Arthroscopic Reconstruction of the Anterior Cruciate Ligament: Comparison between One Day Surgery Care with Remnant Preserving Technique and Conventional Care with Standard Technique

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Purpose: *To compare the outcomes of different methods after arthroscopic ACL reconstruction. The two methods used are: one-day surgery care method, using remnant preserving ACL reconstruction technique, and the conventional care method, using standard ACL reconstruction technique.*

Patients and Methods: *The sample groups include: patients admitted into the orthopedics department at Chonburi Hospital from September 1st, 2017 to June 30th, 2018. The sample groups were divided into experimental (one day surgery care and remnant preserving ACL reconstruction) group of 30 patients and control (conventional care and standard ACL reconstruction) group with 32 patients. The comparison was made on the basis of: scoring of pain after surgery, costs of hospital care, amount of bleeding in the first 24 hours, surgical operation time, postoperative wound infections, and days admitted in the hospital.*

Results: *There were significant difference between postoperative pain (p=0.025), costs of hospital care (p=0.00), amount of bleeding in 24 hours (p=0.00), and amount of days admitted in the hospital (p=0.00). However, the operation time and postoperative wound infections, showed no significant differences.*

Conclusion: *The one-day surgery care, using remnant preserving ACL reconstruction technique, has a better outcome than the conventional care method, using standard ACL reconstruction technique. Furthermore, the one-day surgery care method can be improved and further developed for outpatient care as well.*

Keywords: *one day surgery care, remnant preserving ACL*

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Introduction

Anterior cruciate ligament (ACL) tear is one of the most common types of knee injuries. 70% of ACL injury cases were caused by sport injury[1], which affected both amateur and professional athletes. According to various sources, the incidence of ACL tears for Americans aged 15-45 years was 68.7 of 100,000[2]. In addition, there were more than 200,000 new cases per year, where 80,000 of new cases were treated with ACL reconstruction[3]. In terms of surgical techniques used for ACL surgery, arthroscopic-assisted surgery was more widely accepted than open knee surgery. This was because there were decreased trauma in connective tissues surrounding the site of incision, increased clarity at the site of incision due to the use of a magnifying camera, decreased post-surgical pain, and quicker time of recovery. However, the disadvantage of the main problem was to spend more time learning about functioning and have more complex techniques than the open knee surgery[4].

In 2017, Deisi Ferrari and team[5] reviewed and analyzed the study comparing ACL reconstruction in outpatient care and inpatient care with regards to cost and treatment outcomes in a total of 7 studies. It was found that ACL reconstruction in outpatient care lowered the total cost by 1,371-7,390 USD when compared to inpatient ACL reconstruction. However, there were no significant differences in outcomes between these two groups with regards to complications, pain, or the function of the joint and strength of muscles.

In 2017, Takeshi Muneta and Hideyuki Kogy[6] reviewed the ACL remnant preserving technique and its values for preservation in terms of effects on the healing remnant classifications, assessment of the biomechanics and association with proprioception. In both the animal study and clinical study of the remnant ACL technique, the ACL had the same healing ability as other soft tissues, but the synovial may affect the healing process.

There are many techniques, including the behind-remnant approach[7] and direct visualization established by Sattre and team[8].

Remnant-preservation in ACL reconstruction can decrease the expansion of the tibia tunnel and does not affect the clinical outcomes. From this research it was found that 50% of cases with remnant preservation ACL reconstruction had a larger graft and better synovial coverage. The cyclops lesions found from remnant ACL reconstruction were not significantly greater

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than procedures without remnant ACL preservation, nor do the cyclops lesions found caused pain or impaired full knee extension[8].

In conclusion, remnant preserving ACL reconstruction is effective in healing, faster recovery time for sports, and has fewer occurrences of bruising. Thus, I am interested in ACL reconstruction using arthroscopy in one day inpatient care using remnant-preservation ACL reconstruction technique.

I, as a researcher, have worked in Chon Buri Hospital. From 2015 to 2017, there had been 54, 73 and 112 knee ligament patients respectively. There had been 53, 52 and 90 ACL injury patients respectively[9]. Due to the increasing likelihood of ACL injury occurring yearly, I think over that the cost of the arthroscopic surgery rises, because patients must have stayed in the hospital for several days, according to the research of nursery cost analysis and the length of ACL reconstruction surgery in Men's Orthopedic surgery room at Songkhlanagarind Hospital[10]. Therefore, I was interested in undergoing study to compare the outcomes in terms of postoperative pain scoring, costs of hospital care, amount of bleeding in 24 hours, surgical operation time, postoperative wound infections, and days admitted in the hospital, for different methods of arthroscopic ACL reconstruction, using a one day surgery care with remnant preserving technique and conventional care with standard technique. Based on my research, there should be differences in the outcomes after surgery between a one day surgery care with remnant preserving technique and conventional care with standard technique.

