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The Effect of Proprioceptive Neuromuscular Facilitation (PNF) Exercises on Developing Limb Strength and Flexibility and Achievement in the 200m Sprint for People of Determination, CP38 Category

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Abstract
This category of people with disabilities (CP38) is one of the categories that suffer from cerebral palsy (Cerebral Palsy), whether of the lower or upper limbs. This paralysis causes a disorder in movement and lack of control over body movements in terms of extending and flexing the working muscles and the assistance that the body needs in performance, whether for the upper limbs and lower limbs or the limb alone, and the focus is on the affected limbs that suffer from paralysis, and thus affects the strength and flexibility of the upper and lower limbs of the body.
The research aims to:
1 -Develop proprioceptive neuromuscular (PNF) exercises using the reciprocal motor contraction (AR) method and the slow reciprocal motor contraction (SRHR) method to develop upper and lower limb strength and flexibility for 200m runners in the people with disabilities (CP38) category.
2 -The effect of proprioceptive neuromuscular (PNF) exercises on developing strength, flexibility, and performance for 200m runners for people with disabilities (CP38) category.
Research hypotheses:
1 .Proprioceptive muscle training (PNF) has a positive effect on developing strength and flexibility in upper and lower extremities, or the extremity alone, for people with disabilities in category (CP38).
2 .Proprioceptive muscle training (PNF) has a positive effect on developing the 200m sprint performance of people with disabilities in category (CP38).
The researcher concluded the following:
1 -Proprioceptive neuromuscular (PNF) exercises developed the strength and flexibility characteristics of the upper and lower extremities of 200m runners with disabilities (CP38) in the post-test.
2 -Proprioceptive neuromuscular (PNF) exercises developed the achievement of 200m runners with disabilities (CP38) in the post-test.
The researcher recommends:
1 .Continuing training curricula that will develop the upper and lower extremities in terms of flexibility and strength.
2 .Developing more specialized exercises to develop flexibility and strength in the upper and lower extremities.

Keywords: Neurosensory Receptor Exercises, Strength and Flexibility of the Upper and Lower Extremities, Achievement.

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1-1 Introduction and Importance of the Research

Today, the world is witnessing progress in all aspects of life. Life is becoming more difficult day by day, and research is increasing in all areas that serve humanity. This progress has even affected sports activities. While the development of sports training and the diversity of its methods may play a major role in achieving a specific sporting achievement, many with good training status may fail, and this is due to various phenomena. One of the most important reasons that lead to the develop the level of achievement in the 200m race is the development of the training methods used and the use of modern training devices and equipment, especially for competition, such as the devices used in develop elements of general and special physical fitness, as well as development of methods and means of analyzing tired performance that resulted from the results of studies, research and scientific experiments. The effectiveness of the 200m race is one of the important activities, the performance of which depends on enduring maximum speed. Muscular strength, especially speed strength and strength endurance, which are among the most important forces contributing to the achievement of the 200m race, as this effectiveness depends on two important factors: the length of the stride, which is related to strength and flexibility, as well as the frequency speed, which is related to the central nervous system. The category of people with disabilities is considered one of the important categories in society, as these categories have varied according to the nature of the disability. As for this category of people with disabilities (CP38) It is one of the categories that suffer from cerebral palsy (Cerebral Palsy) whether (for the lower and upper limbs) and this paralysis causes a disorder in movement and lack of control over the body's movements in terms of extending and flexing the motor muscles that the body needs in performance, whether for the upper limbs and the lower limbs or the limb alone, and the focus is on the affected limbs that suffer from paralysis and their support in terms of exercises prepared by the researcher This greatly affects many of the strength and flexibility measures that play a major role during the 200m sprint race. Proprioceptive neuromuscular stimulation (P.N.F) exercises are important exercises that help reduce muscle tension in the extremities, which helps improve the athlete's range of motion and muscle strength. The importance of the research lies in developing proprioceptive neuromuscular stimulation (P.N.F) exercises using the reciprocal contraction method of motor muscles (AR). The slow reciprocal rhomboid (SRHR) method contributes to improving strength, flexibility, and the effectiveness of the 200m sprint.

