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PhD thesis

CLINICAL-STATISTICAL AND THERAPEUTIC CONSIDERATIONS IN THE RECOVERY OF PATIENTS WITH LIGAMENTAL INJURIES AFTER PLACING AN ENDOPROSTHESIS AT THE KNEE

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CONTENTS:

1. GENERAL BIOMECHANICS

The knee's anatomic complex developed a 3rd degree lever, with the force between the point of support and the point of resistance. The main movements of the knee joint are the flexion and extension. The knee has both a good stability and mobility in extension, due to the poor connection of the articular surfaces. The asymmetry of the 2 femoral condyles is obvious, the medial condyle being longer and narrower, descending lower than the lateral one, but both of them lean on the same horizontal plan, because between the femoral shaft axis and that of the calfthere is an angle of a 170-175 degrees,with outward opening (physiological-knee-valgus).[15,16]

WEBER, STRASSER and KAPANDJI consider that starting from a complete extension, the condyle begins to role without slipping in the first 20 degrees of flexion (the first 10-15 degrees for the medial condyle) and the rest for the lateral one, after which the slip appears and becomes predominantly progressive so that by the end of the movement they slip without rolling.

The internal and external menisci, placed on the tibial plateau, ensure the congruence of the articular surfaces and distribute the pressures on the articular cartilage, and on the flexion movement of the knee it slides posteriorly and on the extension movement it slides anteriorly

The lateral femoral condyle rolls 1 cm back on the tibial plateau at the first 15 degrees of flexion.

The medial femoral condyle, attached to the tense medial collateral ligament, rolls a few mm on the tibial plateau, so that in the first 20 degrees of flexion, the internal rotation movement of the tibia under the femur occurs..

The lateral condyle, being shorter, completes the path faster than the medial one, leaning on the condylar cap, getting it in state of tension. The extension is complete when the tibia rotates around its axis or vertically with 2-5 degrees externally to allow the medial condyle to tension the medial condylar cap at the end of the movement (locked position). [17,18]

LINDALIL and MOVIN consider that even in the first 20 degrees of flexion there is no pure rolling. A pure rolling during the entire flexion process is not possible due to the 2 times longer length of the condylar surfaces than those of the tibial glenoid cavities. In order to initiate a new flexion, the contraction of the popliteal muscle is needed, being the oil-starter, determining a new internal rotation of the tibia, the antero-external cruciate ligament and the external collateral ligament relax and the flexion resumes. During the flexion, the external collateral ligament and the antero-external cruciate ligament relax, and the medial collateral ligament and the posterior-internal cruciate ligament become tense.

The kneecap executes an 8 cm vertical translation in flexion, making the knee extensor slip on the femoral inferior extremity.[13]

The active flexion of the knee is 120 degrees, if the hip is in extension and 140 degrees if the hip is in flexion.

The passive flexion is 160 degrees (the heel touches the buttocks).

The capsular retractions of the knee and quadriceps muscle limit the flexion. The automatic rotation involves a longer length of the medial femoral condyle, the concavity of the medial tibial glenoid compared to the convexity of the lateral tibial glenoid, allowing a greater posterior sliding of the lateral femoral condyle.

The oblique orientation of the external collateral ligament allows a greater mobility of the lateral femoral condyle. At the same time, there is also an axial, passive and active rotation, present only at flexion, reaching a maximum amplitude of 30 degrees for internal rotation and 40 degrees for external rotation, at a femoral-tibial angle of 90 degrees.[19,20]

At a 90-degree flexion, the internal rotation aligns extensor apparatus of the knee, centering the anterior tibial tuberosity, the middle of the kneecap and the femoral axis.

The internal rotation is followed by a valgus tibial inclination, and the external rotation is followed by a varus tibial inclination.

On the tibial plateau, in the frontal plan, changes in inclination of 3 degrees (0-6) may occur with respect to the tibial axis, known as congenital varus, which increases the effort on the internal compartment and the anterior cruciate ligament.

The fibula head is an important reference in assessing the position of the joint surface in the knee endoprosthesis, also intervening in the knee biomechanics, as the fibula head is the insertion site of the external collateral ligament, the primary varus stress stabilizer. Under the fibula head, the external popliteal sciatic nerve makes its way to the anterior calf lodge.

Besides the classic flexion-extension movement, the knee biomechanics also shows the varus-valgus movement type, between 6-8 degrees in extension and the internal-external rotation movement between 25-30 degrees in flexion.

