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Original scientific paper

THE IMPACT OF DISC HERNIA ON THE MUSCULATURE FORCE OF THE LOWER LIMBS

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Andrija Atanasković[1]
PhD academic studies at the Faculty of sports and physical education of the University of Niš, Serbia

Vladimir Mutavdžić
Faculty of sports and physical education of the University of Niš, Serbia

Martin Georgiev
PhD academic studies at the Faculty of sports and physical education of the University of Niš, Serbia

Abstract: When a sudden flexion of the lumbar disk, a hernia, occurs, usually in the posterolateral direction, the consequence may be muscular weakness of the lower extremities. The aim of the study was to determine how and in what way hernias affect the strength and endurance of leg and torso muscles among athletes without clinical symptoms of neurological and muscle weakness. The study included 20 male subjects without clinically present motor weaknesses in the lower extremities. The respondents were athletes, aged 28.70 ± 3.22, weight 76.25 ± 4.78 kg, height of 184.35 ± 5.67 cm. They were divided into two groups: the first group (K) of 10 respondents and a completely healthy group, and (E) which included patients with disc hernia. Within the Myotest-m and CMJ, the following variables n were obtained: height (cm), power (W/kg), force (N/kg), acceleration (cm/s); 1RM-maximum weight in one repetition of the thrust legs (kg), repetitive leg strength (REPC), flexion (REPF), trunk extension (REPE). In order to determine the difference in arithmetic means of the respondents, analysis of variance with one factor was used (ANOVA) and multiple analyses of variance (MANOVA). Statistically significant differences exist in the variables of explosive strength $p \leq 0.001$, while the repetitive strength of trunk and legs, maximum power has no differences $p> 0.005$. This suggests intergroup differences in the variables of explosive strength in which a very strong statistical significance $p \leq 0.001$ occurs. It can be concluded that the disc herniation which was not accompanied by neurologic deficit leads to a certain reduction in power parameters, but is not crucial for the termination of sports or achieving good sport results among patients who have no obvious neurological deficit.

[1] ✉ aandrija87@yahoo.com

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INTRODUCTION

When a sudden flexion of the lumbar disk hernia occurs, usually in the posterolateral direction, the consequence may be muscular weakness of the lower extremities. A prolapse of intervertebral discs or disc herniation most commonly occurs in a sudden lifting of the front bend at the knees instead of being extended in a crouch. On that occasion, the forces acting on the spinal column are incomparably greater than the load being lifted, and the maximum load point at the level is L5-S1, L4-L5, the site of the most frequent rupture of the membrane (Karaikovic, 1986).

A herniated disc usually occurs due to degenerative changes that occur owing to water loss, metabolic disorders of chondroitin sulfate, collagen disorders of quantities, and so on. Damage to this part of the spinal column occurs when using force of 5 kn, which corresponds to the heavy lifting of 500kg. Very often, if there is a complete prolapse, it is unlikely that the nucleus pulposis will return to its place. Symptoms include sharp pain in the lower back and a blocking of movement and can cause damage to the nerve roots and even paralysis. The pain can be so intense that the person it happens to remains rooted in the place and position in which the violation occurred (Zivkovic, 2009). Often herniation occurs as a result of professionally practicing sports, swimmers who swim mostly butterfly, judo athletes, due to rotation within flexion, wrestlers, and so on.

As has already been said, disc herniation can restrict movement, reduce mobility or lead to current paralysis. Disc herniation is treated conservatively or surgically, depending on the severity. Therefore, it is very important to examine the condition and the power of the lower extremities of patients who do not have obvious weaknesses of the lower extremities through explosive tests maximum power and repetitive force after the appearance of disk herniation. The vertical jump is designed as a means of assessing the explosive strength of the lower extremities within healthy and injured people. “Myotest” as an instrument (Myotest SA, Sion, Switzerland), has the technology and methodology for assessing the said explosive strength (Bubanj, Stankovic, Bubanj, Crayons, & Dimic, 2010). The absolute strength of the legs is also very important and therefore its trial is of a great importance for further sporting activities of the injured individual. Herniation may also have an impact on troop strength which we can examine with the test of repetitive strength. The aim of the study was to determine how and in what way herniation without clinical neurological and muscular weaknesses affects the strength and endurance of the muscles of the legs and the torso among athletes.

