



THE EFFECT OF USING A THERMAL TERAHERTZ DEVICE PRIOR TO REHABILITATION EXERCISES ON REDUCING ELBOW JOINT PAIN AND IMPROVING RANGE OF MOTION IN ATHLETES WITH DISABILITIES

Asst. Lecturer . Atheer Fawaz karim

College of Education for Women/ Al-Qadisiyah University/ Iraq

Atheer.Fawaz @qu.edu.iq

Abstract

Accordingly, the researcher conducted a case study by designing a rehabilitation program supported by modern modalities using a thermal terahertz device for athletes with disabilities suffering from elbow joint injuries. The significance of this research lies in establishing a rehabilitation protocol accompanied by a terahertz device for the injured limb, enabling the athlete to perform sport-specific activities related to this joint and to return rapidly to normal activity and achievement.

Keywords: thermal terahertz, range of motion, pain

Purpose of the study:

1. To identify the effect of a rehabilitation program accompanied by a thermal terahertz device on increasing the range of motion of the elbow joint muscles.

Methods and Procedures

The nature of the phenomenon addressed by the researcher determined the methodological approach; therefore, the experimental method was adopted as it suits the research problem and objectives. The study population was selected intentionally and consisted of athletes with disabilities suffering from elbow joint injuries in athletics, affiliated with the sub-Paralympic committee in Al-Diwaniyah.

Tests used in the research:

1. Pain intensity measurement using the Visual Analog Scale (VAS).
2. Range of motion angle test for the elbow joint (tennis elbow).

Conclusions

1. The prepared rehabilitation exercises had a substantial effect in reducing pain intensity and injury severity, and in increasing elbow extension and flexion range of motion in athletes with disabilities in athletics.

1. Introduction

There is rapid development all over the world in almost all aspects of life due to the development of scientific knowledge, and so is the case for sports sciences. However, many of modern and advance sports devices – especially sports rehabilitation equipment – have been developed with rapid growth over the past few years. The rapid recovery owing to modern modalities is crucial in rehabilitation, as these allow athletes to return to competition and perform at their best level due to high training loads that prompt injuries in numerous sporting events.



Sports like athletics heavily overuse weights and high training loads, higher duration of daily and weekly workouts and maximum performance. While these forces increase athlete exposure to sports injuries by means of too much effort, inadequate recovery, no orderly progress of competitive load and non-diverse training units. Gapping between training loads and the physical capacities of the athletes similarly heighten injury risk.

Athletes might be at increased risk for elbow joint injuries from repetitive practice and heavy loads in athletic events primarily relying on the upper limbs, particularly among athletics events held in: discus throw, javelin throw, and shot put. Currently, under the paradigm of optimization athletes with disabilities, who achieve high competitive results, and gold medals, train with high-intensity programs based on strength development, which increases injury risk. The elbow joint is one of the most frequently affected and most critical injury in para-athletics. These are chronic injuries sustained over the years because of overuse, not allowing enough therapeutic rest, and eventual soft tissue injury and scarring around the elbow joint, leading to pain, decreased mobility, and pain with repeated use of the arm.

Thus, the researcher has been able to carry out this integrated reconstruction through a rehabilitation program based on contemporary modalization, by using a thermal terahertz device for athletes with disabilities and people with elbow joint injuries. This research will develop a rehabilitation strategy with a thermal terahertz probe to the injured limb to perform sport-specific activities, resume even within a few days to normal activity, and success within the competitive range. success.

2. Purpose of the Study

2. To identify the effect of a rehabilitation program accompanied by a thermal terahertz device on athletes with disabilities suffering from elbow joint injuries in athletics.
3. To determine the effect of the rehabilitation program accompanied by a thermal terahertz device on increasing the range of motion of the elbow joint muscles.
4. To determine the effect of the rehabilitation program accompanied by a thermal terahertz device on reducing injury-related pain in athletes with disabilities in athletics.

3. Methods and Procedures

The nature of the phenomenon addressed by the researcher determined the methodological approach; therefore, the experimental method was used as it is appropriate for the research problem and objectives. The study population was selected intentionally and consisted of athletes with disabilities suffering from elbow joint injuries in athletics, affiliated with the sub-Paralympic committee in Al-Diwaniyah. The sample comprised three male athletes only. After selecting the sample, the researcher established the homogeneity of the main study sample with respect to the variables (age, height, weight, injury duration, range of motion, pain level, and flexion), as shown in Table (1).

