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ON POSSIBLE APPROACHES TO PROLONGATION OF WARM-UP EFFECTS IN SPORT

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SUMMARY:

The article considers the technique of local temperature increase during the training warm-up with the use of a knee with the content of natural wool. The literary data on substantiation and use of the principle of local increase and preservation of thermal effect of training warm-up in athletes are given. The materials of study on evaluation of efficiency of knee knee with content of natural wool during warm-up with use of "Isomove" hardware-programmable complex for estimation of muscle strength and thermal imager NEC 9100 for estimation of gradient of local temperature in athletes are presented. The obtained results make it possible to speak about expediency and effectiveness of application of knuckleball with content of natural wool for the purpose of local increase and preservation of thermal effect of training warm-up in athletes.

Keywords: athletes, thermal effect, warm-up, isokinetic study, thermal vision, knuckleball, natural wool.

One of the most important components of a training session is the warm-up. It is necessary for safe and effective training in almost any sport and allows you to prepare for the full work of the muscles involved, as well as to optimally intensify the functioning of cardiovascular, respiratory, endocrine and other systems of the body during the main part of the training or
as well as optimally intensify the functioning of cardiovascular, respiratory, endocrine and other systems of the organism during the main part of training or part of training or competition. According to modern literature sources in the field of sports medicine, the main effect of warm-up is "warming up", the necessity of which has been confirmed by many studies.

Courtney J. Mcgowan et al (2015) in their review article list the main processes associated with localised increases in muscle tissue temperature:

- Increased muscle fibre metabolism;
- Increase in neuromuscular conduction velocity (MFCV) and consequently,
- Increase in their functional activity.

Also the authors of the article emphasise that there are two types of "warming up" effect: active and passive. Active "warming up" effect is provided by motor activity during training. Passive "warming up" effect is induced by applications of special gels and ointments increasing local skin temperature, as well as special bandages; this method, according to some authors, is more adequate, which is connected with minimisation of energy costs and heat transfer at increase of local temperature. Especially, it concerns bandages, allowing for a longer time to keep the increase of temperature of muscles and skin covering them, which in turn provides higher contractile activity of muscle tissue.

Sebastien Racinais et al. (2017), confirming the conclusions made by the above-mentioned authors, also note an increase in peak muscle strength with a passive increase in local temperature in the area of the involved muscles to 37 ° C and above, which increases the effectiveness of training, as well as prevents the occurrence of muscle injuries and exacerbation of chronic diseases of muscles and joints.

Taking into account the above-mentioned, we have conducted a study to investigate the effect of innovative (Patent Nos. 2319800, 2657996) therapeutic tubular half-woolen bandage, special series Lux, containing camel hair, produced by LLC "Leonarda-Service" (registration certificate of Roszdravnadzor No. FSR 2010/08307, TU 9396-005-75606424-2010), on the severity and duration of the increase in local temperature, increase in muscle strength. The bandage (kneepad) covered the knee joint and adjacent areas of the thigh (lower third) and shin (upper third) - area A; comparisons were made with a similar segment of the contralateral limb, without the use of the kneepad - area B.

The kneecap was put on the leg, which is least involved in the performance of motor acts, peculiar to the profiled sport. Wearing kneepads containing wool has a massaging effect on the skin and promotes blood flow to the area of application, normalisation of increased muscle tone, which along with a pronounced warming effect allows to use them

for prevention or as part of complex therapy of chronic and acute diseases of the lower limbs (arthritis, arthrosis, muscle and tendon strain), as well as for pain relief.

Composition: blended wool - 80%, latex - 11%, polyester thread - 9%. Contraindications: individual intolerance to the components of the product, open wounds, trophic ulcers.

The research methodology consisted in symmetrical fixation of data of remote thermometry - thermal imager NEC, as well as isometric and isokinetic examinations on hardware-software complex Isomove (Tecnobody, Italy) - APK Isomove:

- preliminary testing - determination of background values of the studied parameters on both sides;
- after warm-up (intensive squats and running in place for 3 minutes);
- after 30 minutes of unilateral application of the kneecap "LEONARDA" - bilateral removal of indicators;
- final testing on both sides - 20 minutes after removal of the kneepad.

