Effect of Educational Program on Nurses' Performance Post Arthroscopic Anterior Cruciate Ligament Reconstruction and Patients' Outcomes

Eman Ali Metwaly [1] & Samah Mahmoud Mohamed[2]
[1.] Assistant Professor of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt.
[2.] Lecturer of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt.

Abstract
Arthroscopic Anterior Cruciate Ligament Reconstruction (ACLR) is recognized as the gold standard treatment in restoring static joint stability. **Aim:** This study aimed to evaluate the effect of educational program on nurses' performance post arthroscopic anterior cruciate ligament reconstruction and patients' outcomes. **Design:** A quasi-experimental research design was used. **Setting:** This study was conducted in Orthopedic Department, Arthroscopy Unit and Outpatient Arthroscopy Clinic attached to Zagazig University Hospitals. **Subjects**: A convenience sample of 30 nurses and a purposive sample of 60 patients. **Tools:** Nurses' structured interview questionnaire, Nurses' practice observational checklists, Patients' structured interview questionnaire, Patients' complications assessment questionnaire, and Patients' knee outcomes survey-activities of daily living scale. **Results:** There was a significant enhancement of nurses' knowledge and practice mean scores after program implementation than before with highly statistically significant differences as (P<0.01). There was a significant decrease in mean scores of complications post arthroscopic ACLR among study group patients after 2 and 4 weeks post program implementation than those in control group, with highly statistically significant differences between both groups with (P<0.01). There was a significant improvement in mean scores concerning knee symptoms and functional limitations with activities of daily living among study group patients after 2 and 4 weeks post program implementation than those in control group with highly statistically significant differences between both groups with (P<0.01). **Conclusion:** There was a statistically significant improvement of nurses' knowledge and practice post program implementation, which reflected on patients' outcomes improvement. **Recommendations:** Specialized nurses should be available in the outpatient arthroscopy clinic to provide patients with the needed instructions.

Keywords: Arthroscopic Anterior Cruciate Ligament Reconstruction, Educational Program, Nurses' Performance, & Patients' Outcomes.

Introduction:

The Anterior Cruciate Ligament (ACL) is one of four main ligaments of the knee that binds the tibia (shin bone) to the femur (thigh bone). Ligaments act as "cords" that join one bone to another (**Rambaud, Neri, & Edouard, 2021 & Mattu, et al., 2022**). They guide, regulate, and aid in stabilizing the joint. The ACL forms an "X" with the posterior cruciate ligament (PCL) at the center of knee joint. A c-shaped disc known as "knee cartilage" or "the meniscus" serves as the knee's shock absorber. When the ACL is injured, it often tears (**Tang, et al., 2021).**

The stability and functions of knee joint are seriously impacted by an ACL tear, and the knee may buckle and give way as a result. When the foot is firmly placed on the ground and a twisting force is given to the knee, the majority of ACL injuries take place (**Buelga-Suarez, et al., 2022**). It is essential to identify ACL tears as soon as possible to start early treatment which could avoid further chondral or meniscal damage as well as avoid the development of early osteoarthritis. Arthroscopy is the most precise method for diagnosing ACL tears since it allows

direct visualization of the intra-articular lesions of the knee. Since this surgery is invasive, there may be surgical hazards (**Voss, et al., 2021 & Chen, et al., 2022)**.

Surgery or conservative treatment options are available for ACL rupture. Physical therapy and the use of a knee brace are two typical forms of conservative treatment. Surgery is common for patients who regularly participate in sports (**Henry, 2020**). Arthroscopic ACLR surgeries are typically used to treat anterior cruciate ligament injuries. The gold standard treatment for regaining static joint stability is known as ACLR (**Pastora-Bernal, et al., 2021**).

Significant postoperative pain following arthroscopic knee surgery could prevent patients from leaving the ambulatory surgical setting on time (**Fang, et al., 2022**). Additionally, certain complications may occur after surgery or during rehabilitation and recovery as knee infection that may be superficial or deep, hemarthrosis (bleeding into the knee) (**Arumugam, et al., 2021**). As well, blood clots (deep venous thrombosis) and knee stiffness (arthrofibrosis) which

is relatively rarely occurred with ACL reconstruction surgery (**Deabate, et al., 2020 & Sílvia, et al., 2021**). Also, neurovascular injury (damage to nerves and blood vessels) and rupture or extension of the repaired ligament could occur resulting in frequent instability, fracture through the bone tunnels, pain in the front of knee, tunnel widening, and very few problems with fixation devices could be developed (**Yang, et al., 2022**).

The nurse plays a crucial role in patient's preparation, care, and support (**Johnston, et al., 2020**). Along with playing a vital role in health education through providing clients with written and verbal information as regards pre-operative preparations, recovery, and other post-surgical milestones like home arrangements, physical therapy, wounds care, maintaining a healthful weight, as well as routine follow-up. As a result, fewer hospital readmissions would occur, and successful post-operative functional outcomes would be improved (**Fouasson-Chailloux, et al., 2022 & Dayucos, et al., 2019**).

Nursing care is believed to be the cornerstone in the recovery and advancement of the patient's condition by teaching and providing instructions to patients on how to execute range of motion exercises, weight-bearing limits, walking using crutches, and activity restrictions. Nurse's primary objectives are to decrease knee discomfort and swelling, restore normal joint movement, strengthen the knee's surrounding muscles, check for complications or problems, and establish post-operative follow-up plans (**AbdElghany, et al., (a) 2019**).

Significance of the study:

The incidence of anterior cruciate ligament injuries in general population ranges from 0.01 to 0.08%. It is significantly higher among the sports-active population (1.5-1.7%) than in the general population (**Wohl, et al., 2021**). In the general population of USA, an ACL damage occurs approximately 1 in 3,000 persons a year (**Shen, et al., 2022**). The number of ACLR performed has reached 120,000 annually (**Della Villa, et al., 2021**). ACL injuries are sustained by 1 in 200 people annually among the general population of Egypt, which means occurring more than 100000 cases annually (**Ali, et al., 2022**).

According to the Statistical Research of the Zagazig University Hospitals, a review of the admission rate of patients in Orthopedic Department, Arthroscopy Unit of New Surgery Hospital revealed that approximately 120 patients required arthroscopic ACLR for patients with ACL injuries last year (2021).

Anterior cruciate ligament injury severely restricts knee motion and affects daily activities and quality of life (**Prodromidis, et al., 2021**). Therefore, nurses

should improve their own knowledge and quality of care to enhance patients' conditions and overall health, as well as, to lessen or prevent postoperative complications (**Mahmoud, et al., 2022**). Developing appropriate and comprehensive educational programs will improve the patients' independence in self-care, enable their families to identify the benefits of surgery, assist patients in resuming their daily living activities, and decrease the risk of complications (**Abd-Elghany, et al., (b) 2019**). Therefore, this study was conducted to assess the effect of educational program on nurses' performance post arthroscopic anterior cruciate ligament reconstruction and patients' outcomes.

Aim of the study:

This study aimed to evaluate the effect of educational program on nurses' performance post arthroscopic anterior cruciate ligament reconstruction and patients' outcomes.

