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

Güzelali Özdemir, M.D.,1 Sualp Turan, M.D.,1 Hüseyin Aslan, PhD.,2 Olgun Bingöl, M.D.,1 Alper Deveci, M.D.,1 Enver Kılıç, M.D.1

1Department of Orthopaedics and Traumatology, Ankara Numune Training and Research Hospital, Ankara-Turkey
2Department of Statistics, Ankara Numune Training and Research Hospital, Ankara-Turkey

ABSTRACT

BACKGROUND: To evaluate the cost-effectiveness of the reconstruction of the anterior cruciate ligament tears using either TogglLoc 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
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. The effectiveness of surgery on patients with ACLR was determined by the Lysholm knee score scale. 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. 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. Cost-effectiveness analysis (CEA) was done as follows:

Comparing option A with option B; we first look at the cost-effectiveness ratio (CER). The option with a low CER is preferred. It is also possible to express this in another way; if $A_{\text{effectiveness}} = B_{\text{effectiveness}}$; only the costs are looked at and the option with low cost is preferred. If $A_{\text{cost}} = B_{\text{cost}}$; the option with the higher effectiveness is preferred. However, if $A_{\text{cost}} > B_{\text{cost}}$; 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 turniquet. 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 |
|---------------------------------------------------------------|
| **Gender** | **Incidence** | **Ratio (%)** |
| Female | 7 | 6.8 |
| Male | 96 | 93.2 |
| Total | 103 | 100.0 |

| **Age** | **Incidence** | **Ratio (%)** |
| 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** | **Incidence** | **Ratio (%)** |
| ToggleLoc with ZipLoop | 65 | 63.1 |
| Transfix | 38 | 36.9 |
| Total | 103 | 100.0 |

| **Accompanying intra articular pathology** | **Incidence** | **Ratio (%)** |
| No | 39 | 37.9 |
| Yes | 64 | 62.1 |
| Total | 103 | 100.0 |

| **Time of the surgery** | **Incidence** | **Ratio (%)** |
| 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-1- 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-1 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)

|                                | Surgical procedure | Surgical procedure |
|--------------------------------|--------------------|--------------------|
|                                | TLZ                | Transfix           |
| Length of hospitalization      | 65                 | 38                 |
| Total cost of hospitalization  | No                 | Yes                |
|                                | 39                 | 64                 |
| Surgical procedure             | TLZ                | Transfix           |
|                                | 65                 | 38                 |
| Total charge of hospitalization| No                 | Yes                |
|                                | 39                 | 64                 |
| Surgical procedure             | TLZ                | Transfix           |
|                                | 65                 | 38                 |

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-1 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-1 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-1 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. 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 |  |      |            |         |
| Total                | 103|
|                      |   | 17   | 64.71      | 14.061  | 0.015 |
| 2011                 | 17 | 60.75|            |         |
| 2012                 | 14 | 53.63|            |         |
| 2013                 | 6  | 38.84|            |         |
| 2014                 | 12 | 38.45|            |         |
| 2015                 | 16 | 38.45|            |         |
| 2016                 | 38 | 38.45|            |         |
| Total cost of hospitalization |  |      |            |         |
| Total                | 103|
|                      |   | 17   | 74.94      | 36.952  | 0     |
| 2011                 | 17 | 53.79|            |         |
| 2012                 | 14 | 53.79|            |         |
| 2013                 | 6  | 81   |            |         |
| 2014                 | 12 | 66.5 |            |         |
| 2015                 | 16 | 53.63|            |         |
| 2016                 | 38 | 31.24|            |         |
| Total charge of hospitalization |  |      |            |         |
| Total                | 103|
|                      |   | 17   | 72.18      | 36.683  | 0     |
| 2011                 | 17 | 59.57|            |         |
| 2012                 | 14 | 59.57|            |         |
| 2013                 | 6  | 82.17|            |         |
| 2014                 | 12 | 69.75|            |         |
| 2015                 | 16 | 47.13|            |         |
| 2016                 | 38 | 31.87|            |         |
### 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   |      |      |
| 2012                | 14 | 52      | 36.93  | 517   |      |      |
| 2016                | 38 |         | 22.66  | 861   |      |      |
| 2013                | 6  | 44      | 38.50  | 231   |      |      |
| 2014                | 12 | 50      | 37.33  | 448   |      |      |
| 2016                | 38 |         | 21.76  | 827   |      |      |
| 2015                | 16 | 54      | 35.81  | 573   |      |      |
| 2016                | 38 |         | 24.00  | 912   |      |      |

