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RESEARCH

# Outcomes of revision surgery with reconstruction for patellar tendon re-rupture: a case series study

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## Abstract

**Purpose** Patellar tendon ruptures are infrequent but disabling injuries. Surgical treatment is the gold standard to obtain good outcomes. Failure of primary repair is a catastrophic complication. The literature regarding patellar tendon re-ruptures is very limited. The purpose of the current study was to evaluate the outcomes of a series of patients who underwent revision surgery for re-rupture of the primary patellar tendon repair.

**Methods** All patients with patellar tendon re-rupture surgically intervened in our center between 2019 and 2023 were retrospectively reviewed. Patient characteristics, surgical technique, functional and radiological outcomes, and complications were recorded.

**Results** Five patients with patellar tendon re-rupture were included, all of whom were male. The mean follow-up period was 30 months. The average age was 54.4 years. Patellar tendon reconstruction was performed in four cases using allografts and in one case using an autograft. The average Lysholm and Kujala scores were 88.8 and 86.8, respectively, while the mean Insall–Salvati and Caton–Deschamps indices were 1.07 at the end of the follow-up. No cases of re-rupture of the reconstructed patellar tendon were observed.

**Conclusions** In this case series of patients with patellar tendon re-rupture, revision surgery with reconstruction using autograft or allograft is presented as a valid alternative, with good functional and radiological outcomes at medium-term follow-up.

**Level of evidence** Case Series Study (Level IV).

**Keywords** Patellar tendon · Re-ruptures · Revision · Reconstruction · Failure

## Introduction

Complete ruptures of the patellar tendon (PT) are injuries that typically require surgical intervention due to their impact on the knee extensor mechanism [1]. Their incidence is low, estimated at 0.68 per 100,000 person-years [2]. Multiple surgical techniques have been described for primary surgical management, including isolated repairs or repairs combined with different types of augmentation. Failure of primary repair, leading to tendon re-rupture, is a highly

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debilitating and catastrophic complication, with reported rates ranging from 0.3% to 22.2% in different series [3–6].

These cases, requiring revision surgery due to failure of the primary repair, are generally more complex with higher associated complications, such as soft tissue contractures, knee stiffness, tissue healing problems, and quadriceps atrophy [7, 8]. Despite the limited evidence regarding their management, there is some consensus that PT reconstruction, using techniques involving autografts or allografts, is a valid and recommended alternative [9, 10].

However, there is a lack of case series evaluating the clinical and functional outcomes of patients undergoing patellar tendon reconstruction in the context of revision surgeries due to re-rupture.

The aim of this study is to evaluate the medium-term clinical and radiological outcomes of a series of patients who underwent revision surgery for re-rupture of the primary patellar tendon repair, using a reconstruction technique with allografts or autografts.

## Materials and methods

### Human ethics and consent to participate declarations

The study was designed as a retrospective case series and conducted in compliance with the Declaration of Helsinki and ethical guidelines for medical research involving human subjects. Approval was obtained from the Institutional Ethics Committee (internal approval code: CEC/01/2024), and written informed consent was secured from all participants. No animals were involved in this research.

### Patients

From December 2019 to February 2023, a total of 28 patients (29 knees) underwent PT repair. Five of the 28 patients were diagnosed with a re-rupture, identified by clinical symptoms of an inability to perform a straight leg raise and palpation of a gap at the injury site, corroborated by compatible magnetic resonance imaging (MRI) findings (see Table 1).

All five patients underwent PT reconstruction using either allograft or autograft, as described below. The graft was passed through a transverse patellar tunnel at mid-patella and a second transverse tunnel at the tibial tubercle in a figure-eight configuration. The loop was knotted on itself using high-strength Ultrabraid #2 sutures (Smith & Nephew, Andover, MA, USA), following the technique described by Sundararajan et al. [11] (see Fig. 1).

Graft fixation was performed with the knee at 30° of flexion, using fluoroscopy and imaging of the contralateral knee to reproduce the patellar height. In cases where the native patellar tendon was of adequate quality, the graft ends were sutured using high-strength sutures. No synthetic augmentation was used in any of the cases. All revision surgeries were performed by subspecialty trained knee surgeons of our knee unit. Preoperative prophylaxis with cefazolin or vancomycin (in cases of penicillin allergy) according to the institutional protocol was administered in all cases.

