ORIGINAL RESEARCH

Analysis of Isokinetic Strength Test in Arthroscopic Meniscus Suture to Improve Knee Joint Strength and Function

Shendong Wang, MD; Fengying Guo, BD; Xiaomei Song, BD; Ying Zhang, BD; Honghui Song, BD; Longying Wu, BD; Jia Jin, BD; Qirong Dong, PhD

ABSTRACT

Objective • This study is aimed to examine the correlation between the transitions in the muscular strength pre and post arthroscopic meniscus suture surgery.

Methods • A total of 87 patients records were collected from the electronic medical records of the Second Affiliated Hospital of Soochow University from 2020 to 2021. Patients in the operative group underwent arthroscopic meniscus sutures. The isokinetic muscular strength test system (ISOMED2000) tool was utilized to examine the isokinetic intensity of the knee joins on both sides and the balance was marked and adjusted to the training methods before the test. The HSS score was used to assess the transitions in the knee activity.

Results • There was a significant variation in the extensor muscle strength found on the affected portion where F value was observed at 3747.845 ($P < .01$). The extensor knee joint strength of the affected side was less than the healthy side when compared with pre-operation, one month, three months, and six months post-surgery where F values were found to be 5287.41, 5510.517, and 1947.91 respectively ($P < .001$). After six months of the surgery, there was an improvement in the isokinetic muscular strength of patients, where the measurement of the damaged side and the healthier side was observed as 89.11 ± 6.78 and 93.45 ± 5.59, respectively.

Conclusion • Arthroscopic meniscus suture surgery is observed to have a superior influence on the treatments. After 6 months of surgery, the muscular force of the knee extensor on the affected joint portion enhanced remarkably in contrast to the other durations. (*Altern Ther Health Med.* 2023;29(6):416-424).

Shendong Wang, MD; **Fengying Guo**, BD; **Xiaomei Song**, BD; **Ying Zhang**, BD; **Honghui Song**, BD; **Longying Wu**, BD; **Jia Jin**, BD; **Qirong Dong**, PhD, Department of Orthopaedics, Second Affiliated Hospital of Soochow University.

Corresponding author: Qirong Dong, PhD
E-mail: xwwang2021@sina.com

INTRODUCTION

Menisci of the knee are considered as the most essential part to assure proper functioning of the knee. They assist in absorbing shock, diminishing stress, stabilizing the joint, load transportation, nutrition as well as lubrication for the joint. The menisci are also important in the role of being a neuromuscular regulator of the knee, and to yield the proprioceptive information concerning joint awareness like the direction, acceleration, location, velocity, and deceleration.[1] As a result, the injury of the menisci can lead to a partial or complete meniscectomy, which generates mechanical abnormality comprising reduced stability in the joints, neuromuscular deficiency, and intensified joint degradation.[1] Usually, meniscectomy leads to a partial reduction of the contact region between the femur as well as the tibia, which intensifies 20% of the contact pressure over the articular cartilage, thus diminishing the shock absorption ability of the joints.[2] The treatment for meniscus injuries mainly focuses on preservation and anatomic restoration, because non-operative treatments usually lead to poorer clinical outcomes and a higher rate of knee arthroplasty.

The partial cutting process of the wounded meniscus along with its suture or the repeated fixation is usually implemented in cases of knee meniscus wounds.[3] Usually, partial meniscectomy is carried out; however, the outcome is commonly associated with functional shortages, primarily the reduction of muscular pressure in the knee extensor. The absolute stability of the knee along with the standard distribution of the loading linking the surface of joints, remarkably depends on the muscular force of the thigh.[4] The meniscus suture safeguards the joint cartilage that generally intercepts the initial formation of the degenerative transitions. Owing to the significance of the menisci towards the knee joint from a mechanical as well as the neuromuscular point of view, surgeons are more attentive towards preserving the

integrity of the meniscus via repair. The process of repairing the meniscus comprises inside-out and vice-versa, open, as well as all inside repair. The process of fixing differs from sutures to biodegradable instruments.[5]

The inside-out fixing comprises passing the sutures arthroscopically from the inside of the knee, with the suture tie remaining on the outside of the joint. The outside-in type of fixation comprises passing the sutures from the outside of the knee joint along with tying the sutures in an arthroscopic manner from the inside of the joint. The open repair comprises the fixing procedure of the suture with an open incision.[6]

The instability of the knee found in the patients' post-meniscectomy is regularly observed. Interferences in the proper patterns of the knee extensors, as well as the flexors co-activation, is the frequently observed cause. The most favorable relation of the knee flexors i.e., the hamstrings (H) force to the extensors i.e., quadriceps (Q) force which is the H/Q coefficient safeguards the joint against the repeated and improperly distributed weights over the articular surfaces. The stability of the operated knee affects the stability associated with the entire human body as well as the global movement synchronization along with the recurrent process of the force and endurance of the thigh muscles. Different studies have investigated the force of the knee extensors for the same parameter of the flexors located at the submaximal loadings assuring it. The swift restoration procedure of the proper knee function found in patients after meniscectomy is discussed in some studies. In contrast, the other researchers studied cases of untimely rehabilitation. However, there is very little information known about the functional deficiency found in patients suffering from meniscus sutures or the fixations associated, along with the appropriateness of the post-operative and supervised rehabilitation.

In this study, the muscular strength surrounding the knee in arthroscopic meniscus suture was examined over the affected as well as the healthier side simultaneously. These research-based indicators showed that the muscular strength surrounding the knee joint is significantly less compared to the healthy side, and the joint degradation immediately reduced the day-to-day activities of patients, thus influencing their quality of life.

MATERIAL AND METHODS

In our research, we extracted the data from the electronic medical records of the Second Affiliated Hospital of Soochow University from a period of August 2020 to September 2021. The study was performed for research and the subjects included 87 patients who underwent arthroscopic meniscus sutures, wherein they were treated from August 2020 to September 2021.[5]

The patient data selected for the study were included as per the following inclusion criteria: (i) patients aged between 45-75 years, (ii) patients with no background of trauma as well as operation on the damaged knee joint, (iii) no evident degenerative disorder on the contralateral knee joint, and (iv) patients undergoing arthroscopic meniscus suture.