This APC allows to estimate the speed and strength parameters of the lower limbs - muscle strength of hip flexors and extensors by the value of torque.

The study included 10 athletes, representatives of different sports:

- basketball - 2 people;
- football - 2 people;
- volleyball - 3 people;
- athletics - 3 people.

The results obtained in the course of the study are presented in tables №№1-3 and figures №№1-7.

The results are presented in the Tables No. 1, No. 2, No. 3.

Table No.1 Thermography results

Study stages.	Temperature of the leg in the knee bandage LEONARDA (degrees Celsius)	Temperature of the contra-lateral leg (degrees Celsius)	P
before the use of knee bandage LEONARDA	34.1±0.1 σ=0.23	34.3±0.2 σ=0.28	0.05
after intensive exercises	36.5±0.2 σ=0.31	36.2±0.1 σ=0.23	0.04
after 30 minutes of wearing the knee bandage LEONARDA	38.4±0.4 σ=0.17	35.1±0.4 σ=0.21	0.04
20 minutes after removal of knee bandage LEONARDA	38.2±0.2 σ=0.11	34.2±0.3 σ=0.25	0.03

P- statistical significance of variations in the group

σ- mean square deviation

Figure 1. Temperature readings dynamics

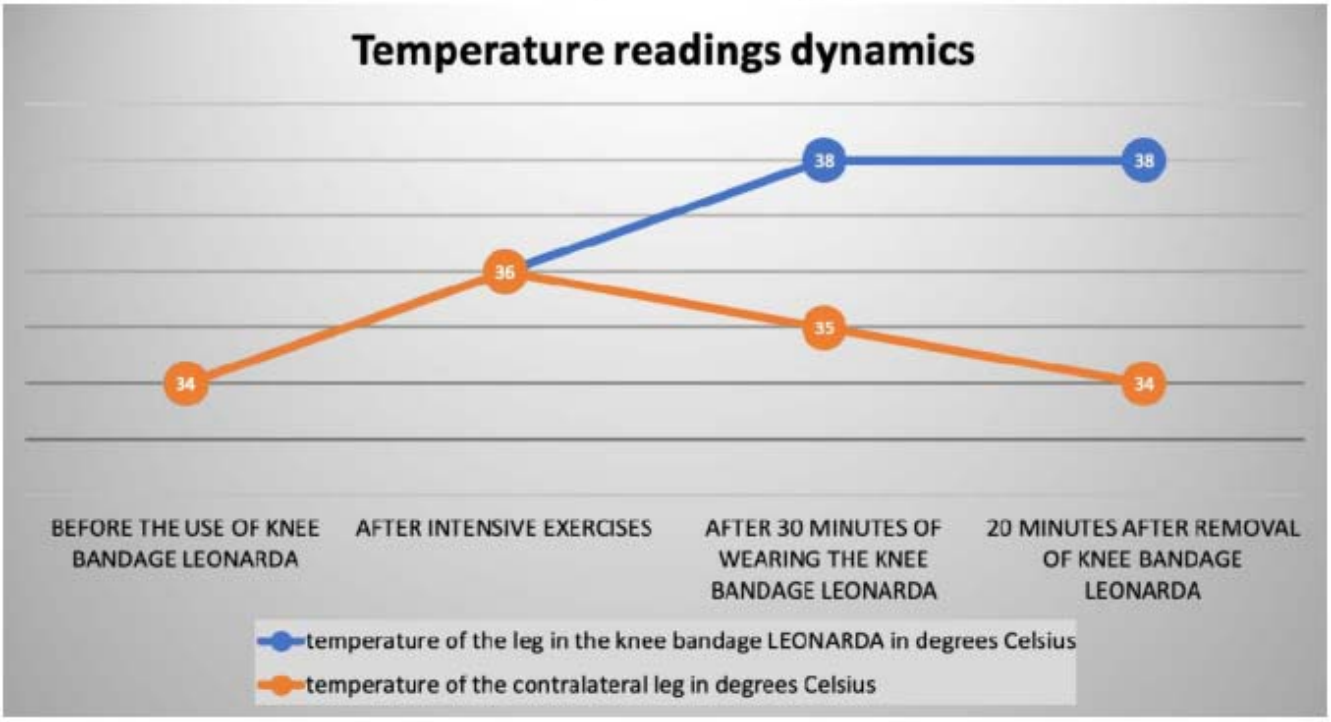


Figure 2. Comparative results of the knee joint local temperature

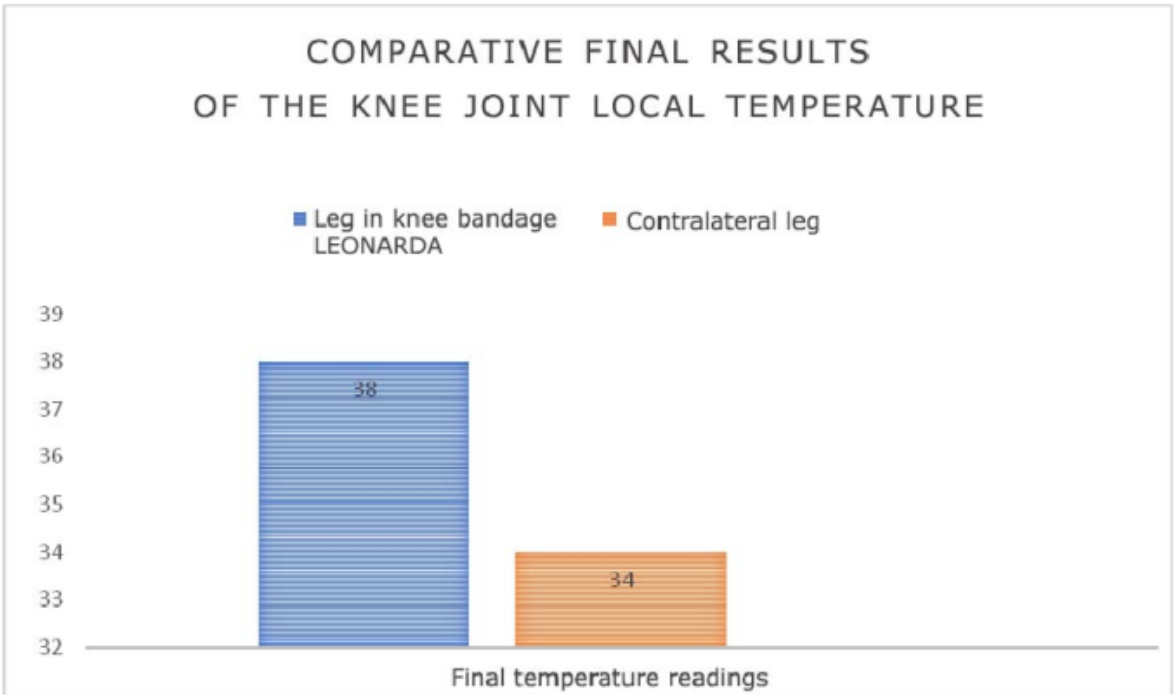


Table No.2 Results of isokinetic and isometric knee joint examinations (hip flexors)

Study stages.	Isokinetic study. Torque (Nm)		Isometric study (10 degrees flexion). Torque (Nm)		P
	Leg in knee bandage LEONARDA	Contralateral leg	Leg in knee bandage LEONARDA	Contralateral leg	0.05
before the use of knee bandage LEONARDA	74.2±2.1 σ=0.16	78±1.9 σ=0.18	85±2.2 σ=0.12	88.4±2.3 σ=0.08	0.05
after intensive exercises	82.4±1.3 σ=0.21	85±2.8 σ=0.18	96±1.3 σ=0.24	100.3±1.5 σ=0.13	0.04
after 30 minutes of wearing the knee bandage LEONARDA	110.7±2.4 σ=0.06	84.6±2.3 σ=0.09	122.3±2.3 σ=0.15	101.4±2.6 σ=0.27	0.05
20 minutes after removal of knee bandage LEONARDA	112.2±1.3 σ=0.26	81.4±1.7 σ=0.22	125.1±2.2 σ=0.14	92.4±1.8 σ=0.18	0.04

