

STRATEGIES FOR THE RECOVERY OF LIA-TYPE KNEE INJURIES IN SKIERS, BY SPECIFIC MEANS OF KINETOTHERAPY

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ABSTRACT

Background: In the present study we analyze the methods of postoperative recovery of knee mobility, as it is known that the most common type of trauma that can occur in skiers after practicing winter sports is the LIA. Method: We conducted a case study on an athlete, more specifically the concrete way of recovery of knee mobility as well as the psychological implications of surgery until full recovery. Results: From the data collected it appears that the knee mobility recovery program we proposed was successful, moreover there were no psychological aspects that could influence the speed of full recovery and the resumption of training at full capacity in a relatively short time. Conclusions: At the end of the recovery program, a constantly positive evolution during the treatment was observed, which meant that at the end of the treatment the subject was able to resume his sports activity, gradually integrating into the specific activity.

Key words: ski, trauma, recovery

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INTRODUCTION

Winter sports have developed rapidly, becoming regional or national development factors in a large number of countries around the world. Official reports on the development of winter tourism and winter sports reveal the huge role they play in many sectors of the economy. This is primarily due to the development of large ski resorts, ski regions, mountains converted into ski slopes, cableways, road infrastructure, snow-making infrastructure, or infrastructure for indoor skiing or skiing on artificial slopes. Alpine skiing seems to have produced the biggest economic, technological and social revolution in many economically developed parts of the world.

An increasing number of people are practicing winter sports for the beneficial effects on health, the development of individual abilities, involving an ever wider range of motivations such as recreation, continuous fortification in the midst of nature, getting to know mountain areas, maintaining high work capacity and even confirming a certain social status. Compared to other mountain disciplines, skiing has recently experienced unprecedented growth, partly because of the satisfaction it offers and partly because of the investments in this field which have made it possible to explore previously unexplored mountain areas.

Nowadays skiing has moved from the utilitarian domain (skiing in certain areas) to the recreational and competitive domain, representing today a winter vacation option for more and more families. Today skiing has become the fastest possible means of land transportation, without a mechanical aid (Rosu D, 2008, 2018). Inevitably, as in most sports, injuries occur, the most common trauma affecting the knee joint, the most complex joint of the human body and the most exposed by practicing this sport. At the same time, the management of winter sports ensures increasingly better conditions for the safety of practitioners. Well equipped ski slopes, equipped with snow and weather monitoring systems, continuous development of ski equipment, development of teaching methods, continuous presence of first aid through specialized services, all these contribute to minimizing risks and accidents in skiing (Vanat L. 2022).

The development of skiing is evidenced by numerous statistics published by researchers around the world. Alpine skiing is an extremely popular sport worldwide with approximately 200 million participants (Hunter R.E., 1999). Alpine skiing is a widely practiced sport with a substantial risk of injury. Since the 1970s, injury rates have decreased from about 5-8 injuries per 1000 skier-days to about 2-3 injuries per 1000 skier-days (Koehle, M.S. et. al., 2002).

More experienced skiers are more likely to sustain injuries due to jumps, whereas novice skiers predominantly experience injuries resulting from falls (Hume P.A., et.al., 2015). A survey by the Norwegian Ski Lift Association on 4548 skiing accidents between 1996-2000 highlights that in general, accidents are suffered by beginners (about 80% of accidents). The knee is also the most affected body part (20.5% in children and 24.4% in adults). The most common type of injury was found to be concussion (about 40% of cases), followed by fractures in children (25.5%) and sprains in adolescents and adults (27-29%). However, the study also showed a high

incidence of head injuries among skiers, which can be improved by wearing ski helmets (Ekeland A, Rodven A, 2002).

A similar study conducted by Langran M. and Selvaraj S. (2001) on skiers in Scotland reveals that out of 732 injuries sustained by 674 people including 336 alpine skiers, the injury rate for the study was 3.7 injuries per 1000 skier days. In the study Alpine skiers accounted for 67% of the slope population, snowboarders for 26%, skiboarders for 4% and telemark skiers for 2% but lower limb and sprains were the most common injuries in alpine skiers (about 32.9% of cases).

