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Rehabilitation or operation after an ALC-injury
- A literature review

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REHABILITATION OR OPERATION AFTER AN ALC-INJURY - A LITERATURE REVIEW

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The purpose of this thesis was to do a systematic literature review comparing conservative and surgical approaches after an anterior cruciate ligament injury. The study question was: "Which is more effective treatment approach after an ACL-injury?"

The information was gathered from articles done within the last ten years.
The thesis is written as a systematic literature review and articles and researches were found with multiple databases, including Cochrane, EbscoHost, Science Direct and Pub Med.

This review shows that there is no clear evidence that either approach would be better than the other. Important fact is to individually decide which is better for the patient.

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1 INTRODUCTION

In todays society people are participating in various sports, some very strenuous and some more mellow. Therefore, injuries occur frequently, especially knee injuries. Of those, the most common is the tear of the anterior cruciate ligament (ACL). In the USA alone there is approximately 200 000 ACL-tears annually and 100 000 of those are being operated (Website of University of California 2016).

The human body is a complex combination of bones, tendons, ligaments, muscles, vessels and nerves, which all work together seamlessly. Still, some events (falls, accidents, etc.) are too much for the complexity to withstand and something falls apart.

Even though ACL-reconstructions have been made for years, still is still no consensus in whether to operate or not. Some suggest that if there are no severe symptoms, no giving-away, the patient is a non-athlete or is willing to reduce the activity level, the decision might be to not go to the operation. On the other hand, if the patient is an active athlete and there are many knee burdening factors in their sport, and if there is the feeling of giving away, the reconstruction is usually the choice. (Andrews, Harrelson & Wilk 1998, 366; Mangine 1995, 165) This is the reason behind of the making of this literature review.

2 PURPOSE OF THE THESIS

The purpose of the thesis was to compare rehabilitation and operation as the treatment approach for an anterior cruciate ligament injury by the literature review. The aim was to find the method, that gives the best out-come in recovery. This review is for helping physicians in the decision making whether to operate or not.

3 THE KNEE JOINT

The knee joint consists of three different joints: medial and lateral tibiofemoral joints, and patellofemoral joint. It is a so called modified hinge. The knee is the most complex and also the largest of the human joints but because of the location it is very vulnerable and must be able to withstand a lot of pressure and strain. The knee is supported only by muscles, tendons and ligaments, and it works together with the hip and the ankles to maintain straight standing posture. It is also mainly responsible for day-to-day movements and more challenging movement patterns, in sports for example. Therefore, it is crucial to maintain good muscle strength to ensure the best possible function of the knee. (Tortora, Derrickson 2011, 316-319; Levangie, Norkin 2011, 396).

The knee is surrounded by an articular capsule which consists of muscle tendons and capsular fibers. The function of the capsule is to join the bony structures of the joint. Under the capsule there are tendons of the muscles going over the knee and a vast number of ligaments. For the stability, the most important ligaments are anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). Both are located in the centre of the knee joint, as shown in the Figure 1; ACL runs from the anterior point in the tibia to a posterior, lateral point in the femur. The main function is to restrict hyperextension and anterior gliding of the tibia. PCL extends from the posterior point in the tibia to the anterior, medial point in the femur. The main function of PCL is to limit posterior gliding of the tibia. (Tortora, Derrickson 2011, 316-319)

Inside the knee joint there are two menisci, composed of fibrocartilage, which distribute the weight in weight-bearing activities and they enlarge the contact area between femoral condyles and tibial plateaus witch decreases joint stress. The menisci also have a role in joint stabilisation and lubrication. (Levangie, Norkin 2011, 400-401).