Besides these movements, there are also the 3 translations:

- From proximal to distal between 1 and 2 mm
- Antero-posterior between 5 and 10 mm
- Medial-lateral between 1 and 2 mm.

MENSCHIK was the first one using the principle of the 4 cross-linked bars in the knee kinematics, meaning that the central pivot is represented by the cruciate ligaments and the meniscal-femoral ligaments.

The menisci work as a lever arm and they guide the rotational stability.

The collateral ligaments represent the main stabilizers of the varus-valgus movements and the internal-external rotation movements. The movement amplitude is influenced by the femoral insertion orientation of the cruciate ligaments (the 4 cross-linked bars system). Consequently, the cruciate ligaments femoral insertion should form anangle of 40 degrees to the long axis of the femur, just like the intercondylar notch ceiling.[21,22,23]

The BURMESTER curve is the biomechanical principle to be considered when performing ligamentoplasty,

meaning the knee ligaments should be on the normal path of the BURMESTER curve, so that it won't suffer ruptures or elongations, thus respecting the principle of isometry and anisometry.

It is considered that a ligament has an isometric behavior when it doesn't change its length during the flexion-extension movement, the ACL central portion being considered isometric.

From a biomechanical point of view, the antero-medial beam is tensioned in flexion and the postero-lateral one is operated in extension and internal rotation. In extension, ACL is vertically oriented and most of the fibers are functional and in flexion, ACL is almost horizontally oriented with a small number of functional fibers opposing to the anterior tibial translation.

On the cap there are some proprioceptors – proprioceptive nerve endings.

In flexion, the contact surface between the tibial plateau and the femoral condyles moves posteriorly. The external meniscus translates approximately 12 mm, and the medial one approximately 6 mm. The medial meniscus occupies over 50 percent of the articular area of the tibial plateau, having a greater width in the posterior part.

2. PURPOSE OF THE WORK

The aim of this paper reflects the possibility of streamlining the therapeutic behavior of postligamentoplasty and postarthroplasty at the knee, as well as determining the association of neutrophil to lymphocyte ratio (NLR) in patients with mild, advanced osteoarthritis and joint effusion.

3. OWN TECHNIQUE OF REABILITATION AFTER KNEE ARTHROPLASTY

After the knee endoprosthesis operation, the recovery begins as soon as the general condition of the patient allows it, prolonged rest preventing the stimulating effect of the stress on the restoration of neuromuscular control and on healing.

- regaining the independence of performing physiological needs is the first proposed objective; in this respect, I encourage the patient to come down to the edge of the bed, after which to begin lung stimulation exercises (tappings), for the evacuation of pulmonary secretions, followed by relaxation breathing exercises. Keep this posture in the seat until the "bad" state improves, then return to the initial dorsal decubitus position. After 2 hours, with the help of the walking frame and in my presence, the patient moves towards the toilet (I do not recommend moving on the first descent at the edge of the bed, there is the danger of sudden installation of orthostatic hypotension, followed by faintness), acting the frame forward, then the operated leg, followed by the healthy one.

- the arthromot has an essential role in the passage of passive flexion, starting at first with a flexion as small as possible (30 degrees), since the medial parapatellar approach partially burdens the activity of the extensor apparatus. Personally, I use the arthromot twice a day for 30-60 minutes. After 14 days, with the daily progression of the flexion amplitude, the knee reaches 90 degrees.

Some orthopedic centers limit the knee flexion to 40 degrees, supporting the theory that high flexion decreases the transcutaneous oxygen tension, with possible postoperative wound damages.

- in the first 14 days, the pain is combated with painkillers, cryotherapy - 20 minutes, whenever necessary, the hemodynamic functions are monitored (pulse, BP), and the body temperature

- the maintenance of the operated pelvic limb in the prone position, and from day 2 postoperatively, when the drainage tube is suppressed, the isometric contraction exercises begin

- reducing the extension by arranging a rolled carpet under the heel for 5-10 minutes

- during the first 2 days, I do not recommend that patients with comorbidities (cardiovascular diseases) go to the toilet otherwise than assisted.