RESEARCH METHODS

Respondents

In this research, some twenty male subjects attended and all of the respondents have been professional athletes for many years, aged 28.70 ± 3.22, with an average body weight of 76.25 ± 4.78 kg and average height 184.35 ± 5.67 cm. Subjects were divided into two groups, the first group (control group) of 10 subjects that were completely healthy, the second group (E) group was composed of patients with disc herniation in the area of the spine L5-S1, asserts reviewing MRI. At the time of the test, the subjects had no symptoms of diseases, and regarding treatment, they occasionally ingested the drug Mydocalm-Midokalm.

Variables

Using the Myotest and performing the jump from half squat (CMJ):

1. Height (expressed in cm)
2. Power (expressed in W/kg)
3. Force (expressed in N/kg)
4. Acceleration (expressed in cm/s).

There was a maximum weight of thruster legs (leg press) in a repeating, formula weight / (1.0278- (0.0278 x number of repetitions)) = One repetition Maximal or one repetition maximum (Brzycki, 1993).

1RM (expressed in kg)

Test repetitive leg strength: REPC- deep squat on one leg (the maximum number of repetitions).

Test repetitive strength of trunk: REPF-flexion (forward bend from the horizontal position back to an angle of 90 °) and REPE- trunk extension (shelter troops from lying down on stomach), (maximum number of repetitions) (Stojiljkovic, 2003).

Before the measurement, the manner in CMJ performance was explained in detail to all the respondents. The respondents performed CMJ from a normal upright position, with hands upon hips, without swinging through the knee joint and flexion to 90° and after the beep, when the maximum strongly reflected in the air and the landing with a slight flexion in the knee joint. After that the respondents took the starting position, waiting for a new sound signal when repeating the mentioned jump technique. All respondents performed vertical jumps five times. The test of the leg press was carried out by the respondents by a full extension of the load on the machine lowered until the angle of the knee joint was not 90º, 130º in the hip joint, and then back to full extension. Bend troops moved from a lying position on the back with a paddle on medium until a flexion of 90°, then the respondent was again returned to the original position and performed the exercise until failure. In the test trunk exercises on a Swedish crate, the respondent took the starting position lying on the stomach, with trunk out of the Swedish crate and an initial position with flexion of 90°, up to a maximum hyperextension, and then returning to the original position. A deep squat on one leg was derived from an upright position, where the subject stood on one leg, then moved into a squat position where the angle was 90º in the knee, and 130º of the hip joint, returning to the original position, with the test being performed to failure.

Data processing

All data was processed in the SPSS 11 program. Variable power was shown by descriptive statistics, separately for each group and the initial and final measurements. To determine the difference in the means of the respondents, used was an analysis of variance with one factor (ANOVA) and multiple analyses of variance (MANOVA).

RESULTS

Table 1. *Descriptive indicators of body weight, body height and age*

	number	minimum	maximum	(x)	(SD)
Height	20	175.00	193.00	184.3500	5.67798
Weight	20	68.40	83.40	76.2550	4.78721
Age	20	22.00	35.00	28.7000	3.22980

Table 2. *Kolmogorov-Smirnov test*

	Sig.
height	.979
power	.386
force	.245
acceleration	.268
RM1	.984
REPF	.789
REPE	.907
REPC	.658

From Table 2 it can be concluded that the distribution of the results were normal $p > 0.05$.

