

# THE COVID-19 PANDEMIC DID NOT AFFECT REHABILITATION FOLLOWING ACL RECONSTRUCTION

A PANDEMIA DE COVID-19 NÃO AFETOU A REABILITAÇÃO DEPOIS DE RECONSTRUÇÃO DO LCA

LA PANDEMIA DE COVID-19 NO AFECTÓ A LA REHABILITACIÓN TRAS LA RECONSTRUCCIÓN DEL LCA

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## ABSTRACT

**Objective:** To assess postoperative rehabilitation patterns in patients who underwent Anterior Cruciate Ligament Reconstruction (ACLR) during the COVID-19 pandemic. **Methods:** A retrospective study of patients who underwent primary isolated ACLR between February 2019 and July 2020. Two different periods were evaluated. The “COVID group” represents the period from February 1<sup>st</sup> to July 1<sup>st</sup> of 2020 and the “non-COVID group” represents the equivalent period in 2019. Rehabilitation features and the effect of the COVID-19 pandemic on rehabilitation habits were assessed. Patient outcome scores were assessed using the Lysholm, Tegner, and International Knee Documentation Committee (IKDC) questionnaires. Subjective satisfaction, post-operative complications, and subsequent surgeries were recorded. **Results:** The groups did not differ significantly in demographics, functional outcome scores, or subjective satisfaction. There was no significant difference in rehabilitation patterns between the groups. In the COVID group, only one patient (4%) reported participation in online physiotherapy. **Conclusions:** There were no differences in the post-operative rehabilitation patterns, including duration, length, and environment of the training, between patients who underwent primary isolated ACLR during the COVID-19 pandemic and those who underwent the treatment in the preceding non-COVID year. Patient outcome scores, subjective satisfaction, and subsequent surgery rates did not differ between the groups. **Level of evidence IV; Therapeutic studies - investigation of treatment results.**

**Keywords:** COVID-19; Anterior cruciate ligament reconstruction; Physical therapy; Telerehabilitation.

## RESUMO

**Objetivos:** Avaliar os padrões de reabilitação pós-operatória em pacientes submetidos à reconstrução do ligamento cruzado anterior (RLCA) durante a pandemia de COVID-19. **Métodos:** Foi realizado um estudo retrospectivo dos pacientes submetidos a RLCA isolada primária no período de fevereiro de 2019 a julho de 2020 avaliados em dois períodos distintos. O “grupo COVID” representa o período de 1 de fevereiro a 1 de julho 2020, e o “grupo pré-COVID” representa o período equivalente em 2019. Os recursos de reabilitação e o efeito da pandemia de COVID-19 sobre os padrões de reabilitação foram avaliados. Os escores dos resultados dos pacientes foram avaliados com os questionários Lysholm, Tegnes e pelo International Knee Documentation Committee (IKDC). Foram relatados os dados de satisfação subjetiva, complicações pós-operatórias e cirurgias subsequentes. **Resultados:** Em ambos os grupos não foram identificadas diferenças significativas nos dados demográficos, escores funcionais e na satisfação subjetiva, assim como nos padrões de reabilitação. No “grupo COVID”, somente um paciente (4%) reportou participação em fisioterapia “on-line”. **Conclusões:** Os pacientes submetidos à RLCA isolada primária durante a pandemia COVID-19 não apresentaram diferença nos padrões de reabilitação pós-operatória, incluindo duração, extensão e ambiente de treinamento em comparação com pacientes do grupo pré-COVID no ano anterior. Os escores dos resultados dos pacientes, a satisfação subjetiva e as taxas de cirurgia subsequentes não diferiram entre os grupos. **Nível de Evidência IV; Estudos terapêuticos - Investigação dos resultados do tratamento.**

