CLINICAL SCIENCE

PAIN ASSESSMENT AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WITH AUTOGRAFT: QUADRUPLED M.SEMITENDINOSUS VERSUS M.SEMITENDINOSUSANDM.GRACILIS

Zoran Nestorovski[1], Zorica Vangelovska[1], Ana-Marija Ilieva[1]

[1] *City General Hospital"8th of September", Skopje, Republic of North Macedonia*

Citation: Nestorovski Z, Vangelovska Z, Ilieva AM .Pain assessment after anterior cruciate ligament reconstruction with autograft: quadrupled m.semitendinosus versus m.semitendinosus and m.gracilis. Arch Pub Health 2023; 15 (1). doi.org/10.3889/aph.2023.6073

OnlineFirst

Key words: anterior cruciate ligament, pain control, knee arthroscopy, anterior ligament reconstruction, autograft

***Correspondence:** Zoran Nestorovski, City General Hospital "8th of September", Skopje, Republic of North Macedonia.

E-mail: nestorovskizoran@yahoo.com

Received: 20-Jan-2023; **Revised:** 10-Feb-2023; **Accepted:** 28-Feb-2023; **Published:** 5-Mar-2023

Competing Interests: The author have declared that no competing interests

Abstract

Anteriorcruciate ligament (ACL) tear is one of the most common sports injuries. The all-inside technique (AIT) for anterior cruciate ligament reconstruction (ACLR) is gaining popularity as a more anatomic, less invasive technique with the potential for more rapid recovery. With the recent advances in the field of sports medicine, the all-inside technique is reported to have less postoperative pain as compared to the conventional transportable procedure. The purpose of this research is to determine the differences in acute pain levels between undergoing ACL reconstruction hamstring autograft m. Semitendinosus and m.gracilis versus hamstring autograft quadrupled m.semitendinosus in first and second postoperative day. Materials and Methods: A total of 80 patients in period of two years who underwent primary ACL reconstruction using either HS autograft m.semitendinosus and m.gracilis or HS autograft quadrupled m.semitendinosus consented to participate. The primary outcome of the study was postoperative pain levels that were collected after surgery at first and second day. For the quantification of the intensity of pain after the surgery the patients were offered a Visual Analogue Scale (VAS scale), numbered from 0 to 10 (0 means no pain, 10 is the strongest pain). This part of the research shows the results obtained by processing patients with ACL, treated at the Department of Orthopaedics and Traumatology in the City General Hospital „8th of September" in Skopje. Results: The average postoperative score one day after surgery for patients with a standard method using a graft in the form of a duplication of m.semitendinosus and m.gracilis based on the VAS scale was 7.70 +0.9 and the score second day after surgery was 4.75 + 1.1.The average postoperative score a day after the surgery for patients treated with the method where only m.semitendinosus is used as a graft and that in the form of quadruplication based on the VAS scale was 3.90 +3.1and the score second day after surgery was 2.70 +2.7. Conclusion: A significant reduction in acute postoperative pain was found when performing ACL reconstruction with HS quadrupled m.semitendinosus compared to HS m.semitendinosus-m.gracilis.

КЛИНИЧКИ ИСПИТУВАЊА

ПРОЦЕНКА НА БОЛКА ПО РЕКОНСТРУКЦИЈА НА ПРЕДЕН ВКРСТЕН ЛИГАМЕНТ СО АУТОГРАФТ:КВАДРИПЛИКАТУРА НА M.SEMITENDINOSUS НАСПРОТИ M.SEMITENDINOSUSИМ.GRACILIS

Зоран Несторовски[1], Зорица Вангеловска[1], Ана-Марија Илиева[1]

[1] *Градска Општа Болница 8ми Септември, Скопје, Република Северна Македонија*

Цитирање: Несторовски З, Вангеловска З, Илиева АМ. Проценка на болка по реконструкција на преден вкрстен лигамент со аутографт: квадрипликатура на m.semitendinosus наспроти m.semitendinosusим.gracilis. Арх J Здравје 2023;15(1) doi.org/10.3889/aph.2023.6073 OnlineFirst

Клучни зборови: преден вкрстен лигамент, контрола на болка, артроскопија на колено, реконструкција на предниот лигамент, аутографт

