

IMPACTS OF PNF STRETCHING ON JOINT FLEXIBILITY IN VOLLEYBALL ATHLETES



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IMPACTOS DO ALONGAMENTO PNF SOBRE A FLEXIBILIDADE ARTICULAR EM ATLETAS DE VÔLEI

IMPACTO DE LOS ESTIRAMIENTOS PNF SOBRE LA FLEXIBILIDAD ARTICULAR EN ATLETAS DE VOLEIBOL

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ABSTRACT

Introduction: It is believed that the stretching method by Proprioceptive Neuromuscular Facilitation (PNF) can improve functional joint flexibility through neural stimuli, resulting in more precise movements for volleyball players. **Objective:** Study the effect of PNF stretching exercise on shoulder joint flexibility in volleyball athletes. **Methods:** A total of 30 members of a university volleyball team were randomly divided into experimental and control groups. The traditional stretching method was used in the control group, while the PNF stretching method was employed in the experimental group. Data regarding the range of motion and functional quality were collected before and after the intervention for statistical analysis. **Results:** After eight weeks of the experiment, the left anterior flexion functional score on the shoulder flexibility index of the experimental group increased from 147.05 ± 4.95 to 160.99 ± 4.56 ; the right frontal flexion score increased from 150.27 ± 5.93 to 162.16 ± 4.46 . Shoulder joint stability was gradually stabilized from 88.33 to 101.17 . The pass functional score increased from 4.17 ± 1.93 to 18.96 ± 1.77 ; the overall functional performance score increased from 9.02 ± 4.04 to 23.07 ± 3.96 . The control group had an increase without statistical significance. **Conclusion:** PNF stretching exercises can improve the shoulder joint flexibility of volleyball players. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: PNF Stretching; Volleyball; Shoulder; Range of Motion, Articular.

RESUMO

Introdução: Acredita-se que o método de alongamento pela Facilitação Neuromuscular Proprioceptiva (PNF) possa melhorar a flexibilidade funcional articular através de estímulos neurais, resultando em movimentos mais precisos para os jogadores de vôlei. **Objetivo:** Estudar o efeito do exercício de alongamento PNF sobre a flexibilidade articular no ombro de atletas de voleibol. **Métodos:** Um total de 30 integrantes de uma equipe universitária de voleibol foram divididos aleatoriamente em grupo experimental e de controle. O método tradicional de alongamento foi usado no grupo controle, enquanto o método de alongamento PNF foi empregado no grupo experimental. Os dados relativos à amplitude de movimento e qualidade funcional foram coletados antes e após a intervenção para análise estatística. **Resultados:** Após 8 semanas de experimento, a pontuação funcional de flexão anterior esquerda no índice de flexibilidade do ombro do grupo experimental aumentou de $147,05 \pm 4,95$ para $160,99 \pm 4,56$; a pontuação de flexão frontal do lado direito aumentou de $150,27 \pm 5,93$ para $162,16 \pm 4,46$. A estabilidade da articulação do ombro foi gradualmente estabilizada de $88,33$ para $101,17$. A pontuação funcional do passe aumentou de $4,17 \pm 1,93$ para $18,96 \pm 1,77$; a pontuação do desempenho funcional geral aumentou de $9,02 \pm 4,04$ para $23,07 \pm 3,96$. O grupo de controle teve um aumento sem expressividade estatística. **Conclusão:** O exercício de alongamento PNF pode melhorar a flexibilidade da articulação dos ombros dos jogadores de voleibol. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Alongamento PNF; Voleibol; Ombro; Amplitude de Movimento Articular.

RESUMEN

Introducción: Se cree que el método de estiramiento por Facilitación Neuromuscular Proprioceptiva (PNF) puede mejorar la flexibilidad funcional articular a través de estímulos neurales, resultando en movimientos más precisos para los jugadores de voleibol. **Objetivo:** Estudiar el efecto del ejercicio de estiramiento PNF sobre la flexibilidad articular del hombro en atletas de voleibol. **Métodos:** Un total de 30 miembros de un equipo universitario de voleibol fueron divididos aleatoriamente en grupo experimental y grupo de control. En el grupo de control se utilizó el método de estiramiento tradicional, mientras que en el grupo experimental se empleó el método de estiramiento PNF. Se recogieron datos relativos a la amplitud de movimiento y la calidad funcional antes y después de la intervención para su análisis estadístico. **Resultados:** Tras 8 semanas de experimento, la puntuación funcional de flexión anterior izquierda en el índice de flexibilidad del hombro del grupo experimental aumentó de $147,05 \pm 4,95$ a $160,99 \pm 4,56$; la puntuación de flexión frontal derecha aumentó de $150,27 \pm 5,93$ a $162,16 \pm 4,46$. La estabilidad de la articulación del hombro se estabilizó gradualmente de $88,33$ a $101,17$. La puntuación funcional de paso aumentó de $4,17 \pm 1,93$ a $18,96 \pm 1,77$; la puntuación de rendimiento funcional general aumentó de $9,02 \pm 4,04$ a $23,07 \pm 3,96$. El grupo de control tuvo un aumento sin expresividad