- exercises for toning the muscles of the upper limbs (lifting from the dorsal decubitus in the sitting with the help of the supporting triangle, 3 series x 10 repetitions)

- after suppression of the suture threads, at 14 days, the counter-resistance exercises begin

- at 21 days postoperatively, patients switch to the stationary bicycle, with the saddle adjusted to a height corresponding to the complete rotation, 10-15 minutes/day, in the first days

- mobilizations of the kneecap, for 5 minutes, 2-3 times/day

- at 6 weeks postoperatively, the knee passive flexion reaches 110-120 degrees

- in the first 6 weeks, the frequency of the recovery program is daily, then 4 days /week, up to 3 months, when the recovery protocol is completed

- 7 days postoperatively, from the ventral decubitus, the extended knee, with one hand the anterior face of the ankle is fixed, with the other the distal 1/3 of the posterior thigh, and the flexion of the calf is performed on the thigh, the amplitude of movement being adapted to the degree of pain tolerance.

- it is very important to know the details of the surgery, the collaboration with the orthopedic surgeon having a special significance in the success of the recovery protocol. The PCL over-tensioning, during the operation, leads to erroneous control of the femoral position towards the tibia in flexion, having the following consequences: increased degradation of polyethylene, in the posterior part of the tibial plateaus, reduction of flexion, posterior impingement with tibial plateau, lower joint congruence

- distal femoral resection, greater than 2 mm, can also affect the biomechanical mechanism, by creating instability in intermediate degrees of flexion (30-60)

- ascending and descending stairs, with bilateral support, from day 7 postoperatively

- leg rolling exercises on the recovery ball, actively training the flexion of the calf on the thigh, for 5-10 minutes

- half-flexion exercises, with both hands supported on the trellis, 10-15 repetitions x 3 series, with breaks of 2 minutes

- exercises to strengthen the calf muscles, in a closed kinetic chain, by alternating lifts on the tips and heels (thus training in addition to the triceps surae, and the anterior tibia), 20 repetitions x 3 series, with breaks of 2 minutes

- exercises for toning the hip muscles, through the flexion of the thigh on the pelvis, from orthostatism, both hands supported on the trellis, 10 repetitions x 3 series, bilaterally, with breaks of 2 minutes

- at 4 weeks postoperatively, the support on the walking frame is waived, and for one week continue with the support on a cane, after which it is suppressed

- claudication is compromised by fitness band walking exercises, under visual control, with bilateral support at the beginning, 10-15 minutes/ day

- the sectioning of the anterior functional cruciate ligament, even if it is replaced by a material that provides antero-posterior stability, causes me to limit in the first 2 months the exercises in the closed kinetic chain, and keeping the collateral ligaments intact allows me to be able to initiate after 3 months slight lateral movements.

4. FUNCTIONAL REHABILITATION RESULTS AFTER KNEE ARTHROPLASTY

A negative consequence after knee arthroplasty is the limitation of extension, with the appearance of knee-flexum followed by local pain, decreased orthostatic stability, claudication.

We conducted a clinical-functional study, from 2008 to date, on 200 patients with gonarthrosis, operated bytotal knee arthroplasty, in the orthopedic clinic, who followed the treatment of post-arthroplasty knee rehabilitation in our recovery clinic. After the postoperative protocol program, followed by the patients in our recovery clinic, the results were favorable, the subjects regained muscle strength and mobility in normal parameters.

Material and method

We conducted a clinical-functional study on 200 patients with gonarthrosis, operated of total knee arthroplasty, from 2008 to the present, and who have undergone post-arthroplasty rehabilitation treatment of the knee in our recovery clinic.

Patients underwent surgery to replace the degenerate parts of the knee joint structure with metal or other prosthetic components by total knee arthroplasty.

Therapeutic conduct in the first 14 days postoperatively:

- immediately postoperative cryotherapy, to reduce edema and pain

- the drain tube is removed the next day postoperatively

- isometric contractions of the quadriceps muscle

- positioning patients at the edge of the bed, mobilizing the knee gravitationally, passively, passive-actively and actively

- travel to the toilet with the help of the walking frame

- discontinuation of recovery for 24-48 hours, if they are anemic patients, or with postoperative transfusion

- exercises for knee extension for quadricipital atrophy prevention

- during the first 14 days, mobilization is done between 0-90 degrees flexion

- in the first 4 weeks, support on the walking frame

- analgesic and prophylactic anticoagulant medication, monitoring the evolution of the wound

- passive extension of the operated knee with a rolled towel

- place the heel on a pillow and leave the knee free in extension for 10 minutes or depending on the pain tolerance. [126]

In the next period of 3-6 weeks, the exercises on the stationary bike will continue 10-15 minutes/ 2 times a day.

Mobilizations of the kneecap and manipulations for wound desensitization and contract prevention are started. After scarring of the wound, the hydro-kinetotherapy begins, and at the end of this period, the extension reaches normal parameters, and the flexion at 110 degrees.

