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Higher incidence of postoperative complications in patients with simultaneous patellar tendon and anterior cruciate ligament ruptures following single surgery: a case series and literature review

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Abstract

Background Patients with simultaneous ruptures of the patellar tendon (PT) and anterior cruciate ligament (ACL) underwent PT repair and ACL reconstruction in a single or staged surgery. However, due to the limited cases, the design of previous studies was mostly case report with varying conclusions regarding recommended surgical strategy selection, the optimal surgical strategy remains a subject of debate.

Methods We conducted a retrospective case series and literature review, including 10 cases from local institution and 27 cases from 17 studies. Demographic information, injury causes, surgical strategies, combined injuries, whether to return to (pre-injury level) sports, postoperative complications, Lysholm score and International Knee Documentation Committee (IKDC) score were identified retrospectively or reviewed from previous studies. The Fisher's exact test was used to compare the incidence of postoperative complications between different surgical strategy groups, and linear logistic regression was used to analyze factors influencing postoperative knee function scores.

Results Of the 37 patients, 15 patients (40.5%) underwent single surgery and 22 patients (59.5%) underwent staged surgery. Postoperative complications occurred in 5 (33.3%) patients after single surgery and in none after staged surgery, with the former being significantly more frequent than the latter ($P=0.007$). Linear regression of postoperative knee function scores showed that surgical strategy did not significantly affect postoperative Lysholm and IKDC scores ($P=0.327$ and $P=0.348$, respectively).

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Conclusions This study demonstrates that staged surgery significantly reduces postoperative complications compared to single surgery in patients with simultaneous PT and ACL ruptures and should be considered the preferred approach, especially when an expedited return to sports is not a priority.

Keywords Simultaneous ruptures, Patellar tendon (PT), Anterior cruciate ligament (ACL), Surgical strategy, Complications

Background

Simultaneous ruptures of the patellar tendon (PT) and anterior cruciate ligament (ACL) is a type of rare combined knee injury, involving the knee extensor mechanisms and intra-articular structures, with acute knee pain, swelling, instability and limited range of motion (ROM) [1–3]. Severe knee symptoms make positioning and ligament testing difficult, and concomitant meniscus and/or medial collateral ligament (MCL) injuries are often found on magnetic resonance imaging [3]. PT repair and ACL reconstruction are the commonly accepted treatments [4–6]. Although well-defined management approaches for isolated PT or ACL ruptures have been established, however, selecting single or staged surgery for simultaneous ruptures of both structures is still no consensus [3, 7, 8].

The single surgery allows patients to return to sports more quickly due to the fewer surgeries. Shortening possible recovery time is important in elite sports, but may cause conflicts in rehabilitation [1, 9]. The fragility of the newly repaired PT and knee fixation limit neuromuscular and early strength training after ACL reconstruction, which increases the risk of knee stiffness [1, 3, 6]. The staged surgery is initiated by PT repair and rehabilitation until extensor function is restored, then followed by ACL reconstruction [4, 10]. This procedure aims to avoid the rehabilitation conflicts but prolongs the patients' recovery periods [3, 9]. Regarding postoperative outcomes, researchers have drawn different results and conclusions, for instance, some researchers have not observed any complications in patients who underwent a single surgery [11–13]. Because the damage is complex, many researchers suggest selecting a surgical strategy based on the surgeon's and patient's preferences, and have not conducted further studies on the selection of the optimal surgical approach [12, 14].

We noticed that most of the previous studies related to surgical strategy were single-center case report with a low level of evidence [5, 6, 13, 15, 16]. Previous literature reviews on this combined injury have been conducted, but the primary focus was on the characteristics of the disease and the diagnostic process [2, 3]. Most of the research methods on surgical prognosis are only at the stage of descriptive statistics. This limitation is further compounded by the scarcity of cases, resulting in few direct comparisons of the prognosis between different surgical strategies. On this basis, we reported 10 patients with simultaneous ruptures of PT and ACL from local institution and reviewed 27 patients reported in previous studies. This study aims to address the research gap regarding the comparison of the postoperative outcomes of single versus staged surgery in patients with simultaneous ruptures of PT and ACL, with a focus on complication rates and functional recovery, which will provide additional evidence to determine the optimal surgical approach for the treatment of the combined injuries.