### Postoperative management

All patients received supervised physical therapy from a physiotherapist 2 to 5 times per week, according to the institutional protocol, for a minimum of 30 sessions. This included immobilization with a knee brace, performing isometric exercises, and partial weight-bearing on the limb with two crutches for 4 weeks. Subsequently, a gradual increase in knee flexion was allowed, aiming to achieve 90° of flexion by 8 weeks post-surgery, with limb loading based on patient tolerance. After 8 weeks, full range of motion and unrestricted weight-bearing were allowed. Radiographic studies were performed on all patients at least two months after surgery.

### Follow-up evaluation

All clinical records and postoperative radiographs of the patients were retrospectively reviewed. Additionally, all

**Table 1** Demographics and definitive treatment data

| ID | Age (y) | Gender | Side | BMI | Smoking | Re-rupture Time (w) | Reconstruction Graft Used |
|---|---|---|---|---|---|---|---|
| 1 | 51 | Male | Left | 25.6 | Yes | 14 | TP Allo |
| 2 | 57 | Male | Left | 32.5 | No | 10 | TA Allo |
| 3 | 51 | Male | Right | 27.7 | No | 12 | TP Allo |
| 4 | 57 | Male | Right | 24.8 | Yes | 14 | ST Auto |
| 5 | 56 | Male | Left | 24.5 | Yes | 6 | TP Allo |
| Overall | 54.4 (3.13) | | | 27.0 (3.31) | | 11.2 (3.35) | |

*y* year, *BMI* body mass index (kg/m$^2$), *w* week, *TP* tibialis posterior, *TA* tibialis anterior, *Allo* allograft, *Auto* autograft, *ST* semitendinous tendon. Overall age, BMI and re-rupture time expressed as mean (SD)



**Fig. 1** PT Reconstruction performed using an autograft (ST) by passing a figure of 8 loop through the patellar transverse tunnel and the anterior tibial tuberosity

patients were assessed by an independent clinician who recorded reconstruction failures, defined as clinical rupture of the reconstruction, reinterventions, medical complications, final range of flexion and extension, the presence of an extensor lag (defined as a loss of more than 5° of active extension), and functional scores using the IKDC and Kujala. Moreover, two independent evaluators assessed patellar height in the follow-up radiographs using the Caton–Deschamps index (CDI) and Insall–Salvati index (ISI) on two separate occasions, one month apart. All strict lateral knee radiographs were performed according to the institutional protocol, with the patient in a supine position, the knee at 30° of flexion, centered 7° cranially through the center of the knee, with overlap of the posterior femoral condyles at a distance of 110 cm, and including 15 cm of the tibia.

## Results

All the patients in our series were men, and their mean age at revision was 54.4 years (SD 3.13; range 51–57 years). The mean body mass index (BMI) was 27.0 kg/m$^2$ (SD 3.31; range 24.5–32.5 kg/m$^2$). None of the patients had a history of diabetes, autoimmune disease, or chronic kidney failure. All patients underwent primary repair surgery without augmentation. The average time between primary repair and failure was 11.2 weeks (range 6–14 weeks).

Only one patient developed an infection following reconstruction, successfully treated with surgical debridement and antibiotics. No cases of deep vein thrombosis or pulmonary embolism were reported. The average flexion range was 114° (SD 17.1; range 90–135°). None of the patients presented an extension deficit or extensor lag. The average follow-up period from reconstruction was 30.0 months (SD 15.9; range 14–51 months), and at the end of the follow-up period, none of the patients had experienced a recurrent rupture. The results of the functional scores and radiological index measurements at the end of the follow-up are presented in Table 2, while patient-specific range of motion (ROM) along with patient-reported outcome measures (PROMs) are summarized in Table 3.

All the patients evaluated on the study returned to their previous work-related activities.

## Discussion

This case series study showed that revision surgery for patellar tendon re-rupture, using figure-eight reconstruction techniques with autografts or allografts, yields good functional

**Table 2** Results

| | Mean (SD) | Min | Max |
|---|---|---|---|
| CDI | 1.07 (0.03) | 1.01 | 1.10 |
| ISI | 1.07 (0.05) | 1.02 | 1.14 |
| Kujala | 86.8 (7.69) | 79 | 95 |
| Lysholm | 88.8 (7.46) | 77 | 95 |
| Flexion | 114 (17.1) | 90 | 135 |
| Follow-up | 30.0 (15.9) | 14 | 51 |

*CDI* Caton–Deschamps index, *ISI* Insall–Salvati index, *SD* standard deviation. Flexion expressed in degrees, follow-up expressed in months

**Table 3** Patient-specific ROM and PROMs

| | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| Extension | 0 | 0 | 0 | 0 | 0 |
| Flexion | 135 | 110 | 125 | 110 | 90 |
| Lysholm | 86 | 77 | 94 | 92 | 95 |
| Kujala | 84 | 81 | 95 | 95 | 79 |

*ROM* range of motion, *PROMs* patient-reported outcome measures, *P* patient. ROM (extension and flexion) expressed in degrees

and radiological outcomes in the medium-term follow-up of patients.

