

The use of early immobilization in the management of acute soft-tissue injuries of the knee: results of a survey of emergency physicians, sports medicine physicians and orthopedic surgeons

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Background: Evidence-based guidelines on the use of immobilization in the management of common acute soft-tissue knee injuries do not exist. Our objective was to explore the practice patterns of emergency physicians (EPs), sports medicine physicians (SMPs) and orthopedic surgeons (OS) regarding the use of early immobilization in the management of these injuries.

Methods: We developed a web-based survey and sent it to all EPs, SMPs and OS in a Canadian urban centre. The survey was designed to assess the likelihood of prescribing immobilization and to evaluate factors associated with physicians from these 3 disciplines making this decision.

Results: The overall response rate was 44 of 112 (39%): 17 of 58 (29%) EPs, 7 of 15 (47%) SMPs and 20 of 39 (51%) OS. In cases of suspected meniscus injuries, 9 (50%) EPs indicated they would prescribe immobilization, whereas no SMPs and 1 (5%) OS would immobilize ($p = 0.002$). For suspected anterior cruciate ligament injuries, 13 (77%) EPs, 2 (29%) SMPs and 5 (25%) OS said they would immobilize ($p = 0.005$). For lateral collateral ligament injuries, 9 (53%) EPs, no SMPs and 6 (32%) OS would immobilize ($p = 0.04$). All respondents would prescribe immobilization for a grossly unstable knee.

Conclusion: We found that EPs were more likely to prescribe immobilization for certain acute soft-tissue knee injuries than SMPs and OS. The development of an evidenced-based guideline for the use of knee immobilization after acute soft-tissue injury may reduce practice variability.

Contexte : Il n'existe pas de lignes directrices factuelles sur le recours à l'immobilisation pour la prise en charge des traumatismes aigus communs qui affectent les tissus mous du genou. Notre objectif était d'explorer les habitudes de pratique des urgentologues, des médecins du sport et des chirurgiens orthopédistes quant au recours à l'immobilisation pour la prise en charge initiale de ces blessures.

Méthodes : Nous avons conçu un sondage Web et l'avons fait parvenir à tous les urgentologues, médecins du sport et chirurgiens orthopédistes d'un centre urbain canadien. Le sondage visait à évaluer la probabilité que l'immobilisation soit prescrite et à dégager les facteurs associés à ce type de décision chez les praticiens de ces 3 disciplines.

Résultats : Le taux de réponse global a été de 44 sur 112 (39 %) : 17 urgentologues sur 58 (29 %), 7 médecins du sport sur 15 (47 %) et 20 chirurgiens orthopédistes sur 39 (51 %). Dans les cas où l'on soupçonnait une blessure du ménisque, 9 urgentologues (50 %) ont indiqué qu'ils prescriraient l'immobilisation, contre aucun médecin du sport et 1 (5 %) chirurgien orthopédiste ($p = 0,002$). Dans les cas où l'on soupçonnait une blessure du ligament croisé antérieur, 13 urgentologues (77 %), 2 médecins du sport (29 %) et 5 chirurgiens orthopédistes (25 %) ont affirmé qu'ils immobiliseraient ($p = 0,005$). Dans les cas de blessure au ligament collatéral latéral, 9 urgentologues (53 %), aucun médecin du sport et 6 chirurgiens orthopédistes (32 %) immobiliseraient ($p = 0,04$). Tous les répondants ont dit prescrire l'immobilisation pour un genou manifestement instable.

Conclusion : Nous avons constaté que les urgentologues étaient plus susceptibles de prescrire l'immobilisation pour certains traumatismes aigus affectant les tissus mous du genou comparativement aux médecins du sport et aux chirurgiens orthopédistes. La formulation de lignes directrices factuelles sur le recours à l'immobilisation du genou après un traumatisme aigu des tissus mous pourrait réduire la variabilité des pratiques.