P- statistical significance of variations in the group

σ- mean square deviation

Figure 3. Hip flexor torque (Nm) in isokinetic mode

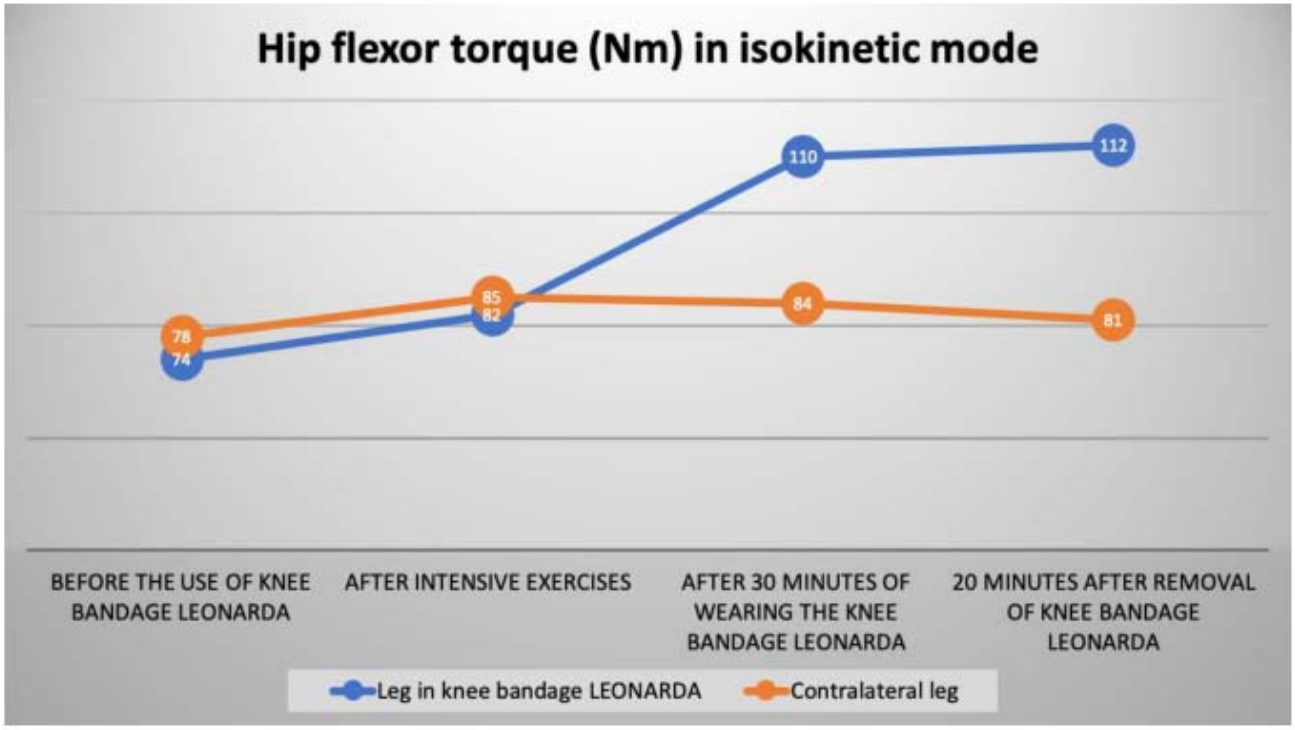


Figure 4. Hip flexor torque (Nm) in isometric mode

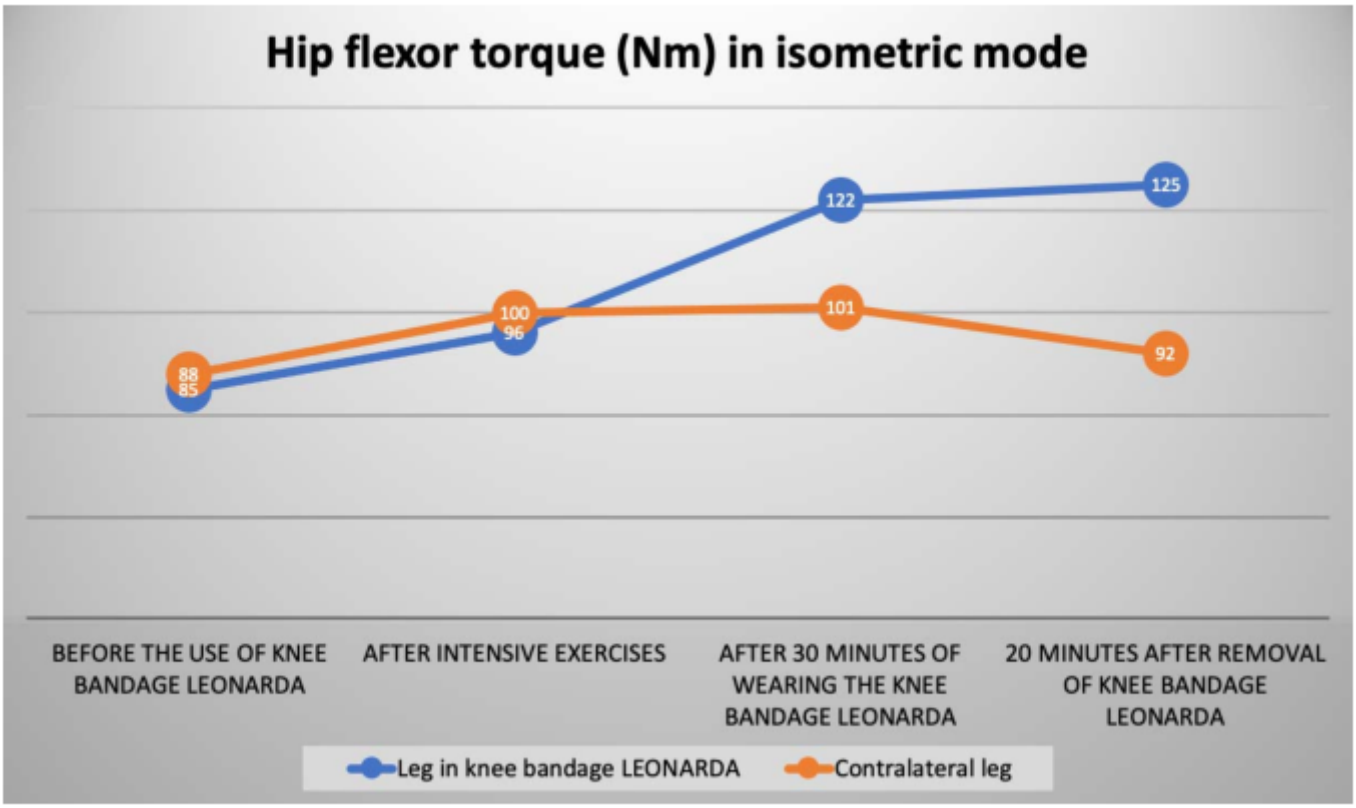


