

Association of Insurance Status With Treatment Delays for Pediatric and Adolescent Patients Undergoing Surgery for Patellar Instability

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Background: Health care disparities have been highlighted in pediatric sports medicine, but the association between insurance status and delayed care for patients undergoing surgery for patellar instability has not been defined.

Purpose: To determine whether there is an association between insurance status and delays in care in pediatric and adolescent patients undergoing surgery for patellar instability.

Study Design: Cohort study; Level of evidence, 3.

Methods: This was a retrospective case series at a safety-net tertiary referral center of pediatric and adolescent patients undergoing surgical treatment for patellar instability. Insurance status was classified as public or private. We calculated the times from injury to clinical evaluation, injury to magnetic resonance imaging (MRI), injury to surgery, clinical evaluation to MRI, and clinical evaluation to surgery. Comparisons were made between insurance groups.

Results: Included were 78 patients (38 public, 40 private insurance) who underwent surgery for patellar instability. The public insurance group was older ($P = .019$), with a lower proportion of White patients (15.8% vs 52.5%; $P = .0005$), higher proportion with Hispanic ethnicity (55.3% vs 15.0%; $P = .0001$), and higher proportion of Spanish-speaking patients (21.1% vs 2.5%; $P = .007$). Publicly insured patients had longer times from initial injury to clinical evaluation (466 vs 77 days; $P = .002$), MRI (466 vs 82 days; $P = .003$), and surgery (695 vs 153 days; $P = .0003$), as well as a longer time from clinical evaluation to surgery (226 vs 73 days; $P = .002$). Multivariable models confirmed insurance status as an independent predictor in each of the identified delays.

Conclusion: Significant delays were seen for pediatric and adolescent patients with patellar instability and public insurance (approximately 6 times longer to clinical evaluation, more than 5.5 times longer to obtain MRI, and 4.5 times longer to surgery) relative to injured patients with private insurance. Even after adjusting for delays to clinical evaluation, publicly insured patients had a delay from clinic to surgery that was triple that of privately insured patients.

Keywords: disparities; insurance; knee general; knee patella; patellofemoral instability; pediatric sports medicine

Disparities in orthopaedic care for pediatric and adolescent patients have been highlighted in the literature.¹⁷ One common pathology among adolescents is patellar instability, for which surgical treatment is increasingly prevalent.^{2,10,19} Rates of recurrent patellar instability events in skeletally immature patients following a first-time dislocation are high, particularly with underlying anatomic risk factors.^{6,20} Because the frequency of recurrence increases with time after first-time dislocation, longer delays in care could lead to more severe pathology. This has

also been shown for other conditions such as anterior cruciate ligament (ACL) tears and shoulder instability.^{1,13} As such, identifying reasons for delayed care and interventions to limit delays is critical.

Recent studies have investigated the role of socioeconomic and characteristic factors in delays in care in pediatric and adolescent orthopaedic sports medicine.^{5,7,12,15,16,18} Much of the literature demonstrates longer time to treatment in those with public or government-based insurance. To date, there is no evidence of similar trends in patients with patellar instability. Evaluating patellar instability promptly with magnetic resonance imaging (MRI) is crucial to rule out urgent operative indications such as intra-articular loose bodies or other bony fragments. Furthermore, delay to

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clinical evaluation and/or surgical treatment could lead to higher recurrence risk and osteochondral injury. Therefore, evaluating these delays is important.

The purpose of this study was to determine whether there is an association between insurance status and delays in care in pediatric and adolescent patients undergoing surgery for patellar instability. We hypothesized that those with public insurance would have longer times from injury to clinical evaluation, injury to MRI, injury to surgery, clinical evaluation to MRI, and clinical evaluation to surgery.

METHODS

A retrospective review from 2013 to 2020 was performed at a single center of pediatric and adolescent patients with symptomatic patellar instability who underwent either medial patellofemoral ligament (MPFL) repair or reconstruction with the senior surgeon (N.K.P.). At our institution, the senior surgeon performs nearly all of these procedures. The institution is a safety-net tertiary referral center in a large metropolitan region that allows for care of patients regardless of insurance status. The study protocol was approved by the institutional review board of the University of California, San Francisco.

