granted. Group A consisted of the control group, which was undergoing regular training and warm up exercises, and progressive resistance exercises. On the other hand, group B comprised of the experimental group and was performing an additional Reverse Nordic Curls three times in a week (Arad et al., 2021). Treatment period of the experiment lasted for six weeks with progressive increase in intensity after one to two weeks. Hand-Held Dynamometer and Manual Muscle Testing was used for measuring the strength of quadriceps. Pressure Biofeedback Unit was used to measure core strength; and Short Passing Test was used for measuring task performance.

3. Results

1. Quadriceps Strength Improvement in Control Group (HHD)

Parameter	Side	Pre (Mean $\pm$ SD)	Post (Mean $\pm$ SD)	p-value	t-value	Significance
HHD	Right	9.894 $\pm$ 3.311	11.0526 $\pm$ 3.374	0.0172	2.625	Significant
	Left	7.947 $\pm$ 2.034	8.421 $\pm$ 2.009	0.0245	2.455	Significant
Short Passing Ball	Dominant	8.2105 $\pm$ 2.016	8.8421 $\pm$ 2.062	0.0296	2.364	Significant
	Non-Dominant	8 $\pm$ 1.732	8.8421 $\pm$ 2.455	0.0281	2.388	Significant
Pressure Biofeedback	—	2.894 $\pm$ 1.197	3.2631 $\pm$ 1.098	0.1490	1.508	Not Significant

Table 1: Comparison of pre and post values of Quadriceps strength by push-pull hand held dynamometer, core strength by pressure biofeedback Unit and task performance by short passing ball by using paired t test within Group A.

In Group A, the quadriceps strength test using the Hand-Held Dynamometer revealed significant increase in strength after six weeks of conventional training, where the right side rose from 9.894 $\pm$ 3.311 to 11.0526 $\pm$ 3.374 ($p=0.0172$) and the left side rose from 7.947 $\pm$ 2.034 to 8.421 $\pm$ 2.009 ($p=0.0245$). From these findings, it is clear that the combination of progressive resistance exercise and core muscle conditioning can result in improved lower limb strength without any eccentric training. But the extent of increase was minimal when compared to the experimental group. In other words, although conventional training methods have been found to be successful in sustaining and increasing strength to some extent, they might not be making full use of the benefits offered by eccentric loading (Moro et al., 2020).

2. Task Performance Gains in Control Group (Short Passing)

In group A, there was a noticeable improvement in the technique of performing short passes after implementing the intervention. For the dominant leg, the scores went up from 8.2105 $\pm$ 2.016 to 8.8421 $\pm$ 2.062 ($p=0.0296$), and for the non-dominant leg – from 8 $\pm$ 1.732 to 8.8421 $\pm$ 2.455 ($p=0.0281$). This is evidence of the value of the classic training in improving the skill level in soccer because of improved neuromuscular coordination and strength transfer. While there were some considerable improvements in terms of performance, their level was relatively low because of the inefficiency of concentric exercises in developing explosive control needed for accurate passes (Peñailillo et al.,

2022). This research revealed that even general training might have an impact on technical performance positively. However, the effectiveness of such training could be enhanced by adding eccentric training because it helps to develop deceleration control and limb stabilization.

3. Core Strength Outcomes in Control Group (PBU)

The strength of the core muscles of Group A measured via Pressure Biofeedback Unit showed a negligible improvement from 2.894 ± 1.197 to 3.2631 ± 1.098 . However, this difference was not statistically significant ($p=0.1490$), and therefore it could be claimed that the traditional program of training was not efficient in increasing the deep abdominal strength of the subjects despite the presence of core stabilization exercises in it (Mousavi & Mirsafaei, 2022). There are several reasons for this lack of a significant improvement in the strength of the deep abdominals of the subjects; one of them is a poor sensitivity of the biofeedback device. This kind of biofeedback cannot measure sport-specific and dynamic strength of the core, but only the static strength control of the abdominal muscles.