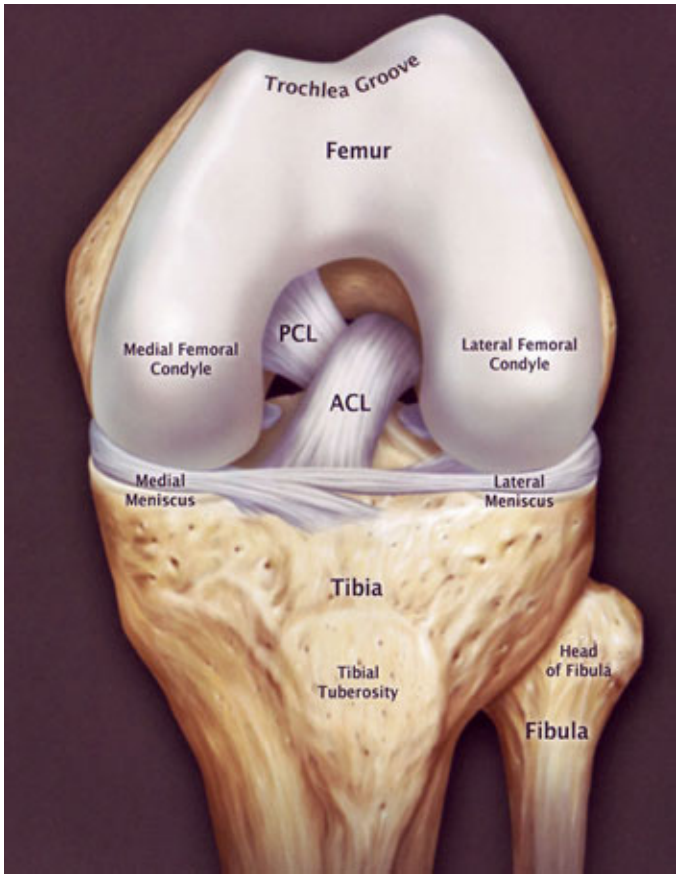

Figure 1 Anatomy of the knee (Website of Sairaala Neo 2016)

3.1 Muscles and ligaments

Around the knee joint there are muscles that are responsible of moving and supporting the knee; seven flexors and four extensors (Table 1). In addition to flexing and extending the knee, the muscles have other functions as well. The popliteus, gracilis, semimembranosus and semitendinosus are also medial rotators and biceps femoris laterally rotates the knee joint. All the other knee flexors, then the short head of biceps femoris and popliteus, and rectus femoris from the extensors, are so called two-joint muscles, which means that between origin and insertion there are two joints and the force which they can produce can be affected by the relative position of the joint they go over. (Levangie, Norkin 1992, 358-362)

Table 1. The flexor and extensor muscles of the knee (Levangie, Norkin 2011, 417; 419)

Flexor group	Extensor group
Semimembranosus	Rectus femoris
Semitendinosus	Vastus lateralis
Biceps femoris	Vastus medialis
Sartorius	Vastus intermedius
Gracilis	
Popliteus	
Gastrognemius	

In and around the knee there is also a vast number of ligaments surrounding it (Fig 2). The four most important ones are anterior and posterior cruciate ligaments, and fibular and tibial collateral ligaments. The function of the ligaments is to maintain stability of the knee during movement, controlling the knee extension, resisting varus and valgus and rotatory stabilization. (Andrews, Harrelson & Wilk 1998, 333-336; Levangie, Norkin 1992, 374)

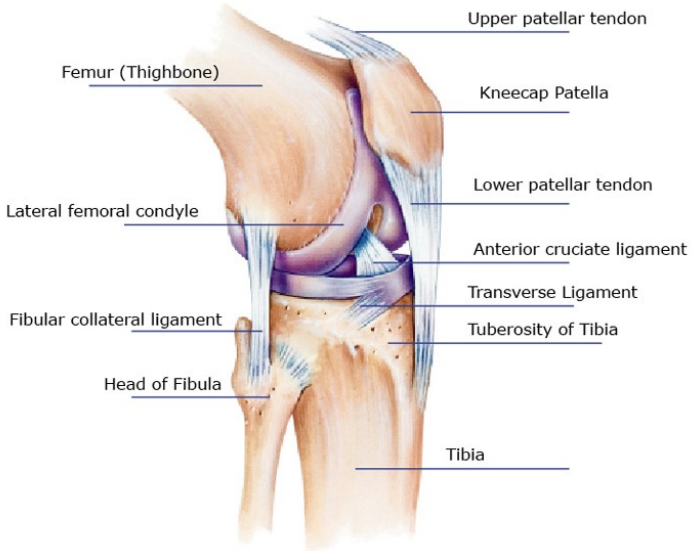

Fig 2 Ligaments of the knee (Website of Healthpages.org 2016)

3.2 Bursae

As the knee joint is under a lot of pressure and has to withstand excursion and friction, there are “cushions” in the joint. They are located for example between ligaments and bone and on top and under the patella. Places where the friction is high. (Levangie, Norkin 1992, 352)

