Comparison of a validated decision-support tool to a standard of care triage system for knee osteoarthritis assessment: a proof-of-concept study

Paige Wagar, BMSc
Simrun Chahal, MSc
Rabail Siddiqui, MPH MHSc
Shalyn Littlefield, MSc
Caroline Fanti, MScPT
Claude Cullinan, MD
Kurt Droll, MD
Travis E. Marion, MD, MSc
T. Derek Cooke, MA, MB BChir
David Puskas, MD

Correspondence to:
R. Siddiqui
980 Oliver Rd
Thunder Bay ON P7B 6V4
rabail.siddiqui@tbh.net

Background: Patients with knee osteoarthritis (OA) in northwestern Ontario are referred by their primary care provider (PCP) to a centralized assessment clinic for evaluation by an advanced practice physiotherapist (APP) to determine if they will require surgical management. However, many patients are found to not require surgical management, resulting in delays for patients who do. A decision-support tool was developed to address this issue and to guide treatment options by determining the need for surgical or nonsurgical approaches.

Methods: We used a proof-of-concept method to assess the use of the decision-support tool in northwestern Ontario. Data from 100 consecutive patients assessed for knee OA management were collected from the Thunder Bay centralized assessment clinic. Two levels of agreement analyses (calculated using Cohen κ statistic) were performed, between the APP assessment decision (surgical or nonsurgical) and the decision-support tool recommendation, and between the surgeon's decision (surgical or nonsurgical) and the decision-support tool recommendation.

Results: We found a near-perfect agreement (κ = 0.870, *n* = 65) between the APP decision and the decision-support tool recommendation, when controlled for patient preference. There was a substantial level of agreement (κ = 0.618, *n* = 72) between the decision-support tool recommendation and the surgeon's decision.

Conclusion: The decision-support tool recommendation showed considerable agreement with the decisions of the APP and surgeon indicating that it could be a valuable tool to guide PCPs caring for patients with knee OA. The applicability of a decision-support tool in northwestern Ontario displayed promising results, but further research is needed to examine the feasibility in a primary care setting.

Contexte : Dans le nord-ouest de l'Ontario, les personnes atteintes d'arthrose du genou sont orientées par leur prestataire de soins de santé primaires vers une clinique d'évaluation centralisée pour qu'un ou une physiothérapeute en pratique avancée détermine le besoin d'avoir recours à une chirurgie. Toutefois, un tel traitement n'est finalement pas nécessaire pour de nombreuses personnes, ce qui entraîne des retards pour ceux et celles qui en ont besoin. Nous avons élaboré un outil d'aide à la prise de décisions cliniques afin de résoudre cet enjeu et d'orienter les options thérapeutiques en déterminant le besoin pour des traitements chirurgicaux ou non chirurgicaux.

Méthodes : Nous avons employé une méthode de validation de principe dans le but d'évaluer l'utilisation de l'outil d'aide à la prise de décisions dans le nord-ouest de l'Ontario. Nous avons colligé les données de 100 patientes et patients consécutifs évalués pour la prise en charge d'une arthrose du genou à la clinique d'évaluation centralisée de Thunder Bay. Nous avons réalisé 2 niveaux d'analyse d'accord (calculée à l'aide de la méthode statistique du κ de Cohen) : entre la décision fondée sur l'évaluation du ou de la physiothérapeute en pratique avancée (traitement chirurgical et non chirurgical) et la recommandation de l'outil d'aide à la prise de décisions, ainsi qu'entre la décision du chirurgien ou de la chirurgienne (traitement chirurgical ou non chirurgical) et celle de l'outil d'aide à la prise de décisions.

Résultats : Nous avons observé un accord quasi parfait (κ = 0,870, *n* = 65) entre la décision du ou de la physiothérapeute en pratique avancée et la recommandation de l'outil d'aide à la prise de décisions lorsqu'on tient compte des préférences du patient ou de la patiente. Nous avons constaté un accord important (κ = 0,618, *n* = 72) entre la recommandation de l'outil d'aide à la prise de décisions et la décision du chirurgien ou de la chirurgienne.

Conclusion : Les recommandations offertes par l'outil d'aide à la prise de décisions ont démontré un accord remarquable entre les décisions prises par le ou la physiothérapeute en pratique avancée et le chirurgien ou la chirurgienne, ce qui permet de croire qu'il s'agit d'un outil précieux pour guider les prestataires de soins de santé primaires auprès des personnes atteintes d'arthrose du genou. La pertinence du déploiement de l'outil d'aide à la prise de décisions dans le nord-ouest de l'Ontario a montré des résultats prometteurs, mais de plus amples travaux de recherche sont nécessaires afin d'en examiner la faisabilité dans le contexte des soins de santé primaires.