Study Variables

Baseline characteristics were recorded, including age at time of surgery (patients 18 years or younger), sex, primary language, insurance status, patient ZIP code, patient-reported race, and patient-reported ethnicity. Preoperative imaging including radiographs and MRI scans were evaluated. From radiographs, physeal status (open or closed), Insall-Salvati ratio, and Caton-Deschamps index were determined. Tibial tubercle-trochlear groove (TT-TG) distances were calculated from MRI studies. All measurements were made by orthopaedic surgery residents (S.A., R.T.H.). Number of previous patellar dislocations, MRI findings, intraoperative arthroscopic findings, concomitant procedures (such as lateral release, loose body removal, cartilage procedures, osteotomies), postoperative complications, and length of final follow-up were also noted.

Insurance status was classified as public or private. City/state insurance programs or Medicaid were deemed public insurance, while health maintenance organization (HMO) and preferred provider organization (PPO) groups were considered private insurance. Date of injury, date of initial surgical consultation at our center, date of MRI study confirming pathology, and date of surgery were recorded. For patients undergoing MPFL procedures on the bilateral knees, the date of the first surgery was used for the

analysis. For patients who were managed nonoperatively after a first-time dislocation event but eventually underwent surgery in the setting of recurrence, we used the date of the first surgical consultation after failure of nonoperative treatment. Times to carepoints of interest were calculated as the primary outcomes of interest. If a date or timeframe was ambiguous or not noted in the medical record, those data were excluded from related analyses. Distance from the care facility was estimated by finding the geographic distance between the home ZIP code of the patient and the care facility ZIP code.

Statistical Analyses

Comparisons were made between patients by insurance status category, and descriptive statistics were used. A Shapiro-Wilk normality test was used to assess normality of continuous variables. Continuous variables that were normally distributed (TT-TG) were assessed using a 2-independent-sample *t* test. Continuous variables found to be distributed differently than normally (age, ZIP code distance from care facility, follow-up duration, Insall Ratio, Caton-Deschamps) were assessed using a Mann-Whitney-Wilcoxon test. Fisher exact tests were used to evaluate differences within categorical variables. Binary variables were evaluated with 2-sample *z* tests for equality of proportions. Predictor variables significantly associated with insurance status on univariate analyses were included in a multivariable linear regression model to predict delays to care. All statistical analyses were performed utilizing R Version 4.0.5 (R Project for Statistical Computing) with 2-tailed significance of alpha <0.05.

RESULTS

Included in the study were 78 patients, 46 (58.9%) of whom were female. Overall, 33 patients (42.3%) underwent MPFL reconstruction and 45 (57.7%) underwent MPFL repair. The mean patient age was 15.3 ± 2.4 years, and the mean follow-up duration was 601 ± 418 days. Of the patients, 38 (48.7%) had public insurance and 40 (51.3%) had private insurance; the baseline characteristics of each group are shown in Table 1. Those with public insurance were more likely than those with private insurance to be Hispanic (55.3% vs 15.0%; $P = .0002$) and Spanish-speaking (21.1% vs 2.5%; $P = .01$). No difference between the groups was observed in distance to the care facility ($P = .46$). A breakdown of the racial groups by insurance status is demonstrated in Figure 1.

No differences between public and private insurance were identified in preoperative radiographic or MRI-based

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evaluation of anatomic factors (Table 2). Publicly insured patients had a significantly longer time from both initial

TABLE 1
Baseline Variables by Insurance Status (N = 78 patients)^a

Variable	Insurance Type		P
	Public (n = 38)	Private (n = 40)	
Age, y	16.1 ± 2.7	14.6 ± 1.8	.019
Sex			.967
Female	23 (60.5)	23 (57.5)	
Male	15 (39.5%)	17 (43.5%)	
Follow-up, days	613.8 ± 471.8	590.1 ± 365.2	.83
Surgery			.252
MPFL repair	19 (50%)	26 (65%)	
MPFL reconstruction	19 (50%)	14 (35%)	
Race			.0005
Asian	2 (5.2%)	6 (15.0%)	
Black or African American	8 (21.1%)	2 (5.0%)	
White	6 (15.8%)	21 (52.5%)	
Other	18 (47.4%)	7 (17.5%)	
Unknown/Declined	4 (10.5%)	4 (10.0%)	
Ethnicity			.0001
Hispanic or Latino	21 (55.3%)	6 (15.0%)	
Not Hispanic or Latino	17 (44.7%)	29 (72.5%)	
Unknown	0 (0.0%)	5 (12.5%)	
Primary language			.007
English	29 (76.3%)	39 (97.5%)	
Spanish	8 (21.1%)	1 (2.5%)	
Arabic	1 (2.6%)	0 (0.0%)	
Distance from care facility, km ^b	46.5 ± 79.0	50.7 ± 83.2	.46

