

# A STUDY OF REHABILITATION IN TRAUMATIC MENISCUS INJURIES

Mihaela Oravitan

## REZUMAT

Reabilitarea care urmează după intervențiile chirurgicale pe meniscul lezat are trei obiective principale: abolirea sau diminuarea durerii și a tumefacției, obținerea stabilității și recuperarea mobilității (scăderea flexumului și redobândirea mobilității în flexie). Au fost urmărite două grupuri de pacienți (un lot martor și un lot de studiu) pe o perioadă de un an (ianuarie 2004 - ianuarie 2005), selecționați din cazistica Clinicii I de Ortopedie-Traumatologie din Timișoara. Pacienții ambelor grupuri au suferit leziuni traumatice meniscale izolate și toți au fost supuși intervenției artroscopice constând din sutură meniscală, meniscectomie parțială sau totală, urmate de tratament medicamentos antiinflamator și imobilizare. Lotul de studiu a fost constituit din 26 de pacienți care au participat la un program de reabilitare, în timp ce pacienții lotului martor (în număr de 26) nu au beneficiat, din diferite motive, de o astfel de recuperare. S-au realizat monitorizări lunare ale parametrilor genunchiului (utilizând scala KOOS - Knee Injury and Osteoarthritis Outcome Score și bilanțurile articular și muscular al genunchiului). Concluzia principală a acestui studiu este aceea că aplicarea unui program de reabilitare grăbește recuperarea forței musculare, a mobilității articulare și îmbunătățește considerabil toate elementele funcționalității genunchiului afectat.

**Cuvinte cheie:** menisc, leziune, intervenție chirurgicală, reabilitare, kinetoterapie.

## ABSTRACT

Rehabilitation which proceeds cautiously after surgery for the meniscus has three main objectives: decreasing or abolishing the local pain and swelling, obtaining stability and recovery of range of motion (decreasing of flexum, increasing of mobility). We have observed two groups of patients (a study group and a control group) over a period of one year (January 2004 - January 2005) selected from the records of the Orthopedics and Traumatology Clinic 1 in Timisoara. Both groups of patients have suffered isolated traumatic meniscus injury and have undergone arthroscopic treatment consisting of meniscus repair, partial or total meniscectomy associated to anti-inflammatory medication and immobilization. The study group was formed by 26 patients who participated to a rehabilitation program, while and the controls were represented of 26 patients who did not benefit the rehabilitation program for various reasons. A detailed record of knee parameters (using KOOS - Knee Injury and Osteoarthritis Outcome Score, articular and muscular strength testing) was filled in monthly. The main conclusion of this study consist in the fact that a rehabilitation program after meniscus surgery accelerates the strength and range of motion recovery and improves all the elements of functionality of injured knee.

**Key Words:** meniscus, injury, surgery, rehabilitation, physical therapy.

## INTRODUCTION

The meniscus is a commonly injured structure in the knee. The two menisci act like shock absorbers in the knee; they play an important role in absorbing about one third of the impact load that the joint surface sees. It is been shown that complete removal of a meniscus can produce progressive arthritis in the joint within a decade or so in a younger patient, sooner in patient who

are older with preexisting arthritic lesions. Forming a gasket between the shinbone and the thighbone, the menisci help spread out the forces that are transmitted across the joint so they protect the joint cartilage from receiving too much pressure on one small area on the joint surface. The menisci add stability to the knee joint; they convert the tibial surface into a shallow socket, which is more stable than a flat surface. Walking puts up to four times your body weight on the joint and running puts eight times the body weight on the knee. When the knee bends, the back part of the meniscus takes most of the pressure.<sup>1</sup>

Meniscus injuries can occur in any age group; in younger people the meniscus is fairly tough and rubbery, and tears usually occur as a result of a twisting injury or a blow to the side of the knee that causes the meniscus to be levered against and compressed; in older people, the meniscus becomes weaker, less elastic and compliant, so the meniscus tears can occur

Faculty of Physical Education and Sport, West University, Timisoara

Correspondence to:  
Mihaela Oravitan, Faculty of Physical Education and Sport, 4 Vasile Parvan Str., 300223 Timisoara, Tel. + 40-256-592129  
Email: ella.oravitan@rdslink.ro

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as the result of a minimal trauma and sometimes there are no memorable injuries or violent events which can be blamed as the cause of the tear.