Objectives:

- Assess nurses' knowledge and practice ragarding post arthroscopic anterior cruciate ligament reconstruction.
- Assess post arthroscopic anterior cruciate ligament reconstruction complications.
- Assess knee symptoms and functional limitations with activities of daily living post arthroscopic anterior cruciate ligament reconstruction.
- Design, implement, and evaluate effect of educational program on nurses' performance post arthroscopic anterior cruciate ligament reconstruction based on their needs and patients' outcomes.

Research hypotheses:

H1: Mean scores of nurses' knowledge regarding arthroscopic anterior cruciate ligament reconstruction will increase after program implementation compared to pre-program.

H2: Mean scores of nurses' practice regarding post arthroscopic anterior cruciate ligament reconstruction care will improve after program implementation than before.

H3: Post arthroscopic anterior cruciate ligament reconstruction complications will be lower among patients in the study group post-program implementation than those in the control group.

H4: Knee symptoms and functional limitations with activities of daily living post arthroscopic anterior cruciate ligament reconstruction will improve for patients in the study group post-program implementation than those in the control group.

Operational definitions:

Nurses' performance refers to knowledge and practice of the studied nurses regarding post arthroscopic ACLR.

Patients' outcomes are the result of educational program applied to studied nurses which in turn reflected on the study group patients including complications, knee symptoms, and functional limitations with activities of daily living post arthroscopic ACLR.

Subjects and Methods:
Research Design:
A quasi-experimental research design was used to accomplish the study. When real trials are prohibited for moral or practical considerations, a quasi-experimental design is a helpful tool because it uses a non-random approach of assigning participants into groups **(Thomas, 2020).**

Research Setting:
The current study was conducted in Orthopedic Department, Arthroscopy Unit of New Surgery Hospital and Outpatient Arthroscopy Clinic attached to Zagazig University Hospitals. Orthopedic Department, Arthroscopy Unit located on the 5th floor, included thirteen rooms; "two for nursing staff, one for medical staff, and ten rooms for patients/six beds for each". Outpatient Arthroscopy Clinic placed on the 3rd floor, had four rooms; "one for new cases assessment, one for post-operative follow up, one for medical staff, and one for nursing staff".

Subjects:
Nurses: A convenience sample of 30 nurses who worked in Orthopedic Department, Arthroscopy Unit during the study period and accepted to take part in the study.

Patients: A purposive sample of 60 patients who underwent arthroscopic anterior cruciate ligament reconstruction was allocated for this study. The recruited patients were randomly divided into two equal groups; study and control group (30 patients for each). The study group received post-arthroscopic ACLR care based on the educational program and the control group received routine hospital post-operative care. The sample was calculated using program to estimate power and sample size, which produces a power analysis of 80% at confidence level 95%. The projected sample size was 60 patients in the previous mentioned setting. The formula for determining sample size was

$$n = \frac{N \cdot Z^2 \cdot p \cdot (1-p)}{(N-1) \cdot e^2 + Z^2 \cdot p \cdot (1-p)}$$

Inclusion Criteria: between the ages of 18 and 60 years old, of both sexes, with an ACL injury diagnosis without any meniscal or chondral injuries, were submitted to arthroscopic anterior cruciate ligament reconstruction, agreed to participate in the study, and capable of oral corresponding and following guidelines.

Exclusion Criteria: knee inflammation, numerous ligament injuries, bleeding disorders, ACL revision surgery, previous surgery on a knee, previous deep venous thrombosis (DVT), or cognitive impairment.

Tools of data collection:
Tool I: Nurses' Structured Interview Questionnaire:
It created by the researchers based on reviewing the related literature and experts' opinions to ensure that the content was valid. To prevent misinterpretation, it has been translated into Arabic. All nurses were subjected to it before and after the educational program. The questionnaire was divided into the following two parts:

Part I: Nurses' Demographic Characteristics: It incorporated 7 components including nurses' age, gender, marital status, level of education, years of experience in nursing field, years of experience in orthopedic department, and previous training programs related to nursing care for patients with ACL injuries.

Part II: Nurses' knowledge questionnaire regarding arthroscopic anterior cruciate ligament reconstruction (Pre/ Posttest): It was used to assess the current nurses' knowledge regarding arthroscopic ACLR. It was adapted from **(Kitaguchi, et al., 2020; Abd-Elghany, et al., (b) 2019; Ahmed & El-kady, 2015)**. It contained 41 multiple choice questions (MCQ) covering anatomy and functions of ACL (5 points), causes, risk factors, symptoms, diagnostic measures, and degrees of ACL injuries (8 points), methods of prevention and treatment of ACL injuries (4 points), arthroscopic ACLR and its complications (4 points), nursing management post ACLR (9 points), exercises post ACLR (5 points), and post-operative patient's instructions (6 points).

The scoring system:
Response scores were assigned as follows: Each question was assigned one for each correct answer and zero for incorrect answer or don't know. The scores of each section were summed-up and divided by the numbers of items to calculate a mean score. Then, the total mean scores of knowledge were calculated as the mean of all sections. Means and standard deviations were then calculated for the studied nurses in the pre and post program implementation phase and then compared based on statistical analysis.

Tool II: Nurses' Practice Observational Checklists Regarding Post Arthroscopic Anterior Cruciate Ligament Reconstruction Care (Pre/Posttest):
It was used to assess nurses' practice regarding post arthroscopic ACLR patients' care. It was adopted from **(Glattke, et al., 2022; Arundale, et al., 2018; Grindem et al., 2015; Ahmed & El-kady, 2015)**. It

included 115 items covering five main sections as the following:

Section 1: Post-operative patients' care: It was composed of 37 items about position of leg, reactions to anesthesia, vital signs assessment, neurovascular assessment of affected knee, applying ice bags, wound dressing…etc.

Section 2: Wearing postoperative knee brace: It included eight items.

Section 3: Walking using crutches: It included three items.

Section 4: Early post-operative exercises: It contained 37 items about ankle pumps (3 points), heel slides/knee flexion (6 points), passive knee extension (4 points), patellar mobilization (5 points), quadriceps sets contraction (4 points), hamstring sets contraction (5 points), straight leg raises (5 points), and calf stretching (5 points).

Section 5: Discharge patient's instructions: It contained 30 items about pain medications, frequency of exercises, applying ice, techniques of upstairs and downstairs using crutches, assessment of neurovascular complications, driving, and follow up plan…etc.

Scoring system:
Each item was checked as "done," and "not done." These were scored from "1" and "0" respectively so that a higher score denoted better practice. The scores of each technique were summed-up and divided by the numbers of steps to calculate a mean score. Then, the total mean scores of practices were calculated as the mean of all techniques. Means and standard deviations were then calculated for the studied nurses in the pre and post program implementation phase and then compared established on statistical analysis.

Tool III: Patients' Structured Interview Questionnaire:
Its creation was based on examination of pertinent literature and experts' judgments to ensure its content validity. It was implemented for study and control groups post arthroscopic ACLR post program, and involved two key parts as follows:

Part I: Patients' Personal Data: It comprised seven components for example patients' age, gender, marital status, level of education, occupation, residence, and smoking.