Injury to the knee is a common cause of disability after sports-related injuries, yet they are often managed in a single visit with a physician.¹ Accurate recognition and appropriate early treatment are critical in minimizing further injury and facilitating recovery.¹ The treatment of acute soft-tissue injuries of the knee is guided by knowledge of the phases of healing.²⁻⁶ In order to protect injured tissues and alleviate pain, complete knee joint immobilization (using either a nonhinged knee brace or splint) is used by some physicians as part of the initial management of these injuries.⁷ However, the early work has demonstrated the harmful effects of prolonged joint immobilization: motion loss, muscle atrophy, decreased synthesis of proteoglycans in cartilage and decreased bone mass.^{2,4,5,8} Clinically, the loss of range of motion is thought to be the most harmful effect to the knee because it prolongs rehabilitation, impairs activities and can delay anterior cruciate ligament (ACL) reconstruction, if required.^{9,10} Striking a balance between the protection of healing tissues and the prevention of the deleterious effects of immobilization is challenging. For most acute soft-tissue knee injuries, complete immobilization is not required; if immobilization is used to alleviate pain and swelling, it should be of limited duration.¹¹⁻¹⁶ Patellar dislocation is arguably an exception, as is the grossly unstable knee.^{1,17-20}

Management of these patients is undertaken in different clinical environments by various health care providers. For many acute injuries, the initial presentation for medical care occurs in the emergency department (ED). Emergency physicians (EPs) may see these patients shortly after an injury occurs; however, other practitioners may also become involved in assessment and treatment. The referral of patients with knee injuries to a sports medicine physician (SMP) or an orthopedic surgeon (OS) for consultation can be delayed considerably.²¹

When managing acute soft-tissue knee injuries, many physicians are influenced by treatment principles that allow motion so long as further injury is avoided, which is evidenced by decreasing levels of pain and inflammation.^{1-6,22-27} Unfortunately, clear guidelines regarding the use of immobilization for specific knee injuries do not currently exist. The purpose of this study was to explore the opinions and reported practice patterns of EPs, SMPs and OS with regards to the use of early immobilization in the management of acute soft-tissue injuries of the knee. We hypothesized that EPs would be more likely to report prescribing immobilization than SMPs and OS in the management of these injuries.

METHODS

Design

A descriptive web-based survey was sent to all EPs, SMPs and OS in a large Canadian health zone (Edmonton,

Alta.) using a modified Dillman technique.²⁸ Because a population-based sampling approach was used, no sample size calculations were performed.²⁹

Setting

Edmonton is the capital of the province of Alberta and has approximately 1 million inhabitants served by 6 acute care EDs and 5 hospitals with orthopedic consultant coverage. There is a main academic sports medicine clinic (the Glen Sather Clinic) and 2 other sports medicine clinics within the city. Since 2009, hospital care within the province has been managed by a single administrative entity — Alberta Health Services (AHS). The University of Alberta is home to residency training programs in orthopedic surgery and emergency medicine. Sports medicine training occurs as an additional certification year through the College of Family Physicians of Canada (CFPC).

Questionnaire

Following a critical literature review, the survey was developed using standardized methodology and an iterative process.²⁴ The survey was developed by a panel of 2 OS with fellowship training in sports medicine (D.O., M.B.), 1 EP (B.R.) and 1 orthopedic surgery resident (M.S.). A survey expert assisted in the formation of questions and response options. A combination of open and closed-ended questions as well as Likert scale and ranking questions were included.²⁹⁻³² After formulation of the survey, it was completed in full by each panel member to ensure questions were structured appropriately. Owing to the small numbers of physicians to whom the survey was ultimately sent, it was not circulated on a trial basis to individuals not involved in its formulation. The final survey (Appendix, available at canjsurg.ca), which contained 19 questions, was designed to evaluate patient and physician factors that may be associated with the use of early immobilization after acute soft-tissue knee injury.

Standardized definitions

In the survey, acute soft-tissue injuries of the knee were defined as injuries that do not result in fractures (with some exceptions, as explained below), extensor mechanism disruption or knee dislocation. Examples of such injuries include ligament injury, meniscus injury and patellar dislocation. This definition was meant to capture those injuries that an EP would discharge from the ED with arrangements made for outpatient follow-up. Fractures not excluded from our definition were those commonly associated with soft-tissue injuries, such as osteochondral or avulsion fractures. Knee immobilization was defined as the prescription of a device that does not allow motion of the knee, such as a non-hinged brace or splint.