Table (1)

Homogeneity of the Experimental Group Participants

No.	Variable	Unit	Mean	Std. Dev.	Skewness	Significance
1	Injury duration	Year	3	0.091	0.004	Homogeneous
2	Chronological age	Year	16.422	0.033	0.058	Homogeneous
3	Weight	kg	57.424	0.021	0.063	Homogeneous
4	Height	cm	161.406	0.046	0.054	Homogeneous
5	Muscle pain	Degree	7.2	0.050	0.03	Homogeneous
6	Range of motion	Degree	148.3	0.063	0.057	Homogeneous
	Flexion	Degree	18.4	0.003	0.004	Homogeneous



Main Experiment

To ensure that the pretests were valid and based on sound scientific principles, the researcher selected the appropriate place, time, and procedures. With the assistance of the supporting research team, the pretests were conducted on Wednesday, 5/2/2025, for the measurements and tests used in the study. The tests were administered in the following sequence:

1. Pain Intensity Measurement (VAS – Visual Analog Scale) (2:42)

VAS was used to measure pain intensity: the researcher who applied it. This is a tool that is generally used in rehabilitation programs and is simple to work with. The scale is a numerical scale from 0 to 10, with 0 being “none” and 10 being “very severe pain” at the highest level of pain. VSAS give an approximate magnitude of pain severity, relief, or elimination.

This test was then introduced to those specializing in sports injuries, and was subsequently validated and used as a last paragraph:

- **Test name:** Elbow joint pain intensity measurement.
- **Test purpose:** To measure the maximum pain level in the elbow joint.
- **Procedure:** The injured participant is asked to place a mark on the drawn line according to the level of pain felt, after being theoretically instructed on how to indicate pain with a specific mark. This is done after each range-of-motion test applied to measure elbow joint mobility in all directions.
- **Recording:** The highest pain score recorded on the pain scale is selected.

The researcher notes that the pain perception scale was applied more than once to the injured participants to monitor each case and track progress throughout the rehabilitation program, due to the sensitivity of the injury. These measurements were not subjected to statistical analysis except for the pre- and post-tests.

2. Test of Range and Flexion Angles of the Tennis Elbow Joint

- **Test purpose:** To measure the range of motion angle of the elbow joint to determine injury severity.
- **Equipment used:**
 1. **Goniometer:** Consists of two arms connected at one end with a circular scale graduated from 1 to 180 degrees, with an indicator on one arm.
 2. **Adhesive tape:** Used to fix the device arms to the injured limb.

Procedure: The examiner was positioned just next to the participant with one arm of the goniometer affixed with tape along and parallel to the longitudinal axle of the humerus. The second arm is positioned parallel, and fixed, to the forearm, while the participant’s arm is fully extended to the max extension (180 degrees) Next, the participant lifts their arm and bends the elbow by moving the forearm towards the above the elbow, above the elbow, above the elbow. The joint flexion is the recorded angle with the maximum flexion of 30 degrees. Every participant gets to attempt two trials and the best angle achieved is taken.

Rehabilitation Program

Thus, the researcher implemented the prepared therapeutic rehabilitation program, which combined exercises with the thermal terahertz device, which aims to eliminate pain and a quick return to the field to achieve performance goals. The program started on 2025/05/02, 5:00 PM, rehabilitation center of injured athletes.

The program consisted of six weeks of stroke rehabilitation, with sessions three times per week, for 40 minutes per session. Overall, there were 18 sessions held. There were three parts to all the sessions — a preliminary (15 minutes), a central (20 minutes) and a concluding (5 minutes).

Thus, total time of rehabilitation sessions during six weeks was 1440 minutes. Preparation portion: 270 min (37% of program duration) Transition portion: 360 min (50%) Concluding portion: 90 min (13%) Table (2) illustrates this distribution.