Within the literature numerous studies present the general framework of post-traumatic knee recovery involving a combination of methods to reduce pain, restore mobility and strengthen the musculature. The main means refer to:

- Rest and protection (use of orthotics or elastic bandages to stabilize the knee and avoid activities that put excessive pressure on the joint (Holden et al., 2024)
- Cryotherapy and thermotherapy to reduce inflammation and pain (15-20 min every 2-3 hours in the acute phase) (Yu SP et. al.2016);
- Heat (thermotherapy) to relax muscles and improve circulation, applied in the chronic phase (Petcu F, 1998).
- Use of non-steroidal anti-inflammatory drugs and supplements (NSAIDs) to control pain and inflammation, along with the use of collagen, glucosamine and chondroitin supplements to support cartilage (Paoloni JA, 2009);
- Physiotherapy through exercises for progressive mobilization and strengthening of quadriceps and hamstring muscles, as well as proprioceptive training to restore balance and coordination (Avramescu T., 2023)
- Physiotherapy using muscle electrostimulation to prevent atrophy, as well as ultrasound and laser therapy to accelerate tissue healing (Malone J.K., 2014);
- Hydrotherapy - Exercises in water to reduce joint pressure and improve mobility (Chen R.,2024);
- Therapeutic massage and manual therapy to improve circulation, reduce muscle tension and stimulate lymphatic drainage (Weerapong P, et al., 2005)
- Adequate nutrition and hydration by consuming protein, vitamins (C, D, E), minerals (calcium, magnesium) and antioxidants for tissue replenishment (Molnar JA, 2014);
- Occupational therapy and functional retraining on gradual integration into daily activities and sports, adapting movements to avoid overstraining the knee (Standaert CJ, 2003).
- As a general rule, specialists mention that the recovery process should be personalized and supervised by specialists in order to avoid complications and relapses.

BACKGROUND

The increased interest in traumatology in recent decades has led to a growing level of research in this field. Thus, a well-defined methodology of functional recovery has been developed in which kinetotherapy occupies a primordial place.

AIM OF THE RESEARCH

In the present work we aimed to present the main means of post-traumatic recovery of the knee and to make a significant contribution to the enrichment of the means of action within the kinetic program. The main aim of this paper is to find kinetic programs for knee trauma recovery as well as to find a way to prevent accidents for skiers.

RESEARCH HYPOTHESES

- √ Post-traumatic recovery of skiers, who have suffered one of the most common knee injuries - anterior ligament rupture, is to restore knee functionality and create an optimal state of health and decrease the time of reintegration into daily activities.
- √ The correlation between the orthopedic-surgical and recuperative measures will create the necessary basis for the reintegration of the subjects in their daily activities and sports;
- √ The realization and application of a physiotherapeutic recovery program as efficient as possible and applied in the shortest possible time after surgery, will be able to ensure on the one hand the athlete's full recovery and on the other hand the return to sport activity in the shortest possible time.

RESEARCH APPROACH

The anterior cruciate ligament (ACL) is one of the two cruciate ligaments with a primary role in stabilizing the knee joint. The ACL is the most commonly affected of all knee ligaments. It is most often injured during the practice of various sporting activities, whether for performance or pleasure, by a twisting mechanism on the lower limb.

Reconstruction of the ACL is one of the most widely practiced procedures in sports traumatology, but it is also the subject of ongoing debate on the ideal methods (type of graft, its placement, means of fixation, etc.). A good pre-operative result can only be achieved in combination with a comprehensive rehabilitation program under the guidance of a physiotherapist. The ultimate aim of treatment is to return patients to a level of activity as close or even identical as possible to that before the injury.

RESEARCH OBJECTIVES

In knee injury recovery the following objectives were pursued: pain control, stability recovery and finally mobility recovery.