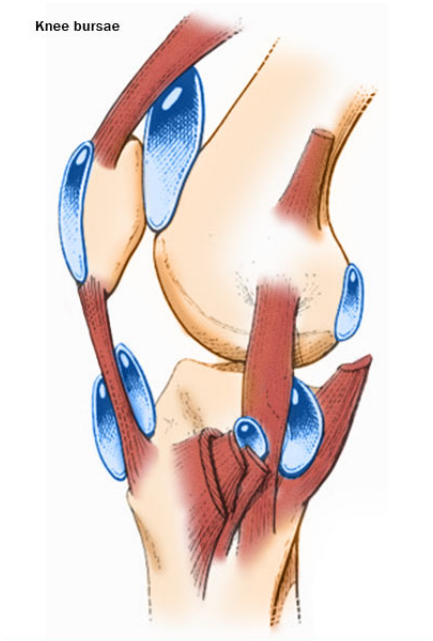

Fig. 3: Bursae of the knee (Website of Cortesia Solomon’s Seal 2016)

3.3 Patellofemoral joint

The patellofemoral joint consists of patella (the largest sesamoid bone in the human body) and the trochlear groove anterior to the inferior head of femur. Patella functions as a pulley in the knee, changing the direction of forces affecting the knee, thus decreasing the load (Mangine 1995, 5). It is also a bony protector for the head of the femur (Andrews, Harrelson & Wilk 1998, 332). Therefore, the importance of the patellofemoral joint to the normal function of the knee is very high.

4 ANTERIOR CRUCIATE LIGAMENT

Anterior cruciate ligament, or the ACL, is one of the most important ligaments of the knee, as stated before. Its main functions are to restrain anterior translation between femur and tibia, and prevention of the hyperextension of the knee. ACL runs from the anterior point in the tibia to a posterior, lateral point in the femur, while twisting on itself, and it consists of two parts: anteriomedial bundle (AMB) and posterolateral bundle (PLB), which have slightly different functions depending on the knee flexion angle. This structure enables the ACL to be tight in every position; AMB in flexion and PLB in extension. (Andrews, Harrelson & Wilk 1998, 333; Levangie, Norkin 2011, 405-406; Mangine 1995, 12-14;)

4.1 Injury mechanisms

The anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee (Website of Physioworks 2016) and it is 3-6 times more likely to happen in women than men (Kallio 2016, 1). Typical ACL-injury appears to happen when the knee is in slight flexion and tibia is rotated in either side when loading the leg (Levangie, Norkin 2011, 407). Mangine and Noyes also suggest other injury mechanisms, such as deceleration with/without rotation, hyperextension and inability in preparing for the landing phase, which results in poor muscle response (Mangine 1995, 165). According to different sources there are about 200 000 incidences every year and roughly half are being operated. Most common sports that may result in ACL-injury are soccer, skiing, football and basketball (Website of University of California 2016)

The ACL-injury is classified according to the severity of the tear. In grade 1 there is no tear in the ligament but the fibers are stretched, little tenderness and swelling, and no feeling of giving out or feeling of not being stable. In grade 2 the fibers are partially torn, there's little tenderness and moderate swelling and possible feeling of being unstable or giving out. The grade 3 has a complete rupture of fibers; ligament is in two parts, some tenderness and swelling and no control in the knee movements; feeling of instability and giving in when moving. There is also an avulsion rupture, where the

ligament has been torn from the bony attachment with a bone piece. The avulsion rupture is most common with children. (Website of WebMD 2016)

4.2 Rehabilitation

After an anterior cruciate ligament (ACL) injury it is possible to have an operation (discussed later) or to rehabilitate the knee with physiotherapy. For a non-athlete doctors usually recommend the non-surgical approach in managing the ACL injury. Also if the knee feels sturdy and it is not giving away in sports or in normal life, the conservative treatment is recommended. (Kallio 2016, 1)

Rehabilitation without surgery and post-operative physiotherapy follow the same main guidelines. Regaining the normal range of motion (ROM) and muscle strength are in the core of the rehabilitation. The isometric quadriceps and hamstrings exercises should be started as soon as possible after initial control of pain and swelling and as the knee is healing more strenuous exercises are added to the program. (Kallio 2016, 1; Website of Medscape 2016)