Methods

Patient selection

This study is a retrospective case series and literature review. After approval by the Institutional Review Board, all patients with simultaneous ruptures of PT and ACL between January 1, 2010, and December 31, 2021 were reviewed from the surgical medical record database in Peking University Third Hospital. The knee injury type was identified through the key words "patellar tendon rupture", "anterior cruciate ligament rupture", "patellar tendon suture repair", "anterior cruciate ligament reconstruction". Meanwhile, English-language literature on simultaneous ruptures of PT and ACL up to 1 January 2023 was searched in the PubMed and Google Scholar databases. The search terms used were (anterior cruciate ligament or ACL) AND (patellar tendon or patellar ligament or PT) AND (rupture or injury or tear) AND (simultaneous or combined or concomitant). Read the abstract to confirm that the literature is related to the simultaneous ruptures, and that at least one patient with this disease was reported in detail. Included patients with simultaneous ruptures of PT and ACL occurred on ipsilateral side. Exclusion criteria were as follows: (1) with a history of prior ipsilateral PT or ACL injury; (2) with concomitant posterior cruciate ligament (PCL) rupture; (3) neither single nor complete staged surgery was performed; (4) surgical techniques not involving PT repair or ACL reconstruction; (5) with a chronic PT rupture; (6) lack of postoperative follow-up evaluation.

10 patients from local institution and 27 patients from 17 studies met the criteria. In local patients, the data collected were as follows: demographic information (age, sex, body mass index [BMI], whether a professional athlete), injury causes, sides, intervals between injury and primary surgery, surgical strategies (Recording the intervals between two operations for staged surgery) and combined injuries. Telephone follow-up surveys were

conducted to obtain pre-injury and postoperative data. All patients' data were collected with informed consent. Follow-up evaluation included postoperative complications, whether to return to (pre-injury level) sports, time to return to sports (from the last surgery), reasons for failure to return to pre-injury level of sports, pre-injury and postoperative Tegner score. Local patients also completed postoperative Lysholm score and International Knee Documentation Committee (IKDC) score. Postoperative complications were defined as infection, stiffness, patella fracture, arthritis, arthrofibrosis, graft failure and thrombotic events [7, 17–19]. The detailed clinical effects and detection of complications were shown in the supplementary material (TABLE S1). A successful return to pre-injury sports levels was defined by identical pre-injury and postoperative Tegner scores and an affirmative response to the question "Have you attempted the sports at the same level that you did before your knee injury?". The above evaluation was conducted by an independent observer who did not participate in the surgical procedure. In the previous studies, the data of patients and various authors' opinions on selecting surgical strategies were reviewed. Most patients in previous reports did not have data on BMI, time to return to sports, and pre-injury and postoperative Tegner scores, and thus were excluded from this study.

Surgical techniques

All surgical procedures were conducted by surgeons who specialized in the sports medicine department and have undergone identical surgical training. The selection of surgical strategy depended on surgeon's and patient's preferences. The ruptured PT was performed by transosseous tendon repair. After accurate dissection of retinacular tears and debridement of the tendon ends, a trough of cancellous bone was created in the distal pole of the patella by using a curette or burr. Three 2.0 mm bone tunnels were drilled from the inferior pole of the patella to the proximal pole of the patella for proximal rupture, and from the tibial tuberosity to the tibia for distal rupture. Krackow whipstitch technique was used to place the Orthocord sutures (DePuySynthes, USA) in the patellar tendon, and the sutures were passed through the three drill holes with knots. The Orthocord suture (DePuySynthes, USA) was passed around the proximal pole of the patella and passed through a tunnel in the tibia with knots, as a "relaxing suture" to protect the repair. The knee was then passively flexed to 90° to ensure that there was no gap in the repair and no excessive tension.

