

Anterior cruciate ligament reconstruction with ToggleLoc with ZipLoop system versus transfix system: A cost-effectiveness analysis

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ABSTRACT

BACKGROUND: To evaluate the cost-effectiveness of the reconstruction of the anterior cruciate ligament tears using either ToggleLoc with ZipLoop or Transfix systems.

METHODS: This study is a cost-effectiveness analysis of patients with anterior cruciate ligament reconstruction, ToggleLoc with ZipLoop and Transfix systems in our clinic between 2011 and 2016. This study was a retrospective cross-sectional study of patient's demographic, clinical and financial data. The effectiveness of surgery on patients with anterior cruciate ligament reconstruction was determined by the Lysholm Knee Score Scale. We compared two systems with the cost-effectiveness ratio.

RESULTS: In this study, 103 patients were included. According to the Lysholm Knee Score Scales in both groups, the findings showed that there was no difference in effectiveness between them. The ToggleLoc with ZipLoop technique was cost-effectiveness ratio 254,57 and the Transfix technique cost-effectiveness ratio was 378,33.

CONCLUSION: According to our results, ToggleLoc with ZipLoop technique was a more cost-effective method than the Transfix technique in the anterior cruciate ligament reconstruction.

Keywords: Anterior cruciate ligament reconstruction; cost-effectiveness; ToggleLoc with Zip Loop; Transfix.

INTRODUCTION

Anterior cruciate ligament (ACL) tears are common, especially in younger, physically active individuals.^[1] Anterior cruciate ligament reconstruction (ACLR) is one of the most commonly performed orthopaedic procedures.^[2]

Anterior cruciate ligament reconstruction has a variety of technical details and applications. Especially femoral fixation, anatomical origo and fixation method are the most studied area. In terms of femoral fixation methods, although there is a transition from transfix system to endobutton system from the past to the present, many authors still apply the transfix

method, especially non-anatomically. Endobutton and Transfix systems are the most commonly used methods on the femoral side.^[3,4] Anterior cruciate ligament reconstruction, in particular in young populations, increases with a financial burden. There are many cost-effective studies in PubMed under the heading ACL reconstruction AND cost-effective. However, when we evaluated the literature, we could not find a study comparing these two most commonly applied femoral fixation systems concerning cost analysis.

The present study aims to (1) perform a comparative analysis of the cost, Lysholm scores and demographic variables of patients with ACLR in our clinic and (2) investigate which of

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the ToggleLoc with ZipLoop (TLZ) and Transfix systems is more cost-effective.

MATERIALS AND METHODS

This study is a cost-effectiveness analysis of patients with ACLR, TLZ (Zimmer Biomet, Warsaw, In, USA) and Transfix (Arthrex, Naples, FL, USA) systems in our clinic between 2011 and 2016. Only the cost of hospitalization where the patient's operation was performed was included in the study. The study was a retrospective cross-sectional study of patient's demographic, clinical and financial data. No specific patient information or identity information was used. Demographic data and financial data were obtained from the hospital information management system. Patient medical data were obtained from the records of Orthopaedics and Traumatology clinic.

After Institutional Review Board approval (E-17-1335); the patients older than 18 years, with a minimum 12 months follow-up, operated with TLZ system or Transfix system were included in this study. Patients with injuries of knee's other ligaments, meniscus repair, microfracture, other orthopaedic trauma and those aged over 45 years were excluded from this study.

Financial data for the years before 2016 were revalued as of 2016, using the revaluation rates of the Ministry of Finance.^[5] The effectiveness of surgery on patients with ACLR was determined by the Lysholm knee score scale.^[6] The year of the surgery, gender, age, accompanying intraarticular pathology, and surgical technique were the independent variables. The length of hospitalization, the total cost of hospitalization, the total charge of hospitalization, preoperative Lysholm knee score (Lysholm-0), postoperative 1-year Lysholm knee score (Lysholm-1), and difference between among these two Lysholm knee scores (Lysholm-difference) were dependent variables.

The invoicing of health services in our country is carried out according to the rules determined by the Health Practice Notification (HPN) of the Social Security Institution.^[7] Medical supplies, medicines, laboratory tests, and other services are priced in detail in the HPN. The sum of HPN prices for all medical supplies, medicines, laboratory tests, and other services used when health care is provided is called total cost of hospitalization. According to the HPN, the health service fee is called total charge of hospitalization.