Survey methods

We obtained email addresses from the University of Alberta’s Department of Emergency Medicine and Division of Orthopedic Surgery as well as the 3 sports medicine clinics in the metropolitan Edmonton area. Physicians received an initial explanatory email and then weekly invitations to respond until they did so or until the survey time period of 3 weeks expired.

The Academic Information and Communication Technologies (AICT) department from the University of Alberta distributed the survey and completed data collection, maintaining anonymity of respondents. The study was approved by the University of Alberta Health Research Ethics Board. Implied consent was assumed if the clinicians completed the survey.

Statistical analysis

The likelihood of prescribing immobilization was assessed using a 7-point Likert scale. To dichotomize the analysis, responses of 1–4 were interpreted as a preference not to immobilize and responses of 5–7 were considered a preference to immobilize. The decision to allocate the response “4” to the “preference not to immobilize” group was made to place emphasis on the decision to immobilize. In reviewing the data, we determined that the number of respondents who selected “4” was small. Further analysis demonstrated that changing the preference not to immobilize category to include responses of 1–3 and the preference to mobilize category to include responses of 4–7 did not change our findings. Dichotomous variables were reported as proportions. Associations between physician specialty and likelihood of prescribing immobilization were examined using χ^2 tests. Continuous variables are reported as means \pm standard deviations or medians with interquartile ranges (IQRs) as appropriate and compared using 1-way analysis of variance (ANOVA). Given the numerous tests performed, we considered results to be significant at $p \leq 0.01$. All analyses were performed using Predictive Analytics Software version 19.0 (SPSS, Inc.).

RESULTS

Demographics and practice patterns

We sent our survey to 112 physicians: 58 EPs, 15 SMPs and 39 OS. The overall response rate was 44 of 112 (39%): 17 of 58 (29%) EPs, 7 of 15 (47%) SMPs and 20 of 39 (51%) OS. The OS had spent more years in practice (median 13.0, IQR 9.3–23.5 yr) than EPs (median 10.0, IQR 3.0–15.5 yr) and SMPs (median 10.0, IQR 2.0–20.0 yr). Over a 4-week period, SMPs reportedly saw an average of 12.9 ± 11.9 patients with acute soft-tissue knee injuries compared with 6.9 ± 3.9 seen by EPs and 5.6 ± 4.9

seen by OS. All of the EPs and none of the SMPs or OS reported seeing patients within 24 hours of the injury, whereas 60% of SMPs and 46% of OS reported seeing patients within 7 days ($p < 0.001$).

Diagnosis and physical exam

Five of 6 (83%) SMPs and 9 of 20 (45%) OS were confident in their diagnoses after interviewing the patient, whereas 12 of 16 (75%) EPs and 10 of 20 (50%) OS were somewhat confident. Confidence in the diagnosis increased after examination of the patient, with 6 of 7 (85%) SMPs, 15 of 20 (75%) OS and 7 of 17 (41%) EPs reporting confidence in their diagnoses. Only 2 of 17 (12%) EPs felt unsure of the diagnosis (Table 1). Overall, 39 of 44 (89%) respondents reported always or almost always inspecting the limb, palpating the knee and assessing range of motion and cruciate stability. Thirty-six of 44 (82%) reported always or almost always assessing neurovascular status and collateral ligament stability. The assessment of strength, menisci, gait and function varied greatly within and among the disciplines.

Likelihood of prescribing immobilization

In cases of suspected meniscus injuries, more EPs (50%) indicated they would prescribe immobilization than SMPs (0%) and OS (5%, $p = 0.002$; Table 2). For suspected ACL injuries, more EPs (77%) would immobilize the knee than SMPs (29%) or OS (25%, $p = 0.005$). For lateral collateral ligament injuries, the differences among the groups in the use of immobilization did not reach the level of statistical significance determined a priori (53% of EPs, 0% of SMPs and 32% of OS, $p = 0.04$). When suspecting an isolated medial collateral ligament (MCL) injury, no differences were found among the groups in the use of immobilization (47% of EPs, 14% of SMPs and 35% of OS, $p = 0.31$). For combined ACL and MCL injuries, no differences were found among the groups in the use of immobilization (77% of EPs, 43% of SMPs and 40% of