1-2 Research Problem

The disability category (CP37) is one of the categories that suffer from spastic hemiplegia, and the limbs of the body suffer from weak flexibility and strength, whether in the upper and lower extremities or the extremity alone, especially in injured individuals. This weakness in these variables significantly affects In achievement, some trainers do not seek to reduce this difference between the limbs in terms of flexibility and strength, as well as in the limb alone between the muscles, and since this is a category of categories that suffer from hemiplegia, they need exercises that help develop flexibility and strength for the upper and lower limbs or for the limb alone, and this feature is present in the (P.N.F) exercises that the researcher will prepare for members of the research community to develop (strength and flexibility) and achievement for the effectiveness of running 200 meters for men.

3- Research objectives

1- Develop proprioceptive neuromuscular (PNF) exercise using the AR and SRHR methods to develop upper and lower limb strength and flexibility for 200m runners for people with disabilities (CP38) category.

2- The effect of proprioceptive neuromuscular (PNF) exercises on developing strength, flexibility, and performance for 200m runners for people with disabilities (CP38) category.

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1-4 Research Hypotheses

1. Proprioceptive muscle training (PNF) exercise have positive effect develop strength flexibility in the upper and lower extremities, or the extremity alone, for people with disabilities (CP38).
2. Proprioceptive muscle training (PNF) exercises have a positive effect on developing the 200m sprint performance of people with disabilities (CP38).

1-5 Research Areas

Spatial field: Stadium and field, College of Physical Education and Sports Science, Al-Qadisiyah University.

Temporal field: From February 13, 2024, to June 27, 2024.

Human field: Players of the national team for people with disabilities (CP38 category).

1-6 Definition of terms

Proprioceptive Neuromuscular Facilitation (PNF) exercises

"PNF is defined as 'flexibility exercises that affect the upper autonomic nervous system, which consist of alternating static muscle contractions with passive stretching through a series of specific movements'" (6:144). "Some define PNF as 'the system that increases the response of neuromuscular mechanisms by stimulating (exciting) sensory receptors,' and assert that this system simply sets the required level of flexibility to achieve the desired response" (13:86).

3- Research Methodology Field Procedure

3-1 Research Methodology

"The method is 'the method followed by the researcher in studying the problem to discover the truth'" (2: 33). The researcher uses a single-group experimental method because it suited the nature of the research.

Table (1): The experiment design of the research.

Pre -test	Exercise used	Post -test
Flexibility testt for upper and lower extremities	PNF exercises Neuromuscular sensory receptors	Flexibility test for upper and lower extremities
Strength test for upper and lower extremities		Strength test for upper and lower extremities
race completion 200m		race completion 200m

3-2 Community and Research Sample

The sample selection must be representative of the original community. A key condition for this sample must be that its results can be generalized to the community from which it was taken. The community was represented by runners with special needs. The research sample included the paraplegic category (CP38), specializing in the 200m race. The sample was chosen intentionally, and the number of runners was (7) using a comprehensive enumeration method.

3-3 Tools, methods, and devices used in the research

In order for the researcher to be able to complete his research, it was necessary to utilize the tools, methods, and devices that would enable him to do so. Research tools mean "(the means or method by which the researcher can solve his problem, whatever those tools may be: data, samples, devices, etc.)" (12: 133)

The tools, methods, and devices used by the researcher are

(personal interviews and expert opinions, observation and experimentation, two SPORT TIME digital electronic stopwatches, 1/100 of a second, made in Japan, two (2) SONY cameras, a medical scale, and a measuring tape for measuring height).

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3-4 Exploratron Experiment

The researcher conducted the exploratory experiment at 9:00 a.m. on Saturday, February 17, 2024, at the College of Physical Education and Sports Science stadium at Al-Qadisiyah University, with a support team of 7 members of the research community (CP38).

"This experiment serves as practical training for the researcher to identify the negatives and positives that may be encountered during the main experiment and avoid them" (8: 107). The exploratory experiment aimed to achieve the following:

(Identifying problems that the researcher might encounter during the main experiment, verifying the suitability of the location, determining the appropriate and required time for the pre-tests, ensuring the validity of equipment tools use, ensuring the safety of the tested players, identifying the competence and number of the support team, and the appropriate placement of the cameras, with each camera being positioned 42 meters away from the other and at a height of 120 cm).