***Кореспонденција:** Зоран Несторовски, Градска Општа Болница 8ми Септември, Скопје, Република Северна Македонија. E-mail: nestorovskizoran@yahoo.com

Примено: 20-јан-2023 **Ревидирано:** 10-фев-2023; **Прифатено:** 28-фев-2023; **Објавено:** 5-мар-2023

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Повредата на предниот вкрстен лигамент (ПВЛ) е една од најчестите спортски повреди. Техниката all-inside (AIT) за реконструкција на предните вкрстени лигаменти (РПВЛ) се здобива со популарност како повеќе анатомска, помалку инвазивна техника со потенцијал за побрзо закрепнување. Со неодамнешниот напредок во областа на спортската медицина, техниката „all-inside" е регистрирана дека има помала постоперативна болка во споредба со конвенционалната транспортна процедура. Целта на овој труд е да се утврдат разликите во нивоата на акутната болка помеѓу аутографтот на тетивата за реконструкција на ПВЛ со m.semitendinosus и m.gracilis наспроти аутографт на тетива со квадрипликатура на m.semitendinosus во првиот и вториот постоперативен ден. Материјали и методи: Вкупно 80 пациенти во период од 2 години кои беа подложени на примарна реконструкција на ПВЛ со користење на аутографт на HS (m.semitendinosus-m.gracilis) или HS аутографт (m.semitendinosus) учествуваа во ова студија. За квантификација на јачината на болка по извршената оперативна интервенција на пациентите им беше понудена ВАС скала, нумерирана од 0 до 10, при што 0 значи нема болкаа 10 најсилна болка.Во ова истражување прикажани се резултатите на пациенти со повреда на преден вкрстен лигамент, лекувани во Градската општа болница „8-ми Септември" на Одделението за ортопедија и трауматологија. Резултати: Просечниот постоперативен резултат еден ден по операцијата за пациенти хируршки третирани со стандардна метода користејќи графт во форма на дуплирање на m.semitendinosus и m.gracilis врз основа на Visual Analogue Scale(VAS) скалата беше 7,70 +0,9, а резултатот од вториот ден по операцијата беше 4,75 +1,1. Просечниот постоперативен резултат еден ден по операцијата за пациенти хируршки третирани со метода, каде што само m.semitendinosus се користи како графт и тоа во форма на квадрипликатура врз основа на VAS скала изнесуваше 3,90 + 3,1, а резултатот од втор ден по операцијата изнесуваше 2,70 +2,7. Заклучок: Значително намалување на акутната постоперативна болка беше забележано при изведување на реконструкција на ПВЛ со HS со квадрипликатура на (m.semitendionosus) во споредба со реконструкција со HS (m.semitendinosus-m.gracilis).

Introduction

Anterior cruciate ligament (ACL) tear is one of the most common sports injuries. ACL rupture is a common type of knee ligament injury that is more common atphysically active people than at non-active people[1]. This ACL injury may result in pain, functional limitations, osteoarthritis after knee trauma, and a lower quality of life[2]. Surgical reconstruction is the most commonly used treatment after high grade ACL injuries[3]. The all-inside technique (AIT) for anterior cruciate ligament reconstruction (ACLR) is gaining popularity as a more anatomic, less invasive technique with the potential for more rapid recovery[4]. ACL tear is a common injury caused by sports accidents or other knee injuries, with little distinction between regions and countries, prevalent among working-age patients. Traditional literature has generally supported ACL reconstruction over ACL repair, considering to be the current 'gold standard' treatment for an ACL tear[5]. The use of hamstring tendons for anterior cruciate ligament reconstruction has become more accepted in recent years. The use of a doubled semitendinosus tendon grafts versus a quadrupled semitendinosus tendon graft is still a matter of contention[6].Anterior cruciate ligament reconstruction using the hamstring tendon autograft is a well-recognised and commonly performed procedure across the world. The 'all-inside' ACL reconstruction technique is a new development which is gaining popularity due to its unique features of using a single tendon autograft as compared to two tendon autografts used in the conventional technique. Many studies have alluded to the good functional results of the all-inside techniquealong with its other advantages for example, its bone preserving nature, reduced postoperative pain and smaller skin incision. The all-inside technique (AIT) for anterior cruciate ligament reconstruction is gaining popularity as a more anatomic, less invasive technique with the potential for more rapid recovery. This systematic review aims to critically assess components of the technique its safety profile, outcomes and complications[7]. The goal of the all-inside method is to minimize surgical trauma. This has also affected clinical outcomes by decreasing pain and morbidity, speeding up recovery and return to activities, more cosmetically attractive results, and finally better stability and overall knee function. All these potential theoretical advantages must be validated in clinical trials[8].