A meniscus tear can appear in almost any conceivable geometric pattern and in any location; however, tears confined to the anterior horn of the cartilage are unusual and typically tears begin in the posterior horn of the cartilage and they can extend after that forward into the middle body or even in anterior horn.

Meniscus injuries, rather frequent in sports field are characterized by a clinical and lesion polymorphism that renders the diagnosis more difficult; many screenings have been made related to meniscus tears topography:<sup>2</sup>

- Internal meniscus also called “fragile” as compared to the external one, which is called “solid”;
- The posterior corn of the menisci is injured more frequently than the anterior one as the forces developed in flexion trauma act predominantly on this particular segment;
- Initially tears usually occur on the inferior side of the menisci which are situated on the “anvil” of the tibial plateau;
- Tears are usually longitudinal following the tract of the long circular fibers of the menisci.

The meniscus injury diagnosis is greatly established by history taking and a pertinent physical examination; it may be completed by imagistic investigations (especially MRI) and arthroscopy which ensures therapeutic solutions.<sup>3,4</sup> Regardless of lesion type, the orthopedic-surgical treatment chosen by the specialist must be mandatory followed by a specific rehabilitation program where an important role has physical therapy as well as complementary methods.<sup>5,6</sup>

## **MATERIALS AND METHODS**

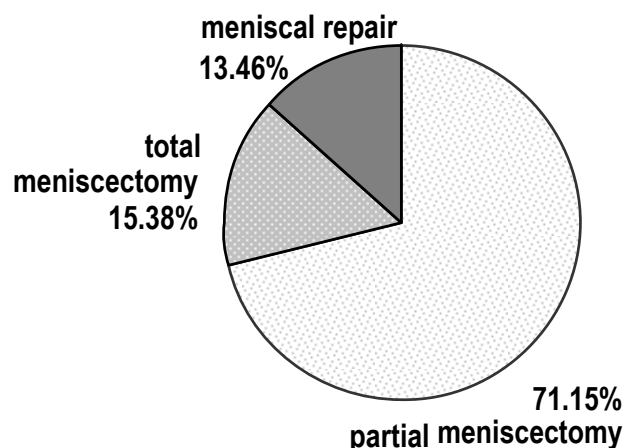
We have enrolled two groups of patients (a study and a control group) over a period of one year (January 2004 - January 2005) selected from the records of the Orthopedics and Traumatology Clinic 1 from Timișoara. Both groups of patients have suffered isolated traumatic meniscus injury and have undergone arthroscopic treatment consisting of meniscus repair, partial or total meniscectomy associated to anti-inflammatory medication and immobilization.

The study group consisted of 26 patients who participated in a rehabilitation program which will be further described. Study group patients were aged between 21 and 45 years of age (average 31 years); 18 of them were males and 8 females; in 10 of the cases

the external meniscus was injured, while in 16 cases the internal meniscus was injured. The orthopedic-surgical treatment for these patients consisted in: partial meniscectomy (19 cases), total meniscectomy (4 cases) and meniscus repair (3 cases), all interventions were performed using arthroscopy.

The control group consisted of 26 patients who, for various reasons, did not benefit the rehabilitation program to which the study group was exposed.

In order to significantly compare the twogroup, we selected patients of the same age who benefited of similar medical and orthopedic-surgical treatment. The controls were selected so that the comparison of the results be relevant for this study. Characteristics of the control patients: age between 21 and 45 years, 17 males, 9 females; the orthopedic-surgical treatment of these patients consisted in partial meniscectomy (18 cases), total meniscectomy (4 cases) and meniscus repair (4 cases), all performed through arthroscopic surgery. Figure 1 presents the type of arthroscopic surgery performed in all 52 patients.



**Figure 1.** Surgical treatment in traumatic meniscus injuries.

KOOS was assessed (KOOS – Knee injury and Osteoarthritis Outcome Score) was initially and in the 4<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup>, 16<sup>th</sup>, 20<sup>th</sup> and 24<sup>th</sup> post-operative week.<sup>1,6,7</sup> This type of evaluation is an instrument to assess the patient opinion about their knee and associated problems; there are 5 subscales which includes questions about pain (P), about other symptoms, about activities of daily living (ADL), sport and recreational activities and questions about the quality of life; always the last week is taken into consideration; standardized answer options are given and each question gets a score from 0 to 4. After the patients had completed the answers, we summed up the total score of each subscale and divide it by the possible maximum score for the subscale. The active and passive joint mobility and muscular strength has also been measured monthly.

