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Return to School After Anterior Cruciate Ligament Reconstruction: A Prospective Study of Adolescents and Young Adults.

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Return to School After Anterior Cruciate Ligament Reconstruction

A Prospective Study of Adolescents and Young Adults

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Investigation performed at Rothman Institute, Philadelphia, Pennsylvania, USA

Background: The ability to return to school after orthopaedic surgery is an important consideration for young patients, as there is substantial literature indicating that school attendance is correlated strongly with academic performance.

Purpose: To evaluate the time to return to school, the barriers that students encounter when returning to school, and the academic effect of anterior cruciate ligament reconstruction (ACLR) in high school (HS) and college students.

Study Design: Cohort study; Level of evidence, 2.

Methods: Full-time HS and college/graduate school (C/GS) students who underwent ACLR during the 2017 to 2018 and 2018 to 2019 academic periods were included in the study. Patients were contacted 2 weeks postoperatively to complete a questionnaire that assessed their time to return to school and barriers that interfered with their ability to return, and they completed a second questionnaire at 6 weeks postoperatively that assessed academic performance and challenges faced upon returning to school.

Results: Included were 36 (52.2%) full-time HS students and 33 (47.8%) full-time C/GS students. HS students reported a longer time to return to school compared with C/GS students (8.51 vs 5.89 days; $P = .008$). In addition, HS students missed more scheduled school days than C/GS students (5.39 vs 2.90 days; $P < .001$). The majority of HS (73.5%) and C/GS (65.5%) students cited pain as a barrier to return, and more than half of HS (70.6%) and C/GS (55.2%) students also cited restricted mobility as a barrier to return. HS students were more likely to miss an examination in the early postoperative period compared with their C/GS counterparts (65.7% vs 39.3%; $P = .037$). Many students in both cohorts received a grade less than expected in the early postoperative period; this was not significantly different between the 2 groups (HS, 50.0%; C/GS, 42.9%; $P = .489$).

Conclusion: ACLR can have a negative effect on school attendance and academic performance among HS and C/GS students. Orthopaedic surgeons should counsel all students and their families adequately about the potential academic effect of orthopaedic surgery in order to maximize clinical results, academic performance, and satisfaction in their patients.

Keywords: academic performance; ACL reconstruction; college; high school; return to school; students

Sports-related injuries are common among teenagers and college-aged individuals and result in as many as 430,000 visits to the emergency department in the United States each year.¹³ Specifically, injuries to the anterior cruciate ligament are exceedingly common, with approximately 80,000 anterior cruciate ligament reconstruction (ACLR) surgeries alone having been performed in this age group in 2006.¹² The ability to return to school after ACLR is an important consideration for young patients, as there is substantial literature indicating that school attendance is correlated strongly with academic performance in

elementary,⁵ middle,^{1,5} and high school (HS),¹ as well as college.^{2,4,10} Class attendance may even be the best predictor of academic performance, more valuable than standardized test scores, study habits, and study skills.² For HS students who attend public school in the United States, there are an average of 180 in-session school days each year.⁹ College students tend to have fewer school days each year, which may cause each day away from school to have an even greater effect on academic performance.

While return to sports after orthopaedic surgery has been studied frequently in young athletes in order to better understand prognosis and risk for reinjury,^{3,7-9,17} few studies have examined timing for return to school. Willimon et al¹⁸ found that the time to return to school after a variety of common pediatric orthopaedic procedures can vary

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between an average of 3.4 and 42 days, depending on the type of procedure. Timing of surgery is an important factor that affects the amount of missed school, as Trentacosta et al¹⁶ found that 96% of students 18 years old and younger who underwent surgery during the school year missed at least 1 day of school. In comparison, nearly 66% of students who underwent surgery during a holiday break and only 12.5% of students who underwent surgery during the summer missed a day of school.¹⁶ Freedman et al⁴ found that, among college students who underwent ACLR, those who had surgery during the academic semester missed more school days (10.5 vs 1.5 days) and examinations (2.2 vs 0.1 examinations) than did those who underwent ACLR during an academic break.

Although a few studies have focused on time to return to school after a variety of sports medicine procedures, most studies have not explored the factors that influence the amount of time missed, the barriers to return to school, or the academic effect of lost time.^{1, 4,5,6,16,18} In addition, these studies often excluded college students, so the effect on this population is less understood. As a result, there are limited data available to sports medicine surgeons when counseling their patients preoperatively. This information is critical in order to counsel and treat the entire “student-athlete” and not just the injury itself. The students-athletes, their families, and the treatment teams should all be aware of the potential barriers to return to school and the effect of missed school time in order to fully optimize outcomes in these patients.