INTRODUCTION

Volleyball is a sport that requires a high level of physical coordination, speed, strength and other comprehensive qualities.¹ It requires good perception, high level of agility and physical coordination ability, and also puts forward higher requirements for flexibility, one of the most important qualities of athletes.² The main method to improve flexibility is stretching exercise, which is also an important part of athletes' preparation. Good flexibility can not only improve sports performance, but also prevent injuries and prolong the athletes' sports time.³ PNF stretching is a relatively new exercise method introduced into sports field by rehabilitation medicine, which is used to improve the flexibility and coordination of athletes.⁴ PNF stretching, which follows the basic theory of proprioceptive neuromuscular facilitation, is a common method of physical therapy, in which active assisted stretching is the most important form.⁵ This study analyzed the influence of PNF stretching on volleyball players' activity ability, mainly analyzed whether to directly or indirectly improve shoulder activity ability and shoulder flexibility, so as to improve athletes' sports ability.⁶ It provides reference for further assisting volleyball players in daily training, achieving excellent results, reducing sports injuries and prolonging sports life.

METHOD

Experimental object

At the initial stage of the experimental design, this paper learned the proportion, importance and influencing factors of flexibility in the daily training of volleyball players by consulting relevant materials, conducting expert interviews and conducting questionnaires to members of a university volleyball team, which provided the relevant theoretical basis for this paper. The study and all the participants were reviewed and approved by Ethics Committee of LiJiang Culture and Tourism College (NO.LJCTC20FD06). According to the survey content and questionnaire results, excluding athletes who are not suitable to participate in this experiment because of physical injuries and training schedule conflicts, this paper selects 30 college volleyball team members who meet the conditions for the experiment. Before the experiment, it is necessary to ensure that the subjects have no sports injury in the near future, and they are suitable for PNF stretching training to a certain extent, and have a better understanding of the purpose and process of the experiment. Before the experiment, 30 athletes were randomly divided into the experimental group and the control group. The basic information of the two groups of athletes is shown in Table 1. There was no significant difference in height, age and other indicators between the two groups, which met the basic requirements of the control experiment.

Table 1. Comparison of basic conditions of athletes in the experimental group and the control group.

Group	Experience group	Control group
N/person	15	15
Age/year	20.47±1.039	20.74±1.489
Height/cm	181.77±2.037	181.71±1.060
Weight/kg	75.60±3.018	73.04±4.092

Experimental design

The experiment lasted for 8 weeks, and the frequency of experimental training was in accordance with the previous training plan of the volleyball team. The training frequency is 3 times a week, with an interval of 24 hours. The duration of each training is 90 minutes, and the duration of stretching training is about 30 minutes. The training contents of the two groups of athletes in preparation activities, physical fitness training and volleyball skills training are consistent. The difference lies in the stretching training after the formal training. The control group adopts the traditional stretching method unchanged, while the experimental group adopts the PNF stretching training method. The traditional stretching method used in the control group was mainly a combination of dynamic and static stretching, which was completed independently by individuals with bare hands. PNF stretching training in the experimental group included active stretching and resistance training, which were completed by individuals with bare hands and partners. The stretching part mainly includes the anterior and posterior muscle groups of the shoulder joint, and the stretching action mainly includes PNF shoulder joint flexion and abduction.

Test index and method

In this paper, the main indicators of the flexibility of the tested athletes include the flexibility and stability of the shoulder joint, and the performance of the passing and serving.

Shoulder flexibility mainly tests ROM value of shoulder joint, including forward flexion and backward extension. The testing instrument is a joint angle ruler. During the measurement, the athletes were required to wear light clothes as much as possible. During the recording, the joint angle ruler was aligned with the joint parts and the angle was adjusted. The movable arm changes position with the movement of the limb and records the data. The data of each part were measured three times, and the highest score was taken as the final result.

Volleyball performance test indicators include two items, namely, passing and serving. During the test of the ball setting technique, the players under test are required to carry out continuous front two handed ball setting, and the lower edge of the thrown volleyball must exceed the upper end of the net. The men's net is 2.2m high and the women's net is 2m high. The ball lands or the timing ends. Record the number of qualified passes of the tested athletes, and each pass counts 0.5 points. In the process of service technology test, the tested athletes are required to stand in the service area for service test, and the service mode of frontal overhand is adopted. It ends after ten consecutive serves, and there is only one test opportunity. Any violation such as trampling, going out of bounds or exceeding the time limit during the service process shall be counted as one chance to be invalid. Record the number of qualified balls in the boundary of the tested athletes, and each ball is counted as 3 points.