Figure 5. Hip extensors torque (Nm) in isokinetic mode

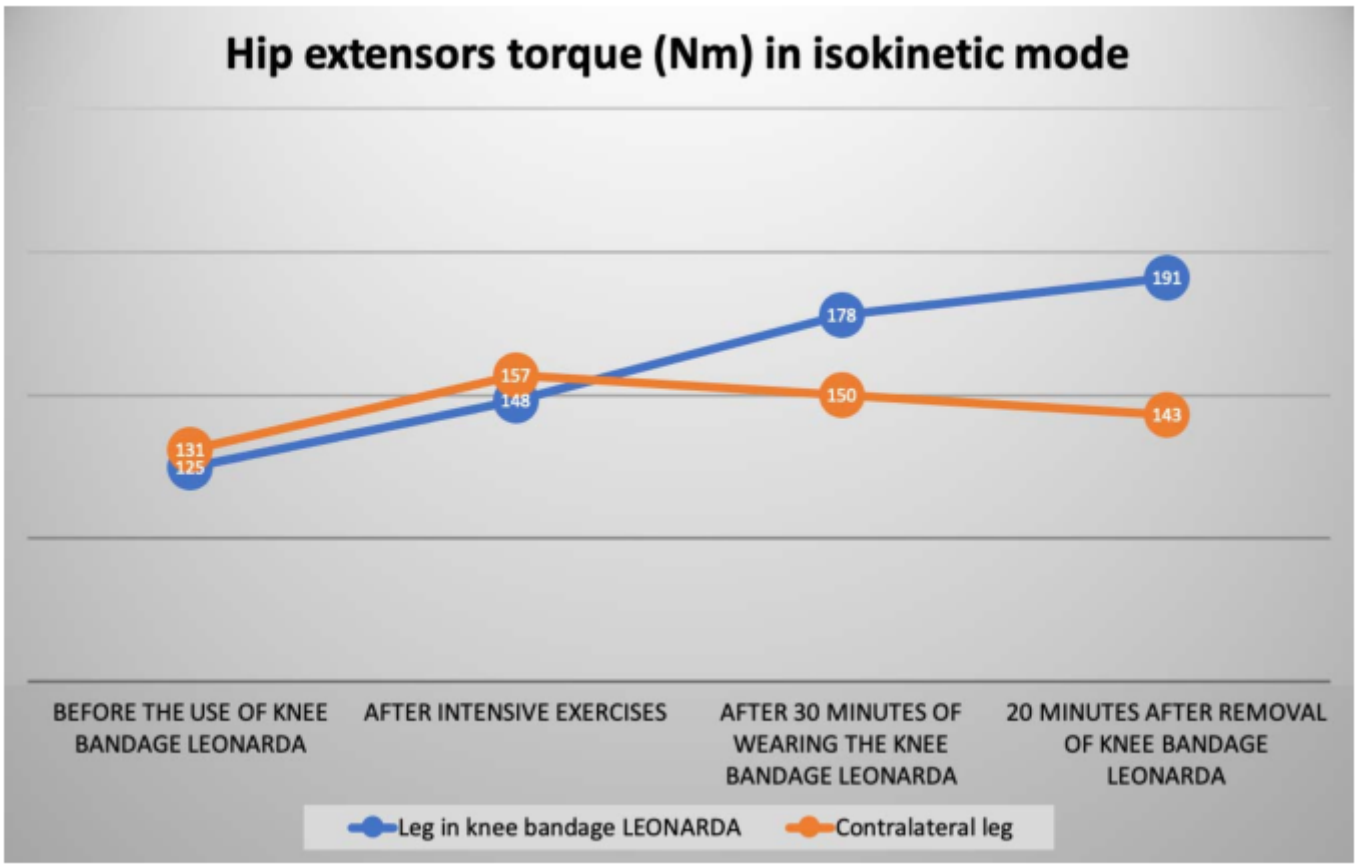


