HHS Public Access

Author manuscript

J Pediatr Orthop. Author manuscript; available in PMC 2021 November 01.

Published in final edited form as:

J Pediatr Orthop. 2020 ; 40(10): e952–e957. doi:10.1097/BPO.0000000000001653.

Delays in Obtaining Knee MRI in Pediatric Sports Medicine: Impact of Insurance Type

Jennifer J. Beck, MD[01], **Nicole West, BS**[01], **Kylie G. Shaw, MD**[02], **Nicholas Jackson, PhD MPH**[03], **Richard E. Bowen, MD**[01]

[01]Orthopaedic Institute for Children and UCLA Department of Orthopaedic Surgery, CA, USA;

[02]David Geffen School of Medicine at UCLA, CA, USA;

[03]University of California Los Angeles (UCLA) Department of Statistics Core, CA, USA

Introduction

In recent years, there has been an increase in participation hours and intensity of children and adolescents in organized sports resulting in a rise of youth sports injuries. Ordering of Magnetic Resonance Imaging (MRI) helps evaluate significant, intra-articular musculoskeletal injuries [1,2,3,4]. Knee pathology identified on MRI, including ligament and meniscal tears, osteochondral fractures, and osteochondritis dissecans (OCD), can have long term detrimental effects on young athletes, and early diagnosis and treatment is imperative for optimal recovery. [1,2] Delaying care can be detrimental to recovery as studies have shown that prompt treatment of pediatric anterior cruciate ligament (ACL) tears, osteochondral fractures, and meniscal tears have better outcomes than delayed or non-operative treatment with less risk of long term pain, instability, and future arthritis or arthrofibrosis. [5] Studies have long shown MRI to be the clinically indicated imaging study to accurately diagnose the anatomic sources of knee pain after acute injury without identifiable pathology on x-ray or pain recalcitrant to conservative measures with negative x-rays. [6,7] However, MRI is also an expensive diagnostic test that can be particularly difficult to efficiently acquire due to insurance plans rules, such as time consuming pre-authorization requirements. [8]

Concern for over or under utilization of MRI studies based on insurance status in this young athletic population exists. Over utilization, indicated by high rates of normal MRI studies can lead to increased health care expenditures while underutilization can lead to misdiagnosis and poor patient outcomes. This study sought to determine differences in access to and results of knee MRI between pediatric sports medicine patients with commercial versus government based insurance plans. We hypothesize that adolescent patients with government insurance plans experience significant delays in obtaining MRIs for sports injuries compared to their counterparts with commercial insurance plans.

Address Correspondence to: Jennifer Beck, 403 W Adams Boulevard. Los Angeles, CA 90007, JJBeck@mednet.ucla.edu.

Financial Disclosure: The authors have indicated they have no financial relationships relevant to this article to disclose.

Methods:

Following approval from the Institutional Review Board, a retrospective chart review was completed of all patients ≤18 years of age, with any type of insurance, who attended one of two sports medicine clinics staffed by physicians under the same academic institution (one urban and one suburban) between 2016–2017, and whose charts indicated an MRI had been ordered to evaluate a "sports medicine diagnosis" of ligamentous/soft tissue injury, structural abnormality, instability, or inflammation. Excluded from the study were patients >18 years of age, a diagnosis other than sports medicine (i.e. tumor, infection, fracture), and/or a lack of health insurance.

Participants were subsequently placed into one of 2 groups based on health insurance status: public/government or commercial. Public insurance included patients covered by a government based program. These plans included mHMO (Medicaid- health maintenance organization), Medicare, and traditional Medicaid. Commercial insurance included patients covered by any insurance company not administered by the government. This coverage included cHMO (commercial- HMO), PPO (preferred provider organization), and EPO (exclusive provider organization) health plans.