Part II: Patients' Medical Data: It concerned three questions as respect to patients' medical history in relation to affected knee, causes of ACL injury, and co-morbid diseases.

Tool IV: Patients' Post Arthroscopic ACLR Complications Assessment Questionnaire (post-test): The researchers created it based on a review of pertinent literature (**Reijman, et al., 2021**). It involved 10 questions to assess complications that arise after ACL reconstruction for study and control

groups. These complications were assessed two times; after 2 weeks and 4 weeks post arthroscopic ACLR post program. It included affected frontal knee pain, knee stiffness, restricted knee joint movement, knee swelling, knee instability, anterior knee muscles weakness, instability during walking, numbness around surgical site, rupture or stretching of the reconstructed ligament, and DVT. Each complication was observed based on both subjective and objective criteria which were verified by doctor.

Scoring system:
Each confirmed complication was scored as "1" for present or "0" for absent. The total mean scores of complications for study and control groups were calculated and then compared established on statistical analysis.

Tool V: Patients' Knee Outcomes Survey-Activities of Daily Living Scale (post-test):
This tool was used to evaluate knee symptoms and functional limitations that patients among the study and control groups experienced while they performed their usual daily activities after 2 weeks and 4 weeks post arthroscopic ACLR post program. It was adopted from (**Kapreli, et al., 2011**). It constituted 14 questions divided into 2 subscales including:

Knee Symptoms Scale: It used to evaluate how patients' knee symptoms affect their level of activities of daily living (6 questions) which included pain, stiffness, swelling, giving way buckling or shifting of the knee, weakness, and limping.

Functional Limitations with Activities of Daily Living Scale: It was used to evaluate how patients' knee condition affects their abilities to perform activities of daily living (8 questions) which composed of walking, going upstairs, going downstairs, standing, kneeling on the front of their knee, squatting, sitting with their knee bent, and rising from a chair.

Scoring system:
The 6-point Likert scale for knee symptoms ranged from 0 (prevents me from all daily activities) to 5 (never have). Established on statistical analysis, the mean of all six elements was derived to represent the total outcome of this scale for each group. The 6-point Likert scale with six responses for functional limitations rated from 0 to 5 (0= unable to do; 1=very difficult; 2=fairly difficult; 3=somewhat difficult; 4=minimally difficult; and 5=not difficult at all). Based on statistical analysis, the total score of this scale for each group was measured as the mean of the eight daily activity elements.

The overall score for Knee Outcomes Survey-Activities of Daily Living Scale for each group was calculated as the mean of all 14 items and then

compared based on statistical analysis. Thus, the higher score indicated the better outcome.

Content validity and reliability:
Content validity is deliberated to examine instruments' components to verify if instruments measured what they were intended to measure. Content validity was accomplished to ascertain if the instruments' content enclosed the aim of the study or not. It was established by a group of five experts "three professors and one assistant professor of Medical-Surgical Nursing, Faculty of Nursing, Zagazig University and one professor of Orthopedic Surgery from Faculty of Medicine, Zagazig University" who verified the instruments for precision, application, inclusiveness, and easiness of fulfillment". Minor changes were made in accordance with their suggestions, and the final form was created.
 The instruments' reliability was verified using internal consistency method. It was determined that Cronbach's alpha reliability coefficient was "0.857, 0.872, 0.864, 0.879 and 0.865" respectively for " nurses' structured interview questionnaire, nurses' practice observational checklists, patients' structured interview questionnaire, patients' post arthroscopic ACLR complications assessment questionnaire, and patients' knee outcomes survey-activities of daily living scale".

Ethical considerations:
Prior to conducting the study, ethical approval was attained from Research Ethics Committee affiliated to Faculty of Nursing, Zagazig University. Official approvals to accomplish the study were attained from the administrator of Zagazig University Hospitals, heads of Orthopedic Department, Arthroscopy Unit and Outpatient Arthroscopy clinic, and nursing heads. Faculty of Nursing, Zagazig University sent letters to them outlining the purpose of the study to secure their cooperation.
Each studied participant was educated about the study's nature, objectives, and advantages before giving their consent, which was obtained prior to the first interview. Nurses and patients were made aware that withdrawal was allowed without giving reasons. Confidentiality and anonymity of subjects were guaranteed through coding of all data.

Pilot study:
A pilot study was conducted on 10% of the overall sample (3 nurses and 6 patients) to test the used tools regarding clarity, applicability, comprehensiveness, ease of implementation, and relevance as well as to estimate the time needed to fill in the study tools. Based on the results of pilot study, some adjustments were made. Pilot participants were later rule out from the main sample.

Fieldwork:
The researchers interviewed the studied subjects on morning and afternoon shifts three days a week. The study was conducted over a period of six months from the beginning of November 2022 to the end of April 2023 throughout the following phases:

Preparatory phase:
The researchers extensively reviewed the relevant literature (textbooks, articles, journals, and internet periodicals) and studies. Then, the researchers constructed the used tools.

Assessment phase:
Once permissions to proceed the study were granted, the researchers established a line of communication with the study sample (nurses and patients) by introducing themselves before initiating data collecting. The researchers conducted a baseline assessment of nurses' knowledge and practice concerning caring for patients post arthroscopic ACLR individually at Orthopedic Department, Arthroscopy Unit using data collection tools (tool I & tool II) as a pretest. Tool I took approximately 20-25 minutes to be filled from each nurse and tool II took approximately 35-40 minutes to observe each nurse to gather the essential data. The collected data assisted researchers in creating content of the educational program.
On the other hand, the researchers conducted individual interviews with each participant among study and control groups (post program implementation) at Orthopedic Department, Arthroscopy Unit to collect baseline data about personal and medical data. The interview was conducted in patient's room of hospital utilizing (tool III, Part I&II) and took about 10-15 minutes to be completely answered by each patient.

Planning phase:
The researchers formulated the educational program based on identified nurses' needs of the pretest, and an extensive review of the relevant literature. Goals and expected outcomes criteria were formulated based on priorities during program implementation for improving nurses' knowledge and practice as regards post arthroscopic ACLR patients' care.
 Lectures, group discussions, demonstrations, and re-demonstrations were chosen as teaching techniques for small groups during program implementation. PowerPoint presentations, instructional videos, colored banners, and informative images were all developed as teaching aids. A schedule for educational program implementation was also created. Furthermore, a colored booklet in plain Arabic was designed by the researchers to aid nurses in assimilating and updating the supplied information.

Implementation phase:

The educational program was implemented in form of sessions which were carried out in Orthopedic Department, Arthroscopy Unit. The nurses were divided into groups by the researchers; four to five nurses in each group. The educational program was spread throughout 16 sessions.

A description of the educational program's purpose, curriculum, and general objectives were included in the first session. The theoretical portion was then covered in 5 sessions in form of lectures and group discussions and 10 sessions for the practical portion in form of demonstration and re-demonstration sessions. Each theoretical session lasted 20 to 30 minutes and practical session lasted 40 to 45 minutes. Each session began with a summary of what was taught in the previous session and the objectives of the new one. Motivation, reinforcement, and active participation were utilized throughout sessions to enhance the learning process. The booklets were provided to the studied nurses at the end of the sessions.