The ruptured ACL was single-bundle reconstructed in the technique previously described, with autologous ipsilateral hamstring tendon preferred as a graft [20]. The femoral tunnel was drilled by using a 2.0-mm Kirschner wire on the apex of the deep cartilage with the knee flexed at 120°. A 4.5-mm reamer was applied along the Kirschner wire, and the medial part of the tunnel was reamed using a 7-, 8-, or 9-mm reamer (Smith & Nephew). The tibial tunnel was drilled at the anatomical central portion by using an Acufex tip-to-tip drilling guide (Smith and Nephew). The femoral graft was fixed with a flipping Endobutton suspensory fixation device (Smith & Nephew), and the tibial graft was fixed with an interference screw and a supplementary staple (Smith & Nephew) with the knee in full extension. Postoperative arthroscopic examination confirmed no graft-notch impingement. In the single surgery, ACL reconstruction was performed first, followed by PT repair. For other concomitant injuries, MCL injuries were treated conservatively for grade I and II injuries and with suture-only repairs, staples, or suture anchors at the first operation for grade III injuries [21]; meniscus injuries were treated with meniscal suture, partial meniscectomy or meniscectomy, preserving as much functional meniscal tissue as possible. The selection of specific surgical procedures depended on the location and mechanism of the injury.

Postoperative protocol

The rehabilitation programs varied according to the different surgical strategies. Patients undergoing single surgery were placed in a knee immobilizer and ROM was restricted to 90° until 6 weeks, as well as exercises for the quadriceps. Patients undergoing staged surgery had their knees immobilized and received physical therapy to restore full knee flexion and improved knee strength after PT repair. Early ROM exercises were performed to gradually build strength and transition to specific activities after ACL reconstruction.

Statistical methods

All statistical analyses were performed using SPSS V. 23.0 (IBM Corp, Armonk, New York, USA). Descriptive statistics were computed via mean, standard deviation and range for continuous quantitative data, and frequencies with percentages for categorical qualitative data. In addition, the proportions of effective cases were provided due to missing records for certain indicators. The statistical tests chosen were based on the nature of the data, the sample size, and the research questions. Independent samples t-test and Mann-Whitney U test were used to compare continuous variables between groups. The Fisher's exact test was used to compare categorical variables between groups due to the small sample size. Linear logistic regression was used to evaluate predictors of postoperative knee function scores and binary logistic regression was used to evaluate predictors of postoperative complications. These statistical methods have been widely used in studies investigating the factors that influence the prognosis of rare knee injuries with a small

Table 1 Comparison of characteristics and preoperative parameters between the single and staged surgery groups[a]

Characteristics	Total cases *(n = 37)*	Single surgery *(n = 15)*	Staged surgery *(n = 22)*	*P* value
Age, y	29.3 ± 9.7 (15–50)	33.0 ± 9.8 (17–50)	26.7 ± 9.0 (15–47)	0.053
Sex, No.				0.505
Female	2 (5.4%)	0 (0.0%)	2 (9.1%)	
Male	35 (94.6%)	15 (100.0%)	20 (90.9%)	
Professional athlete, No.	14 (35.1%)	3 (20.0%)	11 (50.0%)	0.090
Follow-up, y	2.5 ± 2.2 (0.5–11.4)	2.1 ± 1.4 (1–6)	2.7 ± 2.7 (0.5–11.4)	0.457
Side, No.				0.336
Left	16 (43.2%)	8 (53.3%)	8 (36.4%)	
Right	21 (56.8%)	7 (46.7%)	14 (63.6%)	
Combined injuries, No.				
MCL	26 (70.3%)	8 (53.3%)	18 (81.8%)	0.080
LM	15 (40.5%)	9 (60.0%)	6 (27.3%)	0.087
MM	16 (43.2%)	8 (47.1%)	8 (36.4%)	0.336
None	3 (8.1%)	1 (6.7%)	2 (9.1%)	1.000

*a*Sex, professional athlete, side and combined injuries are reported as n (%). Age and follow-up are reported as mean ± SD (range). Analyses are based on the available data, if there are data missing, the proportions of effective cases are presented. SD, standard deviation; MCL, medial collateral ligament; MM, medial meniscus; LM, lateral meniscus