Access to timely and appropriate health care is a challenge in northwestern Ontario[1] where the lack of adequate care in rural areas stems from several factors, including health care staff shortages, geographic remoteness, extensive travel time, unpredictable weather conditions and difficult access to specialty services.[2] Patients with knee osteoarthritis (OA) in northwestern Ontario are referred by their family physician or primary care provider (PCP) to a centralized assessment clinic where they are evaluated by an advanced practice physiotherapist (APP) to determine the best course of management (surgical or nonsurgical). Patients are placed on a waiting list for an assessment, and then again for a consultation with an orthopedic surgeon, if deemed appropriate for surgical management. However, many patients referred to the centralized clinic are found to not require surgical management, resulting in delays for patients who would benefit from surgical intervention. Regardless of efforts associated with this referral pathway, not all barriers can be alleviated, including wait times, travel time and expenses.

Primary care providers may order diagnostic images before the consultation with an orthopedic surgeon. According to Mohammed and colleagues,[3] 35% of patients who were referred to an orthopedic surgeon for knee pain had magnetic resonance imaging (MRI) completed before the consultation; among those, 76% were deemed unnecessary. The costs of unnecessary imaging places an unwarranted financial burden on the health care system. Currently, there is a wide variation when ordering appropriate MRIs between orthopedic clinicians and nonorthopedic clinicians; PCPs are more likely than APPs to order an MRI before the consultation.[4] Moreover, according to an analysis by Harrison and colleagues,[4] PCPs or other health care providers take limited approaches to knee OA care. This suggests a limited understanding of knee OA care or limited tools available to PCPs.

Therefore, there is a need to develop a tool that could be used by PCPs to guide treatment options for knee OA. Such a tool could mitigate unnecessary referrals, extensive travel, preconsultation MRIs and reduce wait times for patients for whom a surgical consultation is warranted.[2,3] Access to timely and appropriate care (surgical and nonsurgical) can reduce the negative effects of waiting, potentially increasing patient satisfaction. To address these needs, a decision-support tool was developed by OAISYS Medical Inc., involving the use of a validated radiograph grading system in combination with a validated functional evaluation, with age metrics to determine the severity level or stage of knee OA.[5] This index of severity aims to guide treatment options by determining the need for surgical or nonsurgical approaches. We aimed to provide a proof of concept of the use and applicability of the decision-support tool in northwestern Ontario before implementation.

METHODS

Ethics approval was obtained from the Thunder Bay Regional Health Sciences Centre Research Ethics Board. Data from 100 consecutive patients assessed for management of knee OA by an APP from 2018 to 2019 were collected from the Thunder Bay Rapid Access Clinic assessment notes and the electronic medical record. Patients with a previous osteotomy or total knee replacement in the same limb were excluded.

The data collected included demographic information (age, sex, body mass index [BMI]), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), referral information and radiographs (frontal standing and skyline view). Outcome of assessment (referral for surgical or nonsurgical options) was also collected.

For each case, age, sex and radiographs were reviewed by the OAISYS team to determine the radiographic grade, and determination was made for surgical or nonsurgical referral (Table 1). The OAISYS reviewers were blinded to the clinical outcome of each case.

For this proof-of-concept study, we aimed to determine the level of agreement between the current process of assessment and the decision-support tool. Two levels of agreement analyses were performed between the APP assessment decision (surgical or nonsurgical) and the decision-support tool recommendation and between the surgeon's decision (surgical or nonsurgical) and the decision-support tool recommendation. The level of agreement was calculated using the Cohen κ statistic.[6]

Table 1. OAISYS Medical Inc. grading guidelines used for triage purposes

Recommendation	WOMAC score	Age, yr	Compartmental osteoarthritis radiographic grading (12)
Timely surgical referral*	< 40	60	6
Good for surgical referral*	40	60	6
Urgent surgical referral*	40	60	8
Nonsurgical	< 40	No specification	6

WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.
*These categories were analyzed as surgical cases.