**Descritores:** COVID-19; Reconstrução do ligamento cruzado anterior; Fisioterapia; Telerreabilitação.

## RESUMEN

**Objetivo:** Evaluar los patrones de rehabilitación postoperatoria en pacientes sometidos a una reconstrucción del ligamento cruzado anterior (RLCA) durante la pandemia de COVID-19. **Métodos:** Se realizó un estudio retrospectivo de pacientes sometidos a RLCA aislada primaria entre febrero de 2019 y julio de 2020 evaluados en dos periodos distintos. El “grupo COVID” representa el período comprendido entre el 1 de febrero y el 1 de julio de 2020 y el “grupo pre-COVID” representa el período equivalente en 2019. Se evaluaron los recursos de rehabilitación y el efecto de la pandemia de COVID-19 en los patrones de rehabilitación. Las puntuaciones de los resultados de los pacientes se evaluaron mediante los cuestionarios de Lysholm, Tegner y del International Knee Documentation Committee (IKDC). Se informaron datos de satisfacción subjetiva, complicaciones postoperatorias y cirugías posteriores. **Resultados:** En ambos grupos no se identificaron diferencias significativas en los datos demográficos, las puntuaciones funcionales y la satisfacción subjetiva, así como en los patrones de rehabilitación. En el “grupo COVID”, sólo un paciente (4%) declaró haber participado en fisioterapia “online”. **Conclusiones:** Los pacientes sometidos a RLCA aislada primaria durante la pandemia de COVID-19 no presentaron diferencias en los patrones de rehabilitación



postoperatoria, incluida la duración, el alcance y el entorno del entrenamiento en comparación con los pacientes del grupo pre-COVID. Las puntuaciones de los resultados de los pacientes, la satisfacción subjetiva y las tasas de cirugía posterior no difirieron entre los grupos. **Nivel de Evidencia IV; Estudios terapéuticos - Investigación de los resultados del tratamiento.**

**Descriptores:** COVID-19; Reconstrucción del ligamento cruzado anterior; Fisioterapia; Telerrehabilitación.

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## INTRODUCTION

Anterior cruciate ligament (ACL) tear is one of the most common sport injuries affecting mainly young and active patients.<sup>1,2</sup> ACL reconstruction (ACLR) became the standard of care for patients who intend to participate in sports after ACL tear, with approximately 200,000 ACLR procedures performed annually in the United States.<sup>3</sup> The success of the procedure depends on various factors, including patient characteristics, surgical technique, associated injuries and postoperative rehabilitation.<sup>4</sup> Postoperative rehabilitation is an essential part of the treatment.<sup>5</sup> Its main role is to protect the ligament reconstruction and preserve the physical and psychological state of the patient.<sup>6</sup> Postoperative rehabilitation addresses common problems such as range of motion and strength deficits, joint stiffness and generalized knee pain.<sup>7</sup> In their systematic review, Kruse et al.<sup>8</sup> reviewed numerous aspects of rehabilitation following ACLR and concluded that minimally supervised home-based rehabilitation, especially for motivated patient had equal levels of effectiveness compared to in-clinic physical therapy.

The COVID-19 pandemic caused by the SARS-CoV-2 virus throughout 2020 had a dramatic medical and economic impact worldwide.<sup>9</sup> As the epidemic spread, governments and national health organizations guidelines called for restrictions limiting elective surgical procedures done by hospitals, mainly to reserve inpatient capacity and to divert medical staff for the critically ill patients. The impact and disruption on orthopedic healthcare services had been documented in the last months, with drastic cutbacks in orthopedic surgeries including ACLR.<sup>10</sup> Post-operative physiotherapies was also reported to be severely impaired, mainly due to limited access to physical therapy services.<sup>11</sup>

The aim of this study was to evaluate patients who underwent ACLR during the COVID-19 pandemic and subsequent lockdown in a tertiary medical center, and to compare their demographics, postoperative rehabilitation characteristics and subjective outcomes to patients in the corresponding period in 2019.

## MATERIALS AND METHODS

### Study design and pre-operative evaluation

Following institutional review board approval, a retrospective study was conducted at an orthopedic division of a single tertiary center. Database from the patients' medical charts was reviewed for all patients who underwent knee arthroscopy between February 2019 and July 2020, of which, only patients that underwent primary isolated ACLR were entered to the study. Each patient was operated by a sports medicine fellowship trained orthopedic surgeon. Exclusion criteria were prior knee surgery and refusal to participate in the study. Data included: demographic characteristics; time interval between injury and surgery and surgical technique information (i.e., graft choice; graft fixation type). Two different periods were evaluated. The first group - "COVID group" represents the period between February 1<sup>st</sup> to July 1<sup>st</sup> of 2020 which was the peak of the outbreak and lockdown period in our country. The second "pre-COVID group" represents the equivalent period of 2019. All patients received similar post-operative physiotherapy protocol that consisted of crutches use for 2-weeks until gait patterns improvement; soft tissue therapy; work on knee range of motion and proprioception. Open kinetic chain work was contraindicated for 6-weeks postoperatively.