- exercises at the trellis of lifts on the tips, balance exercises.

Between 6-12 weeks, the patients can return to the desired activities.

Although the mobility is in progression up to 2 years postoperatively, it is considered to be at 80% of the maximum recovery potential after a period of 3 months.

Subjective results were assessed using the analog visual scale completed by patients, and functional results by measurements of the degree of joint mobility, using the goniometer, at one month, two months, three months postoperatively.

5. DETERMINATION OF THE ASSOCIATION BETWEEN NEUTROPHIL LIMFOCITES RATIO (NLR) AND THE SEVERITY OF CLINICAL DISEASE IN PACIENTS WITH EARLY OR ADVANCED STAGE OF KNEE OSTHEOARTHRITIS

Determining the association of neutrophil ratio to lymphocytes (NLR) and the severity of clinical disease in patients with mild and advanced osteoarthritis of the knee (OA). Mild OA (66), who underwent knee arthroscopy and advanced OA (45), who had total replacement, better scores: Eurociol EQ5D Index (0.50 / 0.25), VAS (65/44); International Knee Documentation Committee Subjective Knee Assessment Form - IKDC (31.6 / 20.24); Score of the result of knee disability and osteoarthritis for joint replacement - KOOSJR (15.5 / 18.3); and a better stage. Kellgren-Lawrence (1.3 / 3.8). Patients with advanced disease had higher NLR compared to the mild OA group and controls: 2.82 versus 1.99 ($p = 0.004$) and 1.98 (p = p, 002). In the multiple regression model, NLR was influenced only by age ($p < 0.001$). In the subgroup analysis, for the first cases of OA, NLR was significantly dependent on VAS ($p = 0.006$), IKDC ($p = 0.001$) and KOOSJR ($p < 0.001$). Conclusion: NLR has not been associated with symptomatic knee OA, as determined by the commonly reported results used by patients. However, for patients with mild degenerative changes, EQ5D, VAS and IKDC were independent predictors of NLR. Keywords: knee joint; osteoarthritis; inflammation markers; neutrophil ratio to lymphocytes; patient-reported outcome measures; arthroscopy; arthroplasty.

Table 1. Demography and severity of clinical disease between mild and severe OA groups. Subgroup analysis of patients with early versus advanced OA: n: number of subjects; Index: higher values indicate better health, VAS: higher values indicate better health, IKDC: higher values indicate better health, KOOSJR: lower values indicate better health;.

	OA low (n=66)	OA advanced (n=45)	P
NLR	1.999	2.821	0.004
Age	54.06	67.11	<0.001

M:F rate	1:1.75	1:5.43	0.011
Index	0.505	0.253	<0.001
VAS	64.92	43.88	<0.001
IKDC	31.66	20.24	<0.001
KOOSJR	1.45	18.33	<0.001
Kellgren-Lawrence	1.3	3.8	<0.001

Table 2. Multiple regression for the entire OA group (p-test value F <0.00l, multiple coefficient of determination 0.9505, adjusted coefficient of determination 0.9467) and for the light OA group (P test value F <0.001, coefficient multiple of determination 0.9839, adjusted coefficient of determination 0.9814).

n=111	P	n=66	P
Age	<0.001	Age	0.133
Type	0.362	Type	0.610
Index	0.673	Index	0.331
VAS	0.287	VAS	0.006
IKDC	0.091	IKDC	0.001
KOOSJR	0.123	KOOSJR	<0.001
Neutrophil	<0.001	Neutrophil	<0.001
Lymphocytes	<0.001	Lymphocytes	<0.001

Table 3. Multiple regression for the advanced OA group. Subgroup analysis of the multiple linear regression model for the advanced OA group: we analyzed two sets of NRLs: NRLpre (before surgery) and NRLpost (first day after surgery) P-test value F <0.001, multiple coefficient of determination 0 , 9893, adjusted coefficient of determination 0.9854;

n=45	P	n=45	P
Age	0.001	Age	<0.001
Type	0.808	Type	0.725
Index	0.924	Index	0.171
VAS	0.913	VAS	0.092
KSS1	0.492	KSS1	0.120
KSS2	0.290	KSS2	0.074
IKDC	0.486	IKDC	0.062
KOOSJR	0.799	KOOSJR	0.693
Neutro_pre	<0.001	Neutro_pre	0.629
Limfo_pre	<0.001	Limfo _pre	0.643
Neutro_post	0.023	Neutro_post	<0.001
Limfo_post	0.595	Limfo_post	<0.001

