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Dynamic intraligamentary stabilization versus conventional ACL reconstruction: A matched study on return to work

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ABSTRACT

Purpose: The dynamic intraligamentary stabilization (DIS) technique is based on a different treatment approach than ACL reconstruction in that it intends to promote self-healing of the ligament. It is only recommended for acute injuries (<21 days). The purpose of the present study was to compare DIS and ACLR with respect to the extent of work incapacity, revision rates, secondary arthroscopies, and treatment costs during recovery.

Methods: The study was a post-hoc analysis of prospectively collected data in the Swiss National Accident Insurance Fund (SUVA) database. All registered DIS cases treated until 31 December 2012 were included in the study. ACLR cases were matched to DIS cases using a propensity score approach and analysed in a follow-up period of 2 years after injury. Paired Student's *T*-test and the Chi-square test were used to compare the outcome measures.

Results: All 53 DIS patients were matched to an ACLR pair. The mean time period from injury to surgery was 14 days for DIS and 50 days for ACLR ($p < 0.001$). Overall work incapacity was 13% for DIS and 17% for ACLR resulting in a difference of nearly 1 month of absence from work ($p = 0.03$). The course of postoperative work incapacity was very similar between the groups, while the work incapacity prior to surgery lower in the DIS group. We found no difference in treatment costs, secondary arthroscopies and revision rates.

Conclusion: DIS patients benefited from nearly one month shorter absence from work than ACLR patients. This difference is likely related to the early surgical timing that is recommended for DIS. Since no differences were found between DIS and ACLR in terms of treatment costs, secondary arthroscopies and revision rates, the study supports the choice of DIS as an additional treatment option for acute ACL injuries. Further comparative studies are proposed to improve the evidence about optimal timing and best practice in ACL treatment.

Introduction

Rupture of the anterior cruciate ligament (ACL) of the knee is increasingly common, and the number of reconstruction surgeries performed annually in western countries is estimated between 34 and 44 per 100′000 people [1,2]. Optimal management of ACL ruptures is still widely discussed, and unsatisfactory recovery of knee function in the short- and long-term is still frequently reported [3–5].

Recently, dynamic intraligamentary stabilization (DIS) was reported as an alternative option for repair of acute ACL ruptures [6], based on the hypothesis that the ruptured ACL possesses an inherent biological healing capacity [7]. In contrast to conventional arthroscopic ACL reconstruction (ACLR), the use of DIS is recommended to exploit the healing potential of the ligament [6]. Graft harvesting in DIS is not required. The technique relies on providing knee joint stability during ACL healing. Proponents of DIS see the advantage of this technique in the preservation of the still living ligament tissue and its sensory pathway to the neuromuscular system [8] to enable faster and better treatment and injury recovery. However, no comparative evidence between DIS and ACL exists so far.

Recovery from ACL injury is frequently measured in terms of patient subjective evaluation or sports-related (dis)abilities [9]. Currently, more attention is focussed on the health-economic impact of ACL injuries, in view of increasing health care expenses

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and limited resources [10,11]. One of the most important aspects in the health care system is 'work capacity', which is a multifactorial concept that includes both economic and health-related perspectives [12,13].

The following study compares the post-injury recovery between DIS and ACLR by investigating work incapacity during an observation period of 2 years after the accident, treatment costs in the Swiss health care system, surgical interventions during follow-up (e.g. secondary arthroscopies) and revision rates.

Materials and methods

Study design

The study was a case-control matching analysis of prospectively collected data in the Swiss National Accident Insurance Fund (Schweizerische Unfallversicherungsanstalt, Suva) database. In Switzerland, all employees are legally required to be insured against accidents. Suva is a public sector social insurance, covering health care expenditures and compensation for work incapacity after accidents for 60% of the overall population in Switzerland. In the case of a reduced work capacity, employees receive 80% of their wages. The Suva database includes socio-demographic and administrative data, medical reports and accounting. The authors retrospectively compared records of patients that underwent either DIS surgery or ACLR surgery as a treatment for ACL injury. The cut-off date for 2 years of follow-up after the accident was 31 December 2014.

For this study, ethical approval and formal consent were not required, as the study used anonymous data from an administrative database.