## Data collection and clinical outcome measures

At latest follow-up, in January 2020, each patient was interviewed and assessed by an independent observer (other than the surgeon). Additional demographic characteristics were collected including work and family status. All patients were asked about their post-operative rehabilitation features using the following queries: a) How many times a week did you practice in-clinic physical therapy? b) How many times a week did you practice home-based physical therapy? c) How long did each practice last? d) What was the overall time period (in months) you practiced physiotherapy? e) Have you practiced in an individual or group setting? f) Have you practiced via telemedicine? (i.e., instructional videos or online sessions). The patients in the COVID group were also asked about the effect of the COVID-19 pandemic on their rehabilitation patterns, such as: a) difficulty coordinating physiotherapy sessions; b) delay in initiating post-operative rehabilitation; c) fear of attending in-clinic sessions due to a potential COVID-19 exposure and d) What was your self-confidence in home self-practice after training with a physiotherapist?

Patient outcome scores were assessed using the Lysholm, Tegner<sup>12</sup> and the International Knee Documentation Committee (IKDC) questionnaires.<sup>13</sup> Finally, patients were asked to answer 3 questions: First, they were asked how they would rate the overall satisfaction of their knee joint on a scale of 1 to 100, with 1 being "least satisfied" and 100 being "most satisfied." Second, patients were asked at most recent follow-up to subjectively quantify their post-operative knee status compared to their uninjured knee on a scale of 1 to 100, with 100 being identical to the uninjured leg. Third, patients were asked to comment on their pain, using visual analog scale (VAS) score. At most recent follow-up, recurrent injury, early (within 3 months) and late complication rate (i.e., adhesions, infection) and subsequent surgery were recorded.

## Statistical analysis

Statistical analysis was performed using SPSS software (IBM SPSS statistics for windows, version 25, IBM corp. 204 Armonk, N.Y., USA, 2017). Continuous variables were reported as means with standard deviation. The chi score test was performed to compare categorical variables. A T-test for independent means was performed to compare normally distributed continuous variables. The Wilcoxon Mann Whitney test was performed to compare ordinal variables. All statistical analyzes were bilateral. A value of <.05 was considered statistically significant.

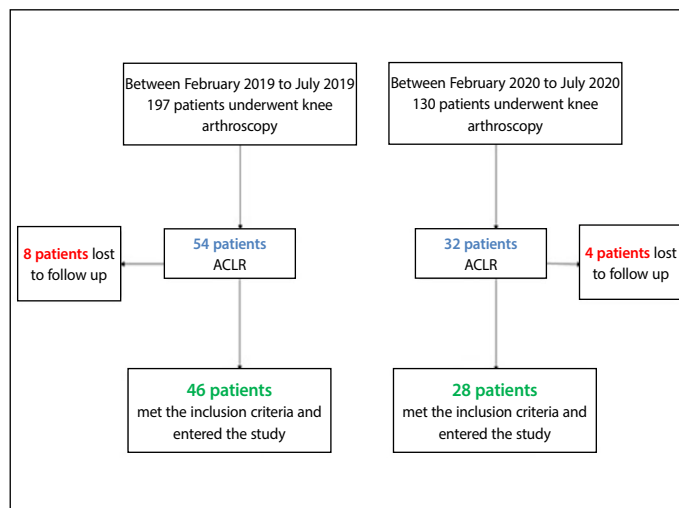
## RESULTS

A total of 54 (8 patients lost to follow-up, 14.8%) and 32 (4 patients lost to follow-up, 12.5%) patients underwent isolated ACLR in the pre-COVID and the COVID groups, respectively. Representing a reduction of 40.7% in ACLR performed during the COVID-19 period compared to the parallel period (Figure 1). 46 patients (36 males, 78%) in the pre-COVID and 28 patients (24 males, 85%) in the COVID groups were included in the study, with a mean age of 27.4 (SD 8.8) and 26.8 (SD 10.2) respectively ( $p=0.81$ ). There was no significant difference in demographics between the two groups (Table 1). Minimum follow-up time was 6 months for all patients (range, 6-23 months).

Regarding post-operative rehabilitation features, the pre-COVID and the COVID groups did not differ significantly as demonstrated in Table 2. Within the COVID group, 8 patients (29%) practiced their post-operative rehabilitation via instructional videos compared to 11 patients (24%) in the pre-COVID group. Only one patient (4%) from the COVID group reported online physiotherapy participation.

12 patients (43%) in the COVID group reported major difficulty to coordinate post-operative physiotherapy sessions which led to delay in initiating post-operative rehabilitation. Only 3 patients (11%) reported moderate or high fear of going to in-clinic sessions during the COVID-19 period (Table 3).