RESULTS

PNF stretching exercise improves the shoulder joint characteristics of volleyball players

After 8 weeks of experimental training, the two groups of volleyball players were first tested for shoulder joint flexibility. The statistics of test results are shown in Table 2.

Table 2. The Improvement of Shoulder Joint Flexibility of Volleyball Players by PNF Stretching.

Option	Left ante flexion		Right ante flexion	
	Experience group	Control group	Experience group	Control group
Before experiment	147.05±4.952	145.56±6.730	150.27±5.932	146.66±5.850
After experiment	160.99±4.564	145.67±6.345	162.16±4.462	149.26±5.201
t	-17.6725	1.4696	-15.8052	0.9877
P	0.0344	0.0359	0.0108	0.0363
Option	Left side extension		Right side extension	
	Experience group	Control group	Experience group	Control group
Before experiment	27.34±4.073	26.67±3.541	28.02±4.776	26.31±3.202
After experiment	37.66±3.374	26.93±3.506	37.95±4.770	26.46±2.993
t	-18.6139	-0.3526	-15.6067	1.1427
P	0.0296	0.0169	0.0333	0.0353

The data in Table 2 can directly show that after 8 weeks of PNF stretching training, the four indicators of shoulder flexibility in the experimental group have significantly changed compared with those before training ($P < 0.05$), and overall, the improvement effect of stretching training on the left shoulder is better than that on the right. The left side forward bending score was 147.05 ± 4.952 before training and increased to 160.99 ± 4.564 after training; The score of right side forward bending was 150.27 ± 5.932 before training and 162.16 ± 4.462 after training; The left extension score was 27.34 ± 4.073 before training and 37.66 ± 3.374 after training; The right extension score was 28.02 ± 4.776 before training and 37.95 ± 4.770 after training. It shows that PNF stretching exercise is effective in improving the flexibility of volleyball players' shoulder joints. In contrast, the score of shoulder joint flexibility in the control group also changed significantly compared with that before training, but the increase was smaller compared with the experimental group. The left side forward bending score was 145.56 ± 6.730 before training and increased to 145.67 ± 6.345 after training; The score of right side forward bending was 146.66 ± 5.850 before training and 149.26 ± 5.201 after training; The left extension score was 26.67 ± 3.541 before training and 26.93 ± 3.506 after training; The right extension score was 26.31 ± 3.202 before training and 26.46 ± 2.993 after training. The comparison results between the experimental group and the control group show that stretching after training is important for shoulder flexibility, which is conducive to protecting body joints and reducing sports injuries. It is an essential part of all sports training. At the same time, the effect of PNF stretching training will be better than that of traditional training methods, so it can be referred in actual training.

Then statistics and analysis were made on the stability of the shoulder joint. Combined with the weekly test results, the average change trend of the shoulder joint stability score of the tested athletes during the 8-week experimental training was shown in Figure 1.

It can be seen intuitively from Figure 1 that during the 8-week training period, the stability of the shoulder joint of the test group and the control group athletes showed a trend of rapid increase to a certain level and then began to decline steadily. The stability of the shoulder joint of the athletes in the experimental group was 88.33 before the experiment, increased to 102.17 in the third week, and reached a maximum of 117.17 in the fourth week. Later, the stability of the shoulder joint of the athletes in the experimental group was relatively stable, maintained at about 116.83 in the fifth to sixth weeks, and gradually decreased in the seventh week, and stabilized at 101.17 in the eighth week. The change trend of the control group was basically the same as that of the experimental group, but the overall average level began to be lower than that of the experimental group after one week of training,

and the overall gap continued to expand. The stability of the shoulder joint in the control group also reached the best level in the 4-5 weeks of training, which were 113.83 and 115.17 respectively. Then it began to decline steadily to 102.17 in the sixth week and remained around 95.17 in the eighth week. The change trend in Figure 1 shows that PNF stretching exercise can effectively improve the stability of shoulder joint during volleyball training.

PNF stretching exercise improves volleyball players' relevant performance

Finally, comparative analysis is made on the impact of PNF stretching exercise on volleyball players' relevant performance, and the data statistics are shown in Table 3.