The purpose of this research is to determine the differences in acute pain levels between undergoing ACL reconstruction hamstring autograft m. semitendinosus - m. gracilis versus hamstring autograft quadrupled m. semitendinosus in first and second postoperative day.

Materials and methods

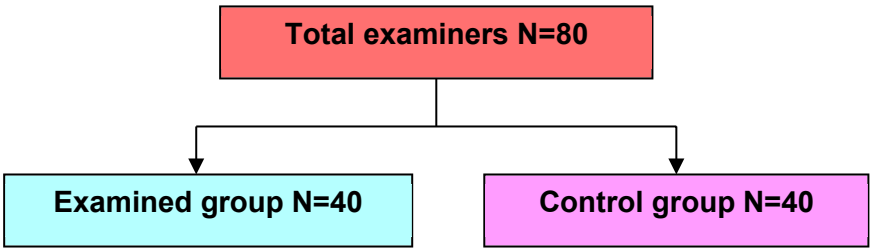
We performed a retrospectively analysis of patients' analysis undergoing ACL reconstruction surgery in early postoperative pain compare HS autografts quadrupled (m.semitendinosus) vs HS autografts (m.semitendinosus-m.gracilis). A total of 80 patients who were surgically treated at City General

Hospital "8th of September" were included in this study in period of two years. Inclusion criteria included patient from 18 to 35 years with complete rupture of ACL and patient without before surgery of the knee. Exclusion criteria were patient under 18 years, patient with other surgery of the knee and patient with partial rupture of ACL. Patients consented for inclusion in the study underwent arthroscopically assisted ACL reconstruction using HS autografts quadrupled (m.semitendinosus) or HS (m.semitendinosus vs m.gracilis). For the purpose of quantifications of strength of the pain in the first and second postoperative days the patients were offered a VAS scale, numbered from 0 to 10 (0 means no pain, 10 is the strongest pain). For statistical analysis, SPSS v19.1 was applied and all data was collected in digital tables. The nonparametric Mann-Whitney U test for independent samples was used to analysedifferences in mean VAS scores between the two patient groups. Intragroup variability for the same subjects was examined using a Wilcoxon matched-pairs test in two measurements on all-inside technique compared to the conventional transportable procedure. Statistical significance was assumed at $p < 0.05$.

Results

80 patients had ACL reconstruction and they were divided in two groups (picture 1). First group (40 patients) consist of control group (CG) and they were operatively treated with standardmethod with hamstrings autograft with depicture od m.semitendinosus and m.gracilis. Second or examined group (40 patients) consist of initial group (IG) operatively treated with hamstring autografts of quadrupled m.semitendinosus.

Fig. 1. Participants of study



Gender difference between the 2 groups is presented in Table 1. Demographic structure of the respondents included 71.2% (N=57) male and 28.8% (N=23) female. Men patients dominated in both groups. Specifically,67.5%(N=27) in examiner group were male and 75%(N=30) in control group. Tested difference for distribution of male and female patient between examiner and control group gave no significant statistical difference (p=0.46). According to the gender distribution, we may conclude that the two groups were homogeneous.

Table 1. Gender of patients

Gender	Groups			p-level
	N (%)	CG* N (%)	IG** N (%)	
Male	57 (71.3)	27 (67.5)	30 (75)	$\chi 2$ =0.55
Female	23 (28.7)	13 (32.5)	10 (25)	p=0.46
Total	80 (100)	40 (100)	40 (100)	ns

Note: *CG (graft from m.semitendinosus), ** IG (grafts from m.semitendinosus and m.gracilis)

Also, concerning the patients age from the both groups they were homogenous,i.e., there was no significant differences concerning the age (p=0.77). Patients from CG were of age between 20 and 52, the mean age was 32.2 ± 9.8 age; patients from IG were of age between 20 to 58 age old, the median age was 31.5 ± 9.0.

