Patient and Healthcare Team Adherence in Orthopaedics: A Systematic Review to Initiate Optimized Definitions, Metrics, and Implementation Strategies

Kylee Rucinski[1,2,3*], Cory R. Crecelius[1,2,3], James L. Cook[1,2,3]

[1]Department of Orthopaedic Surgery, University of Missouri, Columbia, MO, United States;[2]Department of Orthopaedic Surgery, Thompson Laboratory for Regenerative Orthopaedics, University of Missouri, Columbia, MO, United States;[3]Department of Orthopaedic Surgery, Mizzou BioJoint Center, University of Missouri, Columbia, MO, United States

ABSTRACT

Patient adherence in orthopaedics is critical to successful outcomes, but is limited by lack of standardized definitions and terminology, validated measurement tools, and consideration of physician and healthcare team roles and impact. This review was done to comprehensively evaluate and synthesize the peer-reviewed literature surrounding adherence in orthopaedics to ascertain the related terminology, identify common methods for measuring adherence, delineate risk factors for non-adherence, and determine optimal strategies for improving adherence. A systematic literature search was performed of the PubMed and Ovid/Medline databases. Eligible studies included discussion of adherence/compliance in relation to orthopaedic patient and healthcare team populations. One hundred and thirty-one studies meeting criteria were identified. Analysis revealed a lack of standardization in terminology, lack of validated measures, and has fostered widely disparate results regarding the importance of adherence. Physician and healthcare team adherence is a multi-faceted and critical component for assessing and optimizing patient adherence, yet it is often ignored in orthopaedics. Tactics to prevent and/or address non-adherence in orthopaedics have focused on educating patients, measuring and addressing mental health barriers, utilizing wearables, and creating optimized programs to address risk factors. The results of this systematic review make it clear that adherence is a complex, multi-faceted issue in orthopaedics that has not yet been effectively defined, assessed, and implemented. By working towards consensus for standardized definitions and criteria for determining patient and provider adherence, utilizing mixed methods approaches to develop and validate tools to measure adherence, and implementing best practice protocols that foster individualized plans for achieving adherence, the orthopaedic community can expect to improve outcomes across sub-specialties. To realize this goal, integrated healthcare teams must be committed to establishing a culture of patient and healthcare team adherence, and implement comprehensive strategies focused on assisting patients in reaching their best possible outcome.

Keywords: Adherence; Orthopaedic interventions; Treatments; Healthcare teams

INTRODUCTION

Patient adherence has long been recognized as a critical factor for influencing outcomes after orthopaedic interventions [1,2]. Studies have assessed the impacts of adherence with prescribed treatments including medications, surgery, and physical therapy, and reported that adherence is consistently correlated with fewer complications and better patient reported outcomes [3,4]. However, standardized terminology and validated metrics for adherence in orthopaedics have not been firmly established [5], and traditional definitions of adherence are completely patient focused. Without comprehensive definitions and identification of the full range of factors affecting adherence, the ability to moderate non-adherence is severely limited.

An early definition of adherence-"the extent to which the patient's behavior (in terms of taking medications, following diets, or executing other lifestyle changes) coincides with medical or health advice" is used for studies in orthopaedics [6]. The World Health Organization more recently defined adherence as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed

recommendations from a health care provider". Criticism of these definitions identify the paternalistic and domineering connotation [3,5] that fail to consider the entirety of factors affecting adherence [7,8]. In addition to patient-related risk factors, physicians, healthcare teams, and system barriers have direct impact on a patient's ability to adhere with treatment plans.

The objective for this systematic review was to comprehensively evaluate and synthesize the peer-reviewed literature surrounding adherence in orthopaedics to determine commonly used terminology for adherence, identify common methods for measuring adherence, delineate risk factors for non-adherence, and determine optimal strategies for improving adherence. The overall goal of this research is to move adherence from an abstract, patient-focused concept to a clearly defined, valid, and reproducible tool for engaging and partnering patients with their healthcare teams to optimize outcomes after orthopaedic interventions.