There were no significant differences between the groups in Lysholm, Tegner and IKDC questionnaires as well as subjective satisfaction. The VAS score in the COVID group (1.98 SD 1.5) was significantly lower compared to the VAS score in the pre-COVID group (3.6 SD 2.2)  $p=0.001$ . (Table 4)



**Figure 1.** Inclusion criteria for the study. ACLR; anterior cruciate ligament reconstruction.

**Table 1.** Patient Demographics.

Variable	Pre-COVID group	COVID group	Total	P Value
Total (%)	46 (100)	28 (100)	74 (100)	
Gender -Male (%)	36 (78)	24 (85)	60 (81)	0.42
Mean Age (SD) [1]	27.4 (8.8)	26.8 (10.2)	27.2 (9.3)	0.81
<b>Graft Type (%)</b>				
BTB	19 (41)	19 (67)	38 (51)	
Hamstrings	11 (24)	0	11 (14)	
Allograft	11 (24)	6 (21)	17 (22)	
Quadriceps	5 (10)	3 (10)	8 (10)	0.07
Time from Injury to surgery (months) (SD) [1]	6.6 (6.4)	6.4 (5.9)	6.5 (6.1)	0.88
Weight (Kg) (SD) [1]	78.6 (14.5)	80.2 (14.3)	79.2 (14.4)	0.63
Height (m) (SD) [1]	173.6 (8.4)	176.3 (7.8)	174.6 (8.2)	0.15
<b>Work (%)</b>				
Unemployed	6 (13)	3 (10)	9 (12)	
Physical	13 (28)	11 (39)	24 (32)	
Professional athlete	2 (4)	4 (14)	6 (8)	
Office Job	25 (54)	10 (35)	35 (47)	0.2
<b>Family Status (%)</b>				
Single	35 (76)	17 (60)	52 (70)	
Married	9 (19)	10 (36)	19 (25)	
Divorced	2 (5)	1 (4)	3 (5)	0.3

[1] Values are presented as mean and standard deviation. BTB; bone patellar bone graft.

**Table 2.** Post-operative rehabilitation features for all patients.

Variable	Pre-COVID group	COVID group	Total	P-Value
In-clinic session per week [SD]	2.8 (0.98)	2.3 (1.2)	2.7 (2.4)	0.79
Home-based sessions per week [SD]	2.8 (2.5)	2.9 (2.4)	2.8 (2.4)	0.84
<b>Individual vs. Grupo (%)</b>				
Individual in-clinic	24 (52)	13 (46)	37 (50)	
Group in-clinic	2 (4)	0 (0)	2 (3)	
Both in-clinic	6 (13)	5 (18)	11 (15)	
Individual Home-based	13 (28)	10 (36)	23 (31)	
Group Home-based	1 (2)	0 (0)	1 (1)	0.94
<b>Online Session participation</b>				
Yes (%)	0 (0)	1 (4)	1 (1)	0.7
<b>Practice with instructional videos</b>				
Yes (%)	11 (24)	8 (29)	19 (26)	0.65
<b>Session length in minutes (%)</b>				
Under 30	4 (9)	3 (11)	7 (9)	
30-45	12 (26)	4 (14)	16 (22)	
45-60	20 (43)	9 (32)	29 (39)	
>60	10 (22)	12 (43)	22 (30)	0.34
Duration (months) [SD]	7.3 (3.6)	6 (2.4)	6.8 (3.3)	0.07

**Table 3.** Rehabilitation features during the COVID-19 Pandemic.

Variable	COVID group (N=28)
<b>Difficulty coordinating sessions (%)</b>	
No	9 (32)
Minor	7 (25)
Major	12 (43)
<b>Delay in initiating rehabilitation (%)</b>	
No delay	16 (57)
1-7 days delay	3 (11)
1-2-week delay	5 (18)
More than 2 weeks delay	4 (14)
<b>Fear of attending in-clinic sessions (%)</b>	
No fear	20 (71)
Minor fear	5 (18)
Moderate fear	1 (4)
High fear	2 (7)
<b>Self-confidence without supervision (%)</b>	
Lack of self-confidence	0 (0)
Low self-confidence	3 (11)
Moderate self-confidence	9 (32)
Full self-confidence	16 (57)