The purpose of this study was to evaluate the time to return to school, the barriers that students encounter when returning to school, and the academic effect of ACLR in HS- and college-aged students. Our hypothesis was that HS students would miss significantly more schooling in the postoperative period and would be more likely to be affected negatively by their school absence compared with college/graduate school (C/GS) students.

METHODS

This case series was conducted at a single institution by 3 sports medicine fellowship-trained orthopaedic surgeons (M.G.C, C.C.D, S.H.) during the 2017 to 2018 and 2018 to 2019 academic periods after institutional review board approval. Patients were included if they were a full-time HS, college, or graduate student between the ages of 14 and 25 years at the time of surgery and underwent ACLR with or without meniscal surgery. Patients who were

homeschooled and/or attended school online at the time of surgery were excluded. In addition, patients who underwent concomitant meniscal transplant, realignment osteotomy, cartilage repair procedures other than chondroplasty, and multiligamentous repair or reconstruction were excluded.

Patient characteristics, including sex, age, and body mass index (BMI), were collected before surgery. Patient eligibility for the study was then confirmed postoperatively based on the final surgical procedure(s) performed. Patients were contacted 2 weeks postoperatively to complete a questionnaire that assessed their time to return to school, the number of scheduled school days missed, and the barriers that interfered with return to school (Appendix Figure A1). At 6 weeks postoperatively, patients completed a second questionnaire that assessed challenges faced when returning to school, academic performance, and possible causes for lower-than-expected academic performance, if applicable, upon returning to school (Appendix Figure A2). Both surveys included 2 types of questions: “yes/no” format questions and statements with which the participants were asked to respond on a scale of 1 to 5 between *strongly agree* (1) and *strongly disagree* (5). The mean score for each statement was compared between HS and C/GS students using the Likert scale.

Descriptive statistics, including mean, range, and standard deviation, were calculated. Comparisons between groups were calculated using a 2-sample *t* test for normally distributed data and the Wilcoxon rank sum test for nonnormally distributed data. The chi-square and Fisher exact tests were used to compare categorical data. $P < .05$ was considered statistically significant. All statistical analyses were done using R Studio (Version 3.6.3, Vienna, Austria).

RESULTS

During the 2017 to 2018 and 2018 to 2019 school years, 132 HS and 108 C/GS students underwent arthroscopic ACLR at our institution and met the inclusion criteria. A total of 36 (27.3%) HS students and 33 (30.6%) C/GS students consented to participate in the study (Table 1).

A total of 66 patients (35 HS, 31 C/GS; 95.7%) responded to the 2-week postoperative survey that was used to assess time to return to school and barriers that interfered with return. HS students required a greater duration of time to return to school compared with C/GS students after ACLR (8.51 vs 5.89 days; $P = .008$) (Table 2).

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Ethical approval for this study was obtained from Thomas Jefferson University (ref No. 17D.268).

TABLE 1
Descriptive Data Between HS and C/GS Students at the time of ACLR^a

	HS (n = 36)	C/GS (n = 33)	P
Age at surgery, y	17.1 ± 1.3 (14.6-20.9)	20.9 ± 1.7 (18.3-25.9)	<.001
Sex			.121
Male	14 M (38.9)	19 M (57.6)	
Female	22 F (61.1)	14 F (42.4)	
BMI at surgery	23.7 ± 2.7 (19.0-32.0)	25.5 ± 3.3 (20.5-35.8)	.017
Surgery			.961
Isolated ACLR	13 (36.1)	13 (39.4)	
ACLR with concomitant medial or lateral partial meniscectomy	8 (22.2)	7 (21.2)	
ACLR with concomitant meniscal repair	15 (41.7)	13 (39.4)	

^aResults presented as mean ± SD (range) or n (%). Bold indicates statistically significant difference between groups ($P < .05$). ACLR, anterior cruciate ligament reconstruction; BMI, body mass index; C/GS, college/graduate school; F, female; HS, high school; M, male.