MATERIALS AND METHODS

PubMed and Ovid/Medline were searched for the terms "compliance" and "orthopedics", "adherence" and "orthopedics, "patient compliance" or "adherence" and "orthopedics", "adherence" or "guideline adherence and compliance" and "exercise" or "exercise therapy" for all years in the English language. Keywords were chosen by first searching the word "compliance" and identifying relevant keywords listed in resulting studies. "Orthopedics" was expanded in order to include all articles discussing adherence or compliance potentially relevant to orthopedics. Numerous iterations of the keywords were utilized so that a comprehensive results list could be attained. Following PRISMA guidelines (Figure 1), a total of 449 articles were identified from the main search, with an additional 30 found through searching bibliographies of included articles. After removing duplicates, 411 peer-reviewed articles were screened by one reviewer and 88 were excluded if they did not include discussion of adherence within orthopaedics. 323 articles were assessed for eligibility by three independent reviewers. 192 articles were excluded by this process with discrepancies resolved based on simple majority or by lead reviewer's decision, if required, such that 131 full-text articles were included in the qualitative synthesis. The synthesis included reading the full-length article, determining and recording each article's inclusion of measures, risk factors and/or interventions for adherence; patient type; study design; and key outcomes for documentation in the respective table using the PICO (Population or Problem, Intervention, Comparison, Outcome) method as appropriate, as well as for the related discussion for application to the stated objectives. Potential bias was assessed and recorded by the primary reviewer for randomized controlled clinical trials using the Cochrane Risk of Bias Tool.
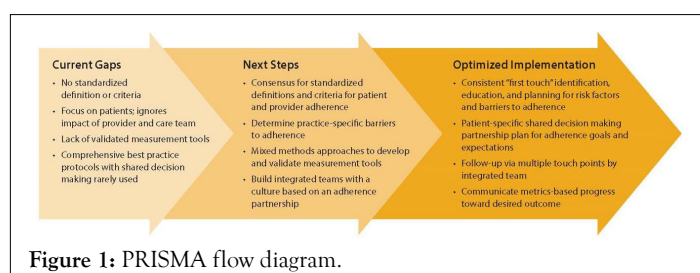

Figure 1: PRISMA flow diagram.

RESULTS

Terminology

The terms 'compliance' and 'adherence' have historically been used interchangeably. For this systematic review, the term adherence is used, as otherwise it is difficult to differentiate between compliance that refers to patient care, and that which refers to health system compliance with regulations. The most commonly definitions for adherence are from Haynes, [6] who defines adherence as "the extent to which the patient's behavior (in terms of taking medications, following diets, or executing other lifestyle changes) coincides with medical or health advice" and the WHO's, which is "the degree to which an individual constantly and accurately follows (both intentionally and unintentionally) the prescribed treatment" [9]. Many other definitions exist, most of which are created for a specific intervention, patient population, and/or study objective [1-3,5,10]. Unfortunately, this lack of standardization in terminology has fostered widely disparate results regarding the importance and effects of adherence, a deficiency in valid criteria or metrics for assessing adherence, and suboptimal progress in improving adherence-related outcomes. In addition, historical definitions of adherence are largely insufficient in that they typically consider only the patient's role in following advice or prescribed treatments.

A more comprehensive definition of adherence includes the roles of the attending physician, their team, and the healthcare system. The results of this systematic review suggest that this approach has been most effectively implemented in studies involving management of club foot in orthopaedics. These studies examined the effects of patient, community, socioeconomic, and healthcare team factors on adherence and the associated outcomes, which have led to significant improvements in club foot management throughout the world [11,12]. Studies on fragility fractures have also involved a more comprehensive approach to assessment of adherence [13]. The "Own the Bone" initiative uses a full healthcare team-focused approach in designing protocols for management of fragility fractures that highlight the impact that a multidisciplinary healthcare team can have on patient adherence and related outcomes. This initiative has led to the creation of bone health liaison services throughout the United States, which have significant impacts on morbidity, mortality, functional outcomes, and costs associated with fragility fractures in elderly patients [13]. Importantly, qualitative and mixed methods experimental designs have played key roles in these comprehensive approaches by helping to delineate the full spectrum of impediments to adherence and elucidate patient-driven mechanisms for feasible solutions for non-adherence [14].