Table 2 Comparison of clinical outcomes between the single and staged surgery groups[a]

Characteristics	Total cases *(n = 37)*	Single surgery *(n = 15)*	Staged surgery *(n = 22)*	*P* value
Complications, No.	5 (13.5%)	5 (33.3%)	0	0.007
Return to sports, No.	23 (88.5%; 26/37)	11 (100.0%; 11/15)	12 (80.0%; 15/22)	0.238
Return to pre-injury level of sports, No.	13 (59.1%; 22/37)	5 (55.6%; 9/15)	8 (61.5%; 13/22)	1.000
Lysholm score	89.1 ± 12.3 (49–100; 24/37)	84.8 ± 15.7 (49–100; 11/15)	92.7 ± 7.2 (75–100; 13/22)	0.119
IKDC score	85.7 ± 12.5 (56–100; 23/37)	80.2 ± 17.4 (56–100; 9/15)	89.2 ± 7.1 (80.5–100; 12/22)	0.173

a Complications and return to (pre-injury level of) sports are reported as n (%). Lysholm and IKDC scores are reported as mean ± SD (range). Analyses are based on the available data, if there are data missing, the proportions of effective cases are presented. SD, standard deviation; IKDC, International Knee Documentation Committee

sample size [22–24]. Significance was set at $P<0.05$. All analyses were performed based on the available data (no imputation of missing data).

Results

Patient demographics

37 patients were included in this study (Table 1). Each patient's information was recorded in detail in the supplementary material (TABLE S2 and S3). There were 35 (94.6%) males and 2 (5.4%) females with a mean age of 29.3 ± 9.7 (range 15–50) years. 14 patients (35.1%) were professional athletes. The average follow-up from the last surgery was 2.5 ± 2.2 (range 0.5–11.4) years. Among local patients, there was a mean BMI of 26.8 ± 4.6 (range 21.6–35.4) and a mean pre-injury Tegner score of 7.6 ± 1.1 (range 6–9), and none of these patients had any limitation of knee movement in their daily lives prior to the injury.

Injury details and surgical strategies

The injured side was the left side in 16 patients (43.2%) and the right side in 21 patients (56.8%) (Table 1). The most common cause of injury was traffic accidents (7 patients, 18.9%), followed by football (6 patients, 16.2%), basketball (6 patients, 16.2%), skiing (4 patients, 10.8%) and other sports. 34 patients (91.2%) had a combination of other knee structure injuries, most commonly MCL (26 patients, 70.3%), followed by medial meniscus (MM, 16 patients, 43.2%) and lateral meniscus (LM, 15 patients, 40.5%). All patients underwent PT repair during the initial surgery. 15 patients (40.5%) underwent single surgery and 22 patients (59.5%) underwent staged surgery, with a mean interval between two operations of 4.7 ± 2.5 (range 1.3–10) months. The baseline characteristics of the patients were comparable between the single and staged surgery groups (Table 1).

Postoperative complications

A significant difference in the incidence of postoperative complications between the single surgery and staged surgery groups was observed (Table 2). In the single surgery group, 5 out of 15 patients (33.3%) experienced complications, including stiffness (3 patients), arthrofibrosis (1 patient), and mechanical arthritis (1 patient). In contrast, no complications were reported in the 22 patients who underwent staged surgery ($P=0.007$). As no

Table 3 Linear regression for Lysholm and IKDC score[a]