The content of the sessions covered the following parts:

The theoretical part included five sessions; Session I: Anatomical overview of knee, definition, and functions of ACL, causes, risk factors, symptoms, degrees, and diagnostic measures of ACL injuries. **Session II:** Methods of prevention, complications, and treatment methods of ACL injuries, as well as, definition of knee arthroscopy. **Session III:** Definition, purposes, advantages, types, duration, and complications of Arthroscopic ACLR. **Session IV:** Preparing patient before undergoing arthroscopic ACLR procedure of arthroscopic ACLR, sources of used grafts, methods of installing new patches, and nursing management after arthroscopic ACLR. **Session V:** Post-operative patients' instructions, types of exercises, importance of each exercise, and precautions during exercises.

The practical part incorporated ten sessions; Session VI: Demonstration and re-demonstration of post-operative patients' nursing care included vital signs measurement, position of leg, as well as neurovascular assessment of affected knee through assessment of pain, pulse, perfusion, poikilothermia, paresthesia, and paralysis...etc. **Session VII**: Demonstration and re-demonstration of wound dressing, and ice compresses application. **Session VIII**: Demonstration and re-demonstration of wearing postoperative knee brace. **Session IX**: Demonstration and re-demonstration of walking using crutches. **Session X**: Demonstration and re-demonstration of early post-operative exercises that were done 1-2 weeks post arthroscopic ACLR as ankle pumps and heel slides (knee flexion). **Session**

XI: Demonstration and re-demonstration of Passive knee extension and patellar mobilization. **Session XII**: Demonstration and re-demonstration of quadriceps sets contraction and hamstring sets contraction. **Session XIII**: Demonstration and re-demonstration of straight leg raises and calf stretching. **Session XIV**: Demonstration and re-demonstration of patient's discharge instructions related to technique of upstairs using crutches and down stairs using crutches. **Session XV**: Demonstration and re-demonstration of patient's discharge instructions as regards instructions when performing exercises, proper nutrition, doing daily activities, walking, bathing, sleeping, swimming, wound care, driving, physical therapy, regular follow up, and observing complications as early as possible.

Evaluation phase:

All the studied nurses were evaluated twice at Orthopedic Department, Arthroscopy Unit using the same data collection tools (tool I & tool II) to assess nurses' knowledge and practice regarding post arthroscopic ACLR patients' care: one before the educational program (pretest) and second immediately after completion of the educational program (posttest). Then, the researchers compared the post-test findings to the pre-test.

After program implementation, individual interviews were conducted with each patient in the study and control groups in the hospital's patient room using (tool III, Part I&II). In addition, patients in the study group as well as patients in the control group were evaluated twice at Outpatient Arthroscopy Clinic by using (tool IV & tool V) after 2 weeks and then after 4 weeks post arthroscopic ACLR post program to evaluate the effect of educational program implementation on patients' outcomes through assessing complications, knee symptoms, and functional limitations with activities of daily living. Comparisons between the findings of patients in study group and those in control group were done.

Statistical Design:

The collected data was organized, tabulated, and statistically analyzed using Statistical Package for Social Science (SPSS) version 25 for Windows, running on IBM compatible computers. Quantitative data were expressed as mean ± SD whereas qualitative data were presented as frequencies and percentages. Qualitative categorical variables were compared using chi-square test or Fisher's exact test, as necessary. The test of significance used to compare the means of quantitative variables was the paired T test (t). Independent T test (t) was used to compare

means between two unrelated groups. Pearson correlation test (r) was used to assess the inter-relationships among quantitative variables. Reliability of the study tools was determined using Cronbach's Alpha. P value < 0.05 was considered statistically significant, p value < 0.01 was considered highly statistically significant, and p value ≥ 0.05 was considered statistically insignificant.

Results:

Table (1): Frequency and Percentage Distribution of Demographic Characteristics of the Studied Nurses (n=30).

Demographic Characteristics	Items	No	%
Age (years)	<40	16	53.3
	≥ 40	14	46.7
	Range: 23 – 57, Mean ± SD= 40.27 ± 9.91, Median= 38 years		
Gender	Males	4	13.3
	Females	26	86.7
Marital Status	Single	4	13.3
	Married	22	73.4
	Widow	4	13.3
Education	Nursing diploma	20	66.7
	Nursing institute	6	20.0
	Bachelor of Nursing	4	13.3
Experience in nursing field(years)	<10	6	20.0
	≥ 10	24	80.0
	Range: 2 – 38, Mean ± SD= 21.20 ± 10.06, Median= 22 years		
Experience in orthopedic department (years)	<10	12	40.0
	≥ 10	18	60.0
	Range: 1 – 31, Mean ± SD= 12.93 ± 10.05, Median= 10 years		
Previous training programs related to ACL injuries	Yes	4	13.3
	No	26	86.7

Table (2): Average Scores of Nurses' knowledge Regarding Arthroscopic ACLR Before and After Program implementation (n=30).

Knowledge items	Before Mean ± SD	After Mean ± SD	Significance test
Anatomy and functions of ACL.	2.63 ± 1.520	4.90 ± 0.548	t=8.641, P<0.001
Causes, symptoms, diagnostic measures, and degrees of ACL injuries.	3.03 ± 1.326	7.47 ± 1.279	t=15.701, P<0.001
Methods of prevention and treatment of ACL injuries.	1.07 ± 1.202	3.80 ± 0.407	t=12.460, P<0.001
Arthroscopic ACL reconstruction and its complications.	1.67 ± 0.959	3.87 ± 0.346	t=12.092, P<0.001
Nursing management post arthroscopic ACL reconstruction.	2.57 ± 1.654	8.57 ± 0.679	t=21.784, P<0.001
Exercises post arthroscopic ACL reconstruction.	1.87 ± 1.279	4.73 ± 0.583	t=12.022, P<0.001
Post-operative patient's instructions.	1.83 ± 1.262	5.53 ± 0.776	t=16.039, P<0.001
Total Knowledge Scores	14.67 ± 6.614	38.87 ± 2.886	t=22.541, P<0.001

t= Paired T- test, P < 0.01 (highly significant).

Table (3): Average Scores of Nurses' Practices Regarding Post Arthroscopic ACLR Care Before and After Program implementation (n=30).

Practices items	Before Mean ± SD	After Mean ± SD	Significance test
Postoperative patient's care.	10.73 ± 2.449	36.77 ± 0.430	t= 64.220, P<0.001
Wearing post-operative knee brace.	2.30 ± 0.877	7.87 ± 0.434	t=35.521, P<0.001
Walking using crutches.	0.87 ± 0.776	2.73 ± 0.450	t=15.004, P<0.001
Early post-operative exercises.	8.87± 4.710	34.87 ± 3.003	t=27.182, P<0.001
Discharge patient's instructions.	5.30 ± 1.291	28.03 ± 2.580	t=50.563, P<0.001
Total Practices Scores	28.07 ± 6.863	110.27 ± 5.343	t=63.177, P<0.001

t= Paired T- test, P < 0.01 (highly significant).