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7. PERSONAL CONTRIBUTIONS TO KNEE RECOVERY

In the rehabilitation of ACL, the basic condition is compliance with the intraoperative technique:

- the femoral tunnel has the aperture centered in the posterior of the lateral face of the notch, posterior to the intercondylar line, by drilling the femoral tunnel, independent of the tibial one
- the neoligament at the tibial level should be oriented in the direction of the native ligament insertion, almost perpendicular to the sagittal plane, in the middle of the tibial fingerprint
- exact drilling of tunnel length, femoral (25 mm) and tibial (30 mm) and diameter (8 mm)
- the harvested graft is quadruple, has a 10 cm length and an 8 mm diameter (some orthopedic surgeons drill the tibial tunnel at 35 mm, and the neoligament strengthen it with 5 bands, to ensure better resistance to mechanical factors).

We used a sample between the ages of 18 and 45, and considered the following factors:

- the age of the patient
- the profession

- sports activity
- the age of the lesion
- the degree of laxity of the knee
- the presence or association of other lesions.

Postoperative functional evaluations were done with: Lachman test, KT1000 arthrometer, anterior drawer test, goniometer.

Objectives proposed:

- pain suppression and restoration of joint mobility
- restoration of tone, symmetrical bilateral circumference, muscle force and strength

Positive prognostic factors for returning to sports or leisure activities:

- high force in quadriceps
- low-level
- knee stability
- pain suppression
- symmetric jump test
- age as young as possible
- positive psychological attitude
- self-confidence.

Postoperatively, the activity of the quadriceps being encumbered, compensatory, hip extensors and plantar flexors can be activated, resulting over time in muscle stifness, with negative effects in sport. I have closely followed this aspect, succeeding through the techniques presented in the chapter "Methods for the recovery of knee ligament injuries" to undo this consequence.

During the study, we were able, through the recovery protocol adapted to ligamentoplasty, to re-educate the extension, both in patients with favorable postoperative evolution and in patients with subsequent complications (cyclops, arthrofibrosis, impingement), revealed by magnetic resonance investigations (MRI).

Flexion recovery was possible in optimal parameters, by the action on the posterior muscle of the thigh, the technique of agonist-antagonist mobilization (increased amplitude of flexion of the calf on the thigh by activating the hamstrings leads to increased amplitude of quadricipital movement, with optimization of the extension) being a success on the rehabilitation of the musculoskeletal mobility.

Regarding the recovery in knee arthroplasty, although some orthopedic surgeons consider that the arthromot is useful for only up to 40-45 degrees flexion, up to 14 days postoperatively, because if the amplitude of passive movement of the flexion increases, the transcutaneous tension of oxygen decreases, with a possible damage to the postoperative wound, in the casuistry passed by me, 90% of patients reached in the first 14 days postoperatively, the amplitude of 90 degrees, on a scale of pain from 1 to 5, to the value of 2, so with a moderate algetic support.

The re-education of flexion over 90 degrees had a longer course, considering the age, knee architecture, degree of wear, body weight, joint mobility, at 3 months postoperatively reaching the threshold of 120-130 degrees passively. The literature claims that the progression of flexion continues over a period of 2 years.

Post-operative knee-flexum also occurs frequently in knee arthroplasties, in this respect we have observed that early re-education of the extension as well as the increase in the number of sessions/day had optimal results on the rehabilitation of the extension.

The impingement can be improved by exercises in LCI – squats performed at a certain amplitude and by passive flexions of the calf on the thigh in progression.

The study was conducted between 2008 and 2019 and involved 10 patients operated by ACL with impingement, a complication detected by MRI examination at 2 months postoperatively.

After 3 months of exercises in LCI and LCD, with the progressive increase in the motion amplitude, with the escalation of the pain threshold, 9 of the 10 patients reached the myo-arthro-kinetic potential before the ACL rupture, and one gave up along the way

8. RESULTS

During the recovery protocol, the graft did not undergo any rupture changes.

A case of ACL with intraarticular infection was identified, which required surgical reintervention, with neoligament ablation; in the first month postoperatively, we encountered 10 cases of hemarthrosis and post-effort hydrarthrosis, where the evacuatory puncture and physical rest were established, without adversely affecting the continuation of the recovery protocol.