Characteristics	Beta	SE	95% CI	*P* value
Lysholm score				
Age	0.201	0.329	-0.497-0.899	0.550
Follow-up	0.635	1.661	-2.887-4.157	0.708
Professional athlete	5.385	6.547	-8.494-19.264	0.423
MCL	4.813	8.169	-12.504-22.129	0.564
LM	5.538	6.821	-8.921-19.997	0.429
MM	-2.063	6.006	-14.794-10.669	0.736
Surgical strategy	7.460	7.383	-8.192-23.111	0.327
IKDC score				
Age	-0.007	0.403	-0.878-0.864	0.987
Follow-up	0.909	1.744	-2.858-4.676	0.611
Professional athlete	7.201	7.789	-9.626-24.029	0.372
MCL	-1.122	9.044	-20.660-18.416	0.903
LM	3.962	8.214	-13.784-21.708	0.638
MM	4.300	6.710	-10.196-18.796	0.533
Surgical strategy	8.171	8.387	-9.949-26.291	0.348

[a]SE, standard error; CI, confidence interval; MCL, medial collateral ligament; MM, medial meniscus; LM, lateral meniscus; IKDC, International Knee Documentation Committee

postoperative complications were observed in patients following staged surgery, it was not feasible to conduct a binary logistic regression to evaluate predictors of postoperative complications. The proportion of patients with complications in the single surgery group was the same in professional athletes and recreational participants (TABLE S4).

Return to sports

A total of 23 out of 26 patients (88.5%) with recorded data returned to sports after surgery (Table 2). Specifically, 11 out of 11 patients (100%) in the single surgery group and 12 out of 15 patients (80.0%) in the staged surgery group returned to sports. 13 out of 22 patients (59.1%) with recorded data were able to return to their pre-injury level of sports after surgery. Of these, 5 out of 9 patients (55.6%) in the single surgery group and 8 out of 13 patients (61.5%) in the staged surgery group demonstrated this outcome. The proportion of return to (pre-injury level) sports did not differ significantly between patients receiving different surgical strategies ($P=0.238$ and $P=1.000$, respectively). Between professional athletes and recreational participants, the proportion of return to pre-injury level of sports was higher in professional athletes than in the latter, regardless of the surgical strategy employed (TABLE S4). In local patients, the mean postoperative Tegner score was 5.9±2.3 (range 4.0–9.0), which is significantly lower than the pre-injury Tegner score ($P=0.016$). 8 patients (80.0%) returned to sports at a mean time of 7.6±3.4 (range 3–12) months.

Functional scores

The mean Lysholm score was 89.1±12.3 (range 49–100), and the mean IKDC score was 85.4±13.0 (range 56–100) (Table 2). There was no statistically significant difference in Lysholm scores between patients who underwent different surgical strategies, with a mean score of 84.8±15.7 and 92.7±7.2, respectively ($P=0.186$). Similarly, there was also no significant difference observed for IKDC scores, with a mean score of 80.2±17.4 and 89.2±7.1, respectively ($P=0.173$). Linear regression of postoperative knee function scores showed that surgical strategy still had no significant effect on postoperative Lysholm and IKDC scores when other factors were considered ($P=0.327$ and $P=0.348$, respectively) (Table 3).

Discussion

In this retrospective case series and systematic review, patients with simultaneous ruptures of PT and ACL who underwent different surgical strategies did not show significant differences in knee function scores and return to (pre-injury level) sports at an average of 2.5 years postoperatively, but they experienced a higher incidence of complications following single surgery compared to staged surgery. Staged surgery should be considered the preferred approach to reduce postoperative complications in patients with simultaneous PT and ACL ruptures, especially when an expedited return to sports is not a priority.

In contrast to the acute phase repair of PT, the timing of ACL reconstruction represents a major point of contention in the management of this combined injury [3]. The prognosis of isolated early versus delayed ACL reconstruction has been compared in many studies. A five-year prospective study also discovered that early (≤6 months) or delayed (>6 months) ACL reconstruction had no significant impact on postoperative functional outcomes in patients who underwent preoperative rehabilitation, justifying the rationale for delayed reconstruction

[25]. A meta-analysis based on randomized controlled trials also showed that the timing of ACL reconstruction after injury (3-week or 10-week as cutoff) had no influence on the final functional outcome, risk of retears, or residual instability [26]. The potential increased risk of cartilage damage and meniscus tears with delayed ACL reconstruction may also be a concern [27]. However, a 2-year randomized controlled trial revealed that the number of meniscal procedures in patients with an ACL rupture who received rehabilitation therapy and optional delayed ACL reconstruction did not differ from those who received early ACL reconstruction [28]. The findings of these studies indicated that delayed ACL reconstruction may be acceptable for patients with simultaneous ruptures of PT and ACL, particularly in the context of the present study, where staged surgery was found to significantly reduce the complication rate in comparison to single surgery.