We also performed a muscular and articular testing in order to survey the increasing of range of motion and of muscular strength in both groups of patients.

### **Meniscus tears treatment**

The meniscus itself is for the most part (70-80%) avascular, that is it does not bleed if it is cut; the exception to this is at the periphery, where it joins to the vascular knee lining providing the meniscus with a blood supply; similarly the nerve supply providing pain and other sensations to the meniscus is for the most part limited to the zone where the blood vessels are located. As a result to this lack of blood vessels, a torn meniscus does not have the ability to heal itself unless there is just a small tear confined to the peripheral vascular zone.<sup>3,9,10</sup>

If the history and the clinical examination indicate a torn meniscus, in almost all cases arthroscopy was suggested to confirm the diagnosis and treat the problem at the same time. The surgeon initially inspects the whole knee joint to see if there are other problems (arthritic areas, ligament tears or tears of the other meniscus) and then evaluates the meniscus tear; based on the location and geometry of the tear the decision is made to either remove (partial or total meniscectomy) or repair the tear(s).<sup>11</sup>

Most meniscus tears need to be removed because they involve areas of tissue that not have the ability to heal; the entire meniscus is removed only if the entire cartilage is damaged; removal of the meniscus increases the risk of future knee arthritis. The repair serves only as a means of securely holding the tissue together enough for this biologic process to occur.<sup>11,12</sup>

### **Rehabilitation after meniscus surgery**

Rehabilitation proceeds cautiously after surgery for the meniscus. The three main objectives of rehabilitation after meniscal surgical procedures are:<sup>13,14</sup>

- Decreasing or abolishing the local pain, which mean:
  - Anti-inflammatory and analgesic medication;
  - Rest;
  - Cryotherapy;
  - Physical procedures;
- Obtaining stability, through:
  - Physical therapy;
  - Knee hygiene;
  - Bracing;
- Recovery of range of motion (decreasing of flexum, increasing of mobility), especially through:
  - Physical therapy;
  - Physical procedures.

Rehabilitation should follow a logical progression regardless of the type of surgery performed. Rehabilitation following knee surgery can be divided into five phases:<sup>15-18</sup>

#### ***I. Immediate post-operative period***

This phase initiates immediately after surgery, even with the possible draining tubes present; it lasts for 1-3 days for as long as the post-operative edema is noticeable and has as a priority the post-operative checking of edema, pain, inflammatory phenomena, and partially the joint dysfunction. Swelling and pain control may be realized by various methods: cryotherapy, compression, anti-inflammatory and analgesic medication, elevation of the inferior limb.

Monitoring of the post-operative wound healing is essential in case of surgical procedure in order to prevent the occurrence of further complications (infections, hemorrhage, etc.).

#### ***II. Early healing phase***

The second period of rehabilitation carries on to the 4<sup>th</sup> day (maximum 10<sup>th</sup> day) and usually covers the hospitalization period. The progressive restitution of range of motion (R.O.M.) is aimed at; the minimum goal for range of motion is 80° for flexion and 10-15° for extension.

It is obvious that the muscular strength increases along with the healing of affected tissues and the range of motion improves at a rate proportional to the muscular strength and thus to the healing level.

The following types of exercises are done: endurance exercises to maintain or recovery the physical condition, less difficult physical activities can be initiated and isometric exercise for quadriceps and hamstrings.

#### ***III. Late healing phase***

This phase goes on from the 5<sup>th</sup> day to the approximately 20<sup>th</sup> day and is followed by isotonic exercises and easy physical activities; the minimum goal for range of motion is 110-120° for flexion, and the 0-5° for extension. This phase consist in: progressive endurance exercises, strength and velocity training exercises, plyometrics (which give the muscles the capability to develop the maximum force within in the minimum of time), practiced sport specific exercises are intensified and counter-resistance exercises.