Patients and Methods

The study is an experimental study design and was approved by institutional board review, and was conducted from September, 2017 till June, 2018. The sample size was determined for experiment according to the central limit theorem of Bartz (1999), with 30 patients per group. The sampling technique used was purposive sampling, where patients with ACL tear were divided into two groups as follows: 32 control group patients (conventional care and standard ACL reconstruction) and 30 trial group patients (one-day care and remnant preserving ACL reconstruction). Inclusion criteria included patients with isolated ACL injuries without any meniscal or chondral injuries, no previous surgery and full range of motion. Exclusion criteria included patients with inflammatory knee, multiple ligament injuries, bleeding disorders and revision case.

The study method consisted of 4 steps: preparation for pre-operation, the way of surgery, postoperative care and an appointment to follow up.

Pre-operative preparation and surgery technique are as follows: in control group, the patients were admitted one day before surgery, standard ACL reconstruction. Conventional care was used until discharge. In trial group, the patients received remnant preserving ACL reconstruction, tranexamic acid, and a one-day post-surgery care (next day discharge). All surgeries were performed by single surgeon, using knee arthroscopic surgery set, branded Stryker, model 2013. In the control group, standard ACL reconstruction uses a technique that removes total ACL remnant for identification of the femoral and tibia site, in order to perform ACL reconstruction with semitendinosus tendon, either alone or accompanied by the gracilis tendon.Bio-absorbable screws were used for graft fixation as shown in the picture:(Fig.1)

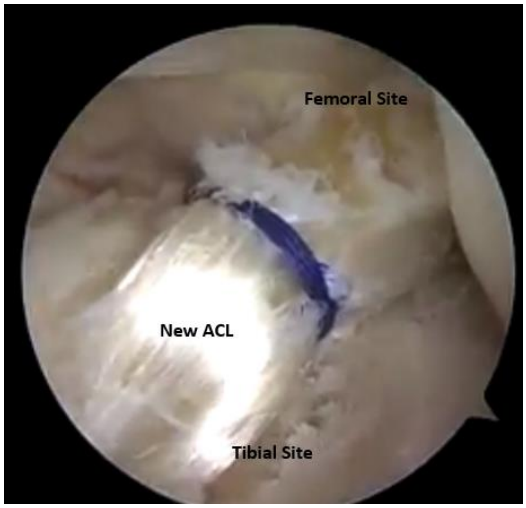


Fig. 1 Standard Technique.

In the experimental group, remnant preserving ACL reconstruction technique does not require debridement or minimal debridement of ACL, but uses the remnant ACL for identification of the ACL graft position with behind remnant approach as shown in the pictures: (Fig.2-4)

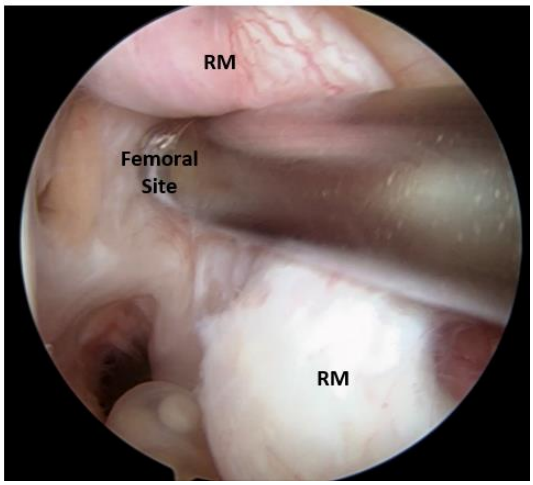
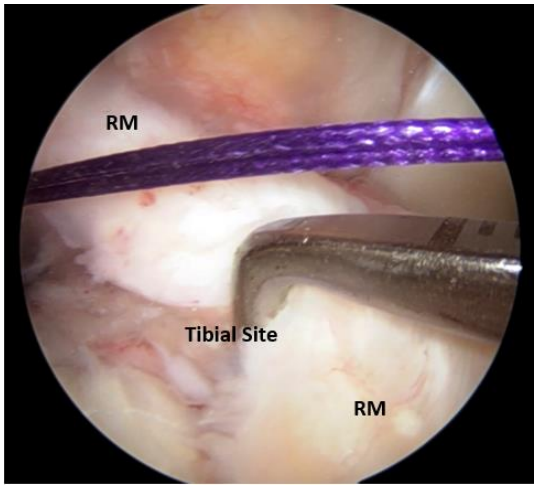


Fig. 2 Remnant technique femoral site.