Although the single surgery strategy increases the risk of postoperative complications, we noticed that some patients who underwent single surgery had no complications during follow-up and had good knee function scores, which may be attributed to changes in specific surgical techniques and rehabilitation protocols. Selva-Sarzo et al. used additional tissue from the hamstring tendon as a support for repaired PT [11]. In the studies by Kim et al. and Scrivano et al., patients started earlier knee exercises at 2 weeks after surgery [9, 12]. Kim et al. mentioned bases for selecting a single surgery, such as the relative youth of the patients and the acute phase of the injury [9]. These applicable conditions and improved techniques reduced the impact of the conflicting rehabilitation programs to some degree.

In the 17 studies reviewed, 1 study recommended single surgery [13], 6 studies recommended staged surgery [6, 15, 29–32], 2 studies did not mention a specific viewpoint [9, 33], and the remaining 8 studies suggested a combination of considerations [2–4, 10–12, 14, 34], such as single surgery is more recommended for professional athletes, staged surgery is more recommended for combined MCL rupture, or taking surgeon's and patient's preferences into account. Considering that traffic accidents are the most common cause of injury, in most patients, time to return to sports is generally the second most important factor to consider, after avoiding complications, except for those patients where professional athletes require a quick return to sports. Sundararajan et al. have proposed a management protocol for concomitant PT tear with cruciate and/or collateral ligament injury, and have reported preoperative and postoperative functional scores in cases of the injury [35]. They recommended that patients with combined PT and ACL injuries (as well as combined lateral collateral ligament injuries) should receive a single surgery. However, the study only included patients after a single surgery, and there were no comparisons with cases that underwent staged surgery. The extent of tendon and ligament injuries in the patients included in their study also differed from ours (tear vs. rupture), which may be one of the reasons for the difference in opinion. In this case series and literature review, we found that postoperative complications were more frequent after single surgery than after staged surgery, and there was a trend towards higher functional scores in the staged surgery group despite a lack of statistical significance. Furthermore, the staged surgical strategy allows the surgeon to choose the most appropriate second-stage treatment option depending on the patient's specific condition and recovery progress. This means that staged surgery may be a better strategy for those without an urgent need to return to sports.

Despite the dramatic nature of the injury and the lack of comparisons of preoperative functional scores, most patients observed were able to regain good knee function and return to sports after surgery. However, only 59.1% of patients were able to return to their pre-injury sports level, and that without considering selection bias. Both physical functioning and psychological factors are important components for patients to return to sports [36, 37]. We observed differences in the frequency of complications between the surgical strategies, but there was no difference in the proportion of return to (pre-injury level) sports. Psychological factors have received much attention in recent years in the study of return to sports after injury, and psychological readiness was found to be the most significant factor related to return to pre-injury level of sports after ACL reconstruction [38–40]. There was also a patient who did not return to exercise due to fear of re-injury in previous studies [31]. In local cases, psychological factors that contributed to patients' failure to return to pre-injury level of sports included fear of sports, fear of re-injury, fear of the long rehabilitation period, and family and work demands that took precedence over pre-injury level sports. Supplementary interventions to address specific psychological factors may play a beneficial role in the return to sports of such patients, an issue that deserves further investigation.

The contribution of this study is that the prognosis between two surgical strategies was compared firstly for this type of combined injuries, and more single-center patients were reported, which to our knowledge is the largest case series of simultaneous PT and ACL ruptures ever reported, as well as in the review of previously reported patients, which will provide surgeons with a detailed reference to characterize the disease and guide management. In a comprehensive risk-benefit assessment, reducing the risk of complications is essential for the long-term health and well-being of the patient, even if this may mean a reduction in mobility in the short

term. Nevertheless, the individual preferences and needs of the patient are always the most significant when recommending a surgical strategy. Surgeons should provide patients with detailed information about both surgical strategies, including postoperative recovery time, potential complications, and long-term functional prognosis so that they can make the most appropriate decision.