Table 3. *Mean values of variables within healthy and injured athletes, and difference mean values between groups*

Group	K	E	K-E
height (cm)	44.18	35.09	Δ visina 9.09
power (w/kg)	42.89	29.73	Δ snaga 13.16
force (N/kg)	28.65	20.37	Δ sila 8.28
acceleration (cm/s)	236.20	198.40	Δ ubrzanje 37.8
RM1 (kg)	119.90	114.20	Δ RM1 5.7
REPF	82.00	80.70	Δ REPF 1.3
REPE	50.60	49.90	Δ REPE 0.7
REPC	7.40	6.30	Δ REPC 1.1

Table 4. *The differences between K and E groups in variables in the multivariate power level*

	value	F	Hypothesis df	Error df	Sig.
Wilks' Lambda	.194	5.713[a]	8.000	11.000	.005

Wilks' Lambda – value of the coefficient Wilks test F – value of the coefficient; F-test for significance, Wilks' Lambda; Hypothesis df and Error: df – degree of freedom; p – relevance of difference between centroids

Table 4 shows that there are statistically significant differences in the multivariate level variables in power, the statistical significance of $p = 0.005$.

Table 5. *Intergroup differences K and E groups in the variables on the univariate power level*

source	Dependent variables	Type III sum of squares	Df	Mean square	F	Sig.
group	visina	413.140	1	413.140	21.405	**.000**
	snaga	865.928	1	865.928	20.544	**.000**
	sila	342.792	1	342.792	24.174	**.000**
	ubrzanje	7144.200	1	7144.200	15.732	**.001**
	RM1	162.450	1	162.450	4.210	**.055**
	REPF	8.450	1	8.450	.475	**.499**
	REPE	2.450	1	2.450	.032	**.860**
	REPC	6.050	1	6.050	.543	**.471**

Wilks' Lambda – value of the coefficient Wilks test F – value of the coefficient; F-test for significance, Wilks' Lambda; Hypothesis df and Error: df – degree of freedom; p – relevance of difference between centroids

From Table 5 we can conclude that statistically significant differences exist only in variables of explosive strenth where the significance is very high $p \leq 0.001$, while in variables of a repetitive strength of the trunk and the legs there are no statistically significant differences, as well as in the maximum strength of the legs $p > 0.005$. All this is also indicated by the results from Table 3 where the intergroup difference is in the variables of an explosive strength in which occur startsictially significant differences (Δ height=9.09cm; Δ strength =13.16 w/kg; Δ force=8.28 N/kg; Δ acceleration=37.8cm/s).

DISCUSSION

In the current study, all patients were still active and professionally engaged in sports, both healthy and injured. However, there are some differences, especially in explosive force, where significantly more force is produced as well as a large number of muscles used, and thus the load on the body of athletes is significantly higher. Schumacher et al. (2003) compared the power of flexion and extensions within the body among patients with and without lumbar disc hernia. Respondents with no damage to the disk showed significantly better results and to 44% more power when isometrically flexed, and 36% when isometrically extended. With dynamic trunk tests respondents with no injuries carried out a 70% higher number of repetitions of the respondents with spinal cord damage. Muscle status mostly depends on the type of hernia, so that when there are two types of hernia, there are intense changes in the development of the muscles in the lumbar region, on the side where the damage occurred as much as 9.8%, and 6.4% with hernia type 1 (Kiyoshi et al., 2001). Cheng-Wen et al. (2005) came to the conclusion that individuals with disc herniation have reduced muscle strength of the trunk muscles and the actuator muscles in the knee joint.

As much as 89.3% of the athletes who stopped playing sports due to disk herniation returned to sports after treatment. The average length of recovery was 5.8 months (Watkins et al. 2012). Herniation is closely associated with a limiting of motion, but if there is no damage to the nerve pathways, disc herniation is no barrier in sports activities. All this was shown in the results of this study, where we could see that the difference is only in explosive force, while the other tests showed no statistically significant changes. When it comes to tests of repetitive power differences, the results are ΔREPF = 1.3, $p = 0.499$; BEET Δ = 0.7, $p = 0.860$; ΔREPC = 1.1, $p = 0.471$. In these tests, no large load was used as the muscles could not overcome excessive force, and therefore the load on the spinal column was reduced.