TABLE 2
Mean Time to Return to School Among HS and C/GS Students After ACLR Surgery^a

	HS (n = 36)	C/GS (n = 33)	P
Days between surgery and return to school	8.51 ± 4.10 (4.00-20.00)	5.89 ± 3.24 (1.00-13.00)	.008
Scheduled school days missed	5.39 ± 3.39 (0-17.50)	2.90 ± 2.16 (0-8.00)	.001

^aResults are presented as mean ± SD (range). Bold indicates statistically significant difference between groups ($P < .05$). ACLR, anterior cruciate ligament reconstruction; C/GS, college/graduate school; HS, high school.

In addition, HS students were found to miss more scheduled school days than were C/GS students. A majority of HS and C/GS students were able to complete full days upon return to school (HS, 71.4%; C/GS, 77.4%; $P = .579$). Only 6 students were unable to complete the full school day upon their return (HS, 14.3%; C/GS, 3.2%; $P = .119$). A total of 5 students (4 HS, 1 C/GS) reported pain or soreness, and 1 HS student cited an emergency department visit for lower extremity deep vein thrombosis for their unplanned early dismissal.

HS students were significantly less likely to report difficulty with accessibility or mobility upon returning to school (31.4% vs 58.1%; $P = .030$). Of the 39 patients who experienced mobility difficulties, the most common difficulty reported was walking, especially in crowded areas (61.5%), followed by climbing stairs (15.4%), carrying books/school materials (10.3%), and pain (2.6%). Most students required a change in school transportation after surgery (HS, 80.0%; C/GS, 77.4%; $P = .798$). Patients were also asked to rate 5 possible barriers to return to school on a scale of 1 to 5 from *strongly agree* (1) to *strongly disagree* (5) (Figure 1).

A similar proportion of HS and C/GS students agreed or strongly agreed that pain did not allow them to return to school earlier ($P = .143$). More than half of students agreed or strongly agreed that restricted mobility ($P = .178$) and ongoing use of opioid medication ($P = .885$) did not allow for an earlier return. Other barriers to return, including surgeon restrictions and school policy restrictions, were less common barriers to return in both groups.

A total of 63 patients (35 HS, 28 C/GS; 91.3%) completed the 6-week postoperative survey that was used primarily to assess the effect of surgery on school performance (Figure 2).

Both groups of students were significantly more likely to experience difficulties with concentration after surgery than immediately before surgery (HS, $P = .005$; C/GS, $P = .020$). There was no difference in the number of HS students who experienced concentration difficulties compared with C/GS students either preoperatively or postoperatively ($P = .758$ and $P = .954$, respectively). Of the patients who experienced difficulty concentrating after surgery, 72.0% reported pain as the primary reason. HS students were more likely to miss an examination in the early postoperative period than were their C/GS counterparts ($P = .037$). The mean number of examinations missed by HS students was 3.8 ± 2.1 as compared with 1.8 ± 0.6 examinations missed by C/GS students ($P = .408$). Students in both groups were no more likely to fail an examination in the 6-week postoperative period than they were in the 6-month preoperative period (HS, $P = .157$; C/GS, $P = .706$).

The 6-week postoperative survey was also used to assess the factors that interfered with school attendance and performance during the postoperative period on a scale from *strongly agree* (1) to *strongly disagree* (5) (Figure 3).

Many students in both groups agreed or strongly agreed that they had difficulty keeping up with assignments ($P = .931$) and that it took longer to complete assignments ($P = .824$). Many students also agreed or strongly agreed that they received a grade less than expected in the early