Table (4): Correlation between Nurses' Total Knowledge and Practice As Regards Post Arthroscopic ACLR Before and After Program implementation (n=30).

Variables	Total Knowledge			
	Before program		After program	
Total Practice	R	P	R	P
	0.656	0.000**	0.722	0.000**

*r= Pearson correlation coefficient test,   **highly significant at p ‹ 0.01.*

Table (5): Frequency and Percentage Distribution of Personal Data for the Studied Patients in Both Groups (n= 60).

Personal Data	Items	Study group (30)		Control group (30)		Significance test
Age (years)	<30	19	63.3	18	60.0	χ^2=0.310, P0.578
	≥ 30	11	36.7	12	40.0	
	Mean ± SD	30.10 ± 5.41		29.87 ± 5.39		t=0.277. P0.782
		N0	%	No	%	
Gender	Males	22	73.3	18	60.0	χ^2=1.200, P0.273
	Females	8	26.7	12	40.0	
Marital Status	Single	6	20.0	10	33.3	χ^2=1.364, P0.243
	Married	24	80.0	20	66.7	
Education	Illiterate	2	6.7	4	13.3	χ^2=5.143, MEP0.169
	Read/write	4	13.3	10	33.3	
	Secondary	16	53.3	12	40.0	
	University	8	26.7	4	13.3	
Occupation	House wives	8	26.7	12	40.0	χ^2=1.600, MEP0.709
	Employee	4	13.3	2	6.7	
	Workers	16	53.3	14	46.7	
	Students	2	6.7	2	6.7	
Residence	Rural	26	86.7	22	73.3	χ^2=1.667, P0.197
	Urban	4	13.3	8	26.7	
Smoking	Yes	8	26.7	12	40.0	χ^2=1.200, P0.273
	No	22	73.3	18	60.0	

χ 2 Chi square test,   t= Paired T- test ,   p>0.05 (in-significant)

Table (6): Frequency and Percentage Distribution of Medical Data among the Studied Patients in Both Groups (n=60).

Medical data	Items	Study group (30)		Control group (30)		Significance test
		N0	%	No	%	
Affected knee	Right	22	73.3	24	80.0	χ^2=0.373, P0.542
	Left	8	26.7	6	20.0	
Causes of injury	Sports	6	20.0	4	13.3	χ^2=5.143, MEP0.169
	Work	12	40.0	14	46.7	
	Daily activities	8	26.7	8	26.7	
	Accidents	4	13.3	4	13.3	
Co-morbid diseases	Absent	16	53.3	20	66.7	χ^2=1.111, P0.292
	Hypertension	12	40.0	10	33.3	χ^2=0.287, P0.592
	Diabetes mellitus	6	20.0	4	13.3	χ^2=0.480, P0.488
	Heart diseases	6	20.0	6	20.0	-
	Lung diseases	0	0.0	4	13.3	FET, P0.112
	Renal diseases	2	6.7	4	13.3	FET, P0.671
	Liver diseases	0	0.0	0	0.0	-

χ 2 Chi square test,   FET: Fisher exact test,   p>0.05:(in-significant).

Table (7): Total Average Scores of Post Arthroscopic ACLR Complications among the Studied Patients in Both Groups after 2 and 4 Weeks Post Program implementation (n=60)

Items	Study (30)	Control (30)	Significance test
	Mean ± SD	Mean ± SD	
Total complications scores after 2 weeks.	2.93 ± 0.45	7.60 ± 0.72	t= 29.989, P<0.001
Total complications scores after 4 weeks.	1.07 ± 0.78	7.40 ± 1.04	t=26.699, P<0.001

t= Independent T- test,   P < 0.01 (highly significant).

Table (8): Total Average Scores of Knee Outcomes Survey-Activities of Daily Activities Post Arthroscopic CLR among the Studied Patients in Both Groups after 2 and 4 Weeks Post Program implementation (n=60).

Items	Study (30) Mean ± SD	Control (30) Mean ± SD	Significance test
Knee symptoms total scores after 2 weeks.	18.60 ± 3.50	6.20 ± 2.73	t= 15.293, P<0.001
Knee symptoms total scores after 4 weeks.	26.13 ± 2.32	7.27 ± 3.27	t=25.797, P<0.001
Functional limitations total scores after 2 weeks.	21.73 ± 3.16	9.40 ± 2.25	t=17.401, P<0.001
Functional limitations total scores after 4 weeks.	32.53± 1.85	10.87 ± 2.85	t=34.920, P<0.001

t= Independent T- test,   P < 0.01 (highly significant).

Table (1): Displays that 53.3% of surveyed nurses' ages were less than 40 years old with Mean ± SD (40.27 ± 9.91), and 86.7 % of them were females and didn't receive any training program. Also,73.4% of studied nurses were married, 66.7% of them possessed Nursing diploma, 80.0% of them had more than or equal to ten years of experience in nursing field with Mean ± SD (21.20 ± 10.06), and 60.0% of them had more than or equal to ten years of experience in orthopedic department with Mean ± SD (12.93 ± 10.05).

Table (2): Illustrates that there was a significant increase of nurses' knowledge mean scores regarding arthroscopic ACLR after program implementation than before with highly statistically significant differences with (P<0.01).

Table (3): Clarifies that there was a significant improvement of nurses' practice mean scores regarding post arthroscopic ACLR care after program implementation compared to pre-program with highly statistically significant differences as (P<0.01).

Table (4): Identifies that there was a highly statistically significant strong positive correlation between nurses' total knowledge and total practice as regards post arthroscopic ACLR before and after program implementation as (P<0.01).

Table (5): Reveals that 63.3% of patients in study group and 60% of patients in control group, their ages were less than 30 years old with Mean ± SD of both groups was 30.10± 5.41, 29.87 ± 5.39, respectively. Also, 73.3% of patients in study group and 60.0% of patients in control group were males and non-smokers, respectively. In addition to 80.0% of patients in study group and 66.7% of patients in control group were married. As well, 53.3% of patients in study group and 40% and 46.7% of patients in control group had secondary education and were workers, respectively. Concerning residence; 86.7% of patients in study group and 73.3% of patients in control group were from rural areas, with no statistically significant differences between the two groups as (p-value > 0.05).

Table (6): Explores that 73.3% of patients among study group and 80.0% among control group had ACL injury in the right knee. Also, less than half of the patients in both groups were injured during doing their work. As well, 53.3% of patients among study group and 66.7% among control group had no co-morbid diseases. Additionally, no statistically significant differences existed between the two groups as (p value > 0.05).

Table (7): Demonstrates that there was a significant decrease in mean scores of post arthroscopic ACLR complications among the study group patients after two and four weeks post program implementation than those among the control group, with differences between both groups being highly statistically significant as (P<0.01).

Table (8): Denotes that there was a significant improvement in mean scores of knee symptoms and functional limitations with activities of daily living post arthroscopic ACLR for study group patients after two and four weeks post program implementation than those among the control group with highly statistically significant differences as (P<0.01).