3-4-1 Pre-test

The research and assistance staff conducted a pre-test over two days at the College of Physical Education and Sport Sciences stadium at Al-Qadisiyah University for members of the research community on Tuesday, February 27, 2024. After being given specifications on how to perform the tests and their sequence, the researcher conducted the tests specified in the research. On the first day, he conducted.

First: "Flexibility Tests for the Body's Extremities" (5:45)

- Leg Flexibility Test (Leg Opening): Using an Algeniometer

This is a large circular protractor with two movable arms that can be changed so that one of the arms extends along any limb of the body and moves with it to measure the angular range of that limb or joint, whether with the body or with another limb. The measurement is done by attaching the device to the knee joint from the outside of the joint and bending the joint At each angle, starting from (zero) to (360) degrees, the joint angles are taken by having the competitors raise their upper or lower limbs to the maximum possible extent they can reach, and thus measuring the distance that the joint can reach, whether the joint is backward or forward, noting that the goniometer device measures in two directions, i.e. from 180 degrees to 0 degrees and from 0 degrees to 180 degrees.

This test involves sitting upright with your legs spread as wide as possible, each as far to the sides as possible. It's best to breathe slowly while doing this. While doing this, raise your arms slightly forward, taking care not to move your back.

Test Description

- Flexibility test for the legs (and arms and shoulders): Using a stick:

The player stands holding the stick with the arms open at chest width and begins to gradually ascend to the top of the head and then backwards, i.e. a complete rotation movement of the shoulder joints as well as the muscles of the right and left arms. As for the leg test, the player sits on the floor and opens his legs to the maximum extent possible, i.e. the legs are extended forward without bending at the knee joint, and the distance between the legs is measured.

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Figure (1): Illustrates the flexibility test of the legs, arms, and shoulders using a stick.
Second: "Muscular strength tests for the extremities. The researcher used a dynamometer" (4:366).

1. Strength test for the two-headed muscles of the arm (biceps muscle).
2. Strength test for the three-headed muscles of the arm (triceps muscle).
3. quadriceps muscle of the leg (triceps muscle).
4. Strength test for the two-headed muscles of the leg (biceps muscle).
5. Strength test for the anterior leg muscle (tibialis muscle).
6 Strength tests for the back and abdominal muscles

Figure (2): Illustrates the strength test using a dynamometer (kg) (11:58)
Purpose of the test: To determine and measure angles in flexion and extension positions.
1- Raising the arm upward to the level the subject can reach: The image is taken from the side of the body:
2- Raising the arm backwards to the level the subject can reach: The image is taken from the side of the body:
Homogeneity of the research sample.
Table (2): The homogeneity test of height, weight, age, achievement, and skewness coefficient for the research population.

ت	Variables	The middle	deviation	Coefficient of skewness	Result
1	**Height(cm)**	162.31	4.63	0.10	homogeneous
2	**Age (years)**	19.14	1.64	0.71	homogeneous
3	**Weight (kg)**	66.97	4.62	0.17	homogeneous
4	**Achievement (s)**	26.39	0.83	0.02	homogeneous

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3-6 200m Run Performance Test

The purpose of the test is to determine the 200m run performance of CP38 category athletes with disabilities and to record the times for the race distance**.**

3-6 Exercises Used (Main Test)

The researcher designed exercises for the experimental group aimed at improving specific physical attributes (flexibility and muscle strength) in both limbs, as well as improving the organization and speed of nerve signals. The exercises included the following: 1- The training method used in the exercises was the repetitive training method for (P.N.F.) exercises**.**

2- The training curriculum was applied during special preparation period and took (6) weeks at a rate of (3) training units per week, as day (Sunday, Tuesday, Thursday) were training day, and thus total number of training units reach 24 training units, corresponding to Sunday 3/10/2024 at nine o'clock in the morning, as the time of the training unit was (35-40 minutes).