1. Pain relief:

- √ massage:
- √ thermotherapy:
- √ galvanic baths;
- √ electrotherapy: galvanic current: ionophoresis (ionogalvanization), diadynamic currents, Trabert electropuncture (to combat pain); ultrasound has analgesic, myorelexic, hyperemiant effects.

1. Increasing joint stability:

To remobilize a joint of the lower limb is by no means to say that it has been made functional, the primary function of the lower limb being stability and secondarily mobility.

To stabilize a joint means:

- √ painless joint;
- √ joint fixed by strong musculature (quadriceps for the knee);
- √ joint protected from abnormal mobility by an intact capsule and ligaments.

Conduct of the research

Tests used in the research

- √ Knee flexion testing
- √ Biceps femoris muscle
- √ The semimembranosus muscle
- √ The semitendinosus muscle
- √ Anterior serratus test
- √ Lachmann test
- √ Pivot test
- √ VAS Scale (Visual Analogue Scale)
- √ ADL Scale
- √ WHOQOL -BREF Quality of Life Questionnaire

CASE STUDY

First name: P.M

Age: 19 years old

Activity : Athlete

Diagnosis: anterior cruciate ligament rupture

History: during a training session - downhill between the gallops he injured his right knee. Following a specialized examination, a right anterior cruciate ligament tear was found. He was hospitalized in a specialized clinic where he underwent arthroscopic surgery.

Recovery program

The recovery program has the following general objectives

General objectives:

- ✓ preservation of the physiological qualities of all muscle groups and joints not traumatized;
- ✓ stimulation of the healing process of the anatomical elements through various procedures (due to increased blood irrigation);
- ✓ combating/preventing muscle contractures and refractures;
- ✓ resolving the inflammatory process;
- ✓ prevention of secondary disorders;
- ✓ prevention of the installation/removal of bad habits due to trying to replace the damaged function;
- ✓ recovery of mobility and muscle strength of the traumatized segment;
- ✓ improvement of general physical and mental state;
- ✓ restoration and development of basic and specific motor skills;
- ✓ improving quality of effort;
- ✓ readaptation to local and general maximal effort
- ✓ improving skills specific to the sport or profession (trade);
- ✓ gradual resumption of sporting activity;
- ✓ removal of excess weight (which puts particular strain on the joints of the lower limb in general and the traumatized knee in particular).

METHODS AND MEANS USED

- ✓ passive exercises;
- ✓ active exercises with assistance,
- ✓ resistance exercises;
- ✓ apparatus exercises;
- ✓ applied exercises.

Toning the flexor muscles

1. Subject supine with thigh at the edge of the mass; physiotherapist grips the dorsal aspect of the thigh and the sole. The patient executes a thigh extension contracted by the physiotherapist, then a leg extension (also contracted), followed by knee flexion. The thigh extension contraction puts tension on the hamstrings, and for the leg -the calf.
2. Patient supine with hip and knee joints slightly flexed, ankle in indifferent position. The grips are applied to the anterior aspect of the thigh and the dors dorsal aspect of the foot. The physiotherapist resists flexion of the dors dorsal thigh of the foot. Follow the triple flexion chain training.
3. Exercises with weight-bearing on pulley cage, helcometer.
4. From sitting on the lower limb opposite to that concerned, the affected lower limb wearing a weighted sandal. Flex as completely as possible. Balance is achieved by grasping a slat from a fixed ladder. Raising the weight causes concentric contraction, slow return of the calf ensures eccentric contraction.

Toning the extensor muscles

Global exercises:

1. Patient supine, thigh extended, calf off the table; opposite lower limb flexed, resting with the foot on the table; physiotherapist grasps the dors dorsal aspect of the foot and the anterior aspect distal to the calf; patient first performs dorsal flexion of the foot, then further extension of the calf. The movements are contracted by the physiotherapist in such a way that dorsiflexion of the foot is completely locked, but calf extension follows its full amplitude.
2. Same position as exercise “1”; train triple flexion: the affected lower limb starts from the triple flexion position. The physiotherapist stops the leg extension (plantar flexion), then the calf extension, which is performed at the same time as the thigh extension.
3. Same position as in exercise “1”; the physiotherapist grips the anterior aspect of the thigh distally and the calf distally: the patient attempts the hip flexion (blocked by the physiotherapist) and then the extension is performed against resistance opposed by the physiotherapist.