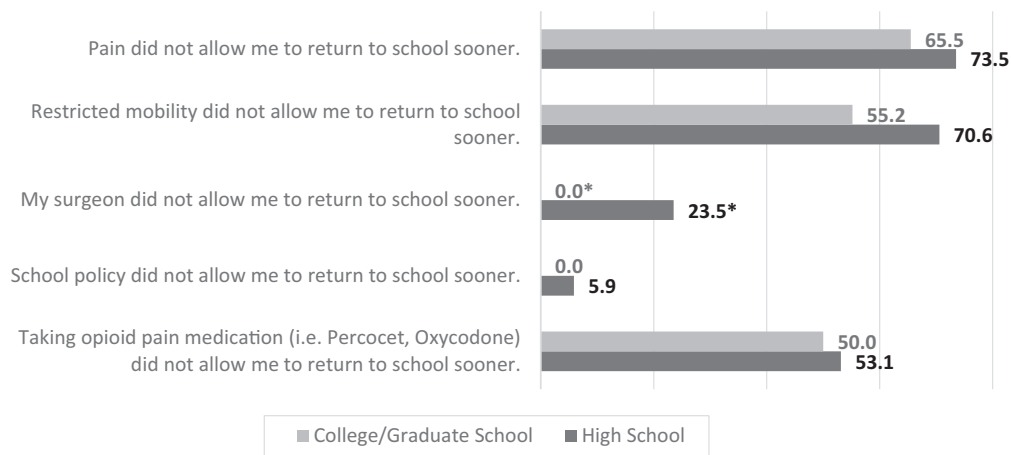


Figure 1. Factors affecting return to school among HS and C/GS students. Values are presented as a percentage of the total respondents in each cohort who answered “agree” or “strongly agree” to the question prompt. *Statistically significant difference between groups ($P < .05$). C/GS, college/graduate school; HS, high school.

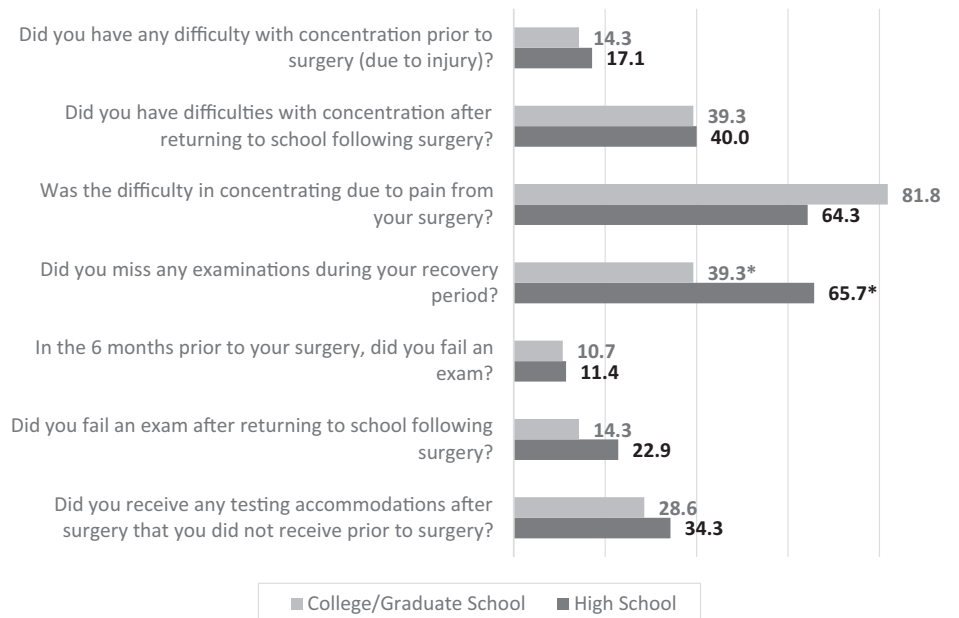


Figure 2. Impact of surgery on examinations after return to school among HS and C/GS students. Values presented as a percentage of the total respondents in each cohort who answered “yes” to the question prompt. *Statistically significant difference between groups ($P < .05$). C/GS, college/graduate school; HS, high school.

postoperative period ($P = .489$), although fewer agreed or strongly agreed that their grades had suffered since returning to school ($P = .824$). While most students reported pain interfered with an earlier return to school, few HS students and C/GS students agreed or strongly agreed that their academic performance suffered due to pain ($P = .486$). Instead, a higher proportion of HS and C/GS students agreed or strongly agreed that their academic performance suffered due to difficulties with concentration ($P = .703$).

Mobility-related challenges were common in both groups of students and included difficulty sitting at a desk

($P = .884$), difficulty moving between school facilities ($P = .901$), and difficulty moving around the school ($P = .901$). However, these factors were not perceived to affect school performance as greatly as concentration, as 11.4% of HS and 25.0% of C/GS students agreed or strongly agreed that limited mobility negatively affected their school performance ($P = .066$). The majority of students in both groups also agreed or strongly agreed that they had difficulties with social activities ($P = .555$) and attending after-school functions ($P = .767$). Finally, a large percentage of students in both groups agreed or strongly agreed that