RESULTS

Among the 150 consecutive patients whose charts that were screened, 100 patients were eligible for inclusion in the study. Most patients were female (60%) with an

Table 2. Demographic and clinical characteristics of patients assessed for knee osteoarthritis management	
Characteristic	No.*
No. of patients	100
Sex	
Male	40
Female	60
Affected side	
Right	53
Left	47
Age, yr	
Mean ± SD	64.54 ± 9.748
Range	27–92
WOMAC scores	
Overall mean ± SD	48.48 ± 18.262
WOMAC score category, no. of participants	
Mild (< 32)	22
Moderate (32–64.9)	62
Severe (> 65)	16
BMI	
Underweight	0
Normal (18.5–24.9)	7
Overweight (25–29.9)	22
Obese I (30–34.9)	24
Obese II (35–39.9)	21
Obese III (> 40)	19
Unknown	7

BMI = body mass index; SD = standard deviation; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.
*Unless indicated otherwise.

Table 3. Level of agreement analysis		
Comparison	κ statistic	Level of agreement
APP decision v. decision-support tool recommendation	0.563	Moderate
Surgeon's decision v. decision-support tool recommendation	0.618	Substantial

APP = advanced practice physiotherapist.

average age of 64.54 years. The average WOMAC score was reported to be 48.48 and only 7 patients had a healthy BMI (18.5–24.9). Complete demographic data are outlined in Table 2.

Results of the level of agreement analyses can be found in Table 3. A moderate level of agreement ($\kappa = 0.563$, $n = 100$) between the APP's assessment decision and the decision-support tool recommendation was determined (Figure 1). There were 69 agreements and 31 disagreements noted. Patients were determined as surgical if a referral for a surgical consultation was made.

Seventy-two patients were referred for surgical consultation by the APP and included in the level of agreement analysis between the surgeon's decision and the decision-support tool recommendation. There was a substantial level of agreement ($\kappa = 0.618$, $n = 72$) between the decision-support tool recommendation and the surgeon's decision, with a total of 46 agreements (Figure 2). To alleviate the potential confounding factor of the patient's impact on the decision made, the level of agreement was re-analyzed to exclude 35 patients whose decision was dictated solely by their preferences (Figure 3). This produced a near perfect agreement between the APP decision and the decision-support tool recommendation ($\kappa = 0.870$, $n = 65$) (Table 4).

DISCUSSION

Patients with knee OA in northwestern Ontario are seen by a PCP and referred to a centralized assessment clinic to determine the best course of management (surgical or nonsurgical). However, patients are often referred to these clinics without undergoing other conservative approaches and with unwarranted imaging, such as MRIs.[3,4] This suggests a limited understanding of knee OA care or limited resources available to guide PCPs caring for patients with knee OA. The development of a decision-support tool that effectively guides PCP treatment decisions would thus be of considerable value; such a tool could mitigate the number of unnecessary referrals, effectively allocate resources, reduce wait times for patients for whom a surgical consultation is warranted and be of added value should it provide nonsurgical, as well as surgical, care considerations. We aimed to provide

		APP decision	
		Surgical	Nonsurgical
Decision-support tool recommendation	Surgical	49	8
	Nonsurgical	23	20

Fig. 1. Agreement between the decision-support tool recommendation and the APP decision ($n = 100$). Blue indicates 69 instances of agreement between the APP decision and the decision-support tool recommendation and red indicates 31 disagreements. APP = advanced practice physiotherapist.

		Surgenor's decision	
		Surgical	Nonsurgical
Decision-support tool recommendation	Surgical	25	25
	Nonsurgical	1	21

Fig. 2. Agreement between the decision-support tool recommendation and treating orthopedic surgeon's decision (*n* = 72*). Blue indicates 46 instances of agreement between the decision-support tool recommendation and the surgeon's decision and red indicates 26 disagreements. *The number of patients referred for surgical consultation of the 100 patients initially assessed by the APP. The moderate level of agreement between the APP decision and the decision-support tool recommendation was further reviewed to understand the reasoning for the decisions made. It was found that the patients' preferences to undergo surgery and insisting to see an orthopedic surgeon for further review were found to be the most frequent reasons for referrals, along with patients' refusal to undergo surgery or be assessed for surgery.

		APP decision	
		Surgeon referral	Did not refer
Decision-support tool recommendation	Surgical	39	2
	Conservative	4	20

Fig. 3. Agreement between the decision-support tool recommendation and the APP decision (controlled for patient preference) (*n* = 65*). Blue indicates 59 instances of agreement between the decision-support tool recommendation and the APP decision and red indicates 6 disagreements. APP = advanced practice physiotherapist. *The number of patients who were not insisting on surgical consult or avoiding surgical consult.