Figure 6. Hip extensors torque (Nm) in isometric mode

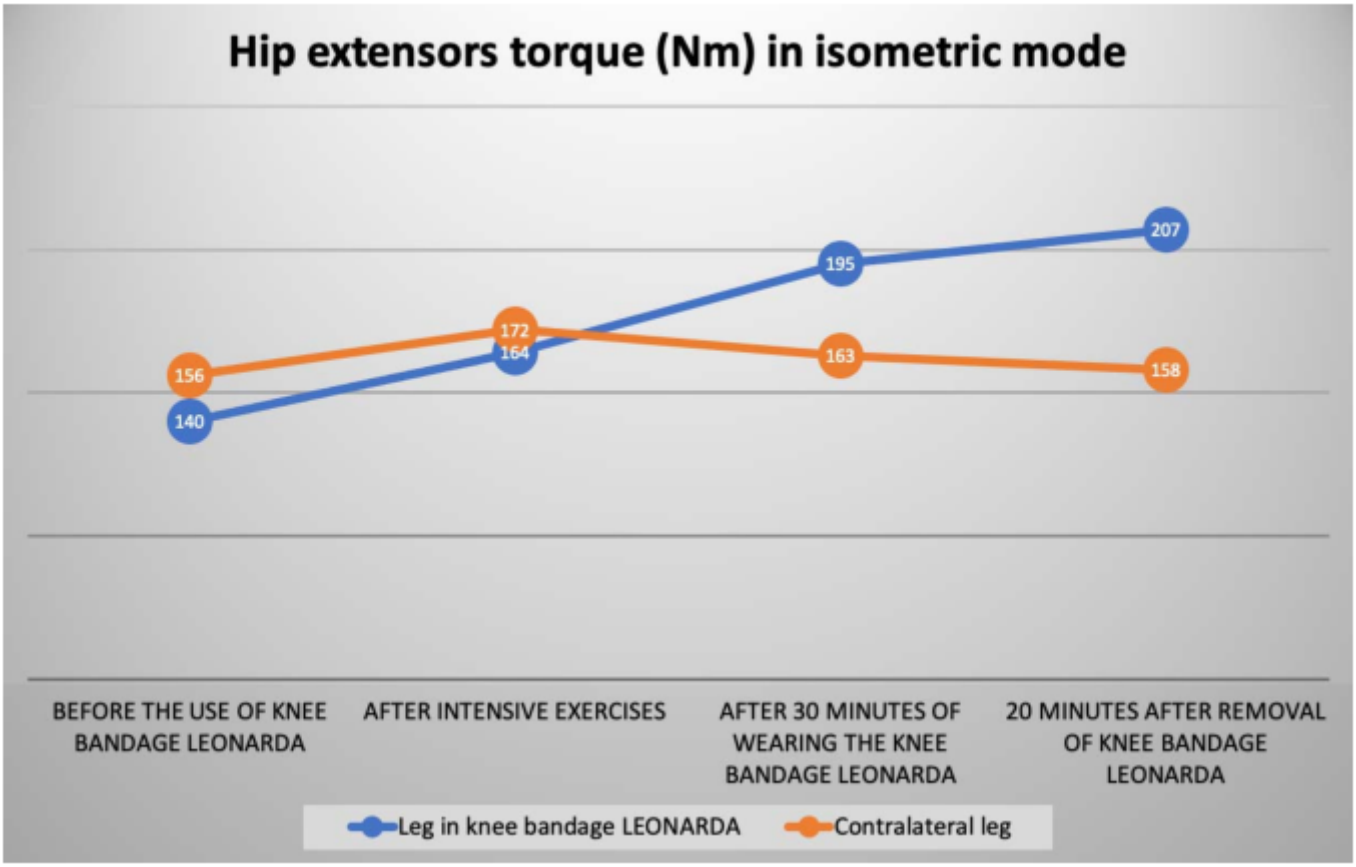
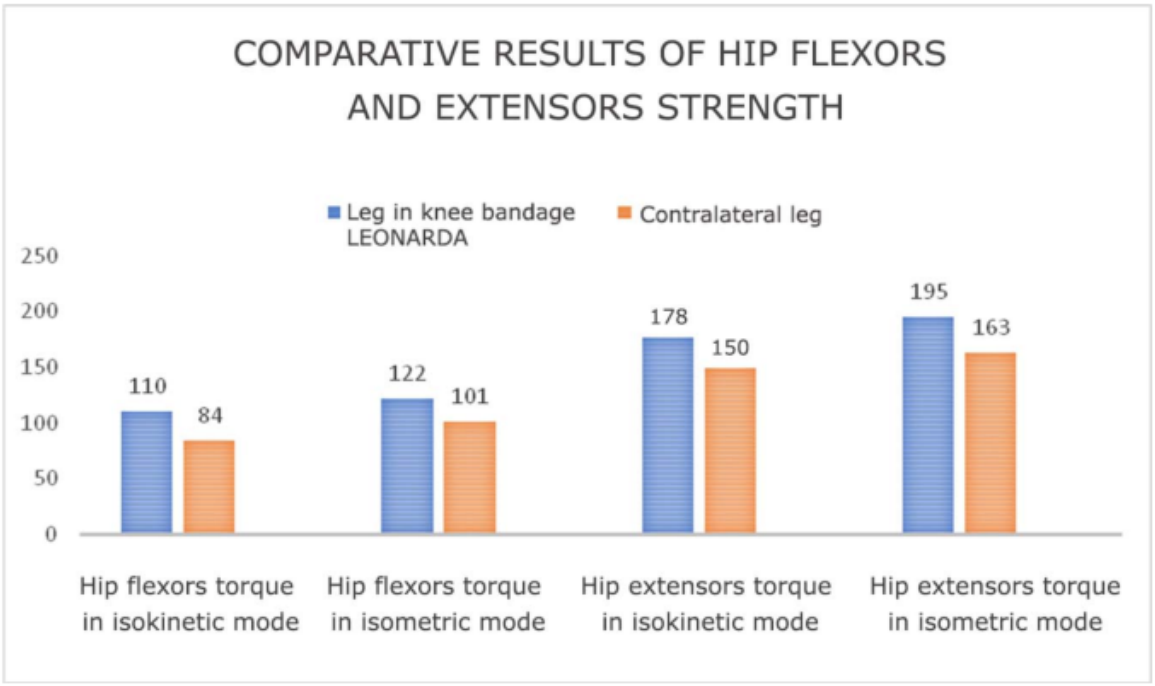