Table (2)

Distribution of Time Across the Rehabilitation Program Sessions

No.	Session Section	Total Time	Percentage
1	Preparatory	270 min	37%
2	Main	360 min	50%
3	Concluding	90 min	13%
	Total	720 min	100%

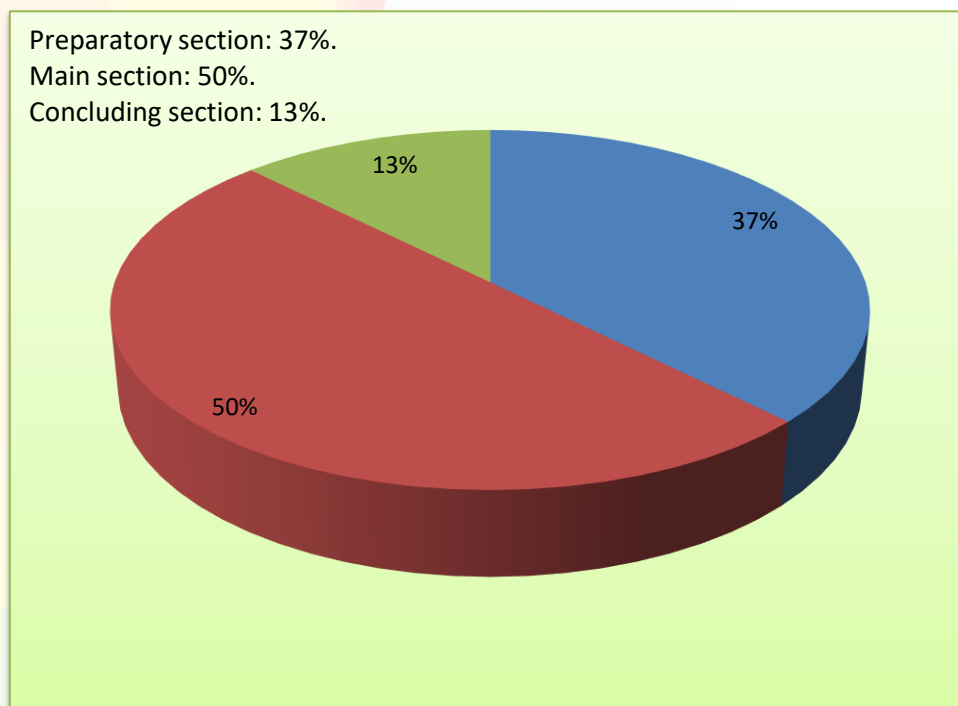


Figure (1) illustrates the distribution of time sections across the units over the duration of the prepared rehabilitation program.

After the rehabilitation program was completed, post-tests of the research sample took place on Thursday 01/05/2025, in the same sequence as the pre-tests. The researcher made certain that the pre-tests were administered in the same conditions as for the pre-tests, in particular regarding the order of the test .

4. Results

Table (3)

Differences in Mean Values Between Pre- and Post-Tests for Pain Assessment

No.	Participant	Pre-test	Post-test	Difference	Z value	Significance
1	First athlete	5.9	5.1	0.8	2.98	0.05
2	Second athlete	7.9	5.5	2.4	3.87	0.03
3	Third athlete	7.7	5.9	1.8	3.63	0.03
4	Total sample	7.2	5.5	1.7	2.96	0.05



The results indicate clear differences between pre- and post-test measurements, reflecting a reduction in pain levels following application of the rehabilitation program supported by the thermal terahertz device