The patient data were excluded based on the following exclusion criteria: (i) patients who had degenerative disorder in the contralateral limb and the ones who already had the surgery, (ii) patients suffering from muscle disorders like periodic paralysis, progressive malnutrition, and myasthenia gravis, (iii) patients suffering from deep vein thrombosis on the lower limbs before the surgery, (iv) patients not related to knee surgery or other joint-related disorders, and (v) patients with incomplete information.[6] Our study was approved by the institutional review board of the hospital and was conducted in accordance with the ethical principles originating from the Declaration of Helsinki.

Surgery and post-operative control

The medical electronic database records all information regarding the blood pressure, respiratory crucial signs, blood oxygen level, and the heart rate.

After successful general anesthesia, the patient lays flat on the operating table and takes a flatbed or half-a-stone position; the limb naturally hangs at the end of the operating table, the root of the thigh is bound to the airbag hemorrhage belt, and the path of surgery is marked with dash pen.

Regular operation procedure: routine disinfection, spreading towels, blood belt blood removal, first establish the upper outer water channel, inlet water pipes, fill the joint cavity, and then establish an arthroscopic surgical operation channel, take the standard front knee outside entry (anterolateral, AL) and the front inner knee inlet (anteromedial, AM), placed in a 30-degree wide-angle joint lens observation, hook detection, and other related surgical instruments. In order to avoid missing the injury part, the under-mirror operation is often carried out in a certain order: the inner ventricle of a femur on the joint surface of the sac an inner ventricle of the knee inner chamber - the outer ventricle of the outer knee of the nest, if necessary, to check the inner gap after the inside, the outer side of the trench. When exploring the inner half-moon plate surface and stability, the assistant needs to position the knee, turn the outer knee and bend the knee 30 degrees, for the outer half-moon board examination, the knee takes "4" bit, maximize the joint gap, in order to facilitate under-mirror detection. According to the need, during the operation, properly clean up the sickening membrane tissue, fully expose the field of vision under the arthroscopic, with a probe to carefully explore the damage of the half-moon plate, under the mirror to further clarify the diagnosis, and according to the injury, the appropriate stitching method is adopted, the probe checks the stability of the half-moon plate, the procedure repeatedly washes the joint cavity. The joint cavity debris and so on rushes out of the joint cavity, stitching along the incision road, sterile dressing.[7,8]

Arthroscopic treatment principle: as much as possible to retain normal half-moon plate tissue, (A) for the red area (less than 3 mm from the edge of the sliding film), red-white area (3-5 mm from the edge of the film), should be stitched repair, the front corner can be inside-out-outside-in stitching

method, the body can be used inside-out. The method consists of t-stitching (vertical or horizontal suture), and the back corner of the half-moon plate can be picked with Fast-fix line All-inside stitching. When stitching the half-moon plate, give the torn edges a polish to establish a fresh edge and promote the healing of the half-moon plate. (B) For the white area of the injury, since there is no blood transport, it is difficult to heal, so do not do use stitch repair treatment. The use of basket pliers bite finishing edge, plasma radio frequency trimming, and other ways to operate, after trimming the half-moon plate shape as far as possible slope- shape, to avoid the shape of the steps, to prevent the walking joints from appearing bouncy in the future. The half-moon chip after the bite is sucked out with a planer or flushed out of the joint cavity with a large amount of physiological saline.

Extroverted inward (outside-in) stitching repair techniques. Surgical methods and precautions: first locate the needle point and press the needle point skin at the same time through the arthroscopic with the corresponding half-moon plate tear. The PDS-II line passes through the epidural puncture needle (or 20 ml syringe needle), the two ends of the line remain outside the joint cavity, from the needle point into the needle tubing, the needle guides the wire ring through the side of the torn half-moon plate, which is operated by the front inner or front outer surgical operation channel with the gripper DS-II line ring leading out of the body, the end of the line of love to cherish Bang 2 into, from the entrance to pull the PDS-II line tail, one and the epidural puncture needle pulled out to bring out the joint sac, with the same method. On the other side of the torn half-moon plate into the needle, will love the other end of line 2 out of the joint sac, pay attention to the two needles into the needle point as close as possible, from all the same mouth into, pull love the two ends of the line 2, under the mirror to observe the tearing position, to ensure good position, and then under the skin fix the knot, so that a stitch is completed. The number of stitches provided are in accordance to the tearing form, length, stability, etc. determined. To conduct a successful surgery, stitching is performed after checking activity, i.e., whether the joint has been stable or not. The position of the knee joint during stitching is of great significance to prevent damage to the vascular nerve, and when stitching is done to repair the front side area of the inner half-moon plate, the knee joint is flexed at 40 -50 degrees position, which prevents injury to the hidden nerve joint branch, and when stitching to repair the outer half-moon plate, the knee is bend at 90 degrees to prevent injury to the total nerve.[9]

Stitch repair techniques from inward-out (inside-out). Surgical methods and precautions: suitable for stitching the body part of the half-moon plate damage, with the conventional AL or AM into the road, into the half-moon plate locator positioning, and then through the locator sleeve into a long needle (half-moon plate stitch), pull out the joint sac, move the locator, locate the second needle into the needle point, follow the same method, through the second needle, joint sac under the skin knot. The position of stitching is 2-3mm from the edge of the torn half-moon plate. The way of stitching is determined according to the different tearing choice of vertical or horizontal suture, so that the vertical suture, in order to ensure successful stitching, the broken end can be dissected and reset. The position relationship between the second needle and the first needle and tear must be noted, the tie-off directly depends on the alignment of the half-moon plate tear edge, in order to prevent excessive tension leading to deformity or too loose knotting leading to invalid stitching.