Cost-effectiveness Analysis

Among the TLZ and Transfix techniques, the cost-effectiveness method of economic valuation methods was used. The cost-effectiveness analysis between TLZ and Transfix techniques was based on the results of Lysholm knee score scale, one of the scores used to measure medical efficacy.^[6] Cost-effectiveness analysis (CEA) was done as follows:

Comparing option A with option B; we first look at the cost-effectiveness ratio (CER).^[8] The option with a low CER is preferred. It is also possible to express this in another way; If $A_{effectiveness} = B_{effectiveness}$; only the costs are looked at and the option with low cost is preferred. If $A_{cost} = B_{cost}$; the option with the higher effectiveness is preferred. However, if $A_{cost} > B_{cost}$; it is decided using an incremental cost-effectiveness ratio (ICER). In other words, if the CER of the options are equal, it is decided by looking at ICER.

Surgical Procedure

All surgical procedures conducted while patient in supine position with pneumatic tourniquet. After arthroscopic evaluation of the knee joint via standard anterolateral and anteromedial portals, the gracilis and semitendinosus tendons were harvested. Femoral tunnels were opened at the 10 or 2 o'clock position through the medial portal. On the tibial side, the ACL guide was set to 45° and placed at the stump

Table 1. Frequency and ratio distribution of patients with anterior cruciate ligament reconstruction

	Incidence	Ratio (%)
Gender		
Female	7	6.8
Male	96	93.2
Total	103	100.0
Age		
0–19	14	13.6
20–24	26	25.2
25–29	20	19.4
30–34	25	24.3
35–>35	18	17.5
Total	103	100.0
Surgical procedure		
ToggleLoc with ZipLoop	65	63.1
Transfix	38	36.9
Total	103	100.0
Accompanying intra articular pathology		
No	39	37.9
Yes	64	62.1
Total	103	100.0
Time of the surgery		
2011	17	16.5
2012	14	13.6
2013	6	5.8
2014	12	11.7
2015	16	15.5
2016	38	36.9
Total	103	100.0

of the ACL, then reamed over the guide wire after verification of the placement. Prepared grafts were embedded intraarticularly through the tibial tunnel. Tibial fixation was done with a bioabsorbable screw and U pin at the tibial side. At the femoral side fixation was done with TLZ system or Transfix system. After fixation of the grafts, Lachman and pivot shift tests were performed for final verification of graft tension.

Statistical Analysis

In this study, IBM SPSS Statistics 23 statistical program was used for descriptive and analysis of differences between groups. The normal distribution of the groups was investigated using the Shapiro-Wilk and Kolmogorov-Smirnov test. In non-normal distribution data, the Mann-Whitney U test was used in two independent samples and the Kruskal-Wallis test was used for independent groups.

RESULTS

In the current study, 103 (n=103) patients were included. The frequency and percentage results of the patients are given in

Table 1. Table 2 shows the normality test results for gender, age, surgical technique, accompanying intraarticular pathology and year of the surgery groups. The groups did not satisfy the normal distribution criterion because p-value was smaller than 0.05 for all groups (p<0.05).

According to gender, there was no statistically significant difference between the results of the length of hospitalization, the total cost of hospitalization, the total charge of hospitalization, Lysholm-0, Lysholm-I- and Lysholm-difference results. Among the groups with and without accompanying intraarticular pathology, there is no statistically significant difference between the length of hospitalization, Lysholm-0, Lysholm-I and Lysholm-difference results but it was found that the group with accompanying intraarticular pathology had a higher total cost of hospitalization and total charge of hospitalization. The length of hospitalization, the total cost of hospitalization and total charge of hospitalization were higher for the Transfix group than the TLZ group. However, there was no statistically significant difference in Lysholm knee scores showing medical efficacy compared to the surgical technique (Table 3).

Table 2. Normality test results for patients with anterior cruciate ligament reconstruction

Groups	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	N	Sig.	Statistic	N	Sig.
Gender	0.538	103	0.000	0.273	103	0.000
Age	0.179	103	0.000	0.900	103	0.000
Surgical procedure	0.408	103	0.000	0.611	103	0.000
Accompanying intra articular pathology	0.403	103	0.000	0.615	103	0.000
Time of the surgery	0.210	103	0.000	0.820	103	0.000

Table 3. The relationship between the surgical procedure and accompanying intraarticular pathology with length of hospitalization, the total cost of hospitalization, and total charge of hospitalization (Mann-Whitney U Test Results)

			n	Mean	Total	U	p
Length of hospitalization	Surgical procedure	TLZ	65	44.99	2924.5	780	0.002
		Transfix	38	63.99	2431.5		
Total cost of hospitalization	Accompanying intra articular pathology	No	39	44.54	1737	957	0.048
		Yes	64	56.55	3619		
	Surgical procedure	TLZ	65	42.49	2762	617	0.000
		Transfix	38	68.26	2594		
Total charge of hospitalization	Accompanying intra articular pathology	No	39	41.46	1617	837	0.005
		Yes	64	58.42	3739		
	Surgical procedure	TLZ	65	41.37	2689	544	0.000
		Transfix	38	70.18	2667		
Total			103				

TLZ: ToggleLoc with ZipLoop.