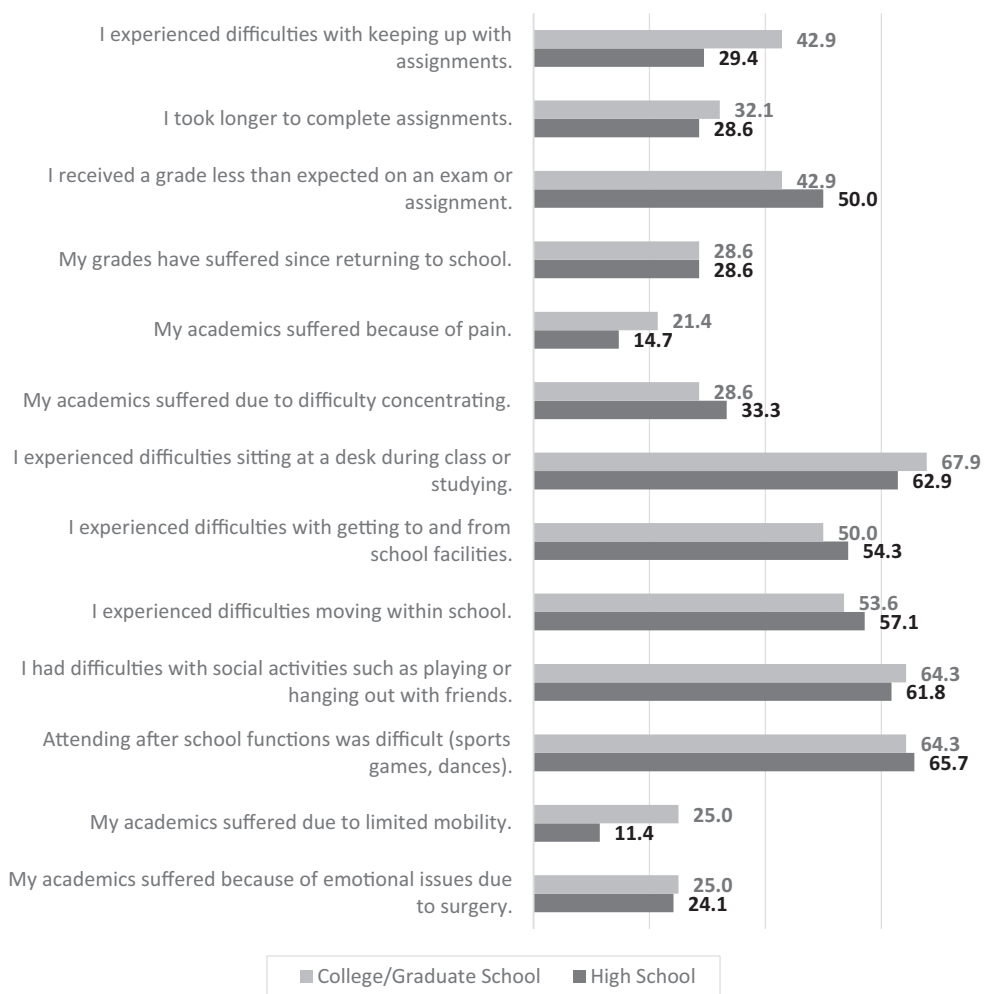


Figure 3. Impact of surgery on school performance and social activities after return to school among HS and C/GS students. Values presented as a percentage of the total respondents in each cohort who answered “agree” or “strongly agree” to the question prompt. C/GS, college/graduate school; HS, high school.

their academics suffered because of emotional issues related to surgery ($P = .356$).

DISCUSSION

While previous studies have examined the time to return to school and effect of orthopaedic surgery on school performance, few studies have also assessed the barriers and factors that influence these 2 measures. This study aimed to fill that gap by evaluating the effect of undergoing ACLR on school attendance, performance, and their associated difficulties in HS- and college-aged students. The hypothesis was partially accepted as HS students missed more days on average after surgery, although both cohorts experienced similar difficulties in the postoperative period that negatively affected not only school performance but also social interactions and emotional well-being.