DIS technique

The DIS technique is used for the same patient population as ACLR. The operative technique for DIS was previously described [6]. In brief, a monobloc screw with an integrated spring system (Ligamys™, Mathys Ltd, Bettlach, Switzerland) is fixed into the tibia. Then, a polyethylene cord is secured in the femur and guided to the tibia (Fig. 1). Before anchoring the cord in the screw-spring system, microfracturing is performed to allow stem cells to migrate into the joint and accelerate the healing process. Finally, the polyethylene cord is fixed with a predetermined tension of 50–80 N (depending on patient sex and weight). This ensures that the femur and the tibia cannot shift against each other during movements and provide continuous stability of the knee joint during the self-healing period. The two ligament stumps are not sutured together, but are kept in close proximity using the cord allowing the stumps to make loose contact and to grow together free from tensile load.

Study population

The inclusion criteria for this study were (i) coverage by Suva compulsory accident insurance (ii) primary traumatic ACL rupture in the years 2011 or 2012, and (iii) age between 18 and 55 years. For ACLR, an additional inclusion criterion was autograft transplants with a delay between the primary rupture and surgery of less than 360 days without initial conservative treatment. All registered cases had a 2-year follow-up. A total of 273 cases with DIS (n = 58) or ACLR (n = 215) met the inclusion criteria. The exclusion criteria were (iv) incomplete patient records (n = 9), (v) conservative treatment approach with delayed ACLR (n = 8), (vi) re-rupture of the ACL during follow-up (n = 7), and (vii) concomitant knee injuries (n = 35) such as knee dislocation (n = 4), reconstructed collateral ligament (n = 3), acute cartilage damage (n = 2), and others (n = 2). The selection resulted in 53 DIS and 185 ACLR cases eligible for matching.

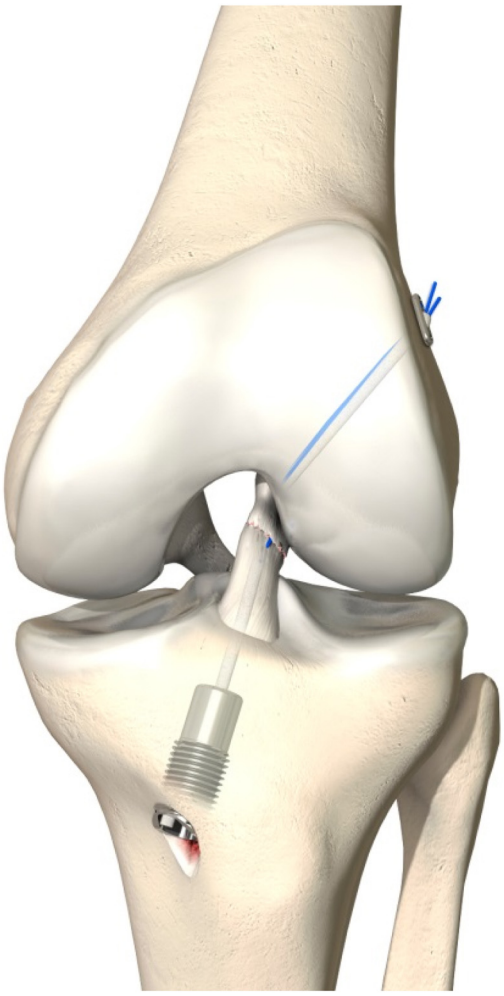

Fig. 1. Schematic illustration of the dynamic intraligamentary stabilization (DIS) technique.
Note: a monobloc screw with an integrated spring system is fixed into the tibia and a polyethylene cord is secured in the femur. The two cruciate ligament stumps are not sutured together but adapted to each other using the cord. The ruptured ends make loose contact and can grow together free from tensile load.

Matching procedure

ACLR patients were matched to DIS patients n:1 on propensity score using criteria which represent key confounders of surgical outcomes [14,15]: (i) age, (ii) sex, (iii) working category, (iv) date of ACL rupture and (v) time between rupture and surgery. The variables of the matching criteria were transformed to z-normalized values and the Euclidian distance between each DIS and ACLR case was calculated. The cases of both groups with the smallest Euclidian distance were matched until the scores indicated that further matching partners fit worse than partners that were already matched. The cut-off criterion for the matching procedure was reached when a total of 80 ACLR cases were matched to the 53 DIS cases. Twenty-one DIS cases had >1 ACLR partner that matched equally well. The final matching obtained was 1:1 for 32 DIS cases (32 ACLR), 2:1 for 17 DIS cases (34 ACLR), 3:1 for 2 DIS cases (6 ACLR), and 4:1 for 2 DIS cases (8 ACLR). Subsequently, ACLR cases with matching ratios >1:1 were proportionally down-weighted to build equal group sizes.

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