| Total cost of hospitalization |    |         |        |       |      |      |
| 2011                | 17 | 31      | 20.94  | 356   |      |      |
| 2012                | 14 |         | 10.00  | 140   |      |      |
| 2011                | 17 | 55      | 44.00  | 748   |      |      |
| 2016                | 38 |         | 20.84  | 792   |      |      |
| 2012                | 14 | 52      | 36.93  | 517   |      |      |
| 2016                | 38 |         | 22.66  | 861   |      |      |
| 2013                | 6  | 22      | 16.33  | 98    |      |      |
| 2015                | 16 |         | 9.69   | 155   |      |      |
| 2013                | 6  | 44      | 38.50  | 231   |      |      |
| 2014                | 12 | 50      | 37.33  | 448   |      |      |
| 2016                | 38 |         | 21.76  | 827   |      |      |
| 2015                | 16 | 54      | 35.81  | 573   |      |      |
| 2016                | 38 |         | 24.00  | 912   |      |      |

| Total charge of hospitalization |    |         |        |       |      |      |
| 2011                | 17 | 31      | 19.47  | 331   |      |      |
| 2012                | 14 |         | 11.79  | 165   |      |      |
| 2011                | 17 | 33      | 20.35  | 346   |      |      |
| 2015                | 16 |         | 13.44  | 215   |      |      |
| 2011                | 17 | 55      | 43.06  | 732   |      |      |
| 2016                | 38 |         | 21.26  | 808   |      |      |
| 2012                | 14 | 52      | 37.93  | 531   |      |      |
| 2016                | 38 |         | 22.29  | 847   |      |      |
| 2013                | 6  | 22      | 17.33  | 104   |      |      |
| 2015                | 16 |         | 9.31   | 149   |      |      |
| 2013                | 6  | 44      | 39.00  | 234   |      |      |
| 2016                | 38 |         | 19.89  | 756   |      |      |
| 2014                | 12 | 28      | 18.17  | 218   |      |      |
| 2015                | 16 |         | 11.75  | 188   |      |      |
| 2014                | 12 | 50      | 38.25  | 459   |      |      |
| 2016                | 38 |         | 21.47  | 816   |      |      |

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

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

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. The Lysholm scale is reliable for use in research on ligament and meniscal injuries, chondral injuries, and patellar dislocation. In the present study, the effectiveness of surgery on patients with ACLR was determined by Lysholm knee score scale.

Endobutton and Transfix systems are the most commonly used methods for fixation on the tendon on the femoral side. Eajazi et al. 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.

ACLR 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. 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.

**Ethics Committee Approval:** Approved by the local ethics committee.

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**Authorship Contributions:** Concept: G.Ö., H.A.; Design: 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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Ön çapraz bağ rekonstrüksiyonunda Ziploop ile ToggleLoc sisteminin Transfix sistemiyle karşılaştırılması: Maliyet etkinlik analizi

Dr. Güzelali Özdemir,¹ Dr. Sualp Turan,¹ Dr. Hüseyin Aslan,² Dr. Olgun Bingöl,¹ Dr. Alper Deveci,¹ Dr. Enver Kılıç¹

¹Ankara Numune Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Kliniği, Ankara
²Ankara Numune Eğitim ve Araştırma Hastanesi, İstatistik Bölümü, Ankara

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

GEREC 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 Ölçeği ile belirlendi. İki sistemi maliyet-etkinlik oranları ile karşılaştırıldı.

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

TARTIŞMA: Elde ettiği 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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