**Table 4.** Patient outcome scores and post-operative satisfaction.

Variable	Pre-COVID group	COVID group	P Value
Knee evaluation 1-100¥ (SD) [1]	64.1 (23.8)	69.9 (17.1)	0.23
Operated Vs Uninjured Knee 1-100* (SD) [1]	65.6 (25)	68.2 (20.3)	0.62
Lysholm (SD) [1]	74.2 (18.3)	82.0 (18.1)	0.08
Tegner (SD) [1]	4.5 (1.9)	4.96 (1.9)	0.32
IKDC (SD) [1]	54.8 (15.3)	60.9 (17.2)	0.12
VAS (SD) [1]	3.6 (2.2)	1.98 (1.5)	0.001

[1] Values are presented as mean and standard deviation; ¥ Subjective evaluation with 1 being "least satisfied" and 100 being "most satisfied"; \*subjectively quantification of post-operative knee status compared to the uninjured knee on a scale of 1 to 100, with 100 being identical to the uninjured leg; IKDC; international knee documentation committee.

At latest follow-up, there was no difference between the groups in terms of postoperative complications ( $p=.58$ ) and subsequent surgery rate ( $p=.97$ ). No early complications and post-operative infections were noted in both groups. In the pre-COVID group, 1 patient (2%) underwent medial partial meniscectomy, 18 months after the index procedure for treatment of meniscus tear. Four patients (9%) underwent subsequent surgery for the treatment of adhesions and cyclops syndrome. 2 patients (4%) suffered a re-tear of the ACL more than 1-year after the surgery and were treated non-operatively. In the COVID group, one patient (4%) underwent medial partial meniscectomy, 11 months after the index procedure for treatment of meniscus tear and 2 patients (7%) underwent subsequent surgery for the treatment of adhesions. No recurrent injury of the ACL was recorded.

## DISCUSSION

Rehabilitation following ACLR is an integral part of the treatment in-order for patients to return to their pre-injury activity levels. Post-operative rehabilitation consists of several elements both physically and psychologically,<sup>6</sup> thus pre-operative education is of paramount importance for mental preparation and setting rehabilitation goals.<sup>14</sup> Still, due to lack of consensus, different physiotherapy protocols post-ACLR are available. Kruse et al.<sup>8</sup> performed a systematic review and addressed numerous aspects of rehabilitation following ACLR and reported little to no evidence supporting the use of bracing or continuous passive motion device postoperatively. Additionally, minimally supervised home-based rehabilitation, especially by the motivated patient had equal levels of effectiveness compared to in-clinic physical therapy. Królikowska et al. demonstrated that the extent of postoperative rehabilitation supervision did not affect the clinical outcomes following ACLR.<sup>15</sup> Moreover, Grant et al conducted 2 consecutive studies, with short- and long-term follow-up, and demonstrated similar 2- to 4-year outcomes in patients who participated in a predominantly home-based compared to in-clinic and supervised rehabilitation programs.<sup>16</sup>

The COVID-19 pandemic caused by the SARS-CoV-2 virus had a dramatic medical and economic impact globally throughout 2020.<sup>9</sup> As the epidemic spread globally, restrictions and guidelines were announced by governments and national health organizations which changed medical services dramatically. In order to minimize the burden on health care systems (i.e., reserve inpatient capacity for the critically ill patients) and diverting medical staff to treat COVID-19 patients, elective procedures were canceled or postponed starting March 2020.<sup>17</sup> Although definitions of elective surgery differ between guidelines and countries, almost all knee arthroscopy procedures were included as non-urgent<sup>11,17</sup> and indeed a drastic reduction was reported in arthroscopic procedures, including ACLR. This significant decrease was reflected in a survey, conducted among orthopedic surgeons in German-speaking countries in May 2020, that showed that only 54.5% of the surgeons reported to be currently performing ACLR procedures.<sup>18</sup>

In accordance with the above-mentioned studies, our study demonstrated that during the COVID-19 period, there was an overall 34% reduction of elective sport's knee procedures, and 40.7% reduction in ACLR surgeries performed compared to the equivalent period in 2019. The low volume of overall surgeries during the COVID-19 period, can probably explain the small reduction in the time interval between injury and surgery in the COVID group compared to the pre-COVID group in our study.