If the tearing area is closer to the inside or rear outside, sometimes in order to prevent damage to the blood vessel nerve, needles can be inserted in the back of the knee or the outside of the rear of a small incision, place a protective hook or bezel. Body selection: when stitching the inner half-moon plate body rear side area, the assistant will keep the knee joint at 15-20 degrees position, so as to prevent damage to the hidden nerve and goose foot, whereas, while stitching the outer half-moon plate, the assistant will maintain the knee joint at 90 degrees position, to prevent damage to the total nerve.

All-inside stitching technology. Surgical methods and precautions: All-inside uses Xerox's Fast-Fix half-moon plate stitching device. First make the tear edge wound surface to be fresh, by placing the AL or AM channel into the Fast-Fix to reach the tearing site, remove the protective sheath, stitch needle positioning stitching. Insert the first needle in the tearing half-moon plate inside through, perpendicular to the half-moon plate tear edge, and continue to pierce into the outer half-moon plate part of the tear edge, the depth of the limiter to reach the surface of the half-moon plate can be light swing the pin handle and back, stitches out of the half-moon plate, anchor nails retained in a predetermined position, so that the first stitch is successfully established, and then the handle on the trigger is pushed forward, so that the second anchor nail is in the ready position, the second needle is in fixed position, about 4-5mm from the first needle. After the two anchor nails are fixed, remove the needle, pull the stitches left outside the body, push the pre-made knots to the surface of the half-moon plate with a push-out knot and tighten them, and then use scissors to cut the pull stitches in the joint. According to the need, there can be more stitches, and stitching must be performed after the detection of the activity of the half-moon plate, to ensure the stability of the half-moon plate.[10]

Post-operative treatment

Postoperative knee treatment. after surgery with elastic bandages (3M, USA) to the knee from the ankle to the root of the thigh, moderate pressure fixation, combined with ice for 48h, when used can be wrapped in plastic bags to prevent water leakage contaminating wounds, ice can help stop bleeding and reduce pain.

Joint cavity drainage. drainage using drainage bag, attention to smooth flow, generally after surgery 24-48h and when the flow rate is less than 30mL/d, pull out the drainage bag.

Raise the affected limb. after surgery, straighten the limb neutral position to give fixed support, and appropriately raise the affected limb to help eliminate swelling;

Routine application of antibiotics. for 1-3 days after normal to give discontinuation of use, in order to prevent post-operative infection.

Bedside rehabilitation training. the first day after surgery can be carried out bedside functional rehabilitation training, to guide patients to promote tibia and ankle pump exercises, knee pressure exercises, with protective straight legs raised, femur and other long contraction training, in the two weeks after surgery, the knee should wear support to avoid bending, with fixed straight position.

Joint activity. within six weeks after surgery is the healing phase of the half-moon plate repair, to avoid excessive stress, this period is mainly to restore the normal activity of the knee joint, to carry out good muscle strength and flexibility exercises. After two weeks of fixing the straightness of the support, the patient can begin to practice knee flexion function for two weeks, after which the joint activity can be moderately increased, increasing by 10 degrees per week, and reaching normal flexion after 8 weeks.

Walking load rehabilitation training. prohibition of weight bearing within two weeks of the stitching repair, the third week walking with knee holding weight of 1/4th of the body weight, the fourth week walking with knee holding 1/2 of the body weight of 1/2, the fifth week walking with knee holding 3/4th of the body weight, in the sixth to the eighth week patients can consider removing the support to ensure full weight walking. Obese patients due to their heavy weight, should appropriately delay step load rehabilitation training, generally delayed by about 1 week. After 2 months, the intensity of functional rehabilitation training is increased, can be carried out using the open chain method, the strength of the knee muscle group should be strengthened, resistance weight should be gradual. According to the human body, knee recovery and timely adjustment should increase gradually. Start jogging practice after 3 months, and basically participate in general sports after 6 months.[11]

Isokinetic strength test

ISOMED2000 i.e., the isokinetic muscular strength test system was implemented by the doctors (the Second Affiliated Hospital of Soochow University electronic data record), to exercise the muscular robustness over the influenced healthy limbs at different time intervals pre and post the arthroscopic meniscus suture to get the specific data analysis-based research outcomes. The posture of the patient was stabilized and the knee joints over both sides were placed facing the front of the instrument and both hands were placed on the armrest to regulate the stability.

The laser positioning was done where the patient's measured limb was placed on the dynamometer and they were guided to exercise the knee extension and the flexion exercises along with the laser position at the midpoint of the knee joint mobility so that it does not obstruct the knee flexion.

Clinical investigation

As per the electronic data records of the Second Affiliated Hospital of Soochow University, the ISOMED2000 tool was utilized to examine the isokinetic intensity of the knee joins of both sides and the balance was marked and adjusted to the training methods before the test. The patients were examined for the isokinetic power of the damaged knee joint before the operation, followed by 1-, 3- and 6-months post-operation, and the uninjured knee joint was examined in the same technique. The patients were individually asked to rest for 15 minutes post each test and then documented the average after the examination.

The angular velocity was documented as 60 degrees per second, investigation and recording were done for the peak hamstring strength i.e., PT value, total knee flexion effort (TW), quadriceps peak torque i.e., PT value along with the knee extension effort i.e., TW and the other parameters. The Hospital for Special Surgery (HSS) score of the knee joint was used to analyze the role of the knee as per the condition of the affected knee pre and post the surgery. The Peak Torque here signifies the maximum influenced torque that is released by the muscles while contracting. This torque value is at the maximum point of the torque curve and demonstrates the highest muscular force generated by the muscular contraction.

The unit of measure (Peak Torque) is the N·m and the test was repeatedly performed thrice to document the average. The utilization of the isokinetic test system, the peak torque of the quadriceps muscles, and the peak force length of the knee hamstring muscles are considered reliable test signs for calculating the muscular strength surrounding the knee joint. Post the system analysis, the calculation outcomes were shown over the display and the statistical tools were used to draw comparisons over the statistical significance of the PT of the knee extension as well as the knee flexion post-operation.