Data included basic demographics; injury date; date and location of first presentation; MRI ordering provider, date, and location; date of MRI follow up; MRI results (divided into negative, minor findings, major findings); and eventual treatment required. Minor findings included diagnoses not typically requiring surgery or immediate intervention (i.e. bone bruises, contusions, patella subluxations, partial thickness meniscus tears, etc). Major findings included diagnoses that would benefit from prompt recognition and intervention, including but not limited to surgery (i.e. full thickness meniscus tears, osteochondral fractures, ligament tears, OCD, etc). (Table 1)

In order to analyze the impact of insurance type on the amount of time it took to obtain an MRI, various timing metrics were computed. We examined the times from injury to the patients first visit, MRI order, and MRI completion (separately) as well as the times from first visit to MRI ordering and MRI completion. Timing data are summarized using medians and interquartile range (IQR) and timing differences between the insurance groups were assessed using a Wilcoxon Rank Sum. Between group differences in other demographic and clinical characteristics were assessed using t-tests or Fisher's exact test as appropriate to the variable distributions.

Results:

Patient Population:

178 patients had a knee MRI ordered as part of routine sports medicine care between 2016–2017 in one of two pediatric sports medicine clinics. Of those, 9 were lost to follow up and 1 had no insurance. 168 charts underwent complete review: average age 14±3 years, 78 males and 90 females (54%). Commercial (N=70) and government insurance (N=98) were documented as well as MRI side (right knee (N=77), left knee (N=87), bilateral knee (N=4)). (Table 2)

Effect of Demographics on Insurance Type:

There was no significant age, gender, or injury laterality difference between commercial and government insurance ($p>0.05$). Guardian primary language was significantly different as the 69 of 70 (99%) of commercially insured patient guardians were primarily English speaking, only 46 of 98 (46%) of governmentally insured patient guardians were primarily English speaking while the remainder were primarily Spanish speaking. ($p<0.001$). Similarly, clinic location was significantly different as all patients receiving care at the suburban clinic (100%) had commercial insurance, while the majority of patients receiving care at the urban clinic had government insurance (95%) ($p <0.001$). (Table 2) These factors make insurance type, clinic location, and guardian language statistical surrogates for each other and could not be separated for individual analysis.

Effect of Insurance Type on MRI Wait Time:

The median time between injury and MRI completion was significantly longer with government insurance (34 vs 66.5 days, $p<0.001$). However, the time between injury and date of first visit was shorter with government insurance than commercial insurance (5 vs 12 days, $p<0.001$). The time between the date of first visit and MRI order and was significantly longer with government insurance (median 0 vs 24.5 days, $p<0.001$). Similarly, the median time between the first visit and MRI completion as well as the time between MRI order and completion was significantly longer with government versus commercial insurance (11 vs 40 days, $p<0.001$, and 9 vs 16.5 days, $p<0.001$, respectively). (Table 3)

Effect of Guardian Language on MRI Wait Time:

The effect of guardian primary language had on MRI wait times was that the primarily Spanish speaking populations experienced significant delays in MRI order and MRI completion ($p <0.001$, p 0.007) when compared to primarily English speaking populations. (Table 4) However, because essentially all commercially insured patients were English speaking (99%), while the majority of government insured patients were Spanish speaking (52%), the data was corrected for this cofounding effect by analyzing the same effect amongst only government insured patients. When correcting for insurance type, there was no longer a significant time difference between primarily English and Spanish speaking populations ($p>0.05$). (Table 5)

Effect of Ordering Provider (MD or NP) on MRI Wait Time:

MDs almost exclusively ordered MRI for patients with commercial insurance (99%), and NPs more were noted to have more frequently ordered MRI among patients with government insurance (22%). The only significant time difference when stratifying data by type of provider ordering MRI was a delay in MRI review (obtaining physician follow up) when the MRI was ordered by an NP. Otherwise, there was no significant difference in time to MRI order or completion. (Table 6)

Effect of Insurance on MRI Findings (Neg, Minor, Major Findings) and Operative Treatment:

There was no significant difference in positive findings on MRI between patients with commercial and government insurance, including both major and minor findings ($p>0.05$).