Bettger et al.,<sup>19</sup> highlighted the importance of maintaining essential rehabilitation services during the COVID-19 pandemic. They addressed several aspects and offered various solution tools, among them telerehabilitation practice, strengthening and improving home-based

rehabilitation and protective measurements for care providers. In a review performed by Wittmeier et al, it was demonstrated that in-clinic rehabilitation services during the COVID-19 were largely discontinued, and tele-rehabilitation was emphasized as important option, whenever possible, in order to continue the treatment sequence.<sup>20</sup>

In this present study and in agreement with the above-mentioned studies, 43% of the patients in the COVID group experienced difficulties in coordinating and initiating post-operative rehabilitation, due to the low availability of in-clinic rehabilitation services. This may have significant implications for treatment outcomes. Interestingly, despite this reported difficulty, the pre-COVID and the COVID groups did not differ significantly in their rehabilitation's characteristics, including length of each physiotherapy session, in-clinic versus home-base practice, individual versus group training and telerehabilitation participation. Moreover, there was no significant difference between the groups in Lysholm, Tegner and IKDC questionnaires as well as in subjective satisfaction. These findings can be explained by the fact that the study population was consisted of young, healthy, and active patients, which are less prone to be affected by the COVID-19, thus, this group of patients did not avoid (social gathering) group physiotherapy sessions.

Telemedicine is increasing in its relevance. Several systematic reviews have investigated the role and importance of telerehabilitation interventions indicating high effectiveness for patients with musculoskeletal conditions.<sup>21-24</sup> It has been shown that telerehabilitation can reduce health care costs, improve treatment continuity, functional outcome and patient satisfaction.<sup>25</sup> Telerehabilitation offers information, tutoring and exercise guidance. These services can be provided via online sessions using audio, video, or both; offline training; remote evaluations of recorded self-videos or images and scheduled assessment via the phone.<sup>26</sup> During the COVID-19 pandemic, this modality seems more relevant than ever, especially for mitigating the consequences of COVID-19 and reduced services available coupled with the patient's will for social distancing.<sup>19</sup>

Surprisingly, despite the opportunity to develop and use telerehabilitation during the COVID period, only 8 patients (29%) practiced their post-operative rehabilitation via instructional videos, similar to the proportion of patients who used this method in the pre-COVID group (24%). In the COVID group, only one patient participated in online physiotherapy session. Therefore, it can be concluded that the study population did not see an advantage in telerehabilitation and found this method less desirable. These findings may have several explanations; 1) We found high rate of self-confidence in training in all patients, minimizing the need for further telerehabilitation sessions; 2) Post-operative rehabilitations features did not differ between groups, indicating continuity of the treatment which obviates the need for complementary treatment; 3) Despite Telerehabilitation's advantages, it has been known that efficacy of musculoskeletal physical therapy depends not only on direct interventions, but also on patient's intrinsic factors during practice (e.g. atmosphere around the session),<sup>27,28</sup> which leads to patients preferring conventional, frontal and familiar setting over an online therapy. Yet, telemedicine is considered a relatively new option, which is not always available to all patients and not always recommended by surgeons and primary care physicians. Patients may be unaware of such option which may introduce bias suggesting an inherent limitation to this conclusion.

## Limitations

There are several limitations to this study. The retrospective nature of this study may introduce bias. As discussed, during the COVID-19 outbreak the number of elective surgeries decreased significantly. The COVID group, represents patients that underwent ACLR during the

period when the epidemic was at its peak and lockdown was imposed in our country, resulting in a relatively small sample size, which makes our results difficult to extrapolate. However, this fact allowed the data collection and latest follow-up assessment to be thorough. Another limitation was follow-up differences between the groups, which may introduce recall bias, specifically in the data regarding the early post-operative rehabilitation features. This study presents short-term results so long-term complications rate cannot be established. Although it is ideal to assess post-ACLR outcomes at minimum 1-year follow-up, the minimum follow-up time was six months for all patients, which in terms of post-ACLR rehabilitation is appropriate to assess outcome including return to sports activities.<sup>6</sup> Additionally, the study main scope was to evaluate the postoperative rehabilitation patterns so that mean follow-up time was considered adequate for the relevant data collection. Finally, this study was conducted in a single tertiary center. Although the rehabilitation post ACLR was not affected in our cohort, other multicenter studies are needed to investigate the effect on other PT clinics or settings.

## CONCLUSIONS

The current study has demonstrated that young, active patients who underwent primary isolated ACLR during the COVID-19 pandemic had no difference in their post-operative rehabilitation patterns, in terms of duration, length and environment of the training, compared to patients in the preceding pre-COVID year. The patient's outcome scores, subjective satisfaction and subsequent surgery rate did not differ between the groups.

## Ethical approval

This study received ethical approval from the Ethics committee of X hospital under the protocol number 0159-19.

## Informed consent

Informed consent was obtained from all patients.

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All authors declare no potential conflict of interest related to this article

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