^aData are reported as mean ± SD or n (%). Boldface P values denote statistically significant difference between groups (P < .05). MPFL, medial patellofemoral ligament.

^bMeasured as the geographic distance between the patient's home ZIP code and the care facility ZIP code in kilometers.

injury to clinic (466 vs 77 days; P = .002) and initial injury to MRI (466 vs 82 days; P = .003). Publicly insured patients also had a longer duration from the initial injury to surgical date (695 vs 153 days; P = .0003) (Figure 2).

Publicly and privately insured patients were equally likely to have an MRI scan before their initial clinic visit (44.7% vs 40.0%; P = .85). Of the patients who obtained an MRI scan following their initial visit, there was an observed, but not statistically significant, difference in the time to obtain an MRI scan after the clinic visit (25.4 vs 12.6 days; P = .23). However, public insurance was associated with longer time from clinic to surgery (226 vs 73 days; P = .002) (Figure 3). There was no difference by insurance status in the number of patients requiring concomitant procedures at time of MPFL surgery (68.4% vs 62.5%; P = .58) or tourniquet time (61.4 vs 60.3 minutes; P = .85).

Multivariable linear regression models demonstrated public insurance status to be an independent predictor of injury to MRI, injury to clinic, injury to surgery, and clinic to surgery delays (Table 3). In these models, race, ethnicity, and language for not independent predictors for delays; however, age was an additional independent predictor of time from injury to clinic.

DISCUSSION

This study found that pediatric and adolescent patients with patellar instability and public insurance (city/state insurance programs or Medicaid) faced longer delays in care than those with private insurance (HMOs, PPOs). Specifically, those with public insurance were observed to have longer time intervals after injury to be seen in clinic, after injury to undergo surgical treatment, after injury to obtain advanced imaging, and after clinical evaluation to have surgery. Public insurance status independently predicted each of these delays after controlling for other factors such as age, race, ethnicity, and primary language. To the best of

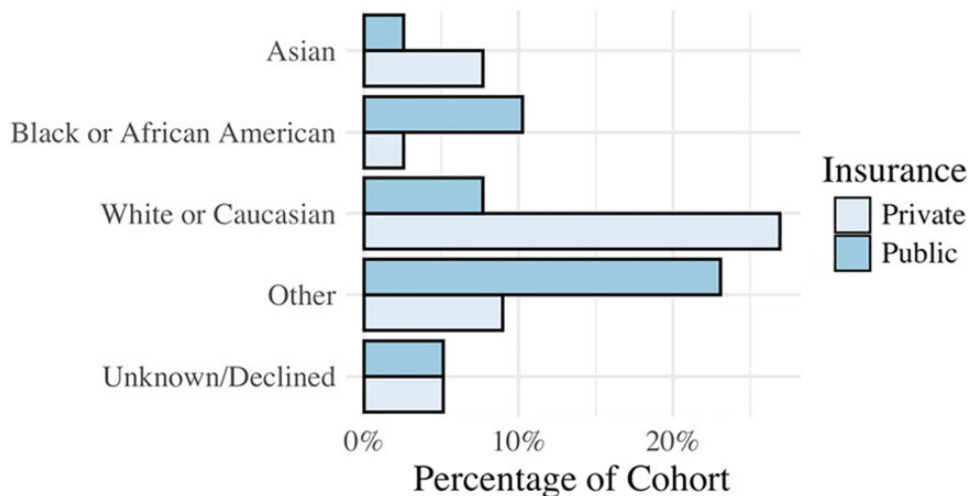


Figure 1. Racial breakdown of patients by insurance status. Numeric values on the x-axis represent absolute numbers of patients in each category. The racial composition was significantly different by insurance status (P = .0005, Fisher exact test).