Table 1. Diagnostic confidence level of physicians after history taking and after physical examination

Confidence level	Group, %		
	EP	SMP	OS
After history-taking			
Not confident	13	0	5
Somewhat confident	75	17	50
Confident	13	83	45
After physical exam			
Not confident	12	0	0
Somewhat confident	47	14	25
Confident	41	86	75

EP = emergency physicians; OS = orthopedic surgeons; SMP = sports medicine physicians.

OS, $p = 0.07$). For patellar dislocations, the differences among the groups in the use of immobilization did not reach statistical significance (77% of EPs, 100% of SMPs and 55% of OS, $p = 0.06$). When diagnosis was uncertain, 47% of EPs indicated they would immobilize compared with 14% of SMPs and 25% of OS; this difference was not significant ($p = 0.20$). For a grossly unstable knee, most (41 of 43) respondents would prescribe immobilization ($p = 0.34$). Once having prescribed immobilization, 12 of 15 (80%) EPs and 4 of 6 (67%) SMPs recommend follow-up within 7 days, whereas 7 of 9 (78%) OS recommended follow-up later than 1 week.

Reasons for immobilization

Pain relief and protection of soft tissues was selected as the first or second reason to immobilize by 72% of respondents, regardless of specialty. Conversely, concern for motion loss was selected as the first or second reason not to immobilize by 66% of respondents. No evidence of effectiveness was ranked first or second by 39%.

DISCUSSION

Knee injuries are common presentations to the ED, and decisions regarding immobilization can be difficult. The development of knee stiffness is a potentially devastating consequence for a patient who is treated unnecessarily with prolonged knee immobilization.^{2,4,8-10,23} Motion loss can delay rehabilitation, impair function and delay surgery if it is required.^{9,10} Unfortunately, there are no evidence-based, accepted and specific guidelines regarding the use of knee immobilization after acute soft-tissue knee injury. Therefore, it is not surprising that practice variation was identified in this survey of knee immobilization practices across disciplines.

The results of our survey suggest that for certain injuries, EPs seem more likely to prescribe immobiliza-

tion than SMPs and OS. Given the reported confidence in diagnosis and the thorough physical exams being performed by all groups, it seems unlikely that this difference is due to diagnostic uncertainty. One possible reason for the reported difference is that EPs reportedly assess these patients earlier than SMPs and OS. This is likely a direct result of the access patients have to an ED compared with an SMP or OS in the Canadian health system. The injured knees of these patients are likely in different phases of healing at the time of assessment. Patients presenting to an ED likely have greater pain and functional impairment. This may cause an EP to be more likely to provide treatment in the form of immobilization.

While immobilization of short duration is unlikely to lead to detrimental effects, patients who are prescribed complete immobilization may inadvertently remain immobilized for a longer period of time than intended. This may be the result of waiting for a follow-up appointment, misunderstanding the instructions of the treating physician or loss to follow-up. Whatever the reason, prolonged inadvertent immobilization should be avoided.

As indicated by our results, practice variability is apparent both among and within the different physician groups. For example, even a substantial number of OS reportedly recommend immobilization for injuries, such as ACL injuries and meniscus tears — injuries for which immobilization is not recommended.³³⁻³⁸

Despite the need to consider each subcategory of injury as a unique entity, current evidence suggests that for most acute soft-tissue knee injuries (except grossly unstable knee injuries and patellar dislocations), complete immobilization is not required and its use should be limited.¹¹⁻¹⁶ Some authors suggest hinged knee braces be used to splint knees that are unstable in the coronal plane to provide protection to the healing tissues while allowing motion.^{3,7,9-11}

In light of our results, there is a need for clarification and distribution of current recommendations. This could