According to Table 2 first day after the operation patient in CG have grade the pain with average score of 7.70 ± 0.9 and the patient IG average of 3.90 ± 3.2. More than half of the patients in CG in the day of the intervention had pain which they have graded with 8, otherwise half of the patients with IG had pain with strength larger than 3. Statistical analyses of signification have confirmed stronger pain by patients treated with graft m.semitendinosus-m.gracilis compare with patients who have used graft form m.semitendinosus (p<0.01).

Table 2. VAS first day post-operations

Group	Post-operations clinical examinations			p-level
	Descriptive Statistics			
	mean ± SD	min – max	median (IQR)	
CG	7.70 ± 0.9	6 – 9	8 (7 – 8)	Z=4.93*
IG	3.90 ± 3.2	1 – 10	3 (1 – 7)	p=0.000001 sig

Note: *Z (Mann-Whitney U Test)

Table 3 shows distribution of the scores for VAS scale in both groups of patients, one day after the surgery procedure. In CG the most patients' intensity of pain has been graded with 7 (N=12; 30%) while patients with IG pain have graded the pain with the weakest grade or score (N=13; 32.5%).

Table 3. VAS scale in both groups

First day post-operation	Groups		
	Total	CG* n (%)	IG** n (%)
1	13	0	13 (32.5)
2	6	0	6 (15)
3	6	0	6 (15)
4	1	0	1 (2.5)
5	2	0	2 (5)
6	5	4 (10)	1 (2.5)
7	15	12 (30)	3 (7.5)
8	20	16 (40)	4 (10)
9	8	8 (20)	0
10	4	0	4 (10)

Note: *CG (graft from m.semitendinosus), ** IG (grafts from m.semitendinosus and m.gracilis)

After second day of the surgery, VAS scale has presented higher scores of CG versus of IG (Table 4). Namely, mean score was 4.75 ± 1.1 in examination group versus 2.70 ± 2.7 incontrol group.Statistics analysis shows that CG patients received higher VAS scores on the second postoperative day compared to IG patients ($p<0.01$). We can conclude that on the second postoperative day, patients operated with HS (m.semitendinosus-m.gracilis) have significantly stronger pain than patients treated with HS quadrupled (m.semitendinosus).

Table 4. VAS scale second post-operation day

Group	Post-operations clinical examinations			p-level
	Descriptive Statistics			
	mean ± SD	min – max	median (IQR)	
CG	4.75 ± 1.1	2 – 7	5 (4 – 6)	Z=4.65*
IG	2.70 ± 2.7	1 – 10	1 (1 – 3.5)	p=0.000003 sig

Note: *Z (Mann-Whitney U Test)

Distribution of score from VAS scale, two days after surgery presented at the CG patients have been scored with intensity of pain 4(N=14;35%) while more than half of the patients in IG second postoperative day don't feel pain (N=23;57.5%) (Table 5).

Table 5. Second post-operation day

First day post-operation	Groups		
	Total	CG* n (%)	IG** n (%)
1	23	0	23 (57.5)
2	5	1 (2.5)	4 (10)
3	6	3 (7.5)	3 (7.5)
4	15	14 (35)	1 (2.5)
5	14	11 (27.5)	3 (7.5)
6	11	9 (22.5)	2 (5)
7	3	2 (5)	1 (2.5)
10	3	0	3 (7.5)

Note: *CG (graft from m.semitendinosus), ** IG (grafts from m.semitendinosus and m.gracilis)

Regarding the VAS scores at CG and IG, evaluation by Wilcoxon Matched Pairs Test showed that there was significant difference between the first and second post-operation day (p>0.01).