Discussion:

Concerning demographic characteristics of the studied nurses, the present study's findings showed that more than half of nurses were under the age of 40 years old, and the majority of them were females and didn't receive any training program. Furthermore, about three quarters of studied nurses were married, more than two thirds of them possessed Nursing diploma, and the majority of them had more than or equal to ten years of experience in nursing field, and less than two thirds of them had around ten years of experience in orthopedic department. These results were consistent with **Abdelhady, et al., (2022)** who reported that more than two-thirds of the participants were females. These findings were also supported by **Ahmed & El-kady, (2015)** who revealed that more than half of nurses were female, married, and between the ages of 19 and 29 years old. The majority of them hold Nursing diploma, more than half of them have less than 10 years of experience and none of them attended any in-service training courses as regards care of ACL injuries. Similarly, **Mahmoud, et al., (2016)** who stated that one quarter of the investigated nurses had more than 10 years of experience.

Concerning nurses' knowledge regarding arthroscopic ACLR, the findings of the current study illustrated that there was a significant improvement of nurses' knowledge after program implementation than before with highly statistically significant differences. This improvement might be attributed to the educational program content which was based on nurses' needs, active participation of nurses in sessions, as well as, nurses' ability to acquire and enrich their knowledge. This result was supported by the finding of a study done by **Abdelhady, et al., (2022)** who pointed that nurses' knowledge statistically significantly improved after implementing of the nursing care guidelines. In the same way, **Ahmed, & El-kady, (2015)** indicated that more than two-thirds of the study group nurses had satisfactory knowledge while majority of control group nurses had poor knowledge post nursing educational program implementation. Also, the current study pointed that nurses in the study group had significantly more knowledge than those in the control group after nursing educational program implementation with highly statistically significant differences between both groups.

The findings of the present study showed a significant improvement of nurses' practice regarding post arthroscopic ACLR patients' care after program implementation than before with highly statistically significant differences. This improvement might be related to the strong desire of all studied nurses to acquire new skills regarding care of patients post arthroscopic anterior cruciate ligament reconstruction, as well as, the content of educational program had a strong positive effect on nurses' practice. This result was in line with **Ahmed & El-kady, (2015)** who claimed that all subjects of the control group had inadequate level of practice and the majority of study group had adequate level of practice after implementing of the designed program.

The result of the present study illustrated that there was a highly statistically significant strong positive correlation between nurses' total knowledge and total practice as regards post arthroscopic ACLR before and after program implementation. This result was similar to the finding of a study done by **Ahmed & El-kady (2015)** who concluded that there was a statistically significant correlation between nurses' score of knowledge and practice that had been noted that after completing the nursing educational program as nurses got high knowledge and practice scores. Similarly with **Abd-Elghany, et al., (b) (2019)** who mentioned that there was a significant positive correlation between total knowledge and total practices post program.

In respect to personal data of the studied patients, the current study findings illustrated that less than two

thirds of study group patients and three fifths of control group patients were under the age of 30 years old. Nearly two thirds of studied patients among both groups were males and non-smokers. In addition, the majority of patients in study groups and about two thirds of patients in control group were married. Also, more than half of patients among study group had secondary education and were workers compared to less than half of patients among control group. The majority of patients in study group and about two thirds of patients in control group were from rural areas.

These findings agreed with **Ali, et al., (2022)** who found that just less than two-thirds of studied patients were under the age of 40 years old, more than two thirds of them were males, less than two thirds of them were educated, and the majority of them lived in rural areas. Similar conclusions were reached by **Ahmed, et al., (2021)** who found more than half of studied patients under the age of 30 and most of the studied patients were males.

Pertaining to medical data of the studied patients, the findings identified that nearly the majority of patients in both groups had an ACL injury in the right knee. Also, less than half of the patients in both groups were injured during doing their work. More than half of patients in study group and about two thirds of those in control group had no co-morbid diseases.

These results corroborated those of **Pokharel, et al., (2022)** who demonstrated that more than half of patients had an injury in right knee. Similarly, **Venkataraman, et al., (2022)** who indicated that less than two thirds of ACL injury were with non-sports causes. Contrary to **Iqbal, et al., (2021)** who showed that ACL tears were caused by traffic accidents in more than half of patients, followed by falls in less than half. In the same way, **Thitirungruang, (2020)** illustrated that all patients of the trial group and the most of patients in the control group had no underlying diseases.

In relation to post arthroscopic ACLR complications, the current study results revealed that there was a significant decrease of post arthroscopic ACLR complications among the study group patients after two and four weeks post program implementation than those in the control group, with differences between the two groups being highly statistically significant. This demonstrated the adherence of patients among the study group to discharge instructions provided to them by the studied nurses, which resulting in a significant reduction in complications.

These findings were in harmony with, **AbdElghany, et al., (a) (2019)** who exhibited that throughout 2nd week and 4th weeks post program implementation, study group had a reduction in knee pain and

improvement in knee muscle strength and knee function than those in the control group. In addition, **Mahmoud, et al., (2022)** who illustrated that merely a few of individuals among the study group experienced complications after meniscus surgery. Low proportion of study group participants reported knee pain, restricted range of motion, and quadriceps muscle weakness, whereas the majority of control group patients experienced complications following meniscus surgery. Furthermore, **Dai & Li, (2022)** pointed that after two and four weeks following program implementation, the study group experienced lower rates of knee pain and incision infection compared to the control group.

According to the current study results, knee symptoms and functional limitations with activities of daily living were significantly improved post arthroscopic ACLR among patients in the study group after two and four weeks post program implementation than those among the control group with highly statistically significant differences between both groups. It demonstrated successful implementation of educational program, efficacy of the early postoperative exercises demonstration and re-demonstration, as well as the incorporation of regular exercises into patients' daily living. As a result, the patient's functional abilities improved since consistent exercises increase autonomy for daily and routine activities, and prevent functional impairment and dependency.

These results were in coordination with those of a study done by **Shu, et al., (2022)** who found that lysholm knee score and knee flexion and extension in study group was significantly improved after training than before training. As the observational group was higher than the control group with a statistically significant difference. In congruent with **Mahmoud, et al., (2022)** who mentioned that the majority of study group patients experienced higher functional ability than those among the control group immediate post-program implementation and three months later. Furthermore, **Dai & Li, (2022)** who found that two and four weeks after program implementation, knee joint function scores and knee joint range of motion were higher among the study group than the control group.

On the same line **Jung, et al., (2022)** who reported that a rehabilitation exercise program with blood flow restriction after ACL reconstruction is a more effective as rehabilitation modality for improving muscle activity during muscle contraction and muscle function compared with the general rehabilitation exercise group. In contrast to **Rhim, et al., (2020)** who documented better functional score and muscle strength among the supervised physiotherapy group of ACLR patients than home based physical therapy

group up to one year post ACLR. Similarly with **AbdElghany, et al., (2019)** who found that ACLR patients had overall mean score for daily living activities that was statistically significantly higher among the study group compared with the control group and a significant improvement of the total Knee Injury and Osteoarthritis Outcome Score (KOOS) among the study group after educational program application, in comparison with the control group.