Table 2. Percentage of respondents likely to prescribe immobilization, by group

Type of injury	EP		SMP		OS	
	Would immobilize	Would not immobilize	Would immobilize	Would not immobilize	Would immobilize	Would not immobilize
Suspected meniscal injury*	50	50	0	100	5	95
ACL injury*	77	23	29	71	25	75
LCL injury	53	47	0	100	32	68
MCL injury	47	53	14	86	35	65
ACL/MCL injury	77	23	43	57	40	60
Patellar dislocation	77	23	100	0	55	45
Diagnosis uncertain	47	53	14	86	25	75
Grossly unstable knee	100	0	86	14	90	10

ACL = anterior cruciate ligament; EP = emergency physicians; LCL = lateral collateral ligament; MCL = medial collateral ligament; OS = orthopedic surgeons; SMP = sports medicine physicians.
* $p < 0.01$.

be addressed through the development of an evidence-based guideline on the use of knee immobilization. Knowledge translation activities following the development of guidelines may further assist in preventing unnecessary knee immobilization and decreasing practice variation. Such efforts may prove to be a worthwhile and cost-effective endeavour for both our patients and our health care system.

Limitations

Despite robust survey methods, there are limitations associated with our survey. First, reliability and validity testing were not performed. Second, the survey was conducted in a northern Canadian metropolitan centre, and these results may not be generalizable to other Canadian or international centres. The low response rate and local sampling resulted in a small sample size, consequently decreasing the precision of our estimates.

CONCLUSION

We found that EPs were more likely to prescribe immobilization for certain acute soft-tissue knee injuries than SMPs and OS; however, EPs reportedly see patients earlier postinjury than SMPs and OS. The development of an evidenced-based guideline for the use of knee immobilization after acute soft-tissue injury may reduce practice variability.

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Competing interests: All authors designed the study. M. Sommerfeldt, B. Rowe and L. Beaupre acquired and analyzed the data, which M. Bouliane also analyzed. M. Sommerfeldt, B. Rowe and L. Beaupre wrote the article, which all authors reviewed and approved for publication.

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References

1. Hunt PA, Greaves I. Presentation, examination, investigation and early treatment of acute knee injuries. *Trauma* 2004;6:53-66.
2. Kannus P. Immobilization or early mobilization after an acute soft-tissue injury? *Phys Sportsmed* 2000;28:55-63.

3. Woo SL, Vogrin TM, Abramowitch SD. Healing and repair of ligament injuries in the knee. *J Am Acad Orthop Surg* 2000;8:364-72.
4. Kannus P, Parkkari J, Järvinen TLN, et al. Basic science and clinical studies coincide: Active treatment approach is needed after a sports injury. *Scand J Med Sci Sports* 2003;13:150-4.
5. Nash CE, Mickan SM, Del Mar CB, et al. Resting injured limbs delays recovery: a systematic review. *J Fam Pract* 2004;53:706-12.
6. Woo SL, Abramowitch SD, Kilger R, et al. Biomechanics of knee ligaments: injury, healing, and repair. *J Biomech* 2006;39:1-20.
7. Gravlee JR, Van Durme DJ. Braces and splints for musculoskeletal conditions. *Am Fam Physician* 2007;75:342-8.
8. Videman T. Connective tissue and immobilization. *Clin Orthop Relat Res* 1987; (221):26-32.
9. Millett PJ, Wickiewicz TL, Warren RF. Motion loss after ligament injuries to the knee: part I: causes. *Am J Sports Med* 2001;29:664-75.
10. Millett PJ, Wickiewicz TL, Warren RF. Motion loss after ligament injuries to the knee part II: prevention and treatment. *Am J Sports Med* 2001;29:822-8.
11. Woo SL, Inoue M, McGurk-Burleson E, et al. Treatment of the medial collateral ligament injury. II: structure and function of canine knees in response to differing treatment regimens. *Am J Sports Med* 1987;15:22-9.
12. Pforringer W, Beck N, Smasal V. Conservative therapy of ruptures of the medial collateral ligament of the knee. Results of a comparative follow-up study [article in German]. *Sportverletz Sportschaden* 1993;7:13-7.
13. Kerkour K, Meier J, Mansuy J. Rehabilitation of the knee after isolated medial collateral ligament injury. *Schweizerische Zeitschrift für Sportmedizin und Sporttraumatologie* 1997