RM: remnant ACL

Fig. 3 Remnant technique tibial site.

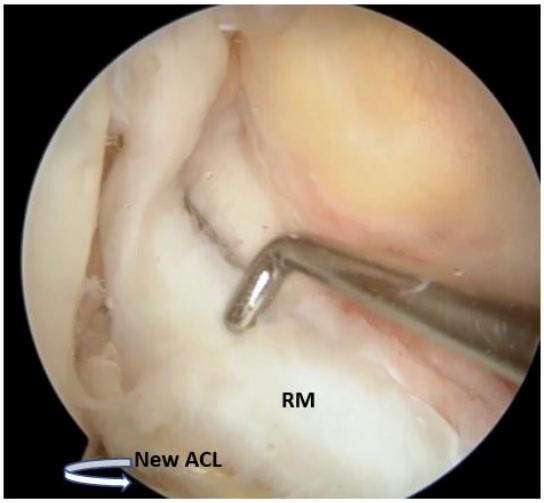


Fig. 4 Remnant preserving ACLR.
New ACL is below the remnant part, as indicated with the arrow

The post-operative criteria for discharge in one day surgery care with remnant preserving technique group included pain scoring on the visual analog scale (VAS), bleeding amount (in milliliters) measured at 24 hours from radivac drain and then taken off immediately, application of knee brace in full extension, and utilization of the axillary crutches for gait training. All post-operative criteria for discharge in conventional care with standard technique group are the same as the remnant ACL preservation group, except that patients in this group were measured the amount of blood from the radivac drain at 24 hours and 48 hours, then immediately taken off the drain, and finally discharged after completion of physical therapy. For both groups, the post-operative pain-killer included paracetamol 500 mg per oral, p.r.n. and naproxen 250 mg 1 tablet per oral, b.i.d. Patient follow-up appointments were scheduled at the 1st week, 2nd week, and 4th week after operation to determine the rate of post-operative wound infection.

Data Analysis: Descriptive Statistics: amount, percent, average and standard deviation and Inferential Statistics: Independent t test and Fisher Exact test

Results

1. General Data

Both the control group and trial group have similar general information. 90% of patients in the trial group were males and 87.5% were males in the control group. 56.7% of patients in the trial group were employees and 50.0% of patients in the control group were employees. 63.7% of patients in the trial group aged 27-48 years while 53.1% of those in the control group were from the same age range. The cause of injury to sports was 80.0% in the trial group and 75% in the control group. 100% of the trial ones and 90.6% of the control ones had no underlying diseases illustrated on the table 1.

2. Surgery Data

The trial group's early 24-hour postoperative VAS score was 5.233 on average; the control group's one was 6.187 on average. For comparative statistics, it indicated that the trial group's pain score was significantly less than the control group's. The trial group's treatment cost was 48,349.53 baht on average; the control group's one was 58,026.68 baht on average. For comparative statistics, it found that the trial group's cost was significantly less than the control group's. The trial group's 24-hour operative blood loss from drain was 55.33 ml. on average; the control group's one was 96.87 ml. For comparative statistics, it showed that the trial group's blood loss from drain was significantly less than the control group's. Trial group's length of surgery was 64.733 minutes on average; the control group's one was 68.437 minutes. Comparative statistics was no significant difference. The trial group's length of stay in the hospital was 1.13 days on average; the control group's one was 4.5 days. For comparative statistics, it found that the trial group's length of stay significantly less than control group's one illustrated on the table 2.

Both the trial and control groups' surgical wound was not infected. Their comparative statistics was no significant difference illustrated on the table 3.

Table 1 Amount and Percent of the trial and control groups, classified by general data.

General Data	Trial Group		Controlled Group		χ^2	P
	Amount	Percent	Amount	Percent		
Gender						
Male	27	90.0	28	87.5	.097	1.0*
Female	3	10.0	4	12.5		
Occupation						
Civilian/Entrepreneur	7	23.3	6	18.8	2.302	.512
Employee	17	56.7	16	50.0		
Student	4	13.3	9	28.1		
Trader	2	6.7	1	3.2		
Age						
19 - 26 yrs. old	11	36.7	15	46.9	.310	.578
27 - 48 yrs. old	19	63.3	17	53.1		
Injury Causes						
sports	24	80.0	24	75.0	.594	.441
traffic	3	10.0	8	25.0		
others	3	10.0	0	0.0		
Underlying Disease						
Yes	0	0.0	3	9.4	4.111	.238*
No	30	100.0	29	90.6		

* Fisher Exact test

Table 2 The trial and control groups' comparison of pain, cost, blood loss from drain, the length of surgery and the length of stay in the hospital.