DATA PRESENTATION AND INTERPRETATION

Table 1 Final joint mobility testing

Testing knee <i>muscle strength</i>	Initial		Final	
	<i>Stg</i>	<i>Dr</i>	<i>Stg</i>	<i>Dr</i>
Flexie	110	45	110	90
Extension	0	-20	0	-5

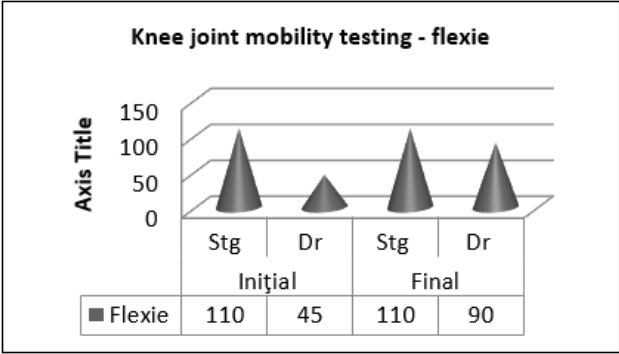


Fig.1 Joint mobility testing – flexion

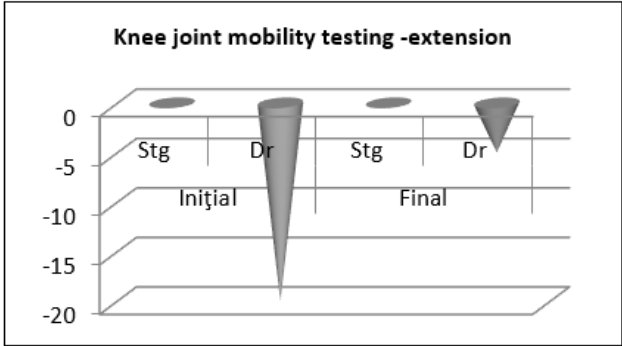


Fig. 2 Joint mobility testing –extension

There was an improvement in joint mobility of the affected knee. The program provided a positive response by increasing the range of motion (by 45 degrees for the right knee) for the flexion movement during the recovery sessions.

Table 2 Final testing of the WHOQOL -BREF Questionnaire

Areas	Initial	Final
Domain 1.-Physical health	12	17
Domain 2.-Psychological	14	18
Domain 3.-Social relations	17	25
Domain 4.-Medium	15	28

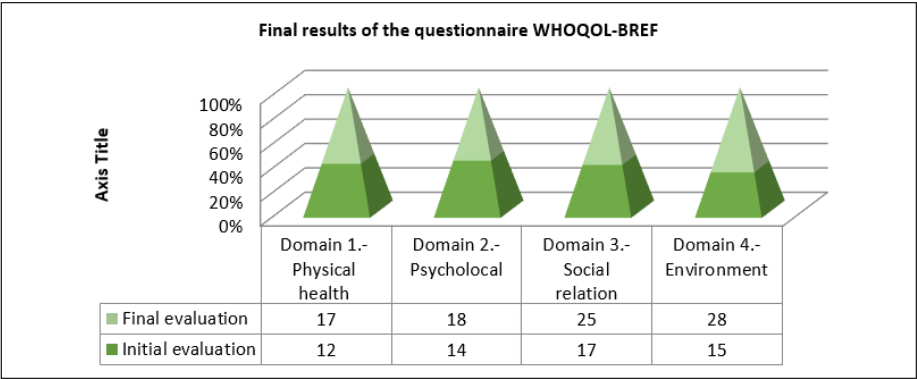


Fig. 3 Representation of the final test of the WHOQOL -BREF Questionnaire

In the final test of domain 1- Physical Health a score of 17 was obtained. This score indicates that the subject:

- ✓ Has achieved following the rehabilitation program an increase in range of motion;
- ✓ The patient’s energy level increased;
- ✓ Periods of insomnia have decreased in intensity and its quality is better.