4.3 Operation

It is not possible to repair the torn ligament, even if it is not completely torn in half. Therefore, a new ligament has to be taken, either from patellar tendon with two bone pieces or hamstrings tendon, or from a dead donor (allograft). There are many different ways to reconstruct the ACL, and there are no significant differences between them. The new ACL might come out even stronger than the original. (Kallio 2016, 1)

The placement of the tendon craft is decided individually to serve the patients needs most effectively. Anatomical structure and function of the lower limbs, age, weight, gender are taken into account when deciding the alignment of the craft. If the graft placement is not considered carefully, there may be restrictions in movements later on. (Mangine 1995, 168-171)

The operation itself is usually done via arthroscopy. The surgeon drills two holes, one to the tibia and the other the the femur, for the craft and it is fixated with screws (Fig 3). (Mangine 1995, 168-171; Website of WebMD 2016)

Fig 3. Reconstructed ACL (Website of Knee-Pain-Explained.com 2016)

5 RESEARCH METHOD

This thesis is done using systematic literature review. Systematic literature review aims to evaluate and summarize information of previous studies in order to find more reliable results about interventions and their effectiveness than just one study can give. A systematic review can also show where there is information missing. There are strict steps to follow in the making of a systematic literature review, from planning to reporting the results, in order to the review to be reliable and repeatable. (Johansson, Axelin, Stolt & Ääri 2007, 5;46; Centre of Reviews and Dissemination…2009, 7)

When making a systematic review the first phase is to make the study plan and to formulate the study questions. The questions should be accurate and to-the point in order to guide the review. It is common to use the PICO model when formulating the study questions. PICO helps in making the questions by identifying the key concepts;

- **P** = patient/problem or population

- **I** = intervention
- **C** = comparison
- **O** = outcome measures

(Website of Duke University 2016; Centre of Reviews and Dissemination…2009, 7)

The next stage is to decide inclusion and exclusion criteria and find the relevant researches by various databases. Everything should be visible in the final review paper. After finding the researches matching the criteria, the quality is assessed with PEDro scale, for example. PEDro scale has the maximum ten points and for the systematic review, the adequate level of points has to be decided. Lastly, the findings are gathered in one table and the researcher draws conclusions and has to make suggestions for future research. (Centre of Reviews and Dissemination…2009, 119;124;133)

6 LITERATURE REVIEW

6.1 Search strategy

In acquiring the articles, various databases were used, such as PubMed, EbscoHost, Cochrane and ScienceDirect. Also suggestions for "similar articles" were included and articles from reference lists of other relevant studies, and references used when gathering information for the theory part of this thesis. Search terms used in database search were: "acl or anterior cruciate ligament" with "rehabilitation" AND/OR "reconstruction", "operation" and "surgery" (used in different combinations). Filters were used in order to find relevant and up-to-date studies: year 2006 or more recent, only humans and only full text for free. Same filters were used on articles found outside of databases. The results are found in the Table 2. The thesis question was: "Which is more effective treatment approach after an ACL-injury?"

6.2 Selection of studies

The initial search gave 2860 results due to the lack of filters in some of the databases (Table 2). From that, articles were excluded in terms of: the comparison was between early and delayed surgery, other reviews, studies concerning only knee osteoarthritis, studies concerning the operation or rehabilitation alone, comparisons between different operation methods and duplicates. 26 articles were selected for the appropriate title and 8 remained to be included after reading the abstracts. After the PEDro scaling, only 5 were accepted into this thesis.

Table 2: Database search

Search terms		Databases				
		ScienceDirect	PubMed	EbscoHost	Cochrane	Other sources
ACL or anterior cruciate ligament	AND Rehabilitation	709	53	127	208	
	AND Operation AND rehabilitation	0	25	2	21	
	AND Surgery AND Rehabilitation	0	22	70	171	
	AND Reconstruction	149	419	215	666	
"similar articles" or from references		0	3	0	0	3
Total		858	519	414	1066	2860

6.3 Quality assessment

Quality assessment in this thesis was done with the PEDro scale. Requirement for the quality was score of 5/10 or higher. All of the articles were assessed by the author of this thesis so there may be some error in the results due to the lack of experience. Table 3 shows the PEDro scores.