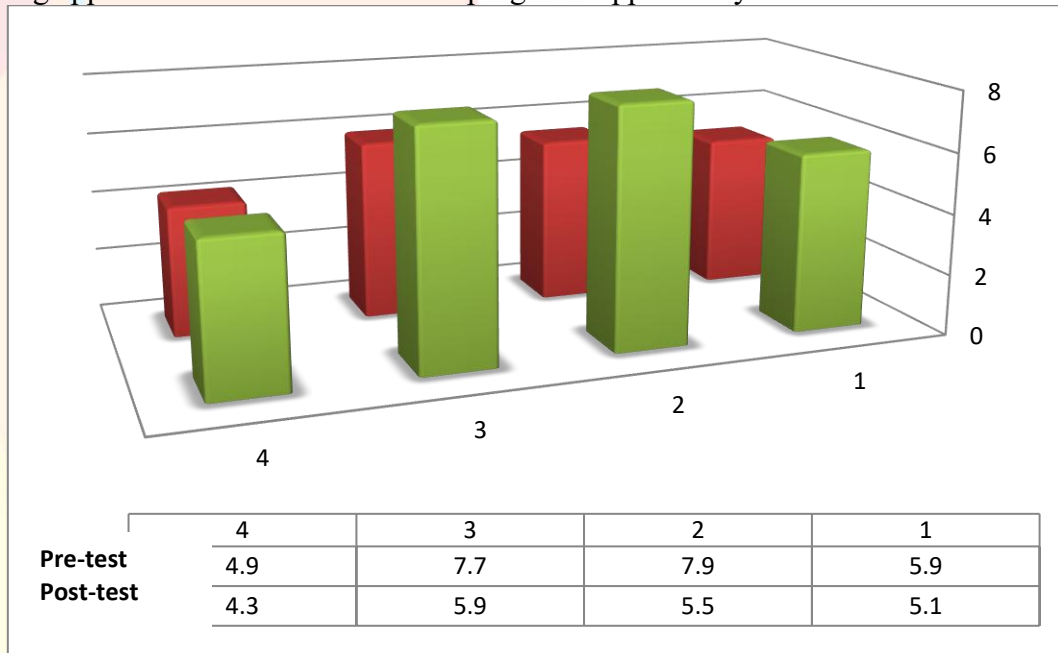


Figure (2) illustrates the differences between the pre- and post-tests of the main research sample in the muscle pain test.

Based on the table above, the pre-test value for the first athlete was (5.9), whereas the post-test value reached (5.1), with a mean difference of (0.8). The second athlete recorded a pre-test value of (7.9) and a post-test value of (5.5), with a difference of (2.4). The third athlete showed a pre-test value of (7.7) and a post-test value of (5.9), with a mean difference of (1.8). For the total sample, the pre-test mean was (7.2), while the post-test mean reached (5.5), resulting in a mean difference of (1.7).

Table (4)

Differences Between Pre- and Post-Tests in Range of Motion

No.	Participant	Unit	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Standard Error	Calculated Z value	p-value
1	First athlete	Degree	155.2	0.514	175.1	0.564	0.89	9.46	0.04
2	Second athlete	Degree	144.3	0.653	161.2	0.252	0.84	6.99	0.05
3	Third athlete	Degree	145.6	0.785	165.5	0.761	0.78	8.06	0.05
4	Total sample	Degree	148.4	0.083	167.3	0.059	0.65		

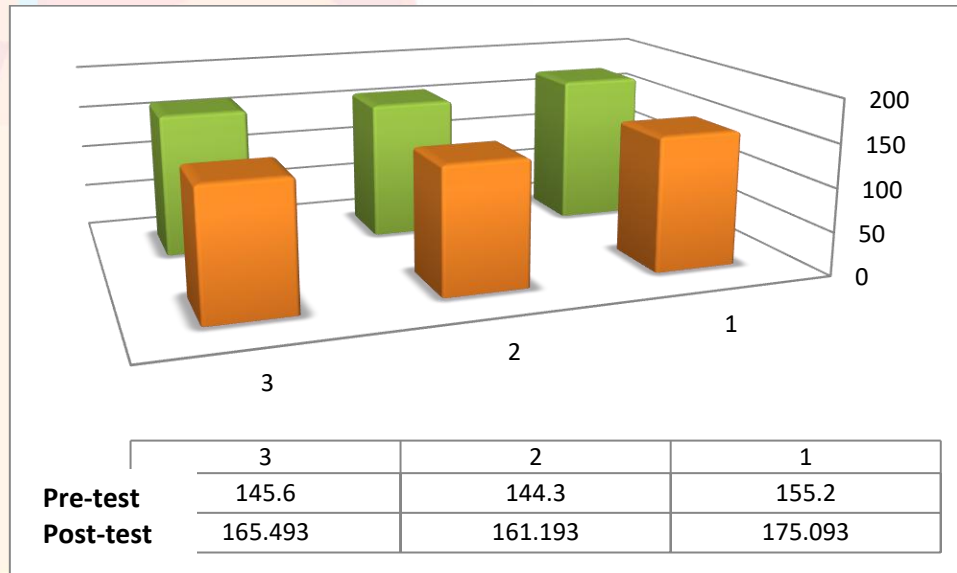


Figure (3) illustrates the differences between the pre- and post-tests of the main research sample in range of motion.