This type of power is not highly genetically determined, and thus it is easily renewable, unlike explosive power. When maximum power there was also no statistically significant differences ΔRM1 = 5.7kg, $p = 0.055$, primarily due to the fact that as a movement it was not too dynamic and no excessive involvement of the spinal column was detected. In the test of maximum power, it was better to use a deep squat or crouch, but people with disc hernia were expressly prohibited to lift weights above their heads, that is, each load had to be at the level of the pelvis. In the last decade, there was an increase in the training and rehabilitation process of "core stability training" i.e. the training of the body's core stability. The goal of this training was to adequately rehabilitate muscle imbalance (Meier, 1997).

CONCLUSION

In this case, disc herniation was not the reason for termination of sport but it did lead to some changes in the strength of athletes. Athletes with disk herniation have less explosive power than athletes without injuries, which can be explained by the engagement of larger muscle groups, a dynamic mode of operation and a production of great power, although other results did not show any statistically significant differences. It can be concluded that herniation leads to certain limitations and reductions of performance parameters, but is not a decisive factor for terminating sports activities or achieving good sports results. Disc herniation in the lumbar region, however, can affect these measures and the function of the muscles of the lower extremities, resulting in termination of sports. In our group of patients without motor deficit, this was not the case. Changes in the parameters of explosive forces were detectable (jump height, force, acceleration), while the repetitive and maximum power of these changes were not visible. It can be concluded that herniation led to certain limitations and reductions of certain performance parameters, but it was not a decisive factor in terminating sports or the failure to achieve good sports results.

REFERENCES

1. Brzycki, M. (1993). Strength testing: predicting a one-rep max from repetitions to fatigue. *Journal of Physical Education, Recreation and Dance*, 64 (3), 88-90.
2. Bubanj, S., Stanković, R., Bubanj, R., Bojić, I., & Dimić, A. (2010). Reliability of Myotest tested by Countermovement Jump. *Acta Kinesiologica*, 4 (2), 46-48.
3. Cheng-Wen, H., Liang-Cheng, C., Hsian-He, H., Shang-Lin, C., Min-Hui, L. & et all. (2005). Isokinetic muscle strength of the trunk and bilateral knees in young subjects with lumbar disc herniation. *Spine*. 30 (18), 828-533.
4. Hakkinen, A., Kuukkanen, T., Tarvainen, U. & Ylinen, J. (2003). Trunk muscle strength in flexion, extension, and axial rotation in patients managed with lumbar disc herniation surgery and in healthy control subjects. *Spine*. 28 (10), 1068-1073.
5. Karaiković, E. (1986). *Kineziterapija*. Sarajevo:Svetlost.
6. Kiyoshi, Y., Yasumasa, S, & Yoshihito, N. (2001). Histochemical changes in the multifidus muscle in patients with lumbar intervertebral disc herniation. *Spine*. 26 (2), 622-626.
7. Meier, H. (1997). *Medizinishe Traningstherapie in der Praxis. Methodikde MIT*. Verlag: Medicion.
8. Safran, M.R., McKeag, D.B., & Van Camp, S.P. (1998). *Manuel of Sport Medicine*. Washington: Lippincott Raven.
9. Stojiljković, S. (2003). *Osnove opšte antropomotorike*. Niš: Crveni krst.
10. Živković, D. (2009). *Osnove kineziologije sa elementima kliničke kineziologije*. Niš: Gleb.
11. Watkins, R. G., Hanna, R., Chang, D. & Watkisn R. G. (2012). Return-to-play outcomes after microscopic lumbar discectomy in professional athletes. *American Journal of Sports Medicine*. 40 (11), 2530-2535.