TABLE 2
Radiographic and Magnetic Resonance Imaging
Evaluation^a

	Insurance Type		P
	Public (n = 38)	Private (n = 40)	
Physal status			.11
Open	17 (44.7)	26 (65.0)	
Closed	21 (55.3%)	14 (35.0%)	
Insall-Salvati ratio	1.18 ± 0.16	1.15 ± 0.19	.31
Caton-Deschamps index	1.23 ± 0.21	1.16 ± 0.21	.14
TT-TG distance, mm	14.40 ± 4.36	13.11 ± 3.24	.16
Concomitant procedure	26 (68.4%)	25 (62.5%)	.58

^aData are reported as mean ± SD or n (%). TT-TG, tibial tubercle-trochlear groove.

where specific health insurance plans are accepted, the findings of the present study may be amplified.

Whereas we did identify a delayed time to evaluation and treatment in patients with public insurance with patellar instability, we did not identify significant differences in degree of pathology before, or at the time of, surgery. Moreover, there was no difference in necessity of concomitant surgical procedures with the MPFL repair or reconstruction, and no difference in proportion of patients receiving a repair or reconstruction. In contrast, literature after adolescent ACL injury demonstrates largely worse pathology after delayed treatment and increased complications in those with public insurance.^{15,18} Similarly, adolescents with shoulder instability have higher rates of bony pathology and anterior labral pathology, in addition to higher incidence of recurrent dislocation.⁷ In this study, we evaluated the influence of anatomic risk factors. Data are

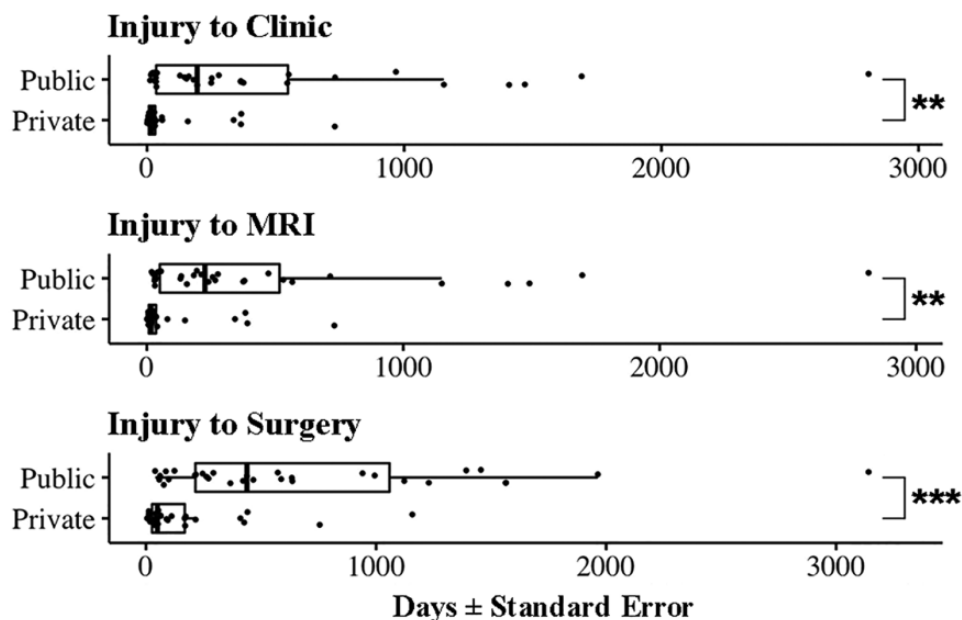


Figure 2. Times to event from the time of injury. Times from injury to surgery, injury to clinic, and injury to MRI were all statistically significant between groups. $**P < .01$. $***P < .001$. MRI, magnetic resonance imaging.

the authors' knowledge, this is the first study elucidating these delay-in-care findings in patients with patellar instability.