The Total Work (TW) value signified the total work performed by the knee joint, once the extension, as well as each flexion, was exercised. TW value of flexors and the extension of the patients were documented pre and post the arthroscopic meniscus suture. Using the statistical comparisons, we measured the TW of the patients pre- and post-surgery.

Hospital for Special Surgery (HSS Score)

The HSS score was used to assess the transitions in the knee activity. This scoring system is reported to be accurate in measuring the recovery of the joint function pre and post arthroscopic meniscus suture and for drawing comparisons pre and post evaluation.[12]

The HSS score ranges up to 100 points, wherein 80 points and above are considered as excellent score, good points range between 75 to 83, points ranging between 61 to 74 are intermediate, and less than 60 points are considered as poor.

Statistical analysis

SPSS 22 statistical tool was utilized to carry out statistical investigation on the gathered outcomes. The data were expressed as mean standard deviation (mean SD). The statistical

Table 1. F-value Determination of Dependent Variables

Model Summary and Parameter Estimates							
Dependent Variable: Calories per kg							
	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	0.040	3.539	1	85	0.063	2.066	-0.011
The independent variable is Age.							

F value was found to be 3.539, age was considered as an independent variable

procedure utilized restated parameters to analyze variance as well as multi-variate analysis of the variance. The statistical method was implemented using the repeated parameter analysis of the variance as well as the multivariate analysis of the variance.

$P < .05$ indicates statistically significant test result, as seen in table 1, containing the results of the correlation analysis of arthroscopic meniscus suture in patients.

RESULTS

General information

Data was collected for a total of 87 patients who underwent arthroscopic meniscus suture surgery. Among them, only 62 patients (43% male and 57% female) completed all of their follow-up examinations. The region of interest (ROI) was calculated for injury due to sports or exercise versus calories per kg as shown in figure 1.

From analysis F-value of 3.539 was obtained, where age was considered as the independent variable, as shown in table 1. The observance of the X-ray was analyzed in the durations of before surgery, one month after, three months after, and six months after the surgery was performed (as shown in figure 2a, b, c, and d). Figure 2a shows the knee joint of patients before surgery after arthroscopic meniscus suture. Figure 2b showed the knee joint of patients before surgery and post one month of surgery and arthroscopic meniscus suture. Figure 2c and d showed the knee joint of patients before surgery and post 3/6 months of surgery and arthroscopic meniscus suture.

Effect on knee extensor muscle strength

A significant variation in the extensor muscles strength was found on the affected portion with multiple surgical durations and an F value of 3747.845 was obtained ($P < .01$) (as shown in table 2). We analyzed and showed the improvement of knee joint strength and function in arthroscopic meniscus suture table 3.

The results showed that the extensor knee joint strength of the affected side was less than the healthy side at the time of pre-operation, one month, three months, and six months post-surgery. The F values were 5287.41, 5510.517, and 1947.91 respectively ($P < .001$). Post 6 months of surgery, the muscular force of the knee extensor on the affected joint portion enhanced remarkably in contrast to the other durations which was close to the muscular power on the healthier side (F = 15.123, $P < .001$).

Figure 1. ROI Depth Calculated with Injury due to Sports or Exercise Versus Calories per kg. ROI Depth Calculated for Injury due to Sports Exercise Versus Calories per kg and Calories per lb

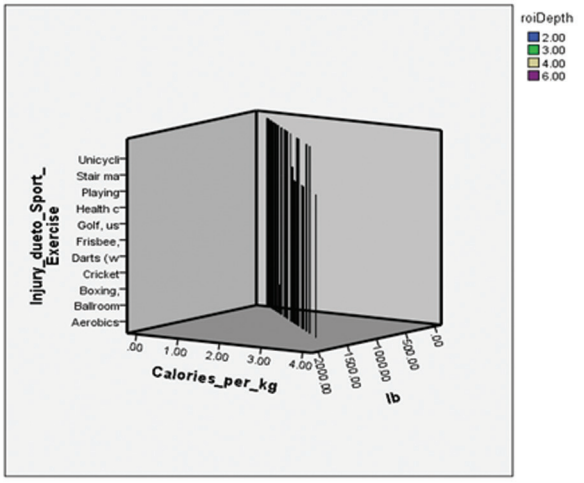
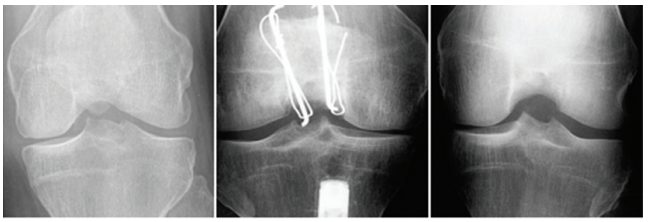
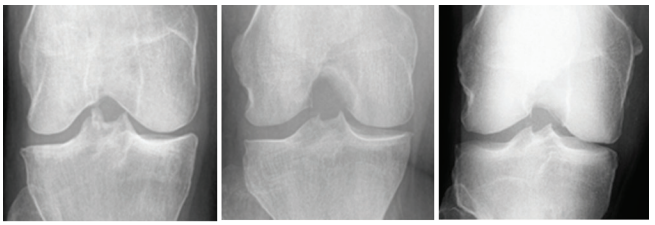


Figure 2. The Image of the Knee Joint. **A**: Knee Joint Before Surgery; **B**: Knee After 1 Month of Surgery; **C**: Knee After 3 Months of Surgery; and. **D**: Knee After 6 Months of Surgery

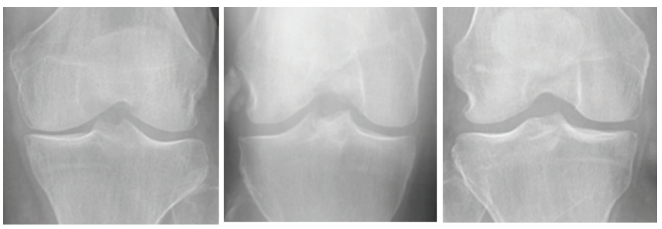
A



B



C



D

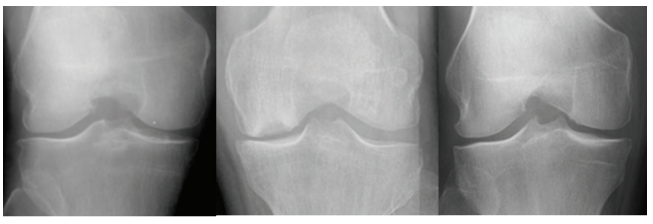


Table 2. Analyzing the Isokinetic Muscular Peak Knee Extension Force for 87 Patients