Similarly, there was no significant difference in patients receiving eventual operative treatment among both groups ($p>0.05$). (Table 7)

Discussion:

This study demonstrates that pediatric sports medicine patients with government insurance have significant delays in ordering, completion, and follow up of knee MRI in comparison to those with commercial insurance plans, despite the fact that there is no significant difference in the rate of positive findings on imaging leading to operative treatment. (Table 3) There was no significant difference in MRI wait time when the same population was analyzed by differences in language (controlling for insurance type) and ordering practitioner. Given that government and commercially insured populations were essentially synonymous with the urban (93 of 98 government patients) and suburban (70 of 70 commercial patients) clinics respectively, it was not possible to analyze office location as an independent predictor of MRI delay due to cofounding. (Table 2) The data shows that there was a significant delay in obtaining an MRI between English and Spanish speaking guardian populations ($p <0.001$), however this difference was no longer significant when controlling for the cofounder of insurance type, and analyzing language as an independent variable amongst only patients with government-based insurance ($p >0.05$). (Table 4, Table 5) These findings continue to affirm numerous previous studies in highlighting the multiple disparities between commercial and government insurance coverage. [9–15]

Due to continuing efforts to improve access to health care, increased availability and enrollment in government based insurance plans has been reported. While increased coverage of typically disadvantaged and underserved patient populations has innumerable benefits, many health care related factors have shown to differ significantly between patient populations with government insurance (mHMO, Medicare, Medicaid), and those with commercial providers (PPO, EPO, cHMO). Numerous studies have explored these differences and have highlighted disparities in health literacy, specialist treatment, physician willingness to provide care, surgical treatment, and much more. [19–15] Notable to this study is the literature in the orthopedic pediatric population where similar discrepancies have been found in regards to treatment of common pediatric fractures, access to rehabilitative physical therapy, and access to orthopedic care in general. [10,11,13,14]

Prompt diagnosis and definitive treatment are imperative in achieving a timely recovery and satisfactory outcome for pediatric sports injuries involving the knee. [4,5] Knee pathologies in the field of sports medicine such as ligament/meniscal tears, patellar dislocations, OCD, and the like are best diagnosed through physical exam by a sports medicine specialist in conjunction with diagnostic MRI imaging interpreted by the same physician. [6,7] The overall process thus involves many steps beginning with seeking care from a specialist who subsequently orders an MRI that must be approved, obtained, and reviewed at a follow up appointment to determine a treatment plan. A delay in any of these steps has the potential to negatively affect outcomes.

For example, studies in pediatric ACL injuries have shown that early operative treatment has far superior outcomes when compared to non-operative or delayed operative treatment.

[5,16] A systematic review of 11 studies comparing type and timing of ACL repair in a pediatric population, showed that patients with delays in operative management were more than 30 times more likely to report instability post-operatively, while patients with early operative treatment were more likely to return to preinjury activity level. [5] One particular study of 135 pediatric ACL reconstructions showed that when compared to acute reconstruction, subacute and chronic reconstruction patients had 1.45 and 3.83 times higher odds of severe secondary lateral meniscal tears. Similarly, increased time to surgery was significantly associated with increased severity of secondary medial meniscal tears, increased likelihood of an instability episode, and increased grade of chondral injury. [16] Delays in definitive operative treatment for ACL injuries in pediatric populations, such as those seen in this study with acquiring appropriate diagnostic imaging, increase the risk of secondary meniscal/chondral injuries, subsequent instability and delayed return to sport. [16]

This study found that, in particular, these delays tend to occur significantly at the point between ordering and obtaining the MRI. (Table 3) This period of time depends on insurance company assessment of the medical necessity of the test in terms of cost-benefit analysis, subsequent approval or denial of coverage, scheduling of the appointment, availability of MRI facility, and ability of patient and family member to travel to the MRI location. Interestingly, the time between injury and first appointment was longer in patients with commercial insurance while the remainder of the study parameters (injury to MRI completion, MRI order to completion, initial appointment to MRI completion, and MRI completion to follow-up consult) were all significantly longer for patients with government based insurance. (Table 3)