Figure 7. Comparative results of hip flexors and extensors strength



Taking into account the active load during the intensive warm-up, both the increase in local temperature and the increase in muscle strength were detected according to the results of all tests on the APC Iso-muv, however, after 30 minutes of wearing the patella, a persistent difference in temperature and a significant increase in muscle strength of this leg compared to the contralateral leg were noted:

1) A homogeneous increase of loco-local temperature in area A by 3°C, compared to area B, was determined.
2) Increase in muscle strength of the tested leg, compared to the contralateral leg, not less than 10%. 20 minutes after removal of the kneecap from area A, was noted:
3) Preservation of temperature data in area A and an increase in the difference, compared to area B, up to 4°C.

4) Further increase in muscle strength of the tested leg (area A), compared to the contralateral leg (area B). The difference between the muscle strength of areas A and B increased by at least 20%, as by this point the strength of the contralateral leg (area B) approached the baseline. This phenomenon was revealed by the results of all tests on the AIC Prokin for hip flexors and extensors.

Based on the results of the study, we can conclude about the real effectiveness of the application of the studied medical bandages "Leonarda", estimated by the degree of increase and prolongation of the "warming" effect caused by muscle activity: hyperthermia on the side of wearing the kneecap not only did not decrease (as on the side without the use of the product), but even increased

in 20 minutes after its removal; there was also an increase in muscle strength after the removal of the kneepad, which indicates not only the thermostabilising effect of medical kneepads, but also the stimulation of trophic and metabolic processes in muscle tissue under the influence of wearing bandages (kneepads) with camel hair.

Taking into account the obtained results, as well as a wide range of medical bandages "Leonarda", we consider it expedient to use them in training and competition process, not only on knee joints, but also in other anatomical areas, especially important for various sports.

Table No.3 Results of isokinetic and isometric knee joint examinations (hip extensors)

Study stages	Isokinetic study. Torque (Nm)		Isometric study (10 degrees flexion). Torque (Nm)		P
	Leg in knee bandage LEONARDA	Contralateral leg	Leg in knee bandage LEONARDA	Contralateral leg	0.05
before the use of knee bandage LEONARDA	125.3±2.2 σ=0.24	131.2±2.1 σ=0.21	140.8±1.4 σ=0.16	156.2.±1.4 σ=0.06	0.04
after intensive exercises	148.1±1.4 σ=0.25	157.6±1.1 σ=0.08	164.5±1.3 σ=0.15	172.8±0.8 σ=0.28	0.03
after 30 minutes of wearing the knee bandage LEONARDA	178.8±2.3 σ=0.11	150.1±1.4 σ=0.17	195.3±2.1 σ=0.29	163.6±1.8 σ=0.07	0.04
20 minutes after removal of knee bandage LEONARDA	191.2±1.2 σ=0.11	143.4±1.3 σ=0.22	207.3±1.7 σ=0.15	158.8±1.4 σ=0.14	0.04

P- statistical significance of variations in the group

σ- mean square deviation

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