Variables	Trial Group		Controlled Group			
	X	S.D.	X	S.D.	t	p
Pain	5.233	1.869	6.187	1.378	-2.292	0.025
Cost (Baht)	48349.53	3706.937	58026.68	7233.280	-6.562	0.000
24-hour postoperative blood loss from drain (ml)	55.33	32.982	96.87	51.708	-3.743	0.00
Length of surgery (minute)	64.733	13.385	68.437	25.391	-0.725	0.472
Length of stay in the hospital	1.13	0.434	4.50	0.879	-19.285	0.00

Table 3 The comparison of the trial and controlled groups' infected wound.

Infected Wounds	Not infected (person/percent)	Infected (person/percent)
Trial group	32/100.00%	0/0.00%
Controlled group	30/100.00%	0/0.00%

Discussion

Part 1 General Data

Both the trial and control groups' sample group consisted of 62 patients. Most of them were male: 90 % of the trial group and 87.5% of the control one. The trial group's age of 27-48 was 29.43 years; the control group's one was 26.93. Most of patients' occupation was employee. The trial group's occupation was 56.7%; the control group's one was 50%. 80% of the trial group's injury cause and 75% of the control group's one came from sports injury, associated with the incident of ACL injuries in USA which were found in male more than female at the age of 15-45. And 70% of the ACL injury cause was found in amateur and professional sports persons[1].

Part 2 Surgery Data

The score of 24-hour postoperative pain of the trial and control groups was 5.2333 and 6.187 on average respectively. For comparative statistics, it found that the trial group's pain score was significantly less than the control group's. As a result, the trial group received 1g tranexamic acid injection intravenously 15 minutes prior to using the tourniquet. Tranexamic acid contributed to the lower pain assessment score seen in the trial group, because the drug can decrease the amount of bleeding from the knee joint after surgery, as

supported by Faith Karaaslan and his team's research[11]. Karaaslan's research found that patients who received intravenous injection of tranexamic acid 15 mg per 1 kg of body weight, 15 minutes prior to tourniquet use, had a lower visual analog score for pain when compared to the group without tranexamic acid injection. The trial group's surgical cost was 48,349.53 baht on average, whereas the control one's was 58,026.68 baht on average. For comparative statistics, the trial group's cost was significantly less than the control one's, associated with Deisi Ferrari and his team's research[5]. They reviewed and analyzed the study of ACL reconstruction surgery for outpatients, compared with inpatients. For treatment cost, outpatients' ACL reconstruction surgery cost could reduce from US dollar 1,371 to 7,390, compared with inpatients' one. For the detailed surgery cost, it found that besides the cost of surgical instruments, nursing service activities after surgery cost so high, associated with Wilawan Tipmongkol and her team's research[10]. They conducted the study of cost analysis of nursing service activities and ACL reconstruction surgery length in Songklanagarind Hospital. It found that the highest nursing service activities cost was the postoperative nursing. It cost 70,874.21 baht. It was 65% of total nursing activities cost. And the surgery cost resulted from the length of stay in the hospital. In the trial group, the stay length in the hospital was 1.132 days on average. It resulted from a patient who could not go back home in the next day due to his inconvenience of returning home. So, he was necessary to prolong his stay in the hospital for next 2 days. And the control group was 4.5 days on average. For comparative statistics, it found that the trial group's length of stay in the hospital was significantly less than the control group's. And there was no effect on the infection of wound which was no significant difference in both groups. In other words, Chon Buri Hospital is the hospital which is placed under standard infection surveillance of each of treatment steps, associated with Alexendre Lunebourg and his team's research[12] who conducted the study of the comparison with the ACL reconstruction surgery results of outpatients and inpatients. It found that 2 groups' clinic and complication scores were not different. The trial group's early 24-hour blood loss from drain was 55.33 ml. on average; the control group's one 96.87 ml. For comparative statistics, it found that the trial group's blood loss from drain was significantly less than the control group's one. Because the trial group's surgery method was treated through1-gram tranexamic acid injection into the vein within 15 minutes before tourniquet to decrease postoperative blood loss, according to Fatih Karaaslan and his team's research[11]. They conducted the study of the result of using tranexamic acid for reducing blood loss. For 105 patients with ACL reconstruction surgery, it found that the group with tranexamic acid could lower blood loss inside the knee. The trial group's surgical length was 64.73 minutes on average; the control group's one 68.43 minutes on average. The comparative statistics' difference was not found because process of operation is similar, except 1-gram tranexamic acid injection into the vein and surgical technique.