Some of the reported differences are likely due to utilization of a local, orthopedic only urgent care by government insurance patients. This urgent care is on the same premises, and part of the same direct health care organization as what we refer to as the ‘urban’ clinic. This urgent care is manned by a variety of pediatric orthopedic subspecialists on rotation, and decision making often includes consultation with the subspecialists who will eventually assume care of the patient (i.e. long term care in the pediatric sports medicine clinic). While less likely, it is possible that advanced imaging such as MRI could be ordered at this time if considering a sports medical diagnosis, and thus it was included in our analysis as the initial presentation. The utilization of this specialized urgent care with extended hours that caters to a typically medically underserved community, allows for patients to be evaluated more promptly after injury, but typically requires follow up in the appropriate subspecialty clinic to get more definitive care and advanced diagnostic workup, such as MRI, thus delaying the time from initial presentation to MRI. This escalation of care differs from the patients with commercial insurance who often had the ability to be seen by a specialist in clinic at initial presentation without referral. The time from injury to evaluation was significantly longer in these patients, likely due to the delay in obtaining a specialist appointment, but once evaluated, definitive diagnostic imaging was able to be ordered more promptly.

Part of the delay in MRI completion seen in the government insurance population can likely be attributed to socioeconomic factors, commonly associated with utilization of government-based insurance, that make the act of obtaining and following up on an MRI more difficult

such as taking time off work, finding child care, or transportation to/from appointments. (8,14) One limitation of this study was that we were unable to collect data that could better elucidate these disparities such as distance between patient address and MRI location as well as, access to these locations, and number of locations available.

Most importantly the main result of this study showed that there was no significant difference in major/minor MRI findings or operation rates between patients with government and commercial insurance, indicating that sports medicine specialists are appropriately and discriminately ordering and utilizing advanced imaging, such as MRI, in both populations. (Table 7) Commercial insurance company concerns over high rates of negative readings due to ease of MRI access are contrasted by government insurance concerns over cost containment of diagnosis and treatment. In efforts to minimize health care costs, insurance companies must rely on their greatest ally, the medical professional, to determine appropriateness of imaging orders and not on an administrator with a checklist. This study provides data that these professionals are judiciously and appropriately ordering examinations and that their clinical decision-making should be considered credible and reasonable. This study also highlights the disparities in care between commercial and government insurance coverage that needs to be addressed to better care for our pediatric sports medicine patients.

Limitations and Future Applications

This study has limitations including convenience sample leading to the potential for selection bias due to the limited amount of pediatric sports medicine clinics available from which to collect data. This is a small sample size of a larger national problem and results could be specific to this location only. Only one location had NPs ordering MRI, which may have altered those results. There are also factors not assessed that may influence the results such as health care literacy, importance of obtaining MRI poorly explained to patients and guardians, patient/guardian ethnicity, inability to travel to MRI, MRI location and accessibility, as well as unquantifiable internal office delays. While the scope of this study was limited to imaging and thus diagnostic procedures, an interesting future application of this study would be analysis of how the aforementioned delays in care lead to harm, treatment changes, or generally poor outcomes.

Conclusion

Pediatric sports medicine patients with government insurance have delays in ordering, completion, and follow up of knee MRI studies in comparison to commercial insurance plans, despite the fact that there is no significant difference in the rate of positive findings on imaging and subsequent operative treatments. This discrepancy is likely multifactorial but processes must in place for ensuring proper and prompt care of these patients.

References:

1. Caine D, Maffulli N. Incidence of Injury in Pediatric Sport. Epidemiology of Pediatric Sports Injuries, 2005 Volume 48: p 181–2.
2. Patel D, Yamasaki A, Brown K. Epidemiology of sports-related musculoskeletal injuries in young athletes in United States. Translational Pediatrics. 2017 Volume 6(3): p160–66.

3. Huleatt Joel B., Nissen Carl W., and Milewski Matthew D.. “Pediatric sports medicine injuries: common problems and solutions.” Clinics in sports medicine 37.2 (2018): 351–362. [PubMed: 29525032]

4. Beck Nicholas A., Patel Neeraj M., and Ganley Theodore J.. “The pediatric knee: current concepts in sports medicine.” Journal of Pediatric Orthopaedics B 23.1 (2014): 59–66.