#### ***IV. Conditioning for return to pre-injury activity***

The fourth phase continues from the 3<sup>rd</sup> to the 6<sup>th</sup> week (period which depends on the type and the seriousness of the initial lesion) and is individualized for each patient. In this phase we made balance and proprioceptive stimulation (starting to a minimum level, that is on stable support surfaces up to evolved

**Table 1.** Rehabilitation program applied to study group.

	Postoperative Weeks				Postoperative Months				
	1-2	3-4	5-6	7-8	9-12	4	5	6	7-12
<b>Brace</b>	•	•	•	•					
<b>Range of motion minimum goals</b>									
<b>0-80°</b>	•								
<b>0-120°</b>		•							
<b>0-135°</b>			•						
<b>Weight bearing</b>									
- <b>in peripheral tear (P)</b>									
toe touch- ½ body weight	P								
¾ to full body weight		P							
- <b>in complex tear (C)</b>									
toe touch -1/4 body weight	C								
½ to ¾ body weight		C	C						
full body weight				C					
<b>Patella mobilization</b>	•	•	•						
<b>Modalities</b>									
- electrical muscle stimulation	•	•	•						
- pain/edema management	•	•	•	•	•	•	•	•	•
<b>Stretching</b>									
- hamstring, gastrocnemius, soleus, iliotibial band, quadriceps	•	•	•	•	•	•	•	•	•
<b>Strengthening</b>									
- quad isometrics, straight leg raises, active knee extension	•	•	•	•	•				
- closed-chain (gait retraining, toe raises, wall sits, mini-squats)		P	C	•	•	•	•	•	
- knee flexion hamstrings curls (90°)			P	C	•	•	•	•	•
- knee extension quads(90-30°)			•	•	•	•	•	•	•
- hip abduction-adduction, multi-hip			•	•	•	•	•	•	•
- leg press (70-10°)			P	P	C	•	•	•	•
<b>Balance/proprioceptive training</b>									
- weight-shifting, plyometrics, mini-trampoline		P	C	•	•	•	•	•	•
<b>Conditioning</b>									
- upper body exercise		•	•	•					
- bike (stationary)				•	•	•	•	•	•
- aquatic program					•	•	•	•	•
- swimming					•	•	•	•	•
- walking					•	•	•	•	•
- stair climbing exercise					•	•	•	•	•
- ski machine					•	•	•	•	•
<b>Running: straight</b>						P	P	C	•
<b>Cutting: lateral carioca, figure 8's</b>							P	P	•
<b>Full sports</b>							P	P	•

levels with mobile support surfaces); proprioceptive, dynamic balance and ability stimulation exercises; it is well known the fact that the muscular strength is established by neuro-motor coordination; that is why its entire rehabilitation should be attained. Stability increment exercises will be performed analytically on muscular groups and synthetically by developing dynamic stability.

The minimum goal for range of motion is 135° for flexion and 0° for extension (full extension).

**V. Late rehabilitation phase**

This phase begin in the 6<sup>th</sup> post-operative week and last until the patient is able to retake the previous physical activity. It practically includes the criteria of

regaining the physical activity prior to the accident. Joint protection and movement restraints are progressively eliminated during this phase. The precise moment of retaking up the usual physical activity is not always easy to settle as each lesion and each patient are unique.

On the one hand, an acceleration of the restarting the sport activity may augment the risk of a burst of chronic pathology or of re-injuring that will need a long period of recovery and a reserved prognosis, and on the other hand an unreasonable delay of reintegrating in sports results in unnecessary physical and psychical breakdown.

Ideally, patients will be able to resume their previous lifestyle activities. Athletes are usually advised

to wait up to six months before returning to their sport; some patients may be encouraged to modify their activity choices, especially if the previous sport is one of great risk for knee injury (handball, football, basketball, skiing).

The next conditions may be considered necessary criteria for the restarting ordinary physical activity:<sup>2</sup>

- The absence of pain;
- Random of motion at maximal level;
- Muscular strength recovered almost completed (90-100%);
- The absence of joint swelling;
- Full weight bearing possible without limping.

The rehabilitation protocol for meniscus repair is presented in Table 1.<sup>5,19,20</sup>

After a partial or a total meniscectomy we should instruct the patient to use a walking aid and place a comfortable amount of weight on the operated knee.

After a meniscus repair, patients may be instructed to keep their knee straight in a locked knee brace and to put only minimal weight on their foot when standing or walking for up to six weeks.