The limitation is that the total case volume was still small because of the rarity of this disease, which may make the power of the test in this study weaker compared to large cohorts. Meanwhile, to ensure the robustness of our results, we utilized only the available data for our analysis, without imputing missing values. This approach maintains the integrity of the data by avoiding potential biases that may arise from imputation methods, but it may introduce selection bias, obscuring or exaggerating the effect of surgical strategy. However, for complications of major concern, the design of the case reports allowed for more details about the original authors' assessment of each patient, which can help to minimize the bias from subjective judgement and provide reliable evidence to compare the prognosis between different surgical strategies. As postoperative complications were not observed in patients with staged surgery, a binary logistic regression as a sensitivity analysis was not feasible.

Variability in surgical techniques and postoperative protocols represents another major limitation, which inherently introduced heterogeneity as many patients were sourced from previous studies. Many studies have compared the effects of different surgical techniques for the treatment of isolated ACL or PT ruptures. For instance, single-bundle versus double-bundle reconstruction for ACL reconstruction, as well as the different graft types, showed similar postoperative outcomes [41, 42]. And there were biomechanical differences between anchor and transosseous sutures in the treatment of PT rupture [43]. However, the applicability of these conclusions to our study population remains uncertain. Similarly, some patients underwent more aggressive rehabilitation than others, which may have affected the complication rates. The impact of these procedural differences on outcomes in the context of simultaneous PT and ACL ruptures is an area that warrants further investigation. In addition, the retrospective nature of the study, with cases having different follow-up periods, makes it impossible to assess surgical effects by comparing pre and postoperative functional scores, as well as potential long-term complications. In order to provide more evidence, more larger scale multi-center and prospective studies with uniform surgical techniques and rehabilitation protocols are needed for the systematic data collection and better control of confounding variables. Long-term follow-up studies should be performed to comprehensively evaluate the efficacy and safety of single versus staged surgery for simultaneous PT and ACL ruptures.

Conclusions

Patients with simultaneous ruptures of PT and ACL who underwent different surgical strategies did not show significant differences in knee function scores and return to (pre-injury level) sports at an average of 2.5 years postoperatively, but they experienced a higher incidence of complications following single surgery compared to staged surgery. Staged surgery should be considered the preferred approach to reduce postoperative complications in patients with simultaneous PT and ACL ruptures, especially when an expedited return to sports is not a priority. In the future, improved rehabilitation protocols that reduce the incidence of complications in patients undergoing single surgery, or shorten the surgical interval and promote faster return to sports in patients undergoing staged surgery, will be meaningful in the management of the combined injuries.

Abbreviations

ACL	Anterior cruciate ligament
BMI	Body mass index
IKDC	International Knee Documentation Committee
LM	Lateral meniscus
MCL	Medial collateral ligament
MM	Medial meniscus
PT	Patellar tendon
ROM	Range of motion

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-024-08173-8.

Supplementary Material 1

Acknowledgements

Not applicable.

Author contributions

All authors contributed to the study conception and design. Detailed contributions are as follows: H.-R. S. (conceptualization, data collection and draft writing), X. G. (data collection, statistical analysis and draft writing), C. W. (data collection and statistical analysis), H.-J. W. (surgical data provision and draft revision), Y.-T. G. (surgical data provision and draft revision), J. W. (statistics analysis and draft revision), Y. M. (surgical data provision and draft revision), J.-Q. W. (supervision and draft revision), W.-L. S. (conceptualization, surgical data provision and draft revision). All authors read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This work was approved by the ethics committee of Peking University Third Hospital (Project Number: M2023562). Every human participant gave informed consent to participate in the study.

Consent for publication

All authors whose names appear on the submission (1) final approval of the version to be published. (2) agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interests

The authors declare no competing interests.

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