5. Dunn Kristina L., Lam Kenneth C., and Tamara C Valovich McLeod “Early operative versus delayed or nonoperative treatment of anterior cruciate ligament injuries in pediatric patients.” Journal of athletic training 51.5 (2016): 425–427. [PubMed: 27244126]

6. Munshi M, Davidson M, MacDonald PB, Froese W, Sutherland K. The efficacy of magnetic resonance imaging in acute knee injuries. Clin J Sport Med. 2000;10(1):34–9. [PubMed: 10695848]

7. Kern LM, Wilcox A, Shapiro J, Dhopeshwarkar RV, Kaushal R. Which components of health information technology will drive financial value? Am J Manag Care. 2012;18(8):438–45. [PubMed: 22928759]

8. Wessman Brooke V., et al. “Reducing barriers to timely MR imaging scheduling.” Radiographics 34.7 (2014): 2064–2070. [PubMed: 25384302]

9. Rogers Miranda J., et al. “Insurance status affects access to physical therapy following rotator cuff repair surgery: A comparison of privately insured and Medicaid patients.” Orthopedic reviews 11.2 (2019).

10. Sarkisova Natalya, et al. “Access to Physical Therapy for Pediatric and Adolescent Patients Following Orthopedic Surgery.” Global pediatric health 6 (2019): 2333794X19848676.

11. Potak Harrison, and Iobst Christopher A.. “Influence of insurance type on the access to pediatric care for children with distal radius torus fractures.” Journal of Pediatric Orthopaedics39.5 (2019): 237–240. [PubMed: 30969253]

12. Sabharwal S, Zhao C, McClemens E, et al. Pediatric orthopaedic patients presenting to a university emergency department after visiting another emergency department: demographics and health insurance status. J Pediatr Orthop. 2007;27:690–694. [PubMed: 17717473]

13. Pierce TR, Mehlman CT, Tamai J, et al. Access to care for the adolescent anterior cruciate ligament patient with Medicaid versus private insurance. J Pediatr Orthop. 2012;32:245–248 [PubMed: 22411328]

14. Skaggs DL, Lehmann CL, Rice C, et al. Access to orthopaedic care for children with medicaid versus private insurance: results of a national survey. J Pediatr Orthop. 2006;26:400–404. [PubMed: 16670556]

15. Su Lisa, et al. “Evaluation of General and Musculoskeletal Health Literacy Disparities in Pediatric Sports Injury Patient and Guardian Populations.” Journal of Pediatric Orthopaedics 40.4 (2020): e237–e242. [PubMed: 31259782]

16. Anderson Allen F., and Anderson Christian N.. “Correlation of meniscal and articular cartilage injuries in children and adolescents with timing of anterior cruciate ligament reconstruction.” The American journal of sports medicine 43.2 (2015): 275–281. [PubMed: 25497145]

Table 1:

Classification of major vs. minor findings

MAJOR		MINOR	
1	ACL tear	**1**	Chondromalacia/synovitis
2	Full thickness meniscus tear	**2**	Plica
3	OCD	**3**	Discoid meniscus, partial meniscus tear
4	Loose body/chondral fragment	**4**	Signs of prior patellar dislocation
		5	Hoffa pad edema

Table 2:

Demographic characteristics of the sample stratified by insurance type

	COMMERCIAL N = 70 % (n)	GOVERNMENT N = 98 % (n)	C vs G p-value
Age, Mean ± SD	14.91 ± 2.35	14.57 ± 3.14	0.4278
Patient gender (%)			0.877
Female	53 (37)	54 (53)	
Male	47 (33)	46 (45)	
Guardian primary language (%)			**< 0.001** *
English	99 (69)	47 (46)	
Spanish	1 (1)	53 (52)	
Side of injury (%)			0.7862
Left	44 (31)	47 (46)	
Right	54 (38)	50 (49)	
Bilateral	1 (1)	3 (3)	
Who ordered (%)			**< 0.001** *
MD	99 (69)	78 (76)	
NP	1 (1)	22 (22)	
Location (%)			
Suburban	100 (70)	5 (5)	**< 0.001** *
Urban	0	95 (93)	