The contraindications for rehabilitation program after meniscus surgery are the general contraindications for physical therapy (serious cardio-pulmonary disease, acute infectious disease and so on), electrotherapy, cryotherapy, massage or hydrotherapy.

Especially in meniscus rehabilitation, early full flexion (full squats) of the knee or full extension with rotation should be avoided.

Interventions will be applied in such manner that the utterly needed forms of the elevation therapy, segmental pause, prohibition of support, immobilization, should have the fewest possible negative consequences.

## RESULTS

Figures 2 - 5 present the results of testing for range of motion and for muscular strength (we use the average between muscular strength of quadriceps femori and hamstrings); a favorable evolution in both groups is observed but a constantly higher values of the mobility and strength of the knee are observed in patients who benefited from physical therapy.

Table 2 and Figure 6 present the values of KOOS subscales in 5 different moments: in pre-operative, after 2 post-operative weeks and after three, six and twelve post-operative months.

A statistical comparison between the two groups was made by applying the Student Test.<sup>3</sup> (Tables 3-6)

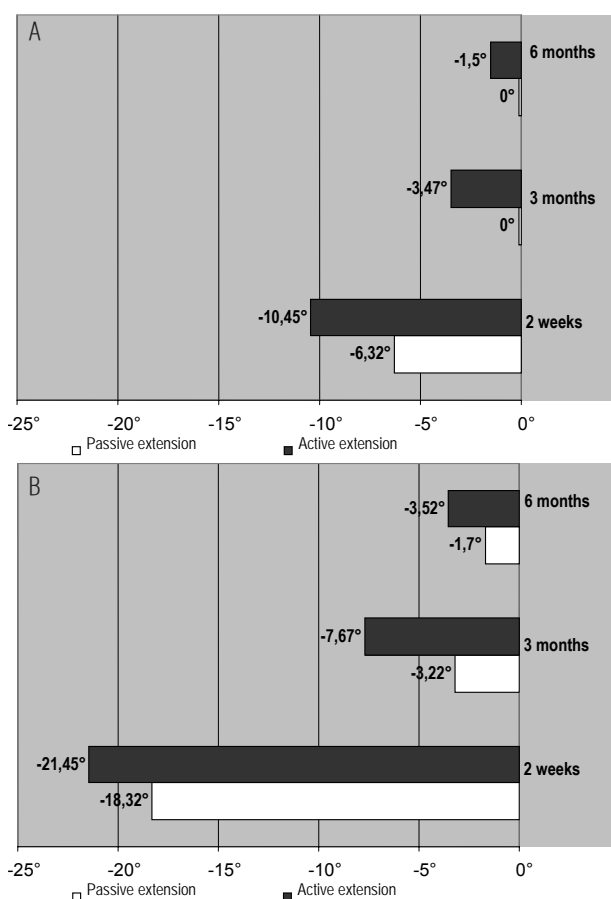


Figure 2. A. Study group - extension testing; B. Control group - extension testing.