The findings of this study corroborate the literature highlighting the discrepancies in time to care between private and public insurance in pediatric and adolescent patients with sports medicine-related injuries.[‡] Public or government insurance has been defined as a risk factor for in adult populations with sports-related injuries as well.^{21,23,24} Because this study was performed at a safety-net hospital, we are able to distinguish care delays by insurance status without preferential access to care. In centers

abundant on the impact of findings such as younger age, skeletal immaturity, increased patellar height, and trochlear dysplasia on increasing risk of recurrent instability.⁸ While our subgroup with public insurance was slightly older, our subgroups had similar proportions with open physes and other anatomic parameters. Furthermore, multivariable models demonstrated that public insurance status was an independent predictor of each of the delays identified, although age was also a predictor of time from injury to clinic.

Among the publicly insured subgroup, there was also a significant delay in obtaining a knee MRI scan from the date of initial injury. However, there was an observed, but not statistically significant, disparity in time from clinic to MRI after controlling for delay in initial presentation. Beck

[‡]References 3–5, 7, 9, 12, 15, 16, 18, 22, 25.

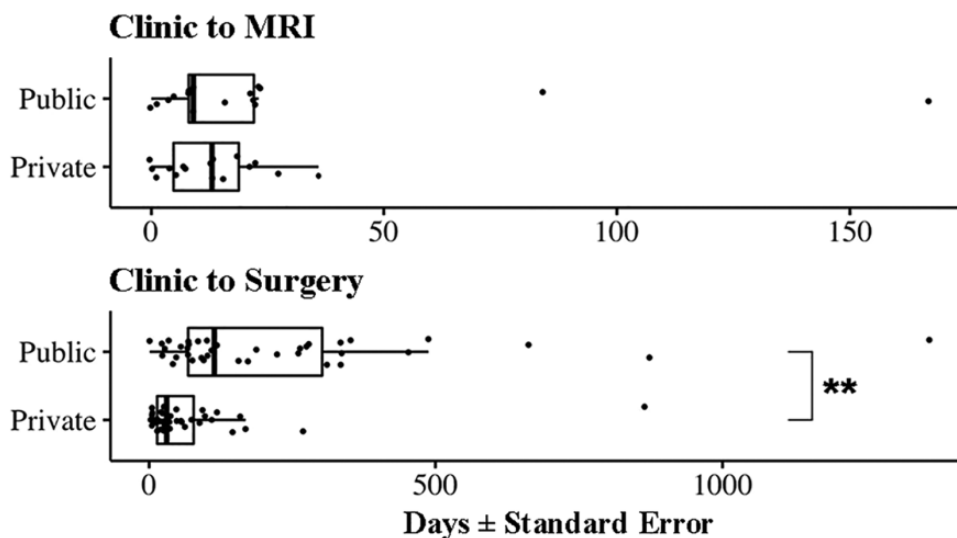


Figure 3. Times to event from the time of clinic visit. Time from clinic to surgery was statistically significant between groups, but time from clinic to MRI was not. ****P < .01.** MRI, magnetic resonance imaging.

TABLE 3
Multivariable Linear Regression Models to Predict Delays to Care Events^a

Predictor	Injury to MRI		Injury to Clinic		Injury to Surgery		Clinic to Surgery	
	Estimate	P	Estimate	P	Estimate	P	Estimate	P
Insurance status								
Private, ref	-	-	-	-	-	-	-	-
Public	513.2	.00255	560.8	<.001	706.7	<.001	151.0	.0209
Age	-57.7	.0781	-57.9	.0446	-41.1	.209	13.3	.226
Race								
White, ref	-	-	-	-	-	-	-	-
Asian	-3.8	.986	-76.3	.721	-188.1	.444	-47.8	.583
Black or African American	-133.1	.526	-229.8	.267	-275.3	.247	7.4	.932
Other	176.2	.331	121.8	.478	85.64	.663	12.4	.866
Unknown/declined	-235.5	.410	-266.3	.294	-388.4	.183	6.7	.949
Ethnicity								
Not Hispanic or Latino, ref	-	-	-	-	-	-	-	-
Hispanic or Latino	128.3	.449	91.1	.569	128.4	.485	30.7	.657
Unknown	-140.8	.778	-139.3	.776	-118.7	.833	228.3	.0615
Language								
English, ref	-	-	-	-	-	-	-	-
Non-English	-313.1	.119	-310.0	.109	-362.1	.103	-44.7	.588
Model characteristics								
P	.0440		.0338		.0117		.0449	
R ²	0.277		0.275		0.314		0.215	
F statistic	2.131		2.234		2.695		2.065	