3- The researcher performed P.N.F. exercises (neuromuscular facilitation) using the reciprocal contraction of motor muscles (AR) by the trainer fixing the player's limb to the maximum extent that it can reached, i.e., a defect in the extent of positive flexibility, i.e., a shortening contraction of the motor muscles and a shortening contraction of the opposing muscles, for a limited number of second (10-15) second. After relaxing muscle for (3-5 seconds), when the player feels that he is able to achieve this, trainer moves the limb With wider range, the player resists so that muscle contraction turns from a fixed contraction to a shortening contraction for a period of (10-15) seconds, and appropriate rest periods are given before repeating the exercise. The slow reciprocal contraction (SRHR) method can also be used, where the contraction is a shortening of the opposing muscles, followed by a fixed contraction of the same muscles. After that, a rest period is given, followed by a shortening contraction of the main motor muscles. This method achieves a high participation of the antagonistic muscles involved in lengthening, as it increases the muscular strength of these muscles. This method achieves a high participation of the antagonistic muscles concerned with lengthening, as it increases the muscular strength of these muscles.

Figure (3): The performance of the PNF exercise method.

When implementing the exercises, the researcher relied on scientific principles in terms:

- The suitability of the exercise content to the level and abilities of the research sample individuals.
- Taking into account the purpose of preparing these exercises.
- Taking into account the appropriate composition of training load in terms of intensity, volume, and rest. The principle of gradual load gradation was used for the weeks (3/1), meaning three weeks of increasing intensity and the fourth week of decreasing intensity. For the days, the principle of gradual load gradation was used (2/1), meaning two days of increasing intensity and the third of decreasing intensity.

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The researcher relied on a gradual increase in intensity and repetitions depending on the level of intensity degrees, then decreasing the intensity in the eighth week in order to reduce the intensity of the load in training before the post-tests.

3-6-1 Post-tests

After completing the PNF exercise prepared by research, the post-tests were conducted on Tuesday, April 23, 2024, at 9:00 AM, at the College of Physical Education and Sport Sciences, Al-Qadisiyah University, two days later, using the same method as the pre-tests.

3-7 Statistical Methods

(Arithmetic mean, standard deviation, skewness coefficient, t-test for correlated samples).

Table (3): The arithmetic mean and standard deviations for the upper and lower limb flexibility and strength tests in the pre- and post-test for the research community.

ت	Testing of upper and lower extremities	Pretest		Posttest	
		س	ع	س	ع
1	Right and left leg flexibility	111.43	7.89	131.43	6.93
2	Trunk flexibility	40.29	1.28	42.00	1.41
3	Right and left arm flexibility	45.57	1.76	51.14	2.17
4	Right arm strength	15.86	1.25	20.57	1.05
5	Left arm strength	15.29	1.03	20.14	1.25
6	Abs strength	48.29	3.65	53.86	3.27
7	Back strength	50.71	2.05	54.29	2.91
8	Right leg strength	61.71	8.29	74.29	8.21
9	Left leg strength	69.00	3.78	80.14	4.22

Table (4): The arithmetic means, standard deviations, T-value, and significance level for the flexibility strength of upper and lower limbs using a dynamometer and an algeniometer (kg) in the pre- and post-test.

ت	Test for upper and lower extremities	Pre-test		Posttest		Level of evidence	T value	Difference
		M	D	M	D			
1	Right and left leg flexibility	111.43	7.89	131.43	6.93	0.00	8.20	Moral
2	Trunk flexibility	40.29	1.28	42.00	1.41	0.00	6.00	Moral
3	Right and left arm flexibility	45.57	1.76	51.14	2.17	0.00	10.55	Moral
4	Right arm strength	15.86	1.25	20.57	1.05	0.00	16.50	Moral
5	Left arm strength	15.29	1.03	20.14	1.25	0.00	14.28	Moral
6	Abs strength	48.29	3.65	53.86	3.27	0.00	5.34	Moral
7	Back strength	50.71	2.05	54.29	2.91	0.01	4.11	Moral
8	Right leg strength	61.71	8.29	74.29	8.21	0.00	12.05	Moral
9	Left leg strength	69.00	3.78	80.14	4.22	0.00	11.30	Moral

The table above show arithmetic means and standard deviations for the pre- and post-test to measure the flexibility and strength of the upper and lower extremities. The significance level for the flexibility