Conclusion:
Based on the results of the current study, it can be concluded that there was a statistically significant improvement of nurses' knowledge and practice post program implementation, which reflected on improvement of patients' outcomes among the study group through reduction in post arthroscopic ACLR complications and improvement of knee symptoms and functional limitations with activities of daily living post program implementation.

Recommendations:
- Continuous educational and in-service programs should be implemented in orthopedic department, arthroscopy unit to enhance nurses' knowledge and practice.
- Creating standardized tools to periodically assess nurses' knowledge and practice in orthopedic wards to identify their needs.
- Nursing staff should be given pamphlets in Arabic with plain words and a variety of images, involving procedures of postoperative exercises, and discharge instructions.
- Specialized nurses should be available in the outpatient arthroscopy clinic to provide patients with the needed instructions.
- Functional abilities of patients with ACLR should be assessed by nurses constantly and progressively.

References:
- **Abd-Elghany, M., El-Monaem, A., & Hassanin, A. (a) (2019)**. Effect of exercises program on knee functional outcomes for patients after arthroscopic anterior cruciate ligament reconstruction, Mansoura Nursing Journal, 6(1), 185-197.
- **Abd-Elghany, S., Hassanein, A., & Mohammed, H. (b) (2019):** Efficacy of Implementing Pre-operative Health Education Program on Post-operative Outcomes of Patients Undergoing Total Knee Arthroplasty. International Journal of Novel Research in Healthcare and Nursing, 6(3), 239-249.
- **Abdelhady, S., Hassanien, A., Hamed, H., & Mohamed, M. (2022)**: Effect of Implementing Nursing Care Guidelines on Nurses' Knowledge for

orthopedic patients undergoing External Fixation. Mansoura Nursing Journal, 9(2), 387-394.

- **Ahmed, A., & El-kady, H. (2015):** Effect of nursing educational program on nurses' knowledge and practice regarding patients with anterior cruciate ligament surgery at Assiut university hospital. Zagazig Nursing Journal, 11(2), 42-50.

- **Ahmed, A., Hassan, A., Khattab, E., &Elfawal, M. (2021):** Assessment of the Complications and Associated Findings by Conventional MRI in Post-Operative ACL Reconstruction. The Egyptian Journal of Hospital Medicine, 85(1), 3487-3490.

- **Ali, A., Taha, N., &Moghazy, N. (2022):** Anterior Cruciate Ligament knee Injuries: Patients' needs. Zagazig Nursing Journal, 18(2), 302-316.

- **Arumugam, A., Björklund, M., Mikko, S., & Häger, C. (2021):** Effects of neuromuscular training on knee proprioception in individuals with anterior cruciate ligament injury: a systematic review and GRADE evidence synthesis. BMJ open, 11(5), e049226.

- **Arundale, A., Bizzini, M., Giordano, A., Hewett, T., Logerstedt, D., Mandelbaum, B., & Beattie, P. (2018):** Exercise-Based Knee and Anterior Cruciate Ligament Injury Prevention: Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Academy of Orthopaedic Physical Therapy and the American Academy of Sports Physical Therapy. Journal of Orthopaedic & Sports Physical Therapy, 48(9), A1-A42.

- **Buelga-Suarez, J., Alba-Martin, P., Cuenca-Zaldívar, N., García-Escudero, M., Bierge-Sanclemente, P., Almazán-Polo, J., & Pecos-Martín, D. (2022):** Test-Retest Reliability of Ultrasonographic Measurements from the Rectus Femoris Muscle 1–5 Years after Anterior Cruciate Ligament Reconstruction in the Ipsilateral and Contralateral Legs: An Observational, Case-Control Study. Journal of Clinical Medicine, 11(7), 1867.

- **Chen, K., Yang, C., Wang, H., Ma, H., & Lee, O. (2022):** Artificial Intelligence–Assisted Diagnosis of Anterior Cruciate Ligament Tears From Magnetic Resonance Images: Algorithm Development and Validation Study. JMIR AI, 1(1), e37508.

- **Dai, J, & Li, Y. (2022):** Effect of Nursing in Operating Room Combined with Intraoperative Heat Preservation Intervention on Prevention of Incision Infection and Improvement of Hemodynamics in Patients with Anterior Cruciate Ligament Injury and Reconstruction under Knee Arthroscopy. Comput Math Methods Med.; 2022(17):1-8.doi:10.1155/2022/2915157.PMID: 35465002; PMCID: PMC9033368.

- **Dayucos, A., French, L., Kelemen, A., Liang, Y., & SikLanyi, C. (2019):** Creation and Evaluation of a Preoperative Education Website for Hip and Knee Arthroplasty Patients-A Pilot Study.Medicina (Kaunas, Lithuania), 55(2), 32.

- **Deabate, L., Previtali, D., Grassi, A., Filardo, G., Candrian, C., & Delcogliano, M. (2020):** Anterior cruciate ligament reconstruction within 3 weeks does not increase stiffness and complications compared with delayed reconstruction: a meta-analysis of randomized controlled trials. The American Journal of Sports Medicine, 48(5), 1263-1272.

- **Della Villa, F., Hägglund, M., Della Villa, S., Ekstrand, J., &Waldén, M. (2021):** High rate of second ACL injury following ACL reconstruction in male professional footballers: an updated longitudinal analysis from 118 players in the UEFA Elite Club Injury Study. British journal of sports medicine, 55(23), 1350-1356.

- **Fang, C., Cheng, R., Jiang, J., Dimitriou, D., Wang, H., Jiang, Z., & Cheng, C. (2022):** An efficient needleless grasping suture technique for graft preparation in anterior cruciate ligament reconstruction. Frontiers in Surgery, 626.

- **Fouasson-Chailloux, A., Crenn, V., Louguet, B., Grondin, J., Menu, P., & Dauty, M. (2022):** Therapeutic Patient Education after Anterior Cruciate Ligament Reconstruction: Evaluation of the Knowledge and Certitudes with a Self-Report Questionnaire. In Healthcare (Vol. 10, No. 5, p. 934). MDPI.

- **Glattke, K., Tummala, S., &Chhabra, A. (2022):** Anterior Cruciate Ligament Reconstruction Recovery and Rehabilitation: A Systematic Review. JBJS, 104(8), 739-754.

- **Grindem, H., Granan, L., Risberg, M., Engebretsen, L., Snyder-Mackler, L., & Eitzen, I. (2015):** How does a combined preoperative and postoperative rehabilitation programme influence the outcome of ACL reconstruction 2 years after surgery? A comparison between patients in the Delaware-Oslo ACL Cohort and the Norwegian National Knee Ligament Registry. British Journal of Sports Medicine, 49(6), 385-389.

- **Henry, K. (2020):** Factors Influencing Recovery from Anterior Cruciate Ligament Reconstruction (ACLR) in High-Performance Athletes (Doctoral dissertation, Auckland University of Technology)

- **Iqbal, J., Khan, Z., Hassan, F., Sidhwa, B., Khan, Z., & Butt, U. (2021):** Functional outcome of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Autograft and Endo button with Supervised Physical therapy Rehabilitation. Journal of Pakistan Orthopaedic Association, 33(01), 25-30.