According to the Kruskal Wallis test results, there was no statistically significant difference between the length of hospitalization, the total cost of hospitalization, the total charge of hospitalization, Lysholm-0, Lysholm-I and Lysholm-difference and age of groups. The length of hospitalization, the total cost of hospitalization and the total charge of hospitalization vary according to the years of surgery. Lysholm-0, Lysholm-I and Lysholm-difference scores did not differ from the year of the surgery (Table 4).

The Mann-Whitney U test results for looking at the difference between the years (Table 5). According to these results, it was seen that the length of hospitalization days for 2011, 2012 and 2013 was higher than the length of hospitalization days for 2016. However, no statistically significant difference was observed between 2011, 2012, 2013, 2014 and 2015. Total cost of hospitalization and total charge of hospitalization varied from year to year (Table 5).

When we compared the differences between Lysholm-0 and Lysholm-I in both groups, it was found that there was no difference in effectiveness between them. The TLZ technique was CER 254,57 and the Transfix technique CER 378,33 (Table 3, Table 6). Since CER results show which method was more cost-effective, ICER did not have to be calculated.

DISCUSSION

In the present study, the TLZ technique was CER 254,57 and the Transfix technique CER 378,33. When we compare the differences between Lysholm scores in both groups, there was no difference in effectiveness between them. According to these results, the TLZ technique was a more cost-effective method than the Transfix technique.

Just as in every field part of the economy, the lack of resources in the health economy is one of the most important problems. The selection of alternative uses of these scarce resources requires the use of economic assessment methods.^[8] The cost-effectiveness analysis is one of the most widely used economic evaluation methods. This analysis is used to find out which of the alternative processes used to achieve the same goal more effectively and cheaper. Generally, the technology being compared is the new technology, which is an alternative to the currently used technology. Health benefits like the number of illnesses prevented, years of life earned, the number of patients treated, deaths prevented, the number of injuries prevented are shown as a sign of effectiveness. The cost-effectiveness ratio yields the health effect of each unit spent.^[9,10]

Lysholm Knee Rating Scale measured daily living activity level and eight factors were rated to produce an overall score on

Table 4. The relationship between time of the surgery with length hospitalization, the total cost of hospitalization, and total charge of hospitalization (Kruskal Wallis Test Results)

			N	Mean	Chi-Square	p
Length of hospitalization	Time of the surgery	2011	17	64.71	14.061	0.015
		2012	14	60.75		
		2013	6	68.5		
		2014	12	53.92		
		2015	16	54.47		
		2016	38	38.84		
Total cost of hospitalization	Time of the surgery	2011	17	74.94	36.952	0
		2012	14	53.79		
		2013	6	81		
		2014	12	66.5		
		2015	16	53.63		
		2016	38	31.24		
Total charge of hospitalization	Time of the surgery	2011	17	72.18	36.683	0
		2012	14	59.57		
		2013	6	82.17		
		2014	12	69.75		
		2015	16	47.13		
		2016	38	31.87		
Total			103			

Table 5. The relationship between time of the surgery with a length of hospitalization, the total cost of hospitalization, and total charge of hospitalization (Mann-Whitney U Test Results)

	Time of the surgery	N	N Total	Mean	Total	U	p
Length of hospitalization	2011	17	55	37.82	643	156	0.002
	2016	38		23.61	897		
	2012	14	52	35.18	492.5	145	0.011
	2016	38		23.30	885.5		
	2013	6	44	32.67	196	53	0.034
	2016	38		20.89	794		
Total cost of hospitalization	2011	17	31	20.94	356	35	0.001
	2012	14		10.00	140		
	2011	17	55	44.00	748	51	0.000
	2016	38		20.84	792		
	2012	14	52	36.93	517	120	0.003
	2016	38		22.66	861		
	2013	6	22	16.33	98	19	0.033
	2015	16		9.69	155		
	2013	6	44	38.50	231	18	0.001
	2016	38		19.97	759		
	2014	12	50	37.33	448	86	0.001
	2016	38		21.76	827		
	2015	16	54	35.81	573	171	0.012
	2016	38		24.00	912		
	Total charge of hospitalization	2011	17	31	19.47	331	60
2012		14		11.79	165		
2011		17	33	20.35	346	79	0.040
2015		16		13.44	215		
2011		17	55	43.06	732	67	0.000
2016		38		21.26	808		
2012		14	52	37.93	531	106	0.001
2016		38		22.29	847		
2013		6	22	17.33	104	13	0.010
2015		16		9.31	149		
2013		6	44	39.00	234	15	0.001
2016		38		19.89	756		
2014		12	28	18.17	218	52	0.041
2015		16		11.75	188		
2014		12	50	38.25	459	75	0.001
2016	38		21.47	816			