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of the right and left legs was (0.00), while the significance level for the flexibility of the trunk was (0.00), while the significance level for the flexibility of the right and left arms was (0.00), while the significance level for the strength of the right arm was (0.00), while the significance level for the strength of the left arm was (0.00), while the significance level for the strength of the abdomen was (0.00), The significance level for back strength reached (0.01), while the significance level for the strength of the right leg reached (0.00), while the significance level for the strength of the left leg reached (0.00), as the value of the (T) table reached greater than calculated value for all, whether for flexibility or strength of the upper and lower limbs, which indicates that the difference is significant between two tests and in favor of post-test, as the exercises prepared by the researcher contributed to the method of reciprocal contraction of the motor muscles (AR) and the method of slow reciprocal contraction (SRHR), In improving and developing the elements of flexibility and strength of the muscles of the upper limb as well as the lower limb in the 200m race event in particular and the rest of the muscles in general, as the nature of these two methods depends on the negative performance that the fellow player performs with the competitors, especially focusing on the muscles with weak performance in terms of the nature of flexibility as well as the strength that this event needs during performance, So the researcher increased the number of repetitions and sets as well as giving a longer duration for the performance to achieve maximum flexibility and maximum development of muscle strength, as the neuromuscular sensory receptor exercises contributed to developing them significantly and had an impact in improving flexibility as well as strength in the competitors of this category to achieve the best achievement during the 200 m race. As Nelson (1991) sees," Strength and flexibility training is considered part of the sports field, especially (P.N.F), which contains multiple useful methods that play an important role in training strength and flexibility in athletes. One of the most important goals of P.N.F. We must clarify that it is a complete preparation system for developing strength and flexibility in all its forms" (14: 98). "This is what was confirmed by (Fadel Salman, 1990 AD) that flexibility should constitute a large part of the training program in general, and the training unit in particular, because it helps in developing and achieving physical achievement" (6: 170). "And (1989, Pettrov. R) also sees that it is better to give flexibility exercises daily, "and the athlete must continue with them even after obtaining the highest degrees of it because it is an acquired trait rather than an inherited one, and when discontinuing its training for a certain period, it leads to its loss" (15: 95). Therefore, the use of the proprioceptive neuromuscular system (P.N.F.) to increase the range of motion depends on many methods that vary in their methods of use with the aim of achieving different results. Therefore, the difference lies in the application procedures, but these methods are very similar in the type and form of the exercises used. However, there is always a difference in the application procedures that always work in the direction of employing these receptors during muscle work. "In general, the basis upon which the work of these sensory neuromuscular receptors is built is the form of fixed contraction and moving contraction (lengthening - shortening) and which of them comes before the other and for which muscle group before the other" (3:30). Therefore, flexibility is considered one of the important characteristics of motor performance, It is also considered one of the basic and necessary physical factors in order to master physical and motor performance and economize energy expenditure. It also forms, along with the rest of the other physical qualities (such as strength, endurance, agility, and speed), the foundations upon which the acquisition and mastery of the motor performance of the body's joints are based. "Abu Al-Ala Abdel Fattah (1997 AD) defines it as the degree of ease of movement in the various joints of the bodyWithout causing any damage to it or tears in the ligaments and muscles, or it is the ability of the joints to reach the natural range that the anatomical structure of the joint allows when moving it, and it is considered the maximum amplitude of the performed movement, and it is expressed in scientific research in degrees of angle or in centimeters" (1: 68).

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Table (5): The arithmetic means, standard deviations, significance level, and T-value for achievement in the pre- and post-test for the research community.