A significant difference in average time to return to school and mean scheduled school days missed was found

between groups, as HS students took longer to return to school and missed significantly more school days compared with C/GS students. The typical amount of time to return to HS after ACLR was similar to data published by Willimon et al¹⁸ that demonstrated a mean of 8.1 days to return to school after isolated ACLR among patients 5 to 19 years old. Trentacosta et al¹⁶ also examined return to school after ACLR and medial patellofemoral ligament reconstruction in slightly younger adolescent patients (mean age at surgery, 15.5 years) and found that the mean number of school days missed was 13.5 days. Several factors may have contributed to the discrepancy in school days missed between the 2 groups in the present study. College and graduate schools tend to have more rigorous coursework and rigid guidelines for absenteeism that do not allow for a delayed return to school. In addition, greater physical maturity and a higher degree of pain tolerance may allow C/GS students to return to school earlier compared with HS students. Finally, differences in surgeon suggestions in regard to

return to school likely played a role in return to school between the 2 groups.

Barriers that inhibited return to school were assessed 2 weeks after surgery in our study, and the factors that had the greatest effect can generally be categorized as either mobility-related or pain-related. More than half of both student cohorts cited restricted mobility as a barrier to return, and crowds, stairs, and transportation changes all appeared to contribute to this issue. Upon return to school, at least 50% of students reported challenges moving between school facilities, at least 53% reported difficulties moving around the school, and at least 62% reported difficulties sitting at a desk. Restricted mobility interfered not only with school attendance but also with social activities and after-school events. C/GS students were more likely to report that they encountered challenges related to mobility, which can likely be attributed to navigating larger campuses, class sizes, lecture halls, and dining rooms at college and graduate institutions, which should be considered by these students when planning for surgery.

In addition to restricted mobility, at least 65% of students in both groups stated that pain was a barrier to earlier return to school, which was the challenge cited most commonly and can be more difficult to plan for. While other studies of pediatric trauma have found that school policy was a barrier to return to school in as many as 70% of patients,^{6,15} school policy was not a primary barrier to return to school in this study. Similarly, surgeon restrictions were a less common barrier for students in both our study and the study by Trentacosta et al,¹⁶ highlighting that mobility and pain are likely the 2 main challenges to consider when planning for a return to school.

The effect of surgery on school performance was also assessed at 6 weeks postoperatively. Both HS and C/GS students noted a significant increase in difficulty concentrating after surgery, and the majority of students reported pain as the primary cause. At least 40% of all students received a grade less than expected after surgery, and nearly 30% of patients had difficulties keeping up with assignments and/or took longer to complete assignments. However, only 28.6% of HS and C/GS students agreed that their school performance had actually declined after surgery. Importantly, more than half of all students missed an examination in the early postoperative period. In addition, HS students were almost twice as likely to fail an examination after surgery than they were in the 6 months leading up to surgery. While the same risk was not found in the C/GS students in our study, Freedman et al⁴ found that college students who underwent ACLR during the school semester were significantly more likely to receive an incomplete or failing grade, missed more examinations, and missed more school than students who underwent the same procedure during an academic break, which demonstrates the same vulnerability of college students to decreased academic performance after surgery.

Comprehensive preoperative counseling regarding the potential barriers to return to school, including pain, mobility, and school or surgeon restrictions, are critical

in order to establish patient expectations before surgery. The importance of patient and family expectations is underscored by the fact that 85% of students cite “not feeling ready” as the biggest barrier to returning to school.¹⁶ By understanding the combination of pain and mobility-related factors discussed, as well as their effect on concentration and school attendance, patients and their families may be able to better prepare for these challenges and feel more ready for when it is time to return to school. This may also help to avoid the unplanned partial school days that nearly 12% of the HS students experienced. Because of the effect that these procedures can have on academic performance well after the student has returned to school, it is equally important to discuss this with patients and their families in order to allow them to plan for potential academic challenges and coordinate with their school as early as possible. To minimize school interference, patients with the ability to undergo an orthopaedic procedure during an academic break may also want to consider the benefits of this timing against other seasonal and timing pressures.

Finally, it is easy to overlook the social and emotional toll that surgery can have on a young patient. This is multifactorial and is likely related to decreased activity, fewer social connections because of time away from school and activities, and the fact that many young athletes have a close tie between their athletics and self-image. While previous literature has shown increased depression in collegiate athletes after an injury,¹¹ some young athletes have even demonstrated symptoms of posttraumatic stress disorder after the injury itself.¹⁴ It is therefore not surprising that 25% of the patients in our study reported that emotional issues were a barrier to postoperative academic performance. An honest discussion of the interplay among pain, concentration, mobility, school attendance, and social/emotional well-being with patients and their families preoperatively may improve expectations and help patients and their families to prepare for these challenges. In addition, the surgical team should also ask about these issues during postoperative follow-up, as addressing them will likely improve overall patient satisfaction and ultimately clinical outcomes as well.