Table 6. Descriptive statistics and cost-effectiveness ratios of anterior cruciate ligament reconstruction techniques

		Incidence	Ratio	Mean Cost Per Surgery	Efficacy	CER
Surgical Procedure	TLZ	65	63.1	5.737.59	23	254.57
	Transfix	38	36.9	7.815.45	21	378.33
Total		103	100			

CER: Cost-Effectiveness Ratio = (Cost-Effectiveness Ratio /Cost per each Lysholm score); Efficacy: Mean Lysholm difference; TLZ: ToggleLoc with ZipLoop.

a point scale of 0 to 100.^[11] The Lysholm scale is reliable for use in research on ligament and meniscal injuries, chondral injuries, and patellar dislocation.^[12] In the present study, the effectiveness of surgery on patients with ACLR was determined by Lysholm knee score scale.^[6]

Endobutton and Transfix systems are the most commonly used methods for fixation on the tendon on the femoral side.^[3,4] Ejajzi et al.^[3] conducted a study on 96 patients to compare Endobutton, Rigidfix and Aperfix using Lysholm score. All three modes of ACL reconstructions increased in Lysholm score. However, there was no significant difference for three modes of femoral fixation. In our study, according to the Lysholm knee scores, the findings have shown that there is no difference in effectiveness between TLZ and Transfix systems.

In the present study, it was seen that the length of hospitalization, the total cost of hospitalization, and total charge of hospitalization vary from year to year. According to these results, it can be said that the surgical technique used has affected recovery periods, and therefore, the length of hospitalization. The total cost of hospitalization and total charge of hospitalization were high due to high length of hospitalization. It is seen that there was a parallel between the length of hospitalization and total cost of hospitalization and total charge of hospitalization.

ACL tears could be treated with surgical methods or with physical therapy. Previous studies evaluated the cost-effectiveness of the treatment of ACL tears with ACLR versus physical therapy. They concluded that ACLR was a cost-effective strategy for patients with an ACL injury.^[13,14] In our study, we investigated which of the TLZ and Transfix techniques are more cost-effective in ACL tears. TLZ technique was a more cost-effective method than the Transfix technique in the ACLR.

There were some limitations, including the retrospective design, a limited number of patients, and cost of physiotherapy. The Social Security Institution did not provide information on the grounds of confidentiality personal data, so we could not add the cost of physiotherapy to financial data. To our knowledge, no study has been performed to compare the cost-effectiveness of the reconstruction of the ACL tears with either TLZ or Transfix systems. This is the strength of the current study.

Conclusion

According to our results, the TLZ technique was a more cost-effective method than the Transfix technique in the ACLR.

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G.Ö., H.A., O.B.; Supervision: G.Ö., A.D.; Resource: O.B., E.K., S.T.; Materials: O.B., EK; Data: O.B., E.K.; Analysis: H.A.; Literature search: G.Ö., A.D., O.B.; Writing: G.Ö., O.B., S.T.; Critical revision: G.Ö., A.D., O.B.