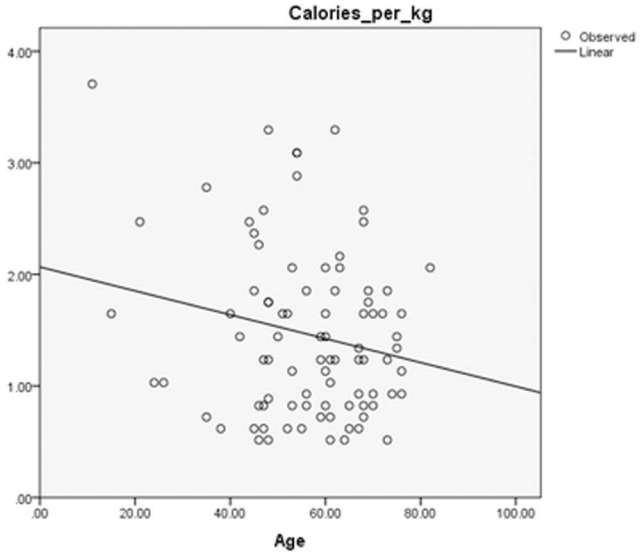
Sides	Before undergoing surgery	1 month post-surgery	3 months post-surgery	6 months post-surgery	F value	*P* value
Affected (or damaged) side	43.67 ± 9.34	45.78 ± 8.84	67.29 ± 9.34	89.11 ± 6.78	3747.845	.001
Healthier side	89.34 ± 6.19	91.35 ± 5.78	91.32 ± 5.78	93.45 ± 5.59	4.783	.002
F value	5287.41	5510.52	1947.91	15.12	4125.25	.001
P value	.001	.001	.001	.001	0.001	

Table 3. Model Description, Analysis on the Improvement of Knee Joint Strength Concerning Injury Caused due to Sport Exercise

Model Description		
Model Name		MOD_1
Dependent Variable	1	Calories per kg
Equation	1	Linear
Independent Variable		Age
Constant		Included
Variable Whose Values Label Observations in Plots		Injury due to Sport Exercise

Age was considered as an independent variable for the study, whereas the cause of injury was the variable case

Figure 3. Scattered Plot of Calories per kg vs. Age in Flexion Peak Knee Moment



Improvement in the knee joint strength and function was noted in patients who underwent arthroscopic meniscus suture surgery. Pearson Correlation analysis was performed for all patients who underwent arthroscopic meniscus suture surgery (Table 4). The analysis of isokinetic muscular peak knee extension force is shown in table 2, results of the muscular flexion peak knee moment are listed in table 5, and total knee flexion of the knee joint and analysis on the improvement of knee joint strength are shown in table 3.

Impact of the isokinetic muscular peal knee extension

Improvement in the isokinetic muscular strength was noted post 6 months of surgery, when the measurement of damaged side and healthier side (as given in Table 2) was observed as 89.11 ± 6.78 and 93.45 ± 5.59, respectively. This demonstrates the enhancement of the peak knee extension force among the 62 patients. Here, the observed F value is 4125.251 ($P < .001$).[12]

This implies that the test result is statistically significant and the peak knee extension force is comparable for both the damaged and the healthy sides of the knee. The isokinetic muscular strength of the damaged side improved significantly between one to three months post-surgery and also between three to six months post-surgery. Among these, the improvement was significant between three to six months, thus indicating that the isokinetic muscular strength enhances swiftly within this duration.[13]

Impact of the knee peak isokinetic muscular flexion peak

Isokinetic knee moment was significantly higher for 6 months post-operation. Post the two-way recurrent measurement-based analysis of the variance, there was a variation observed in the muscular flexion peak as shown in Table 5, between the damaged or the affected side and that of the healthier side, with an observed F value of 6125.251 ($P < .001$).[14]

From the multivariate analysis of the variance, it was observed that the knee peak isokinetic muscular flexion peak associated with the damaged side was observed to be lower than the healthier side before the surgery was performed, followed by one-month post-surgery, three months or six months post the surgery where $F = 1402.701$ ($P < .001$), $F = 2147.591$ ($P < .001$), and $F=11.123$ ($P < .001$) respectively.[15] Therefore, it was inferred that the knee peak isokinetic muscular flexion peak towards the damaged side modifies in the duration of three to six months.[16]

Knee joint functions were analyzed against the appetite of patients (Figure 4)

The comparative difference in the HSS score between the damaged and the healthy sides narrowed down with the healthy group narrowed down (as shown in table 2, 3, 4, and 5). The F value for dependent variables was calculated considering age as the independent parameter (Table 1).[17] When compared to the healthy group, patients after 3-6 months showed mild improvement, whereas those after six months of arthroscopic meniscus suture surgery operation showed a significant improvement in knee extensor muscular strength.[18]

Table 4. Correlational Analysis (where Correlation is Significant Level at 0.01 and 0.05 Levels) in Case of Arthroscopic Meniscus Suture in Patients