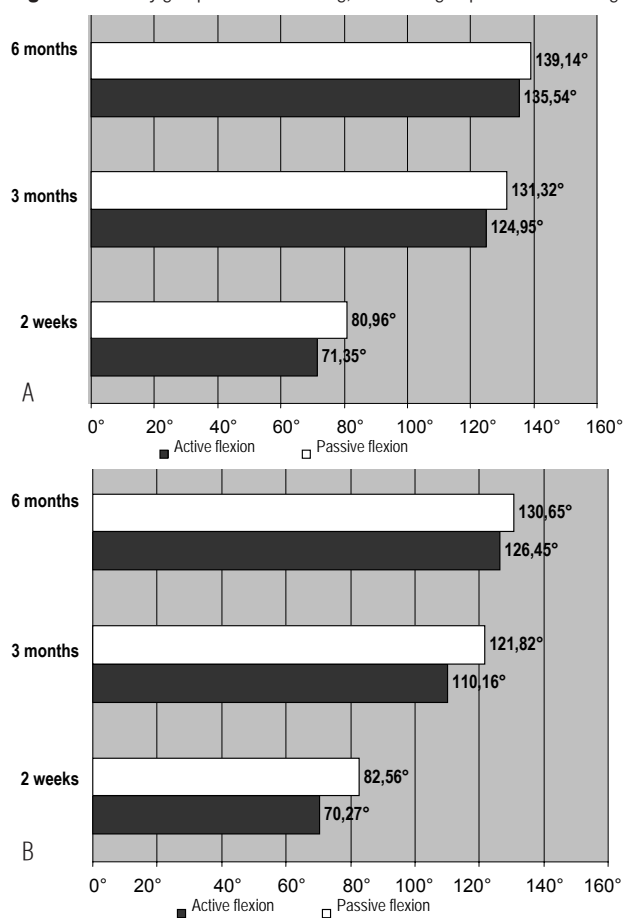
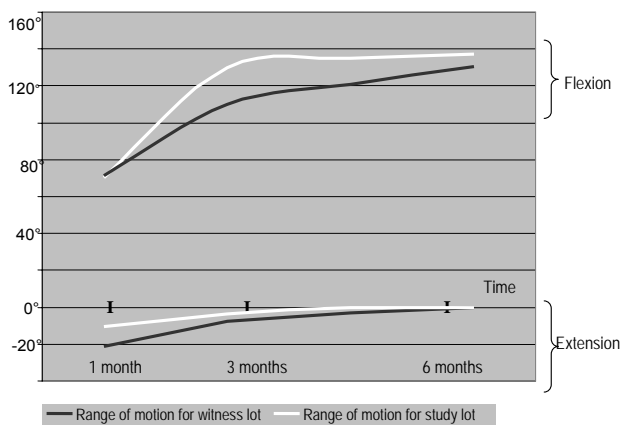
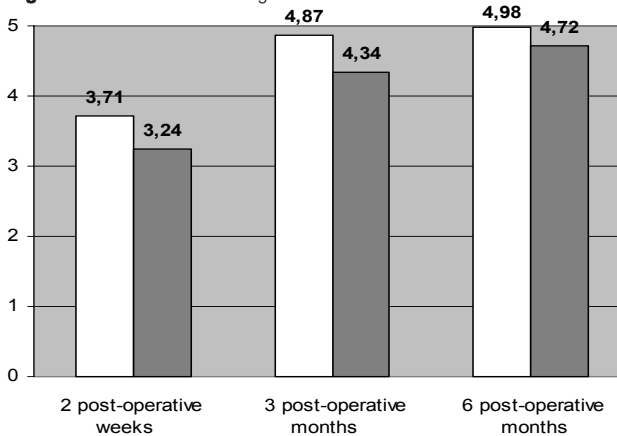


Figure 3. A. Study group - flexion testing; B. Control group - flexion testing.



**Figure 4.** Evolution of the range of motion.



**Figure 5.** Comparison of muscular strength recovery between the two groups.

**Table 2.** KOOS subscales values for the groups (SG-study group; CG- control group).

Period	Subscale	Subscale				
		Pain (P)	Symptoms (S)	Activities of daily living (ADL)	Sports and Recreation (SP)	Quality of life (QOL)
Pre-operative	SG	59.74	65.32	73.34	28.65	36.93
	CG	62.13	63.45	72.79	31.59	35.48
2 weeks post-operative	SG	68.97	75.67	78.98	43.78	45.53
	CG	70.34	78.45	74.32	41.24	46.78
3 months post-operative	SG	82.45	86.39	85.18	64.57	75.29
	CG	74.37	80.65	78.67	53.24	68.34
6 months post-operative	SG	91.67	93.56	94.53	86.54	94.54
	CG	88.73	85.74	86.65	74.32	84.32
12 month post-operative	SG	95.79	92.78	98.34	95.21	98.43
	CG	88.54	89.76	92.57	88.67	88.56

**Table 3.** Statistical assessment of the differences between the two groups regarding knee active flexion (SL-study lot; WL-witness lot).