Limitations

The study is not without limitations. While the geographic area in which the study occurred includes a wide range of patient characteristics, this study took place at a single academic institution, and the results may not be generalizable to the larger student population in the United States. In addition, surgeon suggestions regarding the amount of academic leave were not collected at the time of surgery. Therefore, it is possible that differences in surgeon recommendations regarding the recovery period may have affected the amount of time missed for a given procedure. While students were asked to record school absences and examination outcomes before the 2-week and 6-week survey, respectively, neither absences nor examination information were verified with the students'

school. While the questionnaire utilized in the study was designed to inquire about school absence, school performance, and barriers affecting return, it has not been validated, and it did not address differences in socioeconomic factors between the 2 groups. The type of anesthesia used can affect pain and mobility after ACLR, and it is possible that differences in the anesthetic may influence barriers to return to school.

CONCLUSION

The findings of this study demonstrated that undergoing ACLR can have a negative effect not only on school attendance and academic performance but also on social activities and emotional well-being among HS and C/GS students. Therefore, orthopaedic surgeons should adequately counsel students and their families about the potential academic effect of orthopaedic surgery in order to allow for appropriate preoperative planning and postoperative troubleshooting, with the goal of maximizing clinical results, academic performance, and satisfaction in their patients.

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APPENDIX

2-Week Postoperative Survey	
What is your current grade level?	<input type="radio"/> 9* Grade o 10th Grade <input type="radio"/> 11th Grade <input type="radio"/> 12th Grade <input type="radio"/> College Freshman <input type="radio"/> College Sophomore <input type="radio"/> College Junior <input type="radio"/> College Senior <input type="radio"/> Other
Please describe your other grade level.	
How many days (including weekends) did it take for you to return to school following surgery?	
How many in-session school days were you absent due to your surgical procedure? (This is not including weekends or school holidays).	
Were you able to attend full school days immediately upon returning to school?	<input type="radio"/> Yes <input type="radio"/> No
How many partial school days did you attend before returning to full days?	
Did you have any unplanned early leave on the days you returned to school after your surgery?	<input type="radio"/> Yes <input type="radio"/> No
What were the reasons you required an unplanned early leave from school?	
Did you have difficulty with accessibility or mobility once you returned to school?	<input type="radio"/> Yes <input type="radio"/> No
If you were unable to return to school immediately, please rate the reasons below Immediately would be the following in-session school day after your surgery (if your surgery was right before a weekend, holiday, or break, immediately would be the next in-session school day).	
Pain did not allow me to return to school sooner.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
Restricted mobility did not allow me to return to school sooner.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
My surgeon did not allow me to return to school sooner.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
Taking opioid pain medication (i.e., Percocet, oxycodone) did not allow me to return to school sooner.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree

Figure A1. Two-week postoperative survey.

6-Week Postoperative Survey	
Prior to your surgery, did you have difficulty with concentration due to your ACL injury?	<input type="radio"/> Yes <input type="radio"/> No
After your surgery, did you have difficulty with concentration due to your ACL injury?	<input type="radio"/> Yes <input type="radio"/> No
If you answered 'yes' to the previous question, was the difficulty in concentrating due to pain from your surgery?	<input type="radio"/> Yes <input type="radio"/> No
Did you miss any examinations during your recovery period?	<input type="radio"/> Yes <input type="radio"/> No
Please specify how many exams you have missed since your surgery.	
In the 6 months prior to your surgery, did you fail an exam?	<input type="radio"/> Yes <input type="radio"/> No
Did you fail an exam after returning to school following surgery?	<input type="radio"/> Yes <input type="radio"/> No
How many exams have you failed since surgery?	
Did you receive any testing accommodations after surgery that you did not receive prior to surgery?	<input type="radio"/> Yes <input type="radio"/> No
Based on your experience after returning to school following surgery, please rate the accuracy of each statement below using the scale provided.	
I experienced difficulties with keeping up with assignments.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
I took longer to complete assignments.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
I received a grade less than expected on an exam or assignment.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
My grades have suffered since returning to school.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree <input type="radio"/> Strongly disagree
My academics suffered because of pain.	<input type="radio"/> Strongly agree <input type="radio"/> Agree <input type="radio"/> Neutral <input type="radio"/> Disagree

Figure A2. Six-week postoperative survey.