Healthcare team adherence is a multi-faceted and critical component for assessing and optimizing patient adherence, yet it is often ignored in orthopaedics. Healthcare team adherence involves two main ideas: 1) the degree to which healthcare teams and physicians follow their protocols and policies for delivering evidence-based patient care 2) the impact of the healthcare team's interactions on the ability of patients to be adherent. For example, healthcare teams can directly impact patient attendance at follow-up appointments by failing to make appointments at discharge, [8,15] and bracing through failure of effective patient-centered communication [16]. In the present systematic review, 5 studies evaluated healthcare team adherence with respect to the healthcare team following their self-developed "best practices" from the peer-reviewed literature, and 15 studies looked at risk factors and methods to improve healthcare team adherence [7,8,13,17-19]. The physician and healthcare team most influenced patient adherence through the education provided to the patient, location of the clinic in proximity to the patient, and interpersonal skills [20]. These studies typically utilized retrospective reviews or self-developed questionnaires to gauge healthcare team adherence,

and reported that utilizing protocols, improving healthcare team education on how to communicate to different subsets of patients, and creating integrated teams were effective methods to bolster patient adherence to prescribed treatments [21,22]. The relative paucity of attention and data attributed to the healthcare team as a component for defining and assessing adherence appear to be a severe limitation to optimizing patient adherence and outcomes in orthopaedics.

Measures of adherence

In orthopaedics, adherence is typically measured by determining medication consumption, visits attended, brace or assistive device use, exercises performed, amount of weight bearing, or step counts [23,24]. These quantifiable metrics of adherence are important and useful; however, the methods for measurement have not been formally validated or standardized. Pill counters, patient journals, patient reports, "spot checks", and wearables are the most common measurement tactics. Unfortunately, accuracy is lacking for these metrics, including pill counters and wearables, and none of them account for causes, psychometric components, or external causes of non-adherence [23,25-27].

To address these limitations and deficiencies, researchers have sought to develop patient questionnaires. In the present systematic review, 37 studies were included that sought to quantify adherence in orthopedic patient populations and another 5 measured adherence for orthopaedic healthcare teams (Supplementary Table 1). These studies were effective in the initial stages of quantifying adherence, giving insight into patient adherence rates over the course of various types of treatment. Unfortunately, none of these studies included questionnaire validation or considered psychometric components necessary to provide reliable, accurate data. Because repeatability, specificity, and sensitivity of these instruments have not been ascertained, their use remains limited.

Risk factors for adherence

The author team summarized studies in the present systematic review that specifically assess risk factors for non-adherence in orthopaedic patients (Supplementary Table 2). Each study focused on one specific area of adherence (i.e., weight bearing, physical therapy attendance) and assessed the effects patient-specific variables on adherence. Risk factors associated with non-adherence included low socioeconomic status, education level, and health literacy; high preoperative pain; nicotine use; passive coping skills; and lack of healthcare insurance [28-31]. Importantly, the healthcare system can have major effects on adherence after orthopaedic interventions but rarely included in risk factor analyses. For example, studies focused on management of club foot consistently reported that lack of access to health facilities or insurance as a risk factor for adherence with brace wear and for follow-up appointment attendance [12], yet it was only through qualitative assessment that researchers were able to identify financial limitations were the primary drivers for non-adherence [32]. Similarly, lack of healthcare insurance for orthopaedic trauma patients was consistently reported to be a risk factor for adherence with postoperative physical therapy protocols and for adherence with ambulation restrictions, [33-36] yet qualitative assessments revealed that these uninsured patients had the lowest odds for being transferred to a Skilled Nursing Facility (SNF) or inpatient rehabilitation center, compromising their access to education, training, and guided rehabilitation for their injuries [37].

Studies have recently started to identify healthcare team-specific factors that influence patient adherence [7,8]. These studies have identified that lack of protocols, lack of networking with other attending physicians, and poor communication across healthcare teams as risk factors [16,17]. Additionally, failure of the attending physician and healthcare team to provide adequate education regarding specific treatment options and the location of the clinic contributed to failure of patients to return for follow-up appointments, particularly for more rural populations [38]. In contrast, strong patient-healthcare team relationships and patient impressions of attending physician trustworthiness fostered patient adherence with prescribed treatment plans [19,39,40].

Interventions to improve adherence

Studies assessing interventions to improve adherence were also summarized (Supplementary Table 3). Tactics to prevent and/or address non-adherence in orthopaedics have focused on educating patients, measuring and addressing mental health barriers, utilizing wearables that give patients and/or physician feedback, and creating optimized programs to address factors leading to non-adherence. These have been reported to improve adherence with physical therapy, visit attendance, weight bearing restrictions, home exercises, and patient-reported outcomes for mobility, pain, and function after surgery [41].