It can be seen from Table 3 that after training, the scores of the passing and serving of the experimental group and the control group both showed significant improvement ($P < 0.05$), but according to the statistical results, the changes of the experimental group were more significant and larger. In the experimental group, the score of the passing score was 4.17 ± 1.936 before training and 18.96 ± 1.777 after training; The service performance before training was 9.02 ± 4.040 , and after training was increased to 23.07 ± 3.960 . The increase in the control group was relatively small, but still significant compared with that before training. In the experimental group, the score of the passing score was 4.35 ± 2.167 before the training and 18.24 ± 2.618 after the training; The service performance before training was 8.34 ± 3.494 , and after training was improved to 18.84 ± 4.414 . The data in Table 3 shows the effectiveness of volleyball training for the tested athletes during the experimental period, which has improved the basic volleyball skills of passing and serving. But in contrast, because PNF stretching exercise improved the shoulder flexibility and stability of the experimental group, the experimental group was slightly higher than the control group in the performance of ball setting and service after training. Therefore, PNF stretching exercise can be applied to the daily training of volleyball training, providing some help for further improving the athletes' joint flexibility.

DISCUSSION

The experimental results in this paper show that the influence of PNF stretching on shoulder flexibility is obviously better than that of

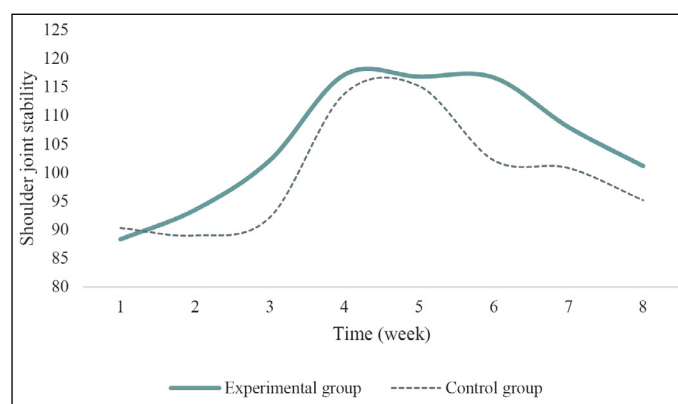


Figure 1. Improvement of shoulder joint stability of volleyball players by PNF stretching exercise.

Table 3. PNF Stretching Exercises to Improve the Performance of Volleyball Players.

Option		Before experiment	After experiment	t	P
Cushion	Experience group	4.17±1.936	18.96±1.777	27.5572	0.0315
	Control group	4.35±2.167	18.24±2.618	26.2158	0.0138
Serve	Experience group	9.02±4.040	23.07±3.960	16.1425	0.0264
	Control group	8.34±3.494	18.84±4.414	13.1447	0.0267

ordinary stretching, and overall, the improvement effect of stretching training on the left shoulder joint is better than that on the right. The main reason is that in daily life and sports, the right shoulder joint is used more frequently than the left, and the flexibility of the right shoulder joint is inevitably better than the left shoulder joint. The muscle extensibility of the right shoulder joint is more developed than that of the left shoulder joint, so it is difficult to have a greater impact on the activity of the right shoulder joint in a few weeks only by stretching. Therefore, Table 1 shows that the improvement effect of stretching training on the left shoulder joint is better than that on the right shoulder joint. Since PNF stretching method adds an external force against active shrinkage on the basis of static stretching, it is balanced by resistance. The high resistance of the stronger sports muscle group can cause the contraction of the weaker sports muscle group and stimulate the untapped potential of individuals. Therefore, in this experiment, PNF stretching has a better effect on shoulder flexibility than traditional stretching, showing greater advantages.

PNF stretching training can stimulate the potential of the body, effectively improve the flexibility of volleyball players, and help improve specific technical performance. Compared with the traditional stretching method, PNF stretching method is a new and exciting way for volleyball players to stretch joints, muscles and ligaments. The result gives people a great sense of achievement and satisfaction. It will improve the volleyball

players' interest in physical fitness to some extent, which is not satisfied by traditional stretching training.

CONCLUSION

When volleyball players are playing volleyball, the flexibility of their shoulders can improve the use of volleyball movements. In volleyball, one must constantly move, evaluate the impact point of the ball, and move quickly to enter the hitting position. Improving shoulder flexibility can make the movement more comfortable and faster, and the perception and evaluation of the ball will be better. You can play more smoothly in the game, improve the stability of the shot, and ultimately improve the game performance. The results of the comparative experiment show that both conventional stretching and PNF training can improve the shoulder flexibility of volleyball players to a certain extent, but PNF stretching training can improve the shoulder flexibility of volleyball players much more than conventional stretching. Therefore, PNF stretching training is a practical choice for volleyball players to train their shoulder and shoulder joint flexibility, which can be appropriately promoted. Combined with traditional training, it can promote the overall quality and performance of volleyball players to a greater extent.

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