^aBoldface P values denote statistical significance (P < .05). Public insurance status was an independent predictor of each time point. Older age was also a predictor of time from injury to clinic. Clinic to MRI multivariable model (P = .183) was not included in the table. MRI, magnetic resonance imaging; ref, reference variable.

et al⁴ performed a retrospective review of 168 adolescent patients with sports medicine knee injuries at a similar tertiary referral center and also found that government insurance was associated with longer time between injury to MRI scan (P < .01), in addition to increased wait time

between visit and MRI scan completion (P < .01) and MRI scan order to completion (P < .01).⁴ The study by Beck et al⁴ and the present study were performed in tertiary referral centers, but it is unclear why the findings on time between visit and MRI completion differ. A contributing factor is

that the present study had 78 total patients and was likely underpowered to detect a difference. Additional possibilities include institutional differences in insurance authorization protocols, behavior of primary care or orthopaedic specialists, and the use of inhouse versus outside imaging facilities. In both studies, there was no observed difference in degree of pathology identified on imaging. Further research is needed to understand why those with government or public insurance may wait longer to obtain ordered imaging studies and how to mitigate that difference.

Several studies exemplify the negative influence of delays in care relating to insurance status and severity of disease in knee and shoulder pathology in adolescents.^{5,7,12,15,16,18,25} How to resolve the gaps in delayed care remains a question of interest. Skaggs et al²² suggest in their study evaluating access to orthopaedic care for children with Medicaid that increasing physician reimbursement rates may be critical. However, in the short term, we suggest close follow-up and scheduling of patient populations at risk for delayed care. In cases of non-English language barriers, facilitating scheduling of studies such as MRIs before the patient leaves the clinic office may be beneficial. When possible, we advocate for in-person language interpreters to improve care satisfaction for providers and patients, or if a remote interpreter is necessary, preferentially using video-based interpreters.^{11,14} Because the non-English-speaking population, specifically Spanish-speaking, was greater in the public insurance group, a language barrier may be a substantial contributing factor in times to care points. Furthermore, our public insurance subgroup was of an older average age, lower proportion of White race, and higher proportion of Hispanic ethnicity, which all may influence and contribute to differences.

Limitations

This study has several limitations. As a retrospective review, it is not possible to discern specifically why patients with public insurance had the delays in care discussed. In terms of patient-specific factors, we were unable to confirm rates of missed appointments, adherence to physical therapy and other nonoperative treatment modalities, and other influences such as parental availability and access for appointments that may play a role in delayed care. Our approximation of travel distance to hospital utilizing ZIP codes may not be accurate and serves only as an estimate. The findings may not be applicable to other medical care settings or environments, particularly of those with a different socioeconomic and racial/ethnic makeup or those centers accepting only specific health insurance plans.

There are also systems-level factors that may be at play that were not adjusted for in this analysis, both at the level of the provider and beyond (eg, billing, administration, and referrals). For example, because there are a variety of initial physicians or surgeons who may have seen our patients before arriving in our clinic, we are unable to control for consistency in prespecialist management. It is likely that this study was underpowered to detect differences in

several parameters, so statistically nonsignificant results should also be interpreted with caution. While we did not identify differences in complications or need for concomitant surgeries by insurance group, it is not possible without additional data, such as patient-reported outcome measures, to assess whether other clinical differences exist, or are affected by, delays in care. The study did not include patients managed nonoperatively, which could have led to selection bias and influenced study outcomes. Future research might take the form of a root-cause analysis and should further explore the relationship between these patient-specific and systems-specific factors leading to delays in care.

CONCLUSION

The study findings showed significant delays for pediatric and adolescent patients with patellar instability and public insurance (approximately 6 times longer to clinical evaluation, more than 5.5 times longer to obtain MRI scan, and 4.5 times longer to surgical date for patellar instability) relative to privately insured patients. Even after adjusting for delays to clinical evaluation, publicly insured patients had a delay triple that of privately insured patients from clinic to surgery. No differences in degree of pathology were identified at time of surgery, though the study may have been underpowered to detect such differences. While the reasons for these delays are currently unclear, increased awareness of the association of insurance status on time to care for pathologies such as patellar instability is crucial to identify patients at risk.

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