Education focused on adherence typically occurs pre-operatively, given either via web-based materials or through in-person communication by the healthcare team [42]. Education has been shown to improve adherence with brace use, program completion, and visit adherence [11,13]. Utilizing effective communication has been noted as key to building trust and patient adherence with the treatment plan [19]. Effective spousal support and trust for the healthcare team were associated with improved patient adherence rates [43].

New, optimized protocols or programs to address specific facets of patient adherence have been identified as another important tool for the healthcare team. These initiatives include the use of multiple patient touch-points by the healthcare team post-operatively [41], changing protocols to ensure scheduling of post-operative appointments before discharge [44], optimized therapy plans that utilized various physical therapy mechanisms intent on improving adherence [45], and health system adjustments to reduce barriers to adherence among low-income patients [46]. While these various program optimizations were patient focused, the majority actually involved adjustments made by the healthcare team with the intent of helping reduce barriers to adherence for their patients.

Mental health assessments are another tool used to address potential barriers to patient adherence [47]. Importantly, mental health evaluations rarely result in patients being refused elective orthopaedic care, but instead identify patient-specific strategies for communication, engagement, and logistics to overcome these barriers preoperatively as well as throughout the post-operative course of treatment. Many of the studies that utilized an optimized protocol or program indirectly addressed these mental health concerns or barriers to adherence, but few included direct interventions for mental health concerns during the pre-operative or post-operative period, and no detailed patient selection strategies based on mental health assessments were provided.

DISCUSSION

This systematic review of the peer-reviewed orthopaedic literature highlights a lack of standardization, consistency, comprehensiveness and validity regarding definitions, criteria, assessment, implementation, and optimization of patient and healthcare team adherence. There are critical unmet needs in each of these areas, which in turn lead to a lack of consistent, validated and widely-accepted best practices for evaluating, reporting, and improving adherence and related outcomes. Historical definitions that put the onus solely on patients fail to consider the ways in which patient-specific barriers, attending physician actions, healthcare team protocol adherence, and health system barriers affect the ability of patients to comply with treatment plans. Multiple studies illustrated the impact improved programs and interventions by healthcare teams had on improving patient adherence. However, no study concluded that healthcare team adherence is directly correlated to patient adherence and should be considered a "risk factor" for patient non-adherence. Similarly, "access" and "lack of insurance" are consistently considered patient risk factors for non-adherence, putting the onus on the patient, when these should instead be labeled as health system barriers to patient adherence. Therefore, these definitions need to be enhanced through mixed methods studies that utilize stakeholder input while considering patient and health system realities in order to create clear, comprehensive definitions of adherence.

In general, methods to measure adherence varied by study and failed to comprehensively assess adherence to an entire plan of care. Likewise, lack of inclusion of psychometric components in adherence assessments undermines their capabilities for attaining all four types of quantitative validity as well as determining their impacts on desired outcomes. To the authors' knowledge, no current assessments of adherence have been validated for standardized use in orthopaedics.

Risk factors that significantly affect adherence for orthopaedic patients include socioeconomic status, mental health, injury severity, health literacy, insurance status, and psychological factors/personality traits [28,36,48]. However, these risk factors are not consistently assessed prior to most orthopaedic interventions. The use of interdisciplinary healthcare teams that comprehensively address patient and health system specific barriers to patient adherence have been reported to help mitigate these risk factors. For nonsurgical and elective surgery interventions, healthcare teams should ensure patients understand their treatment plans, assist patients with establishing mental health support, and identify options for home exercises and physical therapy [49]. Multi-modal education should be provided by the healthcare team, follow-up scheduling convenient for the patient should be sought and proactive education with multiple touch points should be employed. It should be noted that patients experiencing traumatic injuries have much lower adherence rates across all categories. For orthopaedic trauma patients, follow-up through local clinics, healthcare team calls, physical therapy options, and patient feedback devices consistently improve patient adherence [39]. While further research is needed in order to determine optimal strategies for patient and healthcare team-adherence in this complex patient population, healthcare teams that utilized consistent, evidence-based "best practices", that documented each component of their standardized process in the electronic medical record consistently improved patient adherence after orthopedic trauma. In addition, for all patients, attending physicians must create cultures of adherence within their healthcare teams, utilizing checklists and automating processes when possible to ensure patients receive evidence-based care. Physicians should also pay careful attention to the way treatment choices are made and take into consideration patient barriers to adherence when educating patients on treatment protocols [14].