4. Quadriceps Strength Improvement in Experimental Group (HHD)

The group that underwent reverse Nordic curls had highly significant strengthening of the quadriceps muscle. In the right limb, the strength of the quadriceps muscle increased from 10.333 ± 3.812 to 13.9722 ± 4.337 ($p=0.0001$), and in the left limb, it increased from 8.777 ± 2.539 to 10 ± 2.461 ($p=0.0006$). The obtained results definitely reveal the superiority of eccentric strengthening of the quadriceps muscle compared with other methods of training. The high value of the effect size can be explained by specific biomechanics of reverse Nordic curls when muscles have to be stretched under load (Murakami et al., 2023). Such stretching can help muscles develop better and gain more strength, thus making force generation better. Consequently, the results obtained prove that eccentric training has to be used in football training sessions, as it not only strengthens muscles but improves control of muscles at intensive activity such as sprinting or kicking.

5. Task Performance Gains in Experimental Group (Short Passing)

The functional performance of Group B has considerably increased, where performances of dominant legs changed from 9.0555 ± 2.287 to 10.611 ± 2.570 ($p=0.0016$) and non-dominant leg performances from 8.444 ± 1.947 to 10.388 ± 2.090 ($p=0.0056$). This shows that there is a very high level of transfer of the strength of quadriceps eccentric on football techniques. The Reverse Nordic Curls could have helped to improve neuromuscular control and stability of the process of kicking the ball thus increasing power and accuracy of kicks (Islam et al., 2024). It can be seen that the progress of the participants in Group B was considerably higher and more even as compared to Group A.

6. Between-Group Comparisons (Quadriceps, Core, and Task Performance)

Parameter	Side	Post A (Mean $\pm$ SD)	Post B (Mean $\pm$ SD)	p-value	T Value	Significance
HHD	Right	11.0526 ± 3.374	13.9722 ± 4.337	0.0280	2.293	Significant
	Left	8.421 ± 2.009	10 ± 2.461	0.0391	2.143	Significant
Short Passing Ball	Dominant	8.842 ± 2.062	10.611 ± 2.570	0.0266	2.316	Significant
	Non-Dominant	8.8421 ± 2.455	10.388 ± 2.090	0.0471	2.058	Significant
Pressure Biofeedback	—	3.2631 ± 1.098	3.055 ± 1.162	0.5798	0.5589	Not Significant

Table 2: Comparison of post values of Quadriceps strength by push-pull hand held dynamometer, core strength by pressure biofeedback Unit and task performance by short passing ball by using unpaired t test between Group A and Group B.

It should be noted that Group B has proved to be more efficient than Group A in regard to quadriceps muscle strength and performance of short passing task. Quadriceps muscle strength tests showed the following results: 13.97 ± 4.34 (right) vs. 11.05 ± 3.37 ($p=0.028$) and 10 ± 2.46 (left) vs. 8.42 ± 2.00 ($p=0.0391$). The same thing can be observed regarding the task performance: dominant leg – 10.61 ± 2.57 vs. 8.84 ± 2.06 ($p=0.0266$); non-dominant leg – 10.39 ± 2.09 vs. 8.84 ± 2.46 ($p=0.0471$). However, core strength differences have not been revealed ($p=0.5798$). All in all, the above-listed results prove the fact that RNC exercises give much more advantages than traditional training in terms of strength and performance skills development. The lack of core strength differences indicates that RNC training exercises affect mostly the muscles of the lower body. Thus, the above-listed results confirm the hypothesis that eccentric quadriceps training is more beneficial.