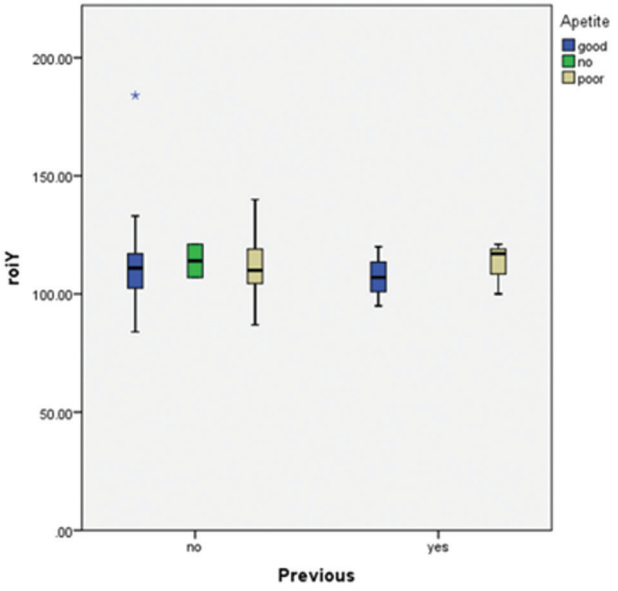
		Age	Blood Pressure	Urine specific gravity	Haemoglobin	Calories per kg	lb	ROI(X)	ROI(Y)	ROI(Z)	ROI Height	ROI Width	ROI Depth
Age	Pearson Correlation	1	0.029	0.142	-0.089	-0.200	-0.200	0.027	0.015	0.019	-0.218[a]	0.049	-0.017
	Sig. (2-tailed)		0.790	0.189	0.412	0.063	0.063	0.802	0.889	0.862	0.042	0.649	0.878
	n	87	87	87	87	87	87	87	87	87	87	87	87
Blood Pressure	Pearson Correlation	0.029	1	0.097	-0.095	0.032	0.032	0.060	-0.040	0.046	0.056	-0.005	-0.003
	Sig. (2-tailed)	0.790		0.374	0.381	0.769	0.769	0.581	0.710	0.674	0.607	0.965	0.982
	n	87	87	87	87	87	87	87	87	87	87	87	87
Urine specific gravity	Pearson Correlation	0.142	0.097	1	-0.220[a]	-0.047	-0.047	-0.015	0.043	0.037	0.048	0.152	-0.076
	Sig. (2-tailed)	0.189	0.374		0.040	0.663	0.663	0.889	0.695	0.732	0.662	0.161	0.483
	n	87	87	87	87	87	87	87	87	87	87	87	87
Haemoglobin	Pearson Correlation	-0.089	-0.095	-0.220[a]	1	0.121	0.121	-0.005	-0.090	-0.082	-0.003	-0.009	0.025
	Sig. (2-tailed)	0.412	0.381	0.040		0.265	0.265	0.961	0.406	0.449	0.976	0.935	0.821
	n	87	87	87	87	87	87	87	87	87	87	87	87
Calories per kg	Pearson Correlation	-0.200	0.032	-0.047	0.121	1	1.000[b]	-0.048	-0.054	-0.057	0.050	-0.061	-0.059
	Sig. (2-tailed)	0.063	0.769	0.663	0.265		0.000	0.661	0.617	0.602	0.642	0.575	0.589
	n	87	87	87	87	87	87	87	87	87	87	87	87
lb	Pearson Correlation	-0.200	0.032	-0.047	0.121	1.000[b]	1	-0.048	-0.054	-0.057	0.051	-0.061	-0.059
	Sig. (2-tailed)	0.063	0.769	0.663	0.265	0.000		0.661	0.618	0.601	0.642	0.576	0.590
	n	87	87	87	87	87	87	87	87	87	87	87	87
ROI(X)	Pearson Correlation	0.027	0.060	-0.015	-0.005	-0.048	-0.048	1	0.113	-0.326[b]	-0.045	-0.241[a]	-0.021
	Sig. (2-tailed)	0.802	0.581	0.889	0.961	0.661	0.661		0.298	0.002	0.682	0.024	0.847
	n	87	87	87	87	87	87	87	87	87	87	87	87
ROI(Y)	Pearson Correlation	0.015	-0.040	0.043	-0.090	-0.054	-0.054	0.113	1	0.012	-0.230[a]	-0.187	-0.132
	Sig. (2-tailed)	0.889	0.710	0.695	0.406	0.617	0.618	0.298		0.911	0.032	0.082	0.224
	n	87	87	87	87	87	87	87	87	87	87	87	87
ROI(Z)	Pearson Correlation	0.019	0.046	0.037	-0.082	-0.057	-0.057	-0.326[b]	0.012	1	0.058	0.120	-0.227[a]
	Sig. (2-tailed)	0.862	0.674	0.732	0.449	0.602	0.601	0.002	0.911		0.594	0.269	0.035
	n	87	87	87	87	87	87	87	87	87	87	87	87
ROI Height	Pearson Correlation	-0.218[a]	0.056	0.048	-0.003	0.050	0.051	-0.045	-0.230[a]	0.058	1	0.529[b]	0.031
	Sig. (2-tailed)	0.042	0.607	0.662	0.976	0.642	0.642	0.682	0.032	0.594		0.000	0.777
	n	87	87	87	87	87	87	87	87	87	87	87	87
ROI Width	Pearson Correlation	0.049	-0.005	0.152	-0.009	-0.061	-0.061	-0.241[a]	-0.187	0.120	0.529[b]	1	0.046
	Sig. (2-tailed)	0.649	0.965	0.161	0.935	0.575	0.576	0.024	0.082	0.269	0.000		0.670
	n	87	87	87	87	87	87	87	87	87	87	87	87
ROI Depth	Pearson Correlation	-0.017	-0.003	-0.076	0.025	-0.059	-0.059	-0.021	-0.132	-0.227[a]	0.031	0.046	1
	Sig. (2-tailed)	0.878	0.982	0.483	0.821	0.589	0.590	0.847	0.224	0.035	0.777	0.670	
	n	87	87	87	87	87	87	87	87	87	87	87	87

[a]Correlation is significant at the .05 level (2-tailed).
[b]Correlation is significant at the .01 level (2-tailed).