In the final testing of domain 2-Psychological domain a score of 18 was obtained. This score indicates that the athlete:

- ✓ The negative feelings about himself and especially about his life have decreased in intensity, the patient having an increased esteem related both to his appearance and to the resumption of sports activities ;
- ✓ He managed to have a correct body image;
- ✓ He managed to have positive feelings about himself and especially about his life;

In the final test of domain 3-Social Relationships a score of 25 was obtained This score indicates that the athlete:

- ✓ Managed to have good social interaction;
- ✓ He has managed to increase his self-esteem but especially his usefulness by the fact that he manages to return to the activities he used to enjoy, meeting with friends, participating in sports activities (skiing), mountain activities.

In the final test of domain 4-Medium he scored 28. This score indicates that the athlete:

- ✓ Successfully engaged in community activities and school/college work;
- ✓ The desire to participate in various recreation/leisure (leisure) activities has returned.

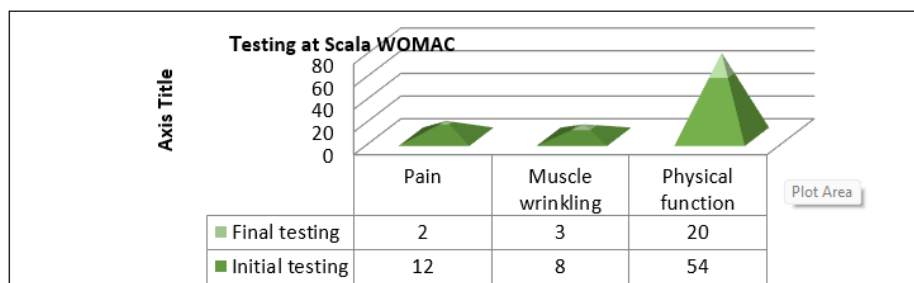


Fig. 4 Graphical representation WOMAC scale

Following the application of the recovery program there was a significant change for the three evaluated indicators. The pain indicator recorded a decrease of 10 points (TI 12/TF 2), which is due to the application of specific techniques and methods to reduce pain and the administration of pain relievers. Joint stiffness decreased by 5 points and the most significant change is related to physical function, which recorded the greatest improvement, a difference of 34 points.

CONCLUSIONS

Currently, there are a limited number of specific academic studies addressing the role of physiotherapeutic methods in ameliorating the effects of skiing injuries. However, the literature does provide general information on the importance of physiotherapy in the recovery from sports injuries, which can also be applied in the context of skiing accidents.

From the graphical presentation of the dynamics of the research subject's evolution, at the end of the recovery program, a constantly positive evolution during the treatment is observed, which meant that at the end of the treatment the subject was able to resume his sports activity, gradually integrating into the specific activity.

The following conclusions could be drawn from the experiment:

- ✓ early application of recovery treatment decreases its duration;
- ✓ means and procedures used in the programs must be individualized and particularized;
- ✓ should be selected those kinetic means and procedures that correspond to the achievement of the proposed objectives;
- ✓ these programs, judiciously put together, can ensure a full and rapid recovery of the athlete in competitive activity.