This technique is simple and reliable, adding minimal morbidity to the patient if autograft is harvest or non if an allograft is selected. The graft reinforces the minimal remaining tendon fibers, adding stability to the construct [11]. Also, as it has no extra fixation methods, avoiding an eventual surgery for implant removal, as in the original article published by Ecker et al. [12]. Is there to highlight that to our knowledge, there is no literature regarding the use of this technique in re-rupture patellar tendon injuries, making our finding difficult to rightfully compare our outcomes.

From an epidemiological standpoint, and similar to other series on PT injuries, we found a high predominance of males [2, 13] and a BMI trending toward overweight [14, 15]. However, unlike previous studies [16–18], we did not find significant systemic diseases contributing to the re-rupture, maybe due to the lack of a larger patient case series.

The literature regarding patellar tendon re-ruptures is very limited, consisting mainly of technical notes and case reports [9, 10, 19–21], likely because it is an infrequent complication of a low-incidence injury. Due to this, we must compare our results with previous series of primary repair. In this regard, we observed good satisfaction levels according to the Lysholm scores in our patients, with an average score of 88.8/100. Also, considering patient-specific results, our patients presented good to excellent results in 80% and only one fair result. These findings align at an intermediate level compared to other series [13, 15, 22–25] analyzing primary PT repair with or without augmentation. Regarding patellofemoral symptoms and function, we found good to excellent outcomes based on the Kujala score, with a mean of 86.8 points, and all our patients reporting good to excellent outcomes. These results also agree with previous published literature [15, 25, 26]. Respecting the postoperative ROM, the average flexion range was 114° (SD 17.1; range 90–135°), with two patients achieving complete ROM and two acceptable ROM. Only one patient presented a flexion deficit of 90°, but these was not clearly related with PROMs, reporting a 95 on Lysholm score and 79 in Kujala score. Is there to highlight that none of our patients presented extension lag. Since our cases involved revision surgery, we interpret these results favorably when compared to primary interventions.

In terms of complications, we observed only one case of postoperative infection in a 57-year-old smoking patient, in whom hamstring autograft was used for reconstruction. This was successfully managed with surgical cleaning and antibiotics, and at 42 months of follow-up, he exhibited excellent functional scores. We did not observe any other medical or surgical complications. One notable point from this series is that we did not observe any new ruptures of the reconstructed tendon following revision surgeries. Considering that the average follow-up of the series was 30 months and that the failure of the primary surgery occurred at an average of 11.2 weeks, we suggest that the technique is reliable for the primary outcome, which is the re-rupture of the PT.

There are several limitations in this study. First, the small sample size and the absence of a control group limit its statistical power and generalizability. However, this reflects the low incidence and complexity of patellar tendon re-ruptures, making the recruitment of larger series inherently difficult. Second, the retrospective design limits the ability to establish causal relationships between the intervention and outcomes. Moreover, as this is a single-center trauma report, the external validity of the findings is limited. Finally, important parameters were not evaluated, such as return-to-sport time, objective assessment of quadriceps muscle trophism, and a longer-term follow-up to confirm whether the current findings are maintained over time.

## Conclusion

In this case series, revision surgery using autograft or allograft reconstruction for patellar tendon re-rupture demonstrated favorable clinical and radiological outcomes at medium-term follow-up. No re-ruptures or extension deficits were observed, and all patients returned to work. These findings support the reliability of this technique, although further studies with larger cohorts are warranted.

**Author contributions** We declare that all authors have seen and agreed to the submitted version of the article, and are responsible for it, and that all authors have participated in authorship and the article has not been submitted to any other journal. R.O. designed the study, coordinated the team, participated in data collection, abstract writing, manuscript drafting, bibliographic references, and is the corresponding author. T.P. was responsible for data collection, materials and methods drafting, synthesis and writing of results, and statistical analysis. T.R., J.L., J.T.M., N.G. and N.F. participated in data collection. J.U. participated in data collection, bibliographic references, and development for approval by the ethics committee of our institution.

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**Data availability** We also declare that all information and dataset related to the study is available in digital format and can be shared upon a reasonable request for academic purposes only.

## Declarations

**Conflict of interest** The authors declare no competing interests.

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