Based on the table above, the pre-test value for the first athlete was (155.2), while the post-test value reached (175.1). The second athlete recorded a pre-test value of (144.3) and a post-test value of (161.2). The third athlete showed a pre-test value of (145.6) and a post-test value of (165.5). For the total sample, the pre-test mean was (148.4), whereas the post-test mean reached (167.3).

Table (5)

Differences Between Pre- and Post-Tests in Flexion Range of Motion

No.	Participant	Unit	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Standard Error	Calculated Z value	p-value
1	First athlete	Degree	19.2	0.114	24.2	0.264	0.89	4.82	0.01
2	Second athlete	Degree	17.3	0.253	26.3	0.342	0.84	6.93	0.02
3	Third athlete	Degree	18.6	0.385	23.6	0.198	0.78	4.23	0.01
4	Total sample	Degree	18.4	0.237	24.7	0.174	0.65		

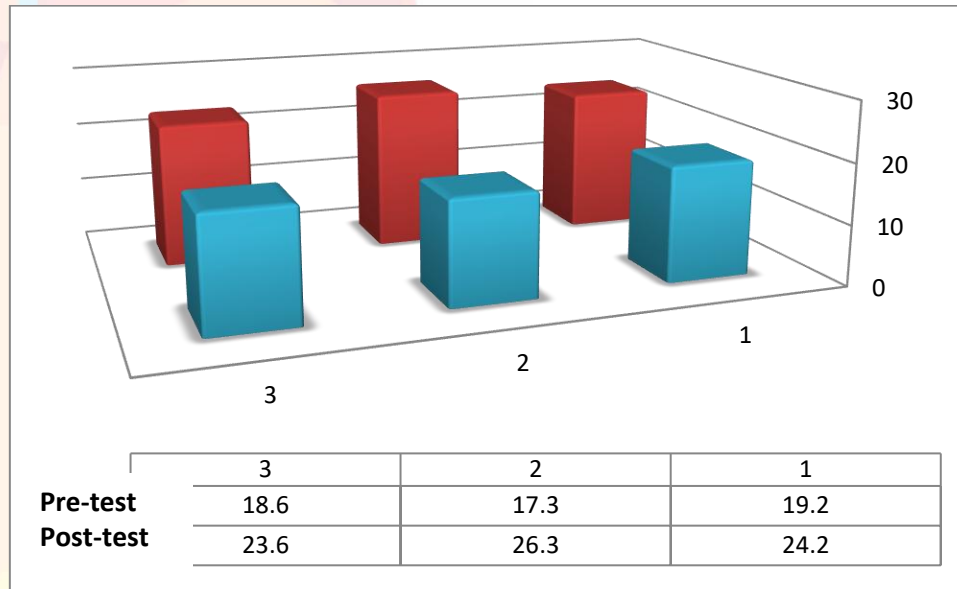


Figure (4) illustrates the differences between the pre- and post-tests of the main research sample in flexion range of motion.

Based on the table above, the pre-test value for the first athlete was (19.2), while the post-test value reached (24.2). The second athlete recorded a pre-test value of (17.3) and a post-test value of (26.3). The third athlete showed a pre-test value of (18.6) and a post-test value of (23.6). For the total sample, the pre-test mean was (18.4), whereas the post-test mean reached (24.7).

5. Discussion

As shown in the tables above, the differences of pre-test and post-test of pain level, range of motion, and flexion were statistically significant. According to the researcher, these results were attributed the rehabilitation exercises associated with the thermal terahertz device, which had a significant effect in reducing pain intensity and increasing extension and flexion range of motion of the elbow joint of the injured individuals of the study sample.

The logic and scientific design of the rehabilitation exercises were consulted with specialists and experts that showed positive reflections on the effect of the rehabilitation program supported by a terahertz device. It is known that pain has negative effects on muscular and joint functional performance. Therapeutic exercises along with modalities similar to shockwave compatible with capacity of the injured person assist in activating functional state of injured part. This neural signaling, coupled by an increased muscle and joint strength and range-of-motion through the subtle excitatory mechanisms, ensures proper scientific practice of appropriate exercise intensity, volume, and rest intervals are exercised for these injured individuals utilizing such modalities. The researcher utilized this methodology all throughout the study process.

The controlled combination of intensity and volume variation, real and perceived, as well as rest intervals is an integral part of a performance improvement strategy by keeping both motivation and arousal high (7: 330–333). In the opinion, therapeutic exercises accordingly comprise a centristically structured program based on individual threshold and successfully performed, such that it assures unique sensor put, of developing potential of healthy and injured athletes.



