



SENSORIMOTOR STIMULATION AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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ABSTRACT:

Introduction: postural balance is a concept that refers to the body's ability to maintain its center of gravity while relying on a support area.

Purpose: to develop and implement a combined physiotherapy programme with sensorimotor exercises and to monitor its effectiveness after anterior cruciate ligament reconstruction.

Material and methods:

Material: 15 men (mean age 25.16) were observed after anterior cruciate ligament reconstruction. They underwent a physiotherapy programme combined with additional exercises for sensorimotor stimulation. The sensorimotor stimulation exercises were specifically tailored to overcome muscle imbalance and pathological proprioceptive information from the operated knee joint.

Methods: Functional methods include lower extremity centimetry, range of motion in the knee joint, manual muscle testing, static and dynamic balance tests, and postural control tests. *Statistical methods:* statistical data grouping; Cronbach's test; descriptive method; statistical hypotheses testing; correlation analysis. The data was processed with SPSS v.24.0 for Windows.

Results: according to the literature, the main cause of impaired proprioception and mechanoreception is the loss of mechanoreceptive afferency due to tissue damage in the knee joint. This requires an income of sensory information from neighboring healthy structures. The inclusion of sensorimotor exercises helps build new motor skills, activity, and regulation that require peripheral stimuli. The results from the static and dynamic portions of the test show the possibility of restoring impaired sensorimotor information.

Conclusion: the combination of classic physiotherapy and sensorimotor stimulation influences the support and motor function of the lower extremities.

Keywords: surgical treatment, anterior cruciate ligament, physiotherapy, sensorimotor stimulation,

INTRODUCTION

Postural balance is a concept that refers to the body's ability to maintain its center of gravity while relying on a support area. Postural balance is a function of various sensorimotor nerve impulses from receptors located in muscles, tendons, capsules, ligaments, i.e. mechanical and proprioceptors rising to the cerebral cortex. In addition to the described receptors, postural control requires visual, auditory, and vestibular analyzers, as well as muscle activity. This so-called automatic postural response is maintained with the help of three kinematic complexes: ankle-soleus, knee and lumbar-pelvic [1, 2]. Studies show abnormal pathological proprioception in patients after anterior cruciate ligament (ACL) rupture and its following surgical treatment. This abnormality in proprioception is assumed to be due to swelling, pain, mechanical damage to the receptors, immobilization, etc. This impaired proprioception of peripheral proprioceptive afferency directly affects postural control.

AIM:

To develop and implement a combined physiotherapy programme with sensorimotor exercises and to monitor its effectiveness after anterior cruciate ligament reconstruction.

MATERIAL AND METHODS

This study's sample population includes 15 men between the ages of 25 and 26 who underwent anterior cruciate ligament reconstruction. They participated in a physiotherapy programme combined with additional exercises for sensorimotor stimulation. Specific sensorimotor exercises were performed from the earliest post-operative recovery period of the lower extremity. The functional research methods were applied as follows:

- lower extremity centimetry;
- range of motion in the knee joint;
- manual muscle testing;
- static, dynamic balance and postural control test

[4]. The test consists of two portions:

Static portion. It includes three positions with three levels of difficulty.

- *position one* - standing on the operated lower extremity as the other steps in front of the toes of the standing extremity; eyes are closed; maintain position (fig. 1);

- *position two* - standing on the operated lower extremity as the other bends at the hip and knee joints with its sole in front of the knee of the standing extremity; eyes are closed; maintain position (fig. 2);

- *position three* - standing on the operated lower extremity with hands placed at a 90° angle and torso bent forward at a 90° angle as the free lower extremity lifts to a 90° angle – balance position eyes are closed; maintain position (fig. 3).

Fig. 1. Position one.



Fig. 2. Position two.



Fig. 3. Position three.



In case of loss of balance and posture disturbance, the test is terminated. The duration of position maintenance is measured in seconds.

Dynamic portion:

- two 150 cm patches are attached to the floor perpendicularly with two more between them at 45° thus forming 4 beams to the left and 4 to the right;
- measuring the length of the non-operated lower extremity, removing 2/3 of that length and projecting it on each beam;
- stepping with the operated lower extremity in the middle (where the beams cross) and the other extremity stepping beside it;
- by signal, the free lower limb touches every point of the 4 beams on its side.

Touching the 4 marks is evaluated at 4 points with 1 point reduced for each omitted mark. The test duration is 5 sec.

Table 1. Comparison of the results from the static portion of the test for static, dynamic balance and postural control among operated and healthy men.

Posture	n	\bar{X}_1	n	\bar{X}_2	n	$\bar{X}_1 - \bar{X}_2$
First	15	31.15	20	29.10	35	2.05
Second	15	21.65	20	20.50	35	1.15
Third	15	10.95	20	8.20	35	2.75

n – number of studies; \bar{X}_1 – healthy men; \bar{X}_2 –men with ACL reconstruction

The combined physiotherapeutic programme, including special exercises for sensorimotor stimulation in men with anterior cruciate ligament reconstruction, resulted in a significant improvement in the static, dynamic balance, and postural control portion of the test. To objectify the obtained results and to prove the programme’s effectiveness in the recovery period, we applied the test three times – in the beginning, the middle and the end. The reported values demonstrate improvement in the postural control. To present the advantages of the combined methodology, we compared the results with those of healthy men. We applied the test to the respondent’s group within the same three periods. The reported values in both groups do not differ significantly, which gives us reason to think that the applied programme has a positive influence in improving postural control after surgical treatment of soft tissue injuries in the knee [6].

b/ Dynamic portion (table 2)

Table 2. Comparison of the results from the dynamic portion of the test for static, dynamic balance and postural control among operated men.

n	\bar{X}_1	Standard	Difference
15	3.30	4	0.70

\bar{X}_1 – study results, \bar{X}_2 – standard – 4 points

RESULTS AND DISCUSSION:

According to the literature, the main cause of impaired proprioception and mechanoreception is the loss of mechanoreceptive afferency due to damage to the tissues in the knee joint. This requires the income of sensory information from neighboring healthy structures. Sensorimotor exercises help build new motor skills and activity, including a new type of motor regulation that requires peripheral stimuli. The results of the static and dynamic portion of the test show the possibility of restoring the impaired sensorimotor information.

Test for static, dynamic balance and postural control:

a/ Static portion. Estimates from the static section were compared with the results of 30 healthy men aged 20 to 30 years [5] (table 1).

The difference is 0.70 points – a small deviation from the standard. The study shows the necessity of applying exercises for sensorimotor stimulation. Similarly, in the dynamic portion of the test, we registered an improvement after the completion of the programme. The inclusion of exercises for sensorimotor stimulation in the generally accepted protocols for recovery of patients with reconstructed anterior cruciate ligament shows good results.

CONCLUSION

In conclusion, sensorimotor stimulation is an important means of restoring the static-dynamic function of the lower extremity after anterior cruciate ligament reconstruction. The surgical interventions in the area of the knee, regardless of the difficulty of the surgical treatment, reflect unfavorably on postural control. The inclusion of specific exercises in the physiotherapeutic practice for a positive influence of these disturbances leads to better functional results and patient satisfaction. We can conclude that sensorimotor stimulation in combination with classic physiotherapy influences the support function of the lower extremities, as well as their motor function.

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