Table 3: PEDro scale summary of the chosen articles

Authors and publication year	**Type of research**	**PEDro scale score**
Frobell et all. 2013	RCT	7/10
Meunier et all. 2006	RCT	6/10
Grindhem et all. 2014	Prospective co-hort study	5/10
Mihelic et all. 2011	Retrospective clinical study	6/10
Streich et all. 2010	Retrospective matched-pair long-term follow up	6/10

7 RESULTS

The summary of results is presented in the table 4. The study done by Richard Frobell et all (2013) indicates there were significantly better results in mechanical stability of the knee in the group which had the initial operation (P<0,001). The radiographs showed no significant difference in the development of osteoarthritis between the two groups (P=0.995 for tibiofemoral radiographic osteoarthritis (OA); P=0.084 for patellofemoral radiographic osteoarthritis). They also conducted a KOOS (the knee injury and osteoarthritis outcome score), which showed no significant difference between groups. The writers state that the results were no different with the ACL-reconstruction surgery done early or later or with those who were treated with the rehabilitation alone. They encourage the clinicians to consider rehabilitation before surgical intervention after an acute ACL tear.

Meunier, Odensten and Good (2006) compared the long-term results between surgical approach and rehabilitation after an ACL rupture. In the surgery group (S), 3 out of 42 had the knee re-operated within 2 to 10 years after the initial operation because of symptomatic instability of the knee, one of the had repeated ACL-surgery three times. In the group NS (rehabilitation and possibility for the operation later) 31% had the operation done between 1 and 14 years from the injury (subgroup NSrec). There were seven operations done using a synthetic graft. All of those ruptured and two of them had to be re-operated using a bone–patellar tendon–bone graft (BPTB). In group S there were lower number of meniscus injuries (P=0.015). In the NS group 35% sustained secondary meniscus tears during the follow up. NSrec had more meniscus injuries compared to the group who remained non-surgically treated (P=0.2). The S group had impaired ROM compared to NS group (P=0.0013). Knee stability was better in S group than in NS. Study concludes that OA frequency does not differ between groups, but in NS group they had more meniscus problems. “Indirectly this supports the hypothesis that early stabilization of the knee after ACL injury is advantageous for the long-term outcome.”

In the study by Grindem et all. (2014) knee function, sports participation, and knee reinjury were the areas which they compared when determining the treatment approach

of ACL-injuries. There were no significant differences over time in patient reported knee function or muscle strength between surgery and non-surgery groups. Also the tested knee function gave no significant differences. In sports participation during the two year follow up, in both groups the median frequency of participation was two to three times per week and there were no significant differences between the groups (P= 0.060). Knee reinjuries happened in both groups, but more in the surgically treated group (4 patients in non-surgical (9%) and 24 in surgical group (24%)). The study concludes that there are few differences between the groups during the two-year follow up but the patients reported large improvements in both groups, however there were knee reinjuries and deficits in muscle strength.

Mihelic et all. (2011) also had a long term follow up of patients with ACL reconstruction and compared them with patients treated non-surgically. Their retrospective study shows that the patient treated conservatively had instability in knees, with increased anterior laxity and higher rate of degenerative changes. All tested areas showed differences between groups and in all, the surgically treated group got better results. In anterior drawer test 11% of the surgery group had a negative result and 72 % had 0-5mm (graded as normal or nearly normal knees) and in the non-surgery group 16 % got normal or nearly normal results, others had 10-15mm. The activity levels were significantly lower in non-surgically treated group (P<0.05). The surgically treated group had mild degenerative changes with 50% and 16,5% had severe OA; in conservatively treated group 56% had severe OA and the rest had degenerative changes of some degree. Patient reported results in the surgery group included good stability in walking or sports, no pain or swelling and they had full ROM; the conservatively treated groups reported little pain or swelling and instability in sports or heavy labour. In conclusion, according to this study the surgically treated group had their knees in better condition.

The study by Streich et all. (2010) followed 80 divided in 40 matched pairs for 15 years, where the other one had the ACL- reconstruction done and the other was treated conservatively. They found no significant differences between ACL and non-ACL groups in the clinical examinations (pivot-shift, KT-1000, ROM) at the15- year follow-up (20% flexion P=0.389, 60% flexion P=0.732). Also in both groups there was an extension deficit of 3°-5° (11 in operated and 13 in non-operated group). The IKDC overall score showed no significant differences between groups; 40% in the operated

and 42,5% in the non-operated group were scored as "nearly normal", when 60% in the operated and 57,75 in the non-operated group were "abnormal" or "severely abnormal. (The IKDC stands for international knee documentation committee. It it one of the most reliable outcome reporting tools and has been proven valid. (Website of Code Tecnology 2016). Significant degrease was seen in both groups in the Tegner activity scale, but between groups there were no significant difference (*P*=0.036).