- **Johnston, D., Sondekoppam, R., Uppal, V., Litchfield, R., Giffin, R., & Ganapathy, S. (2020):** Effect of combining peri-hamstring injection or anterior obturator nerve block on the analgesic efficacy of adductor canal block for anterior cruciate ligament reconstruction: a randomised controlled trial. British Journal of Anaesthesia, 124(3), 299-307.

- **Jung, W., Kim, S., Nam, S., Kim, J., & Moon, H. (2022):** Effects of Rehabilitation Exercise with Blood Flow Restriction after Anterior Cruciate Ligament Reconstruction. Applied Sciences, 12(23), 12058.

- **Kapreli, E., Panelli, G., Strimpakos, N., Billis, E., Zacharopoulos, A., &Athanasopoulos, S. (2011):** Cross-cultural adaptation of the Greek version of the Knee Outcome Survey–activities of Daily Living Scale (KOS-ADLS). The Knee, 18(6), 424-427.

- **Kitaguchi, T., Tanaka, Y., Takeshita, S., Tsujimoto, N., Kita, K., Amano, H., & Horibe, S. (2020):** Importance of functional performance and psychological readiness for return to preinjury level of sports 1 year after ACL reconstruction in competitive athletes. Knee Surgery, Sports Traumatology, Arthroscopy, 28(7), 2203-2212.

- **Mahmoud, A., Hassanien, A., Sherief, W., & Soliman, H. (2016):** Nurses' knowledge regarding traction care in orthopedic unit at Mansoura University Hospitals, Mansoura Nursing Journal, 3(1), 1-21.

- **Mahmoud, H., Dawood, R., &Eldesoky, H. (2022)**: Effect of Nursing Rehabilitation Program on Knee Functional Outcomes for Patients undergoing Arthroscopic Meniscus Surgery, Egyptian Journal of Health Care, 2022 EJHC Vol.13 No.2

- **Mattu, A., Ghali, B., Linton, V., Zheng, A., & Pike, I. (2022):** Prevention of Non-Contact Anterior Cruciate Ligament Injuries among Youth Female Athletes: An Umbrella Review. International Journal of Environmental Research and Public Health, 19(8), 4648.

- **Pastora-Bernal, J., Estebanez-Pérez, M., Lucena-Anton, D., García-López, F., Bort-Carballo, A., & Martín-Valero, R. (2021):** The effectiveness and recommendation of motor imagery techniques for rehabilitation after anterior cruciate ligament reconstruction: a systematic review. Journal of Clinical Medicine, 10(3), 428.

- **Pokharel, S., Thapa, S., & Lamichhane, A. (2022):** Anterior Cruciate Ligament Injury among Patients with Knee Injury Visiting the Out-patient Department of Orthopaedics of a Tertiary Care Centre: A Descriptive Cross-sectional Study. JNMA J Nepal Med Assoc.;60(254):853- 856.doi:10.31729/jnma.7402.PMID: 36705162; PMCID: PMC9924920.

- **Prodromidis, A., Drosatou, C., Thivaios, G., Zreik, N., & Charalambous, C. (2021):** Timing of anterior cruciate ligament reconstruction and relationship with meniscal tears: a systematic review and meta-analysis. The American Journal of Sports Medicine, 49(9), 2551-2562.

- **Rambaud, A., Neri, T., &Edouard, P. (2021):** Reconstruction, rehabilitation and return-to-sport continuum after anterior cruciate ligament injury (ACLR3-continuum): Call for optimized programs. Annals of physical and rehabilitation medicine, 65(4), 101470.

- **Reijman, M., Eggerding, V., van Es, E., van Arkel, E., van den Brand, I., van Linge, J., & Meuffels, D. (2021)** Early surgical reconstruction versus rehabilitation with elective delayed reconstruction for patients with anterior cruciate ligament rupture: COMPARE randomised controlled trial. bmj, 372.

- **Rhim, H., Lee, J., Lee, S., Jeon, J., Kim, G., Lee, K., & Jang, K. (2020):** Supervised rehabilitation may lead to better outcome than home-based rehabilitation up to 1 year after anterior cruciate ligament reconstruction. Medicina, 57(1), 19.

- **Shen, X., Liu, T., Xu, S., Chen, B., Tang, X., Xiao, J., & Qin, Y. (2022):** Optimal Timing of Anterior Cruciate Ligament Reconstruction in Patients with Anterior Cruciate Ligament Tear: A Systematic Review and Meta-analysis. JAMA Network Open, 5(11), e2242742-e2242742.

- **Shu, C., Han, L., & Yang, H. (2022):** Effect of rehabilitation training on cruciate ligament injury. RevistaBrasileira de MedicinadoEsporte, 28, 180-182.

- **Sílvia, F., Bruno, M., Augusto, G., & Célia, S. (2021):** Exergames to improve rehabilitation for anterior cruciate ligament injury: Systematic review and GRADE evidence synthesis. International Journal of Orthopaedic and Trauma Nursing, 100917.

- **Tang, N., Zhang, W., George, D., Su, Y., & Huang, T. (2021):** The Top 100 Most Cited Articles on Anterior Cruciate Ligament Reconstruction: A Bibliometric Analysis. Orthopaedic Journal of Sports Medicine,9(2),2325967120976372.https://doi.org/1 0.1177/2325967120976372.

- **Thitirungruang, K. (2020)**: Arthroscopic Reconstruction of the Anterior Cruciate Ligament: Comparison between One Day Surgery Care with Remnant Preserving Technique and Conventional Care with Standard Technique. Journal of Southeast Asian Orthopaedics, 44(1-2), 27-33.

▪ **Thomas, L. (2020):** Quasi-Experimental Design | Definition, Types & Examples. Available at: https://www.scribbr.com/methodology/quasi-experimental-design/ Accessed on: 19 January, 2023 10:00 pm.

▪ **Venkataraman, S., Ethiraj, P., Shanthappa, A.H., & Vellingiri, K. (2022):** Association of Meniscus Injuries in Patients with Anterior Cruciate Ligament Injuries. Cureus; 14(6):e25878.doi:10.7759/cureus. 25878. PMID: 35844312; PMCID: PMC9275808.

▪ **Voss, A., Pfeifer, C., Kerschbaum, M., Rupp, M., Angele, P., & Alt, V. (2021):** Post-operative septic arthritis after arthroscopy: modern diagnostic and therapeutic concepts. Knee Surgery, Sports Traumatology, Arthroscopy, 29(10), 3149-3158.

▪ **Wohl, T., Criss, C., & Grooms, D. (2021):** Visual perturbation to enhance return to sport rehabilitation after anterior cruciate ligament injury: a clinical commentary. International Journal of Sports Physical Therapy, 16(2), 552.

▪ **Yang, Y., Jin, Z., Luo, J., Zhang, D., Shen, P., Zheng, D., & Bai, L. (2022):** Primary repair for treating acute proximal anterior cruciate ligament tears: a histological analysis and prospective clinical trial. Frontiers in Bioengineering and Biotechnology, 10.