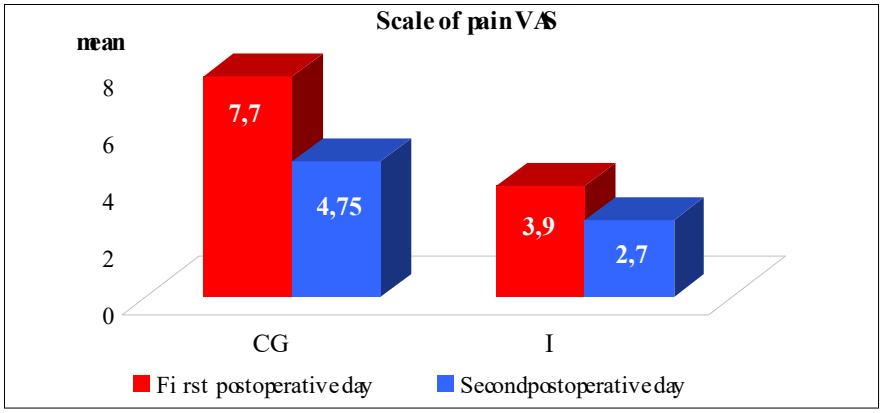
Table 5. Difference between first and second day

Scale of the pain VAS	Groups	
	CG mean ± SD	IG mean ± SD
Scale of the pain VAS	7.70 ± 0.9	3.90 ± 3.1
Second post-operation day	4.75 ± 1.1	2.70 ± 2.7
p-level	Z=5.51 p=0.0000 sig*	Z=3.92 p=0.0000 sig*

Note: *p(Wilcoxon Matched PairsTest)

From Figure 2 it can be seen that IG patients have a lower score on the VAS scale on the first and second postoperative day (3.90 ± 3.1) than CG (7.70 ± 0.9).

Figure 2. Mean difference on VAS



Discussion

Although it is difficult to anticipate the future, historically, sports medicine and arthroscopy are developing to be increasingly less invasive. With the advantages of less trauma (only semitendinosus muscle or allogeneic tendon), less early pain (preservation of bone cortex and periosteum) and reliable fixation effect the All-inside technique has become an increasingly popular approach of ACLR. This technique has limitations as well as a long learning curve and affects proprioception and vascularization since it is unfit for reconstruction through stump preservation.

Also, the titanium plates may lead to bone tunnel enlargement and graft loosening[9]. The literature review did not identify a significant difference in post-operative functional outcomes between AIT and TP group.

Many studies have compared the outcomes between single bundle and double bundle grafts in ACL reconstruction and overall found no significant differences in clinical and functional outcomes. The optimal outcome scoring system for evaluating the outcome of ACLR is still a controversial issue in which various subjective or objective scoring methods such as IKDC, Lysholm, KSS, SF-12, KOOS and VAS scoring systems were used among the studies.

Chorea Benea et al., reported the results of a randomized controlled trial conducted between December 2010 and September 2011. The primary outcome measure analysed was pain score at one month. The results show that postoperative pain was slightly better with the all-inside technique. The difference in postoperative pain between the two groups at one month was at the limit of statistical significance because the study was underpowered.

In particular, a study of 37 patients by Toan D. Duong et al. evaluated postoperative clinical and patient-reported outcomes who underwent total internal arthroscopic anterior cruciate ligament reconstruction with IBLA using semitendinosus tendon autografts. Their results recorded good to excellent patient outcomes in terms of patient-reported outcomes. The mean postoperative Lysholm Knee score at 1 year reached 94.03 +- 3.65 (range 86 to 98), with 24 cases (64.8%) rated as excellent and 13 cases (35.2%) as good.

Sahu SK and Ganesh A compared the All-Inside technique with the conventional transportable reconstruction of the ACL in cases of ACL injuries and evaluated the functional outcome in patients admitted to Imsand Sum Hospital, Bhubaneswar from July 2017 to June 2019. Lysholm and VAS scores were calculated at minimum follow-up of 1, 3, 9 months. The response to VAS shows that the two group show no significant difference as far as the level of satisfaction with their respective operations is concerned.

McDonald et al., compared VAS pain scores and medication consumption in patients undergoing ACL reconstruction with either a single or double-bundle technique. A total of 88 patients who were treated with SB and 41 who underwent DB ACLR were included in the study. After analysing the results, they found a significant difference in pain at 1 hour after surgery, with a lower mean pain score in the SB group than the DB group.

However, post-operative VAS pain scores and complications rates was lower AIT group compared to the TP group in studies directly comparing the two techniques prospectively suggesting AIT as a good alternative method, especially when treating athletes with ACL injury.10.