Variables	Unit of measurement	Pre-test		Posttest		Level of evidence	T value
		M	D	M	D		
Achievement	second	26.39	0.83	25.07	0.92	0.00	8.66

The previous results showed that there are significant differences in favor of the post-tests. The researcher attributes this development in this test first to the effectiveness of the training curriculum used and standardized scientifically in terms of choosing the intensity of training and the size of training, as standardized training loads have a positive impact in achieving a high level and are of good effectiveness, This is what was confirmed by both Alawi and Abu Al-Ala (1984), "The training load is the main means of creating physiological effects on the body, which achieves improvement and then adaptation of the body's systems and raising the level. Therefore, it is one of the most important factors for the success of the training program and thus improving performance" (9: 22). The use of the repetitive training method in the training curriculum for the 200m race for people with disabilities had a clear impact on improving the level of achievement in running the race distance, as the intensity of the exercises included in the training curriculum, which is compatible with the requirements of this event in terms of high-level performance and standardized to reach the highest achievement and achieve the best time in this event. And which is performed with the highest intensity because intensity is one of the basic components upon which the training process is based, which "was defined by both (Robbers and Roberts, 1997) as the pressures used during the period of sports training." The use of research variables that all participated in achieving significant differences, as one of them is related to the other from the physical and functional aspects" (16: 769).

5- Conclusion and Recommendation

5-1 Conclusions

1- Proprioceptive neuromuscular (PNF) exercises improved the strength and flexibility of the upper and lower extremities of 200m runners with disabilities (CP38) in the post-test.

2- Proprioceptive neuromuscular (PNF) exercises improved the performance of 200m runners with disabilities (CP38) in the post-test**.**

5-2 Recommendations

1- Consider the training process for PNF exercise to develop the qualities of flexibility and strength, given their significant impact on improving performance.

2- Follow up on training curricula that develop the upper and lower extremities in terms of flexibility and strength.

3- Develop more specialized exercises to develop the qualities of flexibility and strength for the upper and lower extremities.

4- Using proprioceptive neuromuscular training (PNF) exercises using the reciprocal motor contraction (AR) method and the slow reciprocal motor contraction (SRHR) method, which play a major role in developing two qualities (flexibility - strength).

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Appendices

Exercises for the first week

today	Exercise number	intensity	volume		Rest between sets	Rest between exercises
			Performance time	Number of groups		
Sunday	6-5-4-3-2-1	%100	s.13	4	s. 35	s. 15
Tuesday	6-5-4-3-2-1	%100	s.14	3	s. 40	s. 25
Thursday	6-5-4-3-2-1	%100	s.15	4	s. 45	s. 20

Second week exercises

today	today	Exercise number	intensity		volume	Rest between sets
			Performance time	Number of groups		
Sunday	6-5-4-3-2-1	%100	s.15	4	s. 45	s. 17
Tuesday	6-5-4-3-2-1	%100	s.14	3	s. 35	s. 20
Thursday	6-5-4-3-2-1	%100	s.13	3	s. 40	s. 18

Week third workouts

today	today	Exercise number	intensity		volume	Rest between sets
			Performance time	Number of groups		
Sunday	12-11-10-9-8-7	%100	s.15	3	s. 45	s. 25
Tuesday	12-11-10-9-8-7	%100	s.14	3	s. 35	s. 20
Thursday	12-11-10-9-8-7	%100	s.13	4	s. 40	s. 18

Week Fourth workouts

today	today	Exercise number	intensity		volume	Rest between sets
			Performance time	Number of groups		
Sunday	17-16-15-14-13	%100	s.15	3	s. 45	s. 18
Tuesday	17-16-15-14-13	%100	s.14	4	s. 35	s. 25
Thursday	17-16-15-14-13	%100	s.15	3	s. 40	s. 20