Table 4: PICO model summary of the chosen articles

Authors and publication year	**Patients**	**Intervention**	**Comparison**	**Outcome measures**
Frobell et all. 2013	121 young, active adults (mean age 26 years) w/ acute ACL injury to a previously uninjured knee	All patients received similar structured rehabilitation. 62 patients were assigned to early ACL reconstruction	Comparison between surgical and conservative treatment/optional delayed surgery	Knee injury and osteoarthritis outcome score (KOOS4), the absolute KOOS4 score, all five KOOS subscale scores, SF-36, Tegner activity scale, meniscal surgery, and radiographic osteoarthritis at five years, Lachman and pivot tests
Meunier et all. 2006	100 patients, who admitted to the ER of the University Hospital in Linköping between 1980 and 1983, under the age of 30, allocation into two treatment groups	Surgical and non-surgical approach	Group S: 44 patients, 33 men and 11 women, with a mean age of 22 years (14–30), surgical treatment of the ACL rupture. Group NS: 56 patients, 35 men and 21 women, with a mean age of 21 years (14–30), conservative treatment	Biodex 6000 dynamometer, International Knee Documentation Committee (IKDC) 2000 form, an online survey,

Grindem et all. 2014	Between 2007-2011 143 consecutive patients from the Norwegian Sports Medicine Clinic, ACL injury within the previous three months, age 13-60, participation level I or II in sports twice a week or more	ACL-reconstruction or non-surgical approach, chosen by the patients themselves	Comparison between surgical and non-surgical option in treating ACL-injury	Biodex 6000 dynamometer, International Knee Documentation Committee (IKDC) 2000 form, online survey (QuestBack version 9.6; QuestBack AS, Oslo, Norway)
Mihelic et all. 2011	44 male and 10 female patients, division into two groups based on whether they had the ACL-reconstruction done or not	ACL-reconstruction or conservative treatment	Group 1: 36 patient who had the ACL-reconstruction done Group 2: 18 patients who had been treated conservatively	International Knee Documentation Committee (IKDC) score, the Tegner and Lysholm knee score, self-administrated questionnaire, goniometer, Lachman test and KT 2000 arthrometer, radiographic assessment,
Streich et all. 2010	126 patients who had the ACL-injury, devision into two groups; surgery (67) and conservative (59)	ACL-reconstruction or conservative treatment	Comparison between surgical and non-surgical option	KT-1000 knee arthrometer, the International Knee Documentation Committee (IKDC), Lysholm and Tegner activity scores, radiological assessment, Kolmogorov-Smirnov test, Levene's F-test. A paired T-test, Fishers exact test, Pearson's correlation coefficient, the Wilcoxon signed-rank

8 CONCLUSION

After reviewing the selected studies there is evidence that the conservative approach in treating an ACL-injury should be the prior consideration. Four out of five studies concluded that there are no significant differences between patients who have undergone the ACL-reconstruction and patients who have received only conservative treatment. In one study (Mihelic et all. 2011) there were different results, since their patients, who had the surgery, scored better in all outcome measures. From this scale of review, it can be concluded that it is utmost important to consider the individual needs, physical qualities and sports participation of the patient when deciding whether to have the operation or not, since there is no consensus which is definitely better alternative.

9 DISCUSSION

This thesis was done by a physiotherapy student who has no prior experience in doing a literature review or any other kind of research. The fact that this is my first review has to be taken into consideration when determining the quality of this thesis. Also the number of the articles included is not giving the wide perspective about this matter. Further more, the studies were differently assembled; others had short-term results, others long term results.

Making this thesis was an interesting journey, even though rather long. I decided this topic because of personal interest in the matter; I had an accident couple of years ago and I ruptured ACL from my right knee. I decided to have the reconstruction done due to instability and lack of trust toward the knee. It took me a very long time to get started, but in the end the process went quite smoothly. I didn't have that many problems with the writing of the thesis but finding the appropriate studies took a long time. I was also struggling with technical difficulties; the Word and Exel programs were not working as they should and that slowed me down occasionally.

To have a better picture of which is better treatment approach, there should be more studies done concerning the straight comparison between surgery and conservative treatment. As a suggestion for another thesis, it would be interesting to find out how the different operation methods compare to each other.

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