Lot	At 2 post-operative weeks		At 3 post-operative months		At 6 post-operative months	
	SL	WL	SL	WL	SL	WL
Mean and Standard Error	71.35±2.91	70.27±2.33	124.95±2.78	110.33±2.85	135.54±3.13	126.45±3.23
Student Test	p>0.1		p<0.0001		p<0.0001	

**Table 4.** Statistical assessment of the differences between the two lots regarding knee extension. (SG-study group; CG- control group)

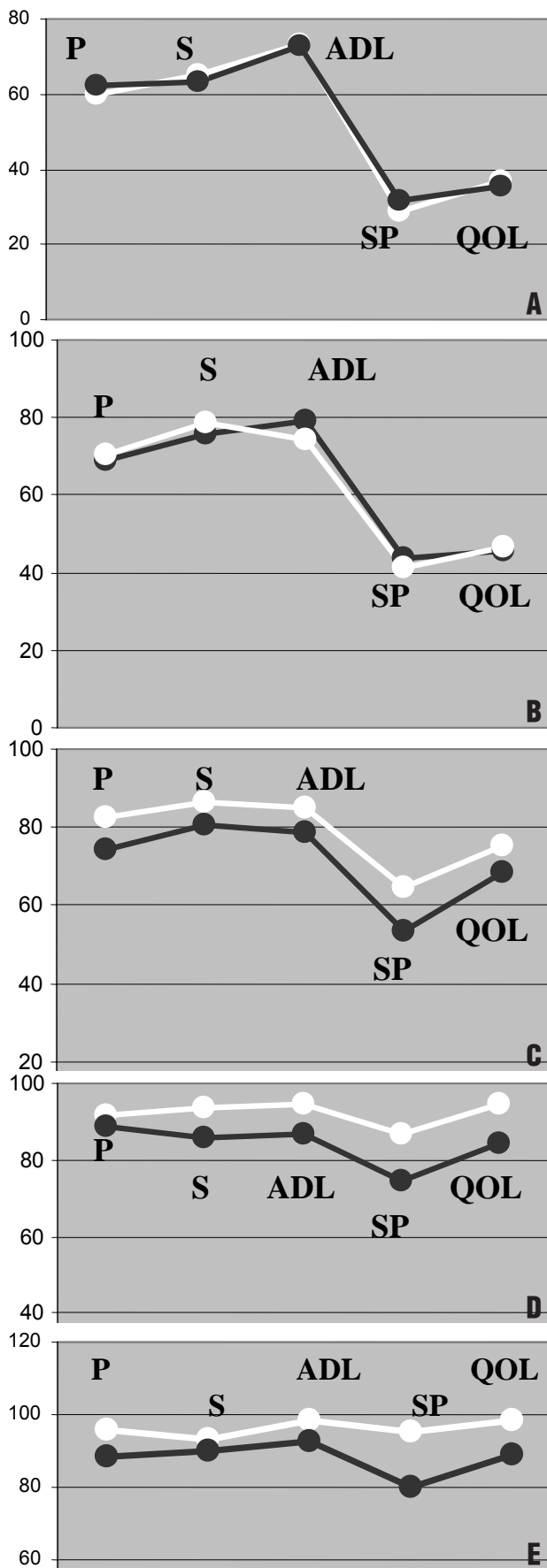
Group	At 2 post-operative weeks		At 3 post-operative months		At 6 post-operative months	
	SG	CG	SG	CG	SG	CG
Mean and Standard Error	-10.39±1.84	-21.45±1.84	-3.47± 1.06	-7.62±1.06	-1.53±1.44	-3.52±1.47
Student Test	p<0.0001		p<0.0001		p<0.0001	

Student test showed very significant differences ( $p<0.0001$ ) between the two groups concerning the knee mobility (active flexion and extension) for each moment of evaluation (at 2 post-operative weeks, at 3 and 6 postoperative-months). (Tables 3 and 4), and for the muscular strength at 3 and 6 post-operative months; no difference was seen between the two groups regarding muscular strengths at 2 post-operative weeks ( $p>0.1$ ). (Table 5)

KOOS scale differed significantly between the two groups at 6 and 12 post-operative months ( $p<0.05$  and  $p<0.01$ ); no- differences were found in pre-operative period and at 2 and 12 post-operative weeks ( $p<0.05$ ) (Table 6).

## DISCUSSIONS

Almost all patients have completely recovered their muscular strength within 6 months from the surgery; the 3-4 muscular strength values maintained a comparatively diminished mobility; two of the patients have erratically participated to the program, and one patient suffered a post-operative complication (thrombophlebitis) ensuing a difficult investigation and carrying out of the recovery.



**Figure 5.** KOOS A. Preoperative period; B. 2 weeks after surgery; C. 3 months after surgery; D. 6 months after surgery; E. 1 year after surgery (the white lines - the study group, the black lines - the controls, P-pain, S-other symptoms, ADL-activities of daily living, SP - sports and recreation activities, QOL-quality of life).