REFERENCES

1. Avramescu T, (2023), -Recuperare funcțională in patologia sportivă, Curs Master, Uz intern. Universitatea din Craiova.
2. Chen R, Ma X, Ma X, Cui C. (2024), The effects of hydrotherapy and cryotherapy on recovery from acute post-exercise induced muscle damage-a network meta-analysis. *BMC Musculoskelet Disord.* 2024 Sep 18;25(1):749. doi: 10.1186/s12891-024-07315-2. PMID: 39294614; PMCID: PMC11409518.
3. Ellison AE. (1977). Skiing injuries. *Clin Symp*; 29 (1): 1-40.
4. Ekeland, A., Rødven A., (2001), Injuries in Norwegian ski resorts, 1998–2000 in Abstracts from the 14th Symposium on Ski Trauma and Skiing Safety, 5–10 August 2001, *Knee Surg, Sports Traumatol, Arthrosc* (2002) 10:383–389, DOI 10.1007/s00167-002-0312-0
5. Holden MA, Murphy M, Simkins J, Thomas MJ, Huckfield L, Quicke JG, Halliday N, Birrell FN, Borrelli B, Callaghan MJ, Dziedzic K, Felson D, Foster NE, Ingram C, Jinks C, Jowett S, Nicholls E, Peat G. (2024). Knee braces for knee osteoarthritis: A scoping review and narrative synthesis of interventions in randomised controlled trials. *Osteoarthritis Cartilage.* 2024 Nov;32(11):1371-1396. doi: 10.1016/j.joca.2024.08.010.
6. Hunter RE. (1999). Skiing injuries, *Am J Sports Med*; 27 (3): 381-9.
7. Hume, P.A., Lorimer, A.V., Griffiths, P.C. et al. Recreational Snow-Sports Injury Risk Factors and Countermeasures: A Meta-Analysis Review and Haddon Matrix Evaluation. *Sports Med* 45, 1175–1190 (2015). <https://doi.org/10.1007/s40279-015-0334-7>
8. Yu SP, Williams M, Eyles JP, Chen JS, Makovey J, Hunter DJ. (2016) Effectiveness of knee bracing in osteoarthritis: pragmatic trial in a multidisciplinary clinic. *Int J Rheum Dis.* 2016 Mar;19(3):279-86. doi: 10.1111/1756-185X.12796. Epub 2015 Nov 12. PMID: 26558446.
9. Johnson RJ, Pope MH, Ettlinger C. (1974), Ski injuries and equipment function. *J Sports Med*; 2 (6): 299-307 3.
10. Koehle M.S., Smith, R.L., Taunton J.E.,(2002), Alpine Ski Injuries and their Prevention, *Sports Med* 2002; 32 (12): 785-793 0112-1642/02/0012-0785, p. 785-793.
11. Malone JK, Blake C, Caulfield BM. (2014), Neuromuscular electrical stimulation during recovery from exercise: a systematic review. *J Strength Cond Res.* 2014 Sep;28(9):2478-506. doi: 10.1519/JSC.0000000000000426. PMID: 24552796.
12. Molnar JA, Underdown MJ, Clark WA. (2014), Nutrition and Chronic Wounds. *Adv Wound Care* (New Rochelle). 2014 Nov 1;3(11):663-681. doi: 10.1089/wound.2014.0530. PMID: 25371850; PMCID: PMC4217039.
13. Paoloni JA, Milne C, Orchard J, Hamilton B.(2009), Non-steroidal anti-inflammatory drugs in sports medicine: guidelines for practical but sensible use. *Br J Sports Med.* 2009 Oct;43(11):863-5. doi: 10.1136/bjsm.2009.059980. Epub 2009 Jun 21. PMID: 19546098.
14. Petcu F. (1998), *Acupunctură fără ace*, Editura Universal Pan, București
15. Roșu, D., (2008), *Schi – Concepte teoretice și metodologice*, Editura Universitaria, Craiova.
16. Roșu D., (2018), *Schi, ramuri, discipline, evoluție*, Editura Universității din Pitești, Pitești.
17. Standaert CJ, Herring S. Physiological and Functional Implications of Injury. *The Encyclopaedia of Sports Medicine – Rehabilitation of Sports Injuries.* 2003:144-157.

18. Vanat L. (2022), International Report on Snow & Mountain Tourism, p.15
19. Weerapong P, Hume PA, Kolt GS. (2005), The mechanisms of massage and effects on performance, muscle recovery and injury prevention. *Sports Med.* 2005;35(3):235-56. doi: 10.2165/00007256-200535030-00004. PMID: 15730338.

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