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REFERENCES

1. Lyman S, Koulouvaris P, Sherman S, Do H, Mandl LA, Marx RG. Epidemiology of anterior cruciate ligament reconstruction: trends, readmissions, and subsequent knee surgery. *J Bone Joint Surg Am* 2009;91:2321–8. [CrossRef]
2. Griffin LY, Albohm MJ, Arendt EA, Bahr R, Beynon BD, Demaio M, et al. Understanding and preventing noncontact anterior cruciate ligament injuries: a review of the Hunt Valley II meeting, January 2005. *Am J Sports Med* 2006;34:1512–32. [CrossRef]
3. Ejajzi A, Madadi F, Madadi F, Boreiri M. Comparison of different methods of femoral fixation anterior cruciate ligament reconstruction. *Acta Med Iran* 2013;51:444–8.
4. Williams RJ 3rd, Hyman J, Petrigliano F, Rozental T, Wickiewicz TL. Anterior cruciate ligament reconstruction with a four-strand hamstring tendon autograft. *J Bone Joint Surg Am* 2004;86:225–32. [CrossRef]
5. Gelir İdaresi Başkanlığı. Yeniden Değerlendirme Oranları. Available from: http://www.gib.gov.tr/fileadmin/user_upload/Yararli_Bilgiler/2007_Degerleme_Oranlari.html.
6. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. *Am J Sports Med* 1982;10:150–4. [CrossRef]
7. Türkiye Cumhuriyeti Sosyal Güvenlik Kurumu. Sağlık Uygulama Tebliği. Available from: <http://www.sgk.gov.tr/wps/portal/sgk/tr/>.
8. Drummond MF, Sculpher MJ, Claxton K, Stoddart, GL, Torrance GW. Introduction to Economic Evaluation. In: *Methods for the economic evaluation of health care programmes*. 4th Edition. Oxford: Oxford University Press, 2015.p:1–19.
9. Hutton G, Rhfuess E. Introduction. In: *World Health Organization. Guidelines for conducting cost–benefit analysis of household energy and health interventions*. Geneva: World Health Organization; 2006.p.1–8.
10. Getzen ET, Allen BH. Cost-Benefit and Cost-effectiveness Analysis. *Making the Most of Limited Funds*. In: *Health Care Economics*. Hoboken (NJ): John Wiley&Sons; 2007.p.47–73.
11. Zhang Q, Hao G, Gu M, Cao X. Tibial tunnel enlargement and joint instability after anterior cruciate ligament reconstruction. A prospective comparison between autograft and allograft. *Acta Cir Bras* 2017;32:1064–74. [CrossRef]
12. Collins NJ, Misra D, Felson DT, Crossley KM, Roos EM. Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). *Arthritis Care Res (Hoboken)* 2011;63:S208–28. [CrossRef]
13. Mather RC 3rd, Koenig L, Kocher MS, Dall TM, Gallo P, Scott DJ, et al; MOON Knee Group. Societal and economic impact of anterior cruciate

ligament tears. J Bone Joint Surg Am 2013;95:1751–9. [CrossRef]
14. Stewart BA, Momaya AM, Silverstein MD, Lintner D. The Cost-Effec-

tiveness of Anterior Cruciate Ligament Reconstruction in Competitive Athletes. Am J Sports Med 2017;45:23–33. [CrossRef]

ORJİNAL ÇALIŞMA - ÖZET

Ön çapraz bağ rekonstrüksiyonunda Ziploop ile ToggleLoc sisteminin Transfix sistemiyle karşılaştırılması: Maliyet etkinlik analizi

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AMAÇ: Ön çapraz bağ yırtıklarının rekonstrüksiyonunda kullanılan Transfix ve Ziploop ile ToggleLoc sistemlerinin maliyet-etkinlik açısından karşılaştırılması amaçlanmıştır.

GEREÇ VE YÖNTEM: Bu çalışma, kliniğimizde 2011 ve 2016 yılları arasında Transfix ve Ziploop ile ToggleLoc sistemlerinin kullanıldığı ön çapraz bağ rekonstrüksiyonu yapılan hastaların maliyet etkinliği analizidir. Bu çalışma geriye dönük ve kesitsel olup hastaların demografik, klinik ve finansal verilerinin değerlendirilmesiyle yapılmıştır. Cerrahinin etkinliği, ön çapraz bağ rekonstrüksiyonu olan hastalarda Lysholm Diz Skoru Ölçeği'yle belirlendi. İki sistemi maliyet-etkinlik oranı ile karşılaştırdık.

BULGULAR: Çalışmaya toplam 103 hasta dahil edildi. Her iki grup Lysholm Diz Skor Ölçeği'ne göre değerlendirildiğinde istatistiksel olarak gruplararası etkinlik farkı bulunmadığı tespit edildi. Ziploop ile ToggleLoc tekniğinin maliyet etkinlik oranı 254.57 iken Transfix tekniğinin maliyet etkinlik oranı 378.33 olarak bulunmuştur.

TARTIŞMA: Elde ettiğimiz sonuçlara göre, Ziploop ile ToggleLoc tekniği ön çapraz bağ rekonstrüksiyonunda Transfix tekniğinden daha maliyet-etken bir yöntem olarak bulundu.

Anahtar sözcükler: Maliyet-etkinlik; ön çapraz bağ rekonstrüksiyonu; Transfix; Ziploop ile ToggleLoc.

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