The KOOS evaluation scale offered the possibility to highlight the post operative problems of the operated knee encountered by the studied subjects and the witness lot subjects. Thus, the values of the 5 subscales revealed similar results during the pre-operative and post-operative periods.

Immediately after the surgery, the similar values of the subscales which refer to the typically symptoms of the operated knee (subscale P and S) - with non-significant differences - are gained in the majority of cases, due to the fact, that the patients try not to tension their knee. This behavior characterizes the patients which are not involved in a kinetic recovery program.

The statistical significant differences which result from the tardy estimation (at operative after 6 and 12 post-operative months) however are in favor of the studied subjects, especially in what concerns the sport activities, quality of life, and less, in case of pain, the other symptoms and daily activities.

The range of motion has to a certain extent rapidly risen after the surgery and, to the great majority of the patients, a constant increase followed until the moment of the final assessment, to which 21 patients of the study group presented a range of motion to be situated within the physiologic limits of the joint balance.

The patients who benefited from total meniscectomy must be instructed on the methods of preventing the premature arthritis of the knee, to which they are predisposed; the fact that total meniscectomy determines a rapid and constant recovery within the first post-operative months is to be observed.

Patients who have undergone meniscus repair experience a longer period of recovery by contrast to those with meniscectomy since the repaired meniscus must benefit from optimal conditions of tissue healing.

Not all patients are rehabilitated uniformly, and a great deal of variability exists following arthroscopic surgery. Factors that affect the speed of rehabilitation and return to normal function are the extent of meniscectomy performed, the coexistence of additional pathology and individual patient differences (age, physical condition).<sup>21</sup>

The patient must meet certain criteria for the return to the physical activity prior to the trauma. Disregarding these conditions may lead to re-impairing. In that case, a new recovery program would be more difficult to deal with, would last more and the psychic state of the patient would also be affected.<sup>21</sup>

## **CONCLUSIONS**

The main conclusion of this study consist in the fact that a rehabilitation program after meniscus surgery accelerates the strength and range of motion recovery and improves all the elements of functionality of injured knee. A monitored kinetic therapy which is appropriate for the injury type of the meniscus and of the surgical intervention leads to a more efficient recovery as reveled by the data of mobility and muscular testing and the results of KOOS scale.

The surgical interventions due to meniscus injuries which are not followed by a kinetic program lead to a spontaneous and quite quick recovery, but the quality of the rehabilitation and its complexity does not represent the most appropriate method for the introduction of the patient into the physical activity performed before the trauma.

Recovery must be adjusted to each patient, correlated to their characteristics (their health condition, physical activity, age).

Patients, who wore knee braces, in consistence with the recommendations, have obtained better results during the recovery process.

The carrying out of the entire set of the program stages is indispensable in order to achieve full recovery. A premature come-back, mostly when physical activity is concerned (games team sports, ski) may lead to a re-impairment.

## **PROPOSALS**

The way the first medical care is provided (at the very scene of the accident and immediately after) is also very important, as it influences considerably the necessary time and the quality of the recovering process through the reduction of the swelling phenomena and of the post-lesion hemorrhage as well as through the fight against the appearance of immediate post lesion complications (ligament lesions, encapsulation etc.)

It is recommended that any intense physical activity be performed following a complete and correct warm up, and if the individual claims new knee soreness, it is essential that he should contact at once a specialized physician; attention is drawn especially to those with whom preserving treatment was installed, after a posttraumatic meniscus lesion or to those with whom the re-integration was applied through a full-weight bearing physical activity that overcharges predominantly the knee.

It is recommended that the patient should use adequate equipment, wear braces and elastic straps in with the purpose of diminishing the risks of re-impairing.

Patients with meniscus lesions will be informed on rules related to the "hygiene of the knee".

A survey of the patients with whom total meniscectomy was implemented is hereby proposed in order to expose the arthritis phenomena they are predisposed to due to the removal intervention of the damaged meniscus.

A trauma at knee-level must be assessed completely and accurately so as to produce a complete diagnosis and to instate a complete orthopedic-surgical treatment. Pre-operative exercises and home exercise program are equally important as the recovery under therapeutic control.

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