Table 5. Analyzing the Knee Peak Isokinetic Muscular Flexion Peak Knee Moment for n = 87

Sides	Before undergoing surgery	1 month post-surgery	3 months post-surgery	6 months post-surgery	F value	*P* value
Affected (or damaged) side	31.25 ± 5.34	35.78 ± 5.84	57.29 ± 6.34	59.11 ± 4.78	4747.845	.001
Healthier side	69.34 ± 9.19	61.35 ± 7.78	61.32 ± 6.78	63.45 ± 6.59	2.783	.1152
F value	1294.149	1402.701	2147.591	11.123	6125.251	.001
P value	.001	.001	.001	.001		

Figure 4. Knee Joint Functions were Analyzed Against the Appetite of Patients



DISCUSSION

It has been researched that the proper function of the knee is mainly dependent on the torques and moments of extensor and flexor muscles.[19] Their values are dependent on the proprioceptive sensors which transmit proprioceptive signals via the meniscus mechanoreceptors. A decrease in mechanoreceptors was noted in patients post partial meniscectomy via quantitative and qualitative analysis. The existence of such inappropriate neuron transference disorganizes the operation of extensors as well as flexors moto-neurons by the inter-neuronal interrelatedness bilaterally that eventually transitions the muscular actions as well as their strength with long-lasting effect.[20]

The observed neural transmission was improper and disturbed in function. Similarly, there is a reduction in the muscular force of the thigh among the patients post the meniscus suture which is possibly due to the qualitative modification of the afferent stimulation. The count of the meniscus proprioceptor does not modify notably but few of them are destroyed in the region of suture that also alters the afferent system.[21]

A greater reduction of muscular force of the thigh is observed in the knee joint surfaces wherein the expanded intra-articular pressure, and this expands proportionally along the occurrence of meniscus injury. It can be deduced that among the patients with a suture of the destroyed meniscus, specifically when the range of the trauma is extensive, there is a probability of previously degraded transitions at the supervised joint, as observed among patients post meniscectomy that has been reported among the patients post the meniscectomy. A contrast in the peak torque values is documented from the quadriceps muscles of both limits among the population of the healthy population.[22]

Some researchers invalidate the existing asymmetry if the anthropomorphic characteristics of the investigated subjects are taken into consideration. The reduction of the peak torque of the extensor muscles was detected in the current study. There were similar observations of 60 degrees/s angular velocity for the knee flexors[23] in this research, but have not been documented.

Previous researches have proven that meniscus stress and its successive surgical procedures may invoke the occurrence of the slow-contracting motor components primarily within the knee extended. The long-lasting constraints of the patient's physical activity following the post-operative duration may even induce the supplementary deactivation of the quickly contracting motor components.[24]

A modest variation between surgical and non-surgical limits among the outcomes of the patients post the meniscectomy was observed. However, among the patients, post the meniscus suture, insignificant variation was observed in the outcomes. In our research, an average correlation was observed between the mean value of the knee extensors with a peak torque at 60 degrees.s^{-1} angular velocity as well as the mean of single-leg-rising examination.[24]

This study reports the existence of some correlations in the outcomes of the bio-mechanical as well as the clinical tests among the patients post the meniscus tear operation, with successful rehabilitation involving a special utilization of the peak torque measurement at 60 degree/s angular velocity and the single rising test for the assessment of knee operation.

After different comparisons were performed, it was observed that the knee flexion muscular strength before operation was less than 6 months post-operation. No difference was observed in the flexor knee muscular strength between the different surgical methods towards the healthy side. There was a difference in muscle flexion between the damaged knees after the two-way repeated calculation of a variance. It can be concluded that the flexion power of the knee flexion improved post six months of treatment.

CONCLUSION

Arthroscopic meniscus suture surgery is observed to have a superior influence on the treatment of patients. After the 6 months of surgery, the muscular force of the knee extensor on the affected joint portion enhanced remarkably (in contrast to the other durations) and was close to the muscular power of the healthier side. Therefore, the isokinetic muscle strength test system has to implement the detection of the muscular strength surrounding the knee joint, specifically in 3-6 months post-operation.

DATA AVAILABILITY

The data used to support this study is available from the corresponding author upon request.

AUTHOR DISCLOSURE STATEMENT

The authors declare that they have no conflicts of interest.

ACKNOWLEDGEMENT

The authors Shendong Wang, Fengying Guo, Xiaomei Song, and Ying Zhang have contributed equally to this paper.

FUNDING

This paper was funded by Second Affiliated Hospital of Soochow University Pre-research Project of National Natural Science Foundation of China (SDFEYGJ2004).