Week Fifth exercises

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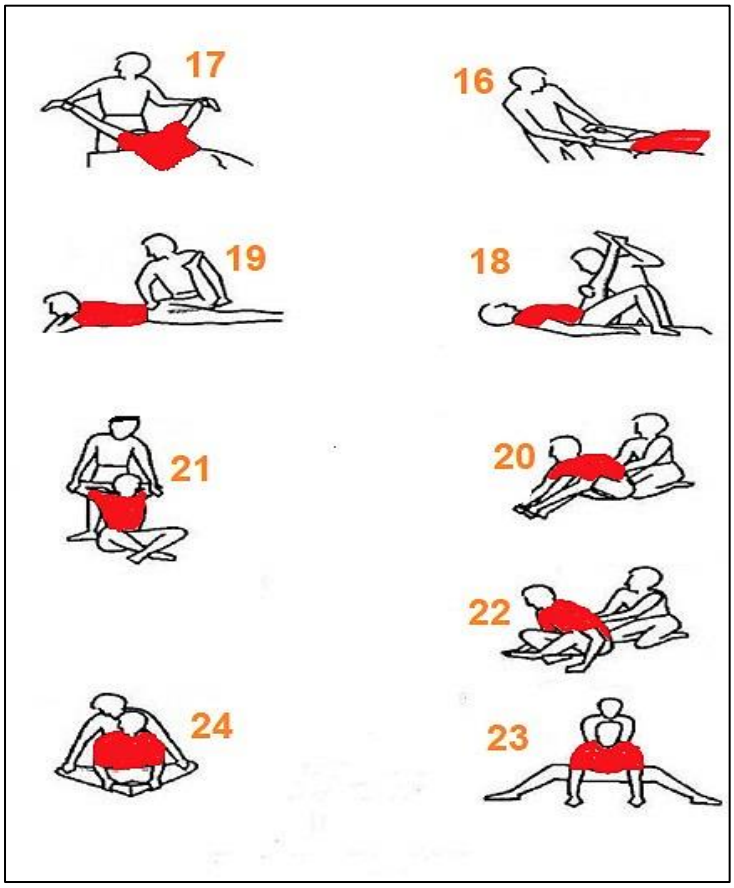
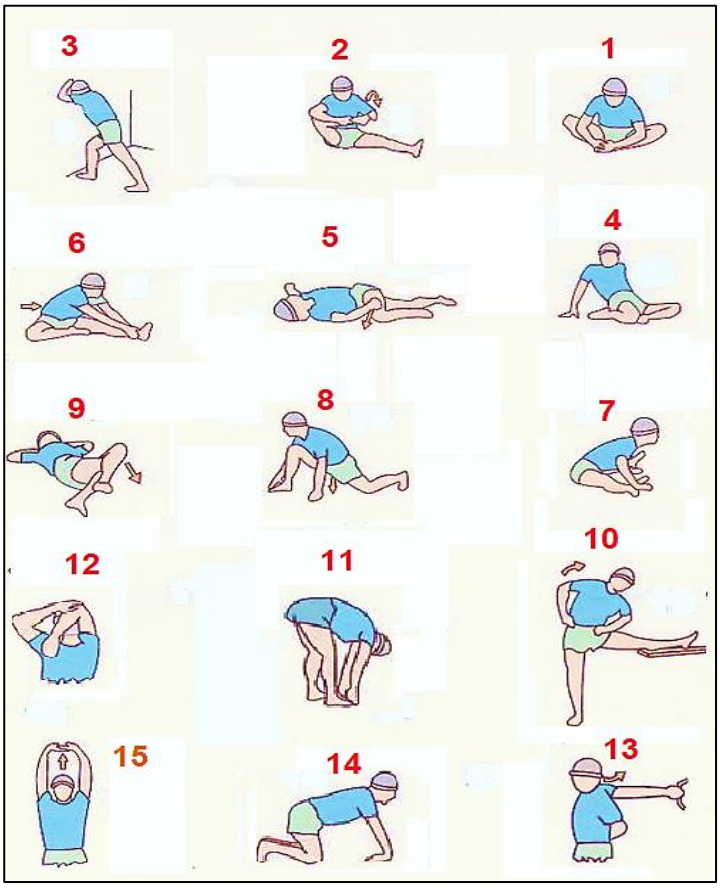
today	Exercise number	intensity	volume		Rest between sets	Rest between exercises
			Performance time	Number of groups		
Sunday	23-22-21-20-19-18	%100	s.15	4	s. 45	s. 20
Tuesday	24-23-22-21-20-19	%100	s.16	3	s. 50	s. 18
Thursday	24-23-22-21-20-19	%100	s.18	3	s. 40	s. 19

Week Sixth exercises

today	Exercise number	intensity	volume		Rest between sets	Rest between exercises
			Performance time	Number of groups		
Sunday	24-23-22-21-20-19	%100	s.16	4	s. 45	S. 25
Tuesday	24-23-22-21-20-19	%100	s.15	3	s. 40	S. 18
Thursday	24-23-22-21-20-19	%100	s.14	4	s. 50	s. 20

Shows P.N.F. exercises





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