Quadriceps Strength Outcomes in Control Group (MMT)

Variable	Pre-Training (Mean $\pm$ SD)	Post-Training (Mean $\pm$ SD)	p-value	Significance
Right Quadriceps Muscle Strength (MMT)	4.42 ± 0.50	4.52 ± 0.51	0.5000	Not Significant
Left Quadriceps Muscle Strength (MMT)	4.42 ± 0.50	4.47 ± 0.51	0.8125	Not Significant

Table 3: Comparison of Pre- and Post-Training Quadriceps Muscle Strength (MMT) in Control Group (Group A) After Six Weeks

For the control group (Group A), the outcomes of the test using the MMT demonstrate that there were no significant improvements in the participants' muscle strength after completing the six-week training program. In particular, the right and left quadriceps muscle strength increased from 4.42 ± 0.50 to 4.52 ± 0.51 and 4.47 ± 0.51 , respectively. Therefore, the changes in the results for both legs are insignificant because the p-value is 0.5 and 0.8125 for the right and left legs, respectively. Thus, based on the quantitative data collected from the participants in Group A, it would be possible to conclude that there is no significant increase in the grade of muscle strength using concentric and resistance exercises.

Quadriceps Strength Gains in Experimental Group (MMT)

Variable	Pre-Training (Mean $\pm$ SD)	Post-Training (Mean $\pm$ SD)	p-value	Significance
Right Quadriceps Muscle Strength (MMT)	4.44 ± 0.51	4.94 ± 0.23	0.0039	Significant
Left Quadriceps Muscle Strength (MMT)	4.50 ± 0.51	4.94 ± 0.23	0.0195	Significant

Table 4: Comparison of Pre- and Post-Training Quadriceps Muscle Strength (MMT) in Experimental Group (Group B) After Six Weeks

Group B (experimental group with Reverse Nordic Curls) made significant improvements with respect to their MMT score values. An improvement in the right quadriceps was observed with respect to change in value from 4.44 ± 0.51 to 4.94 ± 0.23 ($p = 0.0039$), while for the left quadriceps, there was an improvement in value from 4.50 ± 0.51

to 4.94 ± 0.23 ($p = 0.0195$). It is evident that through the use of RNC, eccentric load was placed on the quadriceps, which improved strength in the ordinal scale of the MMT.

4. Discussion

General conclusions about the obtained results are evident – the usage of Reverse Nordic Curls in the training of football players is definitely more effective than a traditional training program. The increase in quadriceps muscle strength and short pass efficiency has been observed in both experimental groups; thus, confirming that training impacts the physical fitness and technical skills of athletes (Alhamashi, Rahnama & Sadeghi, 2023). However, in this case, the level of improvement has been much higher for the second group; thus, confirming the effectiveness of eccentric muscle loading method. There were some significant improvements in the strength and short pass efficiency in the first group as well; however, the level of improvement was quite low. At the same time, in the second group, there were high levels of significance concerning the quadriceps muscle strength, with very large effect size in the results from Hand-Held Dynamometer, as well as the short passes for dominant and non-dominant legs.

Manual Muscle Testing (MMT) was utilized to assess the quadricep muscle strength before and after a six-week intervention (Nurhakiki, Hidayat & Rosidawati, 2026). The obtained results suggest that Reverse Nordic Curl can be considered a more effective means of increasing muscle strength as compared to traditional training. Thus, it can be concluded that this exercise protocol is more beneficial for amateur football players, as it allows them to improve their physical performance. Interestingly enough, no significant distinctions have been detected when it comes to core strength development, thus indicating that the proposed training program was not intense enough to result in any changes. From the findings obtained, the effectiveness of the conventional concentric and resistance exercises in developing the strength of the quadriceps muscles was found to be poor for a duration of six weeks in the control group. The comparison of the two groups has also shown that the exercises called Reverse Nordic Curls provided better outcomes in terms of strength and execution with no influence exerted on core strength (Cuthbert et al., 2020). In general, it should be said that eccentric quadriceps training like Reverse Nordic Curls is a key part of football training. The findings indicate that the Reverse Nordic Curl intervention proved effective in enhancing functional strength of quadriceps muscles in less than six weeks, proving more efficient than conventional training programs.