Table 4. Level of agreement analysis		
Comparison	κ statistic	Level of agreement
APP decision v. decision-support tool recommendation decision	0.563	Moderate
APP decision v. decision-support tool recommendation (controlled for patient decision)	0.870	Near perfect
APP = advanced practice physiotherapist.		

a proof of concept to assess the applicability of a decision-support tool in northwestern Ontario.

The comparison of the decision made by the APP and the decision-support tool recommendation showed that there was a moderate level of agreement (κ = 0.563). There were 35 cases noted to have disagreements owing to the patient's preferences: patients insisting on a surgical consultation despite the APP nonsurgical recommendation, patients wanting a referral to pursue cortisone injections and others who declined a referral in favour of nonsurgical management. There was only 1 case where the APP assessment resulted in a nonsurgical recommendation, whereas the decision-support tool recommended a surgeon consultation.

In comparing the 72 patients who underwent a surgical consultation (after being assessed by the APP), the level of agreement between the surgeon's decision and the decision-support tool recommendation was deemed to be substantial (κ = 0.618). There were a total of 26 disagreements, of which 16 were cases where the surgeon recommended nonsurgical management, whereas the decision-support tool recommended surgical management.

The surgeon chose nonsurgical management for several reasons, including elevated BMI, older age and medical history (e.g., diagnosis of an uncommon disease). There were 9 cases where the patient did not want to pursue surgical intervention, whereas the decision-support tool recommended surgical management. There was 1 disagreement where the decision-support tool recommended nonsurgical management as opposed to the surgeon recommending surgical management. In this case, the patient insisted on surgical management as they wanted to improve pain and maintain their independence.

The patient's decision and preference had a considerable effect on the management pathway and accounted for most of the disagreements between the decision-support tool recommendation and the assessments by the APP and the orthopedic surgeon. Patient preference has been shown to have a considerable effect on management pathways in other studies. Specifically, Churchill and colleagues[7] showed that, among patients who were not suited for total knee arthroplasty referrals, patient unwillingness was the strongest predictor for distinguishing between nonsurgical and surgical candidates. After removing cases where the decision was dictated by the patient's preference, there was a near-perfect level of agreement between the decision-support tool recommendation and the assessments by the APP or the orthopedic surgeon. This suggests that the use of a validated radiograph grade, functional evaluation and the age metrics triage system could be of considerable value in evaluating patients with knee OA in a primary care setting. However, for those patients considered suitable, ascertaining their willingness for a surgical consultation

may help reduce needless referrals. Consultation with a surgeon undertaking nonsurgical orthopedic care might be used to support those patients with the preference for a consultation, but lacking the severity for surgery.

Patients in northwestern Ontario are assessed by their PCP before being referred for further assessment by an APP or an orthopedic surgeon. The primary care setting would be an optimal place for such a decision-support tool as it will provide guidance to PCPs on taking appropriate actions when assessing a patient for knee OA. The high level of agreement shown in the results of this study supports the applicability of this tool in northwestern Ontario and highlights the need for a prospective study in a primary care setting implementing the tool. Implementation of this tool could have considerable effects on the health care system, such as reducing wait times, and improving patient experience and satisfaction by reducing travel from rural areas and accessing care in a timely manner.

Limitations

There are several limitations to the current study, which are related to the retrospective study design. Chart reviews are limited in their ability to collect data beyond what was documented. We also used data from a centralized assessment clinic, which is not the applicable setting for the decision-support tool to be used. However, conducting the study in this setting provided support for the applicability of the decision-support tool for use in northwestern Ontario, and for conducting future studies in a primary care setting. Moreover, data were collected from a single clinic providing service to a diverse patient population where English may be a second language to many; it is unclear if the self-reported functional outcomes were influenced by language barriers.

CONCLUSION

For a preliminary proof-of-concept study, the applicability of a decision-support tool for patients with knee OA in northwestern Ontario showed promising results. Future research needs to be conducted in the form of a pilot prospective study in a primary care setting, which will also assess the feasibility of using such a tool. Findings could lead to modification of the tool's features and include factors such as patient preference.

Affiliations: Clinical Research Services Department, Thunder Bay Regional Health Research Institute, Thunder Bay, Ont. (Wagar, Chahal, Siddiqui, Littlefield); Thunder Bay Regional Health Sciences Centre, Thunder Bay, Ont. (Fanti, Cullinan, Droll, Marion, Puskas); Northern Ontario School of Medicine University, Thunder Bay, Ont. (Cullinan, Droll, Marion, Puskas); Orthopedic Alignment and Imaging Systems Inc., Maberly, Ont. (Cooke); School of Rehabilitation Therapy, Queen's University, Kingston, Ont. (Cooke).

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