Shared Decision Making (SDM) in healthcare can be an effective way of encouraging patient adherence [3,14,50]. In SDM, patients and physicians enter into a conversation, discussing risks and potential outcomes with each treatment plan while also uncovering potential barriers to adherence in order to partner in determining the optimal treatment plan for the individual patient [51]. This approach allows physicians, healthcare teams, and patients to work through barriers together in advance of treatment or choose a treatment option that obviates unavoidable or unforeseen barriers [52]. For example, a patient seeking Anterior Cruciate Ligament (ACL) reconstruction who currently lacks the time and resources for postoperative recovery restrictions and physical therapy can opt for use of a functional knee brace while adjusting their schedule to allow for surgery. If a sole-income single-parent with 3 young children sustains injuries in a motor vehicle accident that render them unable to work, physicians should work with the patient to determine options for follow-up care that considers their childcare needs and financial capabilities. Connecting this patient to a local non-profit that assists with childcare and transportation, providing alternatives for low-cost physical therapy or tools that guide home-based physical therapy in conjunction with more telephonic or telehealth touchpoints by the healthcare team may significantly improve patient adherence and achieve the desired outcome. While this strategy may seem daunting and labor-intensive, implementation of a coordinated and comprehensive patient-specific approach by an integrated healthcare team can be a time and cost-effective method for consistently improving patient and healthcare team adherence, ultimately leading to better outcomes [41,44].

While this systematic review included many high-quality studies covering a large spectrum of orthopaedic disorders, it was limited by a lack of consistency, standardization, and validity with respect to defining, assessing, and reporting adherence among eligible studies. In addition, because there is a paucity of consistent language surrounding patient and healthcare team adherence in orthopaedics, it is possible that relevant articles might have been missed during searches. Most eligible studies had risk for bias in that they utilized physician or healthcare team impressions, patient reports, retrospective reviews, or non-validated instruments to measure patient adherence. The orthopaedic disorders and patient populations studied, measurements used, and interventions assessed were highly variable such that major unmet needs for optimizing adherence and related outcomes remain (Table 1).

Table 1: Checklist-strategy to address critical unmet needs for optimizing adherence-related outcomes in orthopaedics.

Section and topic	Item #	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review.	1-2
Abstract			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	24-55
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	58-82
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	83-90
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	105-110
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	92-95
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	92-99
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	101-105
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	105-110
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	103-110
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	105-110
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	110-112
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	105-110
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	106-110
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	N/A
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	106-110
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	106-110
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A

Reporting biases assessment	14	Describe any methods used to assess risk of basis due to missing results in a synthesis (arising from reporting biases).	110-112
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome	N/A
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	113
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	116-214
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	190-238
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	190-238
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	116-278
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	116-278
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	116-276
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	377
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	372-381
Discussion			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	280-371
	23b	Discuss any limitations of the evidence included in the review.	372-381
	23c	Discuss any limitations of the review processes used.	372-381
	23d	Discuss implications of the results for practice, policy, and future research.	384-397
Other information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	N/A
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	N/A
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	N/A
Competing interests	26	Declare any competing interests of review authors.	N/A
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

CONCLUSION

The results of this systematic review make it clear that adherence is a complex, multi-faceted issue in orthopaedics. These gaps in communication, measurement, and management contribute to non-adherence and prevent implementation of effective strategies to address barriers to adherence. It is evident that patient and healthcare team adherence are interconnected, and that by working toward a more holistic understanding of the multiple barriers patients face to adherence, the orthopaedic community can expect to improve outcomes across sub-specialties. To realize this goal, integrated healthcare teams committed to shared decision making can create and implement comprehensive strategies focused on assisting patients in reaching their best possible outcome.

DECLARATION

Conflicts of interest

James L. Cook receives research support from AO Trauma; receives IP royalties, is a paid consultant and receives research support from Arthrex, Inc; receives research support from Collagen Matrix Inc; receives research support from DePuy, A Johnson & Johnson Company; is on the editorial or governing board for Journal of Knee Surgery; is a board or committee member for Midwest Transplant Network; is a board or committee member, receives IP royalties and research support from Musculoskeletal Transplant Foundation; receives research support from National Institutes of Health (NIAMS & NICHD); receives research support from Orthopaedic Trauma Association; receives research support from Purina; receives research support from Regenosine; receives research support from SITES Medical; receives publishing royalties and financial or material support from Thieme; is a paid consultant for Trupanion; receives research support from U.S. Department of Defense.

Kylee Rucinski and Cory Crecelius have no conflicts of interest to disclose.

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