5. Conclusion

Thus, this study proves the effectiveness of implementing reverse nordic curls into the football training program in order to increase the strength of quadriceps muscles and enhance sport-specific skills, in comparison with using the traditional training approach. The experimental group demonstrated better results in developing strength and sport-specific skills, particularly short passing. The findings received prove that the specific effect of eccentric quadriceps muscles training is not only associated with increasing muscle strength but also with improving neuromuscular coordination and skill execution. It should be noted that no significant differences in the strength of core muscles were found among both groups of subjects. Thus, it can be concluded that the training program implemented was not effective enough to provoke adaptation processes associated with improving trunk stability. Generally, the findings support the initial hypothesis about the extreme value of eccentric training.

Reference

1. Alhamashi, F., Rahnama, N., and Sadeghi, M. Investigating the effect of eight weeks of reactive neuromuscular training (RNT) on body control, muscle strength and quality of life of older adults. *Studies in Sport Medicine*, 15, no. 35 (2023) 91-108.
2. Arad, M., Goli, R., Parizad, N., Vahabzadeh, D., & Baghaei, R. (2021). Do the patient education program and nurse-led telephone follow-up improve treatment adherence in hemodialysis patients? A randomized controlled trial. *BMC nephrology*, 22, no. 1 (2021) 119.
3. Castagna, C., Krstrup, P., & Póvoas, S. (2020). Yo-Yo intermittent tests are a valid tool for aerobic fitness assessment in recreational football. *European Journal of Applied Physiology*, 120, no. 1 (2020), 137-147.

4. Cuthbert, M., Ripley, N., McMahon, J. J., Evans, M., Haff, G. G., and Comfort, P. The effect of Nordic hamstring exercise intervention volume on eccentric strength and muscle architecture adaptations: a systematic review and meta-analyses. *Sports Medicine*, 50, no 1 (2020) 83-99.
5. Islam, M. S., Rahman, M. H., Mola, D. W., Adane, A. K., and Pramanik, T. N. 2024. Nordic hamstring curls are a remedy for hamstring muscle injury: A narrative review. *International Journal of Human Movement and Sports Sciences*, 12, no. 4 (2024) 692-698.
6. Marcelino, R., Sampaio, J., Amichay, G., Gonçalves, B., Couzin, I. D., & Nagy, M. Collective movement analysis reveals coordination tactics of team players in football matches. *Chaos, Solitons & Fractals*, 138, (2020) 109831.
7. Moro, T., Tinsley, G., Longo, G., Grigoletto, D., Bianco, A., Ferraris, C., ... and Paoli, A. Time-restricted eating effects on performance, immune function, and body composition in elite cyclists: a randomized controlled trial. *Journal of the International Society of Sports Nutrition*, 17, no. 1 (2020) 65.
8. Mousavi, S. M. S., and Mirsafaei, R. R. Effect of central stability and dynamic neuromuscular stabilization exercises on pain, flexibility, balance, muscle endurance and quality of life in men with nonspecific chronic low back pain, 2022.
9. Murakami, Y., Nishida, S., Kasahara, K., Yoshida, R., Hayakawa, R., and Nakamura, M. Eccentric force and electromyogram comparison between the eccentric phase of the Nordic hamstring exercise and the razor hamstring curl. *PLoS One*, 18, no. 12 (2023) e0293938.
10. Nurhakiki, E., Hidayat, T., & Rosidawati, I. (2026). Literature review: Efektivitas latihan range of motion (ROM) terhadap peningkatan kekuatan otot pada pasien stroke berdasarkan Manual Muscle Testing (MMT). *Jurnal Media Akademik (JMA)*, 4(1). <https://jurnal.mediaakademik.com/index.php/jma/article/view/4909>
11. Peñailillo, L., Valladares-Ide, D., Jannas-Velas, S., Flores-Opazo, M., Jalón, M., Mendoza, L., ... and Diaz-Patiño, O. Effects of eccentric, concentric and eccentric/concentric training on muscle function and mass, functional performance, cardiometabolic health, quality of life and molecular adaptations of skeletal muscle in COPD patients: a multicentre randomised trial. *BMC Pulmonary Medicine*, 22, no. 1 (2022) 278.