*Indicates statistical significance at p<0.05

**NOTE: P-values are from Fisher exact test (categorical variables), and two sample t-test (continuous variables). N = number of participants within a group. C= commercial, G= government

Table 3:

Median (IQR) in days stratified by insurance type

TIMELINE (date→date)	COMMERCIAL N = 70 N (range)	GOVERNMENT N = 98 N (range)	C vs G p-value
Initial evaluation (days)			
Injury→1st visit	12 (3.5 – 92)	5 (1 – 41)	**< 0.001** *
MRI order (days)			
1st visit→MRI order	0 (0 – 1)	24.5 (3.25 – 59)	**< 0.001** *
MRI completion (days)			
Injury→MRI completion	34 (16 – 124)	66.5 (38 – 136)	**< 0.001** *
1st visit→MRI completion	11 (4 – 24)	40 (23 – 74)	**< 0.001** *
MRI order→MRI completion	9 (3 – 14)	16.5 (9 – 22)	**< 0.001** *
MRI review (days)			
MRI completion→follow-up	6 (4 – 12)	17 (10 – 27)	**< 0.001** *

* Indicates statistical significance at $p<0.05$

** NOTE: P-values are from Wilcox rank sum test. C= commercial, G= government

Table 4:

Median (IQR) in days stratified by guardian primary language

TIMELINE (date→date)	ENGLISH N = 115 N (range)	SPANISH N = 53 N (range)	E vs S p- value
Initial evaluation (days)			
Injury→1st visit	9 (2 – 57)	5 (1 – 4)	0.37
MRI order (days)			
1st visit→MRI order	0 (0 – 26)	28 (16 – 77)	**<0.001** *
MRI completion (days)			
Injury→MRI completion	42 (20 –136)	72 (46 – 125)	**0.007** *
1st visit→MRI completion	16 (6 – 39)	49 (30 – 98)	**<0.001** *

* Indicates statistical significance at p<0.05

** NOTE: P-values are from Wilcox rank sum test. E= English, S= Spanish

Table 5:

Median (IQR) in days stratified by guardian primary language amongst government-insured patients only

TIMELINE (date→date)	ENGLISH N = 41 N (range)	SPANISH N = 52 N (range)	E vs S p- value
Initial evaluation (days)			
Injury→1st visit	7 (1 – 41)	5 (1 – 48)	0.94
MRI order (days)			
1st visit→MRI order	21 (0 – 34)	29 (15 – 73)	0.177
MRI completion (days)			
Injury→MRI completion	63 (36 – 204)	72 (46 – 124)	0.476
1st visit→MRI completion	37 (23 – 68)	49 (30 – 96)	0.230

*Indicates statistical significance at $p<0.05$

**NOTE: P-values are from Wilcox rank sum test. E= English, S= Spanish

Table 6:

Median (IQR) in days stratified by ordering provider

TIMELINE (date→date)	NP N = 23 N (range)	MD N = 145 N (range)	NP vs MD p- value
MRI order (days)			
1st visit→MRI order	22 (0 – 40.5)	9 (0 – 34)	0.37
MRI completion (days)			
Injury→MRI completion	69 (45 –103)	50 (27 – 162)	0.49
1st visit→MRI completion	37 (17 – 68)	26 (9 – 50)	0.14
MRI order→MRI completion	16 (9 – 21)	12 (6 –21)	0.15
MRI review (days)			
MRI completion→follow-up	16 (10 – 27)	10 (5 – 21)	**0.039** *

* Indicates statistical significance at $p<0.05$

** NOTE: P-values are from Wilcox rank sum test.

Table 7:

Results of positive MRI findings and eventual operative treatment (%) stratified by insurance type

CLINICAL FACTORS	COMMERCIAL N = 70 N (%)	GOVERNMENT N = 98 N (%)	C vs G p-value
Positive findings on MRI (%)	42 (60)	61 (62)	0.7700
Major	27 (39)	43 (44)	0.4945
Minor	14 (20)	20 (20)	0.9486
Operative treatment performed (%)	22 (30)	41 (42)	0.2140

*Indicates statistical significance at $p<0.05$

**NOTE: P-values are from Wilcox rank sum test. C= commercial, G= government