At 7 weeks postoperatively, I had 2 cases of ACL with fibrillary rupture, at the short end of the femoral biceps, after 2 weeks of rest resuming recovery.

Another patient entered my recovery program, 9 months postoperatively, with flexion limited to 90 degrees, muscular hypotrophy on the side of the operated pelvic limb, limitation of extension, claudication to light runs, problems in stability control, prior to following the recovery protocol in another specialized center, and after 10 months of kinetic rehabilitation has regained its normal biomechanical function.

Another case, after 4 months postoperatively, had flexion limited to 100 degrees, and after the objective clinical examination and MRI it was concluded that the graft was too thick, with the creation of an impingement, practicing arthroscopic surgical reintervention.

I also encountered a case of post-ligamentoplasty knee-flexum, which after 3 months postoperatively gave up, during this period managing to decrease this extension deficit, reaching 10 degrees.

A few cases gave up along the way, and 90% followed rehabilitation without complications, among them performance athletes (footballers, handball players, athletes, volleyball players) who continued their competitive activity without further relapses.

In the recovery of the prosthetic knee, the result is conditioned by the success of the surgery, following some techniques:

- correct resection at the tibial and femoral level (distal femoral bone trance to overlap exactly with the femoral prosthetic component, and the trance of tibial osteotomy is perpendicular to the mechanical axis of the tibia). The alignment of the femur above 8 degrees in the valgus, is poorly tolerated.

- the surface on which the prosthesis is arranged contains richly vascularized spongy tissue

- maintaining symmetrical ligament tension

- removal of osteophytes

- the correct arrangement of the prosthetic components, with the verification of the extension at 5 degrees, the flexion at 140 degrees, the thigh axis, respecting the physiological tibial-femoral angle of 5-7 degrees.

Patients with total knee endoprosthesis in my study group had a good recovery path, except of 2 cases of prosthetic infection, 1 case with peripheral circulatory complication due to comorbidity, and 11 other cases giving up during the rehabilitation protocol.

9. CONCLUSIONS

- the preservation of the tibial blunt subsequently showed, through magnetic resonance imaging, larger neoligaments, without an increase in the incidence of cyclops lesion, and with a progressive remodeling

- MRI provides the best post-ligamentoplasty information on integrity, healing, angle of inclination, orientation, graft length, possible associated lesions, impact of ACL on PCL in knee extension (aspect that cannot be detected by normal arthroscopy)

- the most common ACL rupture mechanism is by landing with the knee in extension, with the leg fixed in torsion and stress in the valgus, the area of rupture being frequently located at the level of the femoral insertion (the remaining blunt is attached to the tibia)

- "Cyclops eye" syndrome occurs post-ligamentoplasty, at the level of the intercondylar incision, where a lump develops, as a postoperative complication, with consequences on the decrease of the extension (knee-flexum) and with pain phenomenon.

- arthrofibrosis occurs as another undesirable post-ligamentoplasty consequence, in which the synovial sticks through the scar tissue the cartilage capsule, resulting in a marked joint redness

- Idiosyncratic biomechanical behavior caused by mal-positioning of the apertures (the wrong orientation of the niche) negatively influences the re-education of the postoperative extension, with repercussions on quadricipital activity, stability and walking

- 1 square cm of muscle tissue develops a force of 3,5-4 kg, and the muscle strength can be calculated by manometry, inserting a catheter into the muscle mass, or by electromyography (EMG) during isometric contraction

- during their exercises in LKD, at the last 15-20 degrees of extension, the vast internal muscle intervenes, instead in walking, at the last 15-20 degrees of extension intervenes and the contraction of the hamstrings intervenes

- the functional rehabilitation protocol must be adapted to the biomechanical potential of the operated knee

- restoring tone - mobility - strength - endurance, in conjunction with massage, physiotherapy, therapeutic swimming, and an appropriate food program, have led to very good results

- the study in patients has shown that the highly intense isometry at the quadricipital level does not pose a risk when performed with the knee in a flexion position of 50-60 degrees

- no significant differences were reported between the groups of young patients and those aged 40-45 years in ligamentoplasties

- patients with a high laxity after the rupture of the ACL and with a late recovery had a poorer outcome

- in the case of ACL, the study showed the importance of the functional rehabilitation protocol and the best results were obtained in patients following the preoperative recovery protocol

- while mean age and active life expectancy have increased, ACL reconstruction is recommended for all patients with functional instability in the knee

- the impingement and the cyclops eye can be improved by a rigorous recovery program, but not a short neoligament.