Less postoperative pain is an evidence-bases advantage of all-inside. This was shown first in Level 1 randomized controlled trial with allograft comparing all-inside reconstruction to a full tibial tunnel.It was then proven again using semitendinosus autograft with the Graft-Linktechnique. Given the trend for outpatient surgery and accelerated rehabilitation after ACL reconstruction less postoperative pain is an advantage for patients.11 Differences in postoperative pain between various surgical options should be discussed with patients before a treatment plan is made.Postoperative pain after ACL reconstruction in an individualized patient experience that contributes significantly to patient -perceived outcome. Post discharge pain after any outpatient surgery is known to delay return to normal daily activities and thus rehabilitation.

Conclusion

The early postoperative period is frequently marked by severe pain after anterior cruciate ligament (ACL) reconstruction. Therefore, postoperative pain control is still a major issue in ACL reconstruction in order to increase preoperative patient satisfaction. The all-inside technique with quadrupled semitendinosus graft appears to be equivalent to the classic interference screw technique with a semitendinosus-gracilis grafts in terms of outcomes and failure rates. Based on our results we have stronger pain by patients treated with autograph tm.semitendinosus and m.gracilis compare with patients which has used autograft form m.semitendinosus.

References

1. Moses B, Orchard J, Orchard J. Systematic review: Annual incidence of ACL injury and surgery in various populations. Res Sports Med 2012; 20(3–4):157–79. doi: 10.1080/15438627.2012.680633
2. Mouton C, Moksnes H, Janssen R, Fink C, Zaffagnini S, Monllau JC, et al. Preliminary experience of aninternational orthopaedic registry: the ESSKA Paediatric Anterior Cruciate Ligament Initiative (PAMI)registry. J Exp Orthop 2021; 8(1):45. doi: 10.1186/s40634-021-00366-7
3. Sahu SK, Ganesh A. All-inside technique versus conventional transportal anterior cruciate ligament reconstruction: A retrospective study. Int J Orthop Sci 2020;6(1):39-44. doi: 10.22271/ortho.2020.v6.i1a.1831
4. de Sa D, Shanmugaraj A, Weidman M, Peterson DC, Simunovic N, Musahl V, Ayeni OR. All-Inside anterior cruciate ligament reconstruction-A systematic review of techniques, outcomes, and complications. J Knee Surg 2018;31(9):895-904. doi: 10.1055/s-0038-1627446
5. Duong TD, Tran DT, Do BNT, Nguyen TT, Le SM, Le HH. All-inside arthroscopic anterior cruciate ligament reconstruction with

internal brace Ligament Augmentation using semitendinosus tendon autograft: A case series. Asia Pac J Sports Med Arthrosc RehabilTechnol 2022;29:15-21. doi: 10.1016/j.asmart.2022.05.002

6. Gobbi A. Single versus double hamstring tendon harvest for ACL reconstruction. Sports Med Arthrosc Rev 2010;18(1):15-9. doi: 10.1097/JSA.0b013e3181cdb4a6
7. Ashraf Y, Senevirathna SR, Ashraf T. Conventional versus 'all-inside' anterior cruciate ligament reconstruction: a randomized controlled trial comparing hamstring strength and functional outcome. Bone Jt Open. 2020;1(11):706-708. doi: 10.1302/2633-1462.111
8. Benea H, d'Astorg H, Klouche S, Bauer T, Tomoaia G, Hardy P. Pain evaluation after all-inside anterior cruciate ligament reconstruction and short term functional results of a prospective randomized study. Knee 2014;21(1):102-6. doi: 10.1016/j.knee.2013.09.006
9. Yang YT, Cai ZJ, He M, Liu D, Xie WQ, Li YS, Xiao WF. All-Inside anterior cruciate ligament reconstruction: A review of advance and trends. Front Biosci (Landmark Ed). 2022;27(3):91. doi: 10.31083/j.fbl2703091. PMID: 35345323
10. Bhimani R, Shahriarirad R, Ranjbar K, Erfani A, Ashkani-Esfahani S. Transportal versus all-inside techniques of anterior cruciate ligament reconstruction: a systematic review. J OrthopSurg Res 2021;16(1):734. doi: 10.1186/s13018-021-02872-x
11. Sgaglione N, Lubowitz J, Provencher M, Editors: The Knee: AANA advanced arthroscopic surgical techniques. SLACK, Inc. Thorofare, NJ. 2015.