REFERENCES

1. Inui H, Yamagami R, Kono K, et al. Comparison of the joint laxity of total knee arthroplasty evaluated by the distraction force and the varus-valgus force. *Knee*. 2022;34:98-107. doi:10.1016/j.knee.2021.10.019
2. Kumar S, Srivastava S, Kumar S, Verma V. Proximal Fibular Osteotomy for Medial Joint Osteoarthritis of the Knee: A Prospective Cohort Study. *Cureus*. 2021;13(11):e19180. doi:10.7759/cureus.19180
3. Desy NM, Ng R, Wong MT. Reply to the Letter to the Editor: Can Topical Vancomycin Prevent Periprosthetic Joint Infection in Hip and Knee Arthroplasty? A Systematic Review. *Clin Orthop Relat Res*. 2022;480(2):435-436. doi:10.1097/CORR.0000000000002076
4. Pijls BG, Nelissen R. Letter to the Editor: Can Topical Vancomycin Prevent Periprosthetic Joint Infection in Hip and Knee Arthroplasty? A Systematic Review. *Clin Orthop Relat Res*. 2022;480(2):433-434. doi:10.1097/CORR.0000000000002075
5. Yuen WLP, Raghuraman R, Loh SYJ. Proximal Tibiofibular Joint Stabilization With Concurrent Posterolateral Corner Reconstruction in Multiligamentous Knee Injury. *Arthrosc Tech*. 2021;10(11):e2457-e2462. doi:10.1016/j.eats.2021.07.025
6. Müller PE, Niethammer TR. Editorial Commentary: Bone Marrow Lesion as a Prognostic Factor for Osteochondral Allograft Transplantation of Cartilage Defects in the Knee Joint. *Arthroscopy*. 2021;37(12):3498-3499. doi:10.1016/j.arthro.2021.07.027
7. Park J, Song K, Lee SY. Single-Leg Drop Jump Biomechanics After Ankle or Knee Joint Cooling in Healthy Young Adults. *J Sport Rehabil*. 2022;31(3):271-278. doi:10.1123/jsr.2020-0529
8. Bobunov DN, Volkova AS, Seleznev DM, Iordanishvili AK, Senyukov AV, Arutiunov VA. [Evaluation of the effectiveness of the third stage of rehabilitation after a knee joint injury in persons of older age groups by means of physiotherapy exercises.]. *Usp Gerontol*. 2021;34(4):609-613. doi:10.34922/AE.2021.34.4.015
9. Hanrahan CJ. Editorial for "Device for Assessing Knee Joint Dynamics During MR Imaging". *J Magn Reson Imaging*. 2022;55(5):1549-1550. doi:10.1002/jmri.27998
10. Kellis E, Sahinis C. Effect of knee joint angle on individual hamstrings morphology quantified using free-hand 3D ultrasonography. *J Electromyogr Kinesiol*. 2022;62:102619. doi:10.1016/j.jelekin.2021.102619
11. Cerfoglio S, Galli M, Tarabini M, Bertozzi F, Sforza C, Zago M. Machine Learning-Based Estimation of Ground Reaction Forces and Knee Joint Kinetics from Inertial Sensors While Performing a Vertical Drop Jump. *Sensors (Basel)*. 2021;21(22):7709. doi:10.3390/s21227709
12. Roberti Di Sarsisa T, Fiore M, Coco V, et al. Fresh Osteochondral Allograft Transplantation in Osteochondritis Dissecans in the Knee Joint. *Life (Basel)*. 2021;11(11):1205. doi:10.3390/life11111205
13. Cheung JC-W, Tam AY-C, Chan L-C, Chan P-K, Wen C. Superiority of Multiple-Joint Space Width over Minimum-Joint Space Width Approach in the Machine Learning for Radiographic Severity and Knee Osteoarthritis Progression. *Biology (Basel)*. 2021;10(11):1107. doi:10.3390/biology10111107
14. Kendall J, Pelt CE, Yep P, Mullen K, Kagan R. Trends in Polyethylene Design and Manufacturing Characteristics for Total Knee Arthroplasty: An Analysis From the American Joint Replacement Registry. *J Arthroplasty*. 2022;37(4):659-667. doi:10.1016/j.arth.2021.11.012
15. Maniar RN, Dhiman A, Maniar PR, Bindal P, Arekar A. Forgotten Joint Score Post Total Knee Arthroplasty and Its Correlation with the New Knee Society Score. *Indian J Orthop*. 2021;55(5):1175-1179. doi:10.1007/s43465-021-00452-z
16. Trepczynski A, Moewis P, Damm P, et al. Dynamic Knee Joint Line Orientation Is Not Predictive of Tibio-Femoral Load Distribution During Walking. *Front Bioeng Biotechnol*. 2021;9:754715. doi:10.3389/fbioe.2021.754715
17. Huang D, Parker DM, Mandell JB, et al. Prospective Activity of PLG0206, an Engineered Antimicrobial Peptide, on Chronic Periprosthetic Joint Infection Total Knee Arthroplasty Components *Ex Vivo*: The Knee Explant Analysis (KnEA) Study. *Microbiol Spectr*. 2021;9(3):e0187921. doi:10.1128/Spectrum.01879-21
18. Elbardesy H, McLeod A, Gul R, Harty J. The role of joint line position and restoration of posterior condylar offset in revision total knee arthroplasty : a systematic review of 422 revision knees arthroplasty. *Acta Orthop Belg*. 2021;87(3):453-460. doi:10.52628/87.3.10
19. Wei J, Tong K, Wang H, Wen Y, Chen L. Dosage, Efficacy, and Safety of Intra-articular Vancomycin for Prophylaxis of Periprosthetic Joint Infection Caused by Methicillin-Resistant Staphylococcus aureus after Total Knee Arthroplasty in a Rat Model. *Antimicrob Agents Chemother*. 2022;66(2):e0164121. doi:10.1128/AAC.01641-21
20. Heinrich SM, Sendi P, Clauss M. Methylene blue for the diagnosis of a sinus tract in periprosthetic knee joint infection. *J Bone Jt Infect*. 2021;6(9):423-424. doi:10.5194/jbji-6-423-2021
21. Chowdhury JM, Lineham B, Pallett M, Pandit HG, Stewart TD, Harwood PJ. Comparison of Mechanical Performance between Circular Frames and Biplanar Distraction Devices for Knee Joint Distraction. *Strateg Trauma Limb Reconstr*. 2021;16(2):71-77. doi:10.5005/jp-journals-10080-1530
22. Campbell TM, Trudel G, Conaghan PG, Reilly K, Feibel RJ, McGonagle D. Flexion contracture is associated with knee joint degeneration on magnetic resonance imaging: data from the Osteoarthritis Initiative. *Clin Exp Rheumatol*. 2022;40(5):993-998. doi:10.55563/clinexprheumatol/u8itzf
23. Ma W, Han Z, Sun S, Chen J, Zhang Y, Yu T. Use of a suspended and straightened knee joint position when fixing steel plates can prevent the increase in postoperative posterior tibial slope after openwedge high tibial osteotomy. *J Orthop Surg Res*. 2021;16(1):684. doi:10.1186/s13018-021-02834-3
24. Song SJ, Lee HW, Park CH. Intraoperative Assessment of Gap Balancing in Total Knee Arthroplasty Using Navigation with Joint Stability Graphs. *J Knee Surg*. 2023;36(5):540-547. doi:10.1055/s-0041-1739200
25. Song SJ, Lee HW, Park CH. Intraoperative Assessment of Gap Balancing in Total Knee Arthroplasty Using Navigation with Joint Stability Graphs. *J Knee Surg*. 2023;36(5):540-547. doi:10.1055/s-0041-1739200