Additionally, data collected for long-term follow-up of the remnant ACL preserving group, the international knee documentation committee (IKDC) score improved from 41.5 points to 76.70 points, and the Lysholm score improved from 55.4 points to 92.6 points after one year, all without complications.

Part 3 Additional Benefits of Study

The outcomes of this experiment can establish the foundation for surgical operations and guide the development for the one day surgery method in various operations and serve as a guide for the creation of the CPG (Clinical Practice Guideline) for the treatment of patients with anterior cruciate ligament tear. Furthermore, this experiment allowed for a lower total costs and days admitted in the hospital for injured patients.

Conclusion

The one-day surgery care, using remnant preserving ACL reconstruction technique, has a better outcome than the conventional care method, using standard ACL reconstruction technique. Furthermore, the one-day surgery care method can be improved and further developed for outpatient care as well.

Suggestions for next Research

1. Develop guidelines for outpatients' ACL reconstruction surgery.

2. Conduct the study of the result of the medium-term, long-term treatment through Arthroscopic surgery with remnant preserving ACL reconstruction technique in the aspect of the efficiency on the function of ACL.

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การเปรียบเทียบผลการผ่าตัดสร้างเส้นเอ็นไขว้หน้าผ่านการส่องกล้องด้วยวิธีดูแลภายใน 1 วัน โดยวิธีเก็บรักษา ALC ส่วนที่เหลือไว้กับวิธีดูแลแบบเดิมโดยวิธีตัด ACL ส่วนที่เหลือออกในโรงพยาบาลชลบุรี

กันตนพ ฐิติรุ่งเรือง, พบ

การวิจัยครั้งนี้เป็นการวิจัยเชิงทดลอง (True experiment research) มีวัตถุประสงค์เพื่อเปรียบเทียบผลการผ่าตัดสร้างเส้นเอ็นไขว้หน้าผ่านการส่องกล้องโดยวิธีการดูแลภายใน 1 วัน (One day surgery care) โดยเทคนิคการรักษา ACL ส่วนที่เหลือเดิมไว้ (remnant preserving ACL reconstruction) กับวิธีดูแลแบบเดิม (conventional care) โดยเทคนิคการเอา ACL ส่วนที่เหลือเดิมออก (standard ACL reconstruction) ในด้านต่าง ๆ ได้แก่ คะแนนความเจ็บปวดหลังผ่าตัด ค่าใช้จ่ายในการผ่าตัด ปริมาณเลือดที่ระบายออกใน 24 ชั่วโมงแรก ระยะเวลาในการผ่าตัดการติดเชื้อของแผลผ่าตัด และจำนวนวันนอนในโรงพยาบาล กลุ่มตัวอย่างได้แก่ผู้ป่วยที่เข้ารับการรักษาเอ็นไขว้หน้าข้อเข่าฉีกขาดที่มารับการรักษาที่แผนกออร์โธปิดิกส์ โรงพยาบาลชลบุรีตั้งแต่วันที่ 1 กันยายน 2560 ถึงวันที่ 30 มิถุนายน 2561 โดยการเลือกกลุ่มตัวอย่างแบบเจาะจง จำนวน 62 คน แบ่งเป็นกลุ่มทดลอง 30 คน กลุ่มควบคุม 32 คน วิเคราะห์ข้อมูลโดยใช้สถิติพรรณนา ได้แก่ ร้อยละ ค่าเฉลี่ย และส่วนเบี่ยงเบนมาตรฐาน และสถิติอนุมาน ได้แก่ Independent t test และ Fisher Exacttest ผลการวิจัยพบว่า ผลการผ่าตัดมีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติในด้านความเจ็บปวดหลังผ่าตัด(p=0.025) ค่าใช้จ่ายในการผ่าตัด(p=0.00) ปริมาณเลือดที่ระบายออกใน 24 ชั่วโมงแรก (p=0.00) และ จำนวนวันนอนในโรงพยาบาล(p=0.00) ส่วนระยะเวลาในการผ่าตัดและการติดเชื้อของแผลผ่าตัดไม่แตกต่างกัน ดังนั้นการผ่าตัดสร้างเส้นเอ็นไขว้หน้าผ่านการส่องกล้องโดยวิธีการดูแลภายใน 1 วันโดยเทคนิคการรักษา ACL ส่วนที่เหลือเดิมไว้ ให้ผลที่ดีกว่าวิธีดูแลแบบเดิม (conventional care) โดยเทคนิคการเอา ACL ส่วนที่เหลือเดิมออก และสามารถพัฒนาต่อเป็นการผ่าตัดแบบผู้ป่วยนอกได้