Rehabilitation: “process of restoring the injured part to its original state preinjury” (10: 9). Physical therapy is crucial for it being a fast recovery without any side-effects. HENTD-based thermal terahertz device incorporated with therapeutic exercises based on physiological, anatomical, and mechanical principles according to individual diagnosis and physical assessment. Such programs comprise preparatory exercises that focus on strength, endurance, speed, flexibility, balance, cardiorespiratory endurance, and proprioception training (5: 90).

According to the Webster Dictionary, physical therapy is use of physical methods in the treatment of disease (11: 1). One of them is the terahertz device, working in the electromagnetic range located between infrared and microwave radiation. Terahertz (THz) is a division of the electromagnetic spectrum electromagnetic radiation with unique properties such as thermal effects, high penetration performance, and so on, which increases the treatment efficiency of sports injury by penetrate the injured site, and causing an acceleration of the blood vessels expansion and a decrease in the disorders caused by the injury.

One of the most significant analgesic methods of physical therapies is electrical therapies. They are known to have an impact on the human body for quite some time. When these currents of different frequencies are utilized, in addition to relief from pain, they can help in increased range of motion and strengthen the muscle. During physical rehabilitation, for example, terahertz therapy has a stimulator effect on tissue growth. It activates biological transformations where tissue is treated by removing damaged or degenerative lesions, promoting tissue development. Application of this modality has been in biomedical practice since long in several medical fields.

Differences in the amount of exercise performed in a specific training program help to train muscles in different physiological states, and variably applied, systemic exercise induces novel physiological adaptations (3:196–197). The avoid pain and adhesions and create joint full range of motion (1: 102). Zaki Hassan (2004) confirmed that the rehabilitation exercise programs also reduce the severity of the injury and the effectiveness of the pain. Exercises that help gain a range of motion of the joint, relieving muscle spasm and keeping the joint mobile will minimize the pain and also relax and activate the muscle. He also noted that the modalities most critically needed in the approaches for rehab exercise programs due to their beneficial effects in injury prevention and rehabilitation should be strength and flexibility exercises. The proposed rehabilitation program included these principles, which showed a distinct, tangible influence on the functional status of the elbow joint (4: 35).

Administering infrared radiation before exercises can improve blood circulation, relax muscles, and enhances the pain threshold.

6. Conclusions

1. The prepared rehabilitation exercises had a significant effect in reducing pain and injury severity and in increasing both extension and flexion range of motion in athletes with disabilities in athletics.
2. Modern devices and modalities, such as the thermal terahertz device, contribute to accelerating recovery and restoring the injured part to its normal functional state in a shorter period of time.

References

1. Osama Riyadh. *Physical Therapy and Rehabilitation of Athletes*. Dar Al-Fikr Al-Arabi, Cairo, 1999.
2. Basim Mohammed Khalil. *The Effect of a Proposed Aquatic Rehabilitation Program Accompanied by Therapeutic Exercises on Patients with Lower Back Pain*. Master’s Thesis, Faculty of Physical Education, Helwan University, 2009.



3. Hussein Ali Al-Ali & Amer Fakher Shaghati. *Strategies, Methods, and Approaches of Sports Training*, 1st ed., Baghdad, Al-Noor Printing Press, 2010.
4. Zaki Mohammed Mohammed Hassan. *Cross Training: Modern Trends in Sports Training*. Egyptian Library for Printing and Publishing, Alexandria, 2004.
5. Saleh Bashir Saad. *Posture and Methods of Maintaining It*, 1st ed., Alexandria, Dar Al-Wafaa for Printing and Publishing, 2011.
6. Abbott H.G. and Kress G. *Archives of physical medicine and Rehabilitation*, New York university, 1969
7. Bailey S, Davis M, Ahlborn E. Brain serotonergic activity affects endurance
8. performance in the rat *Int J Sports Med* 1993
9. Baran A. R. and et al : Psychology Second edition Holt Saunders & in tenti and editionses gopen & 1981
10. Dorothee, Marjorie K; proprioceptive neuromuscular facilitation copyright co, 3rd ed, 1985
11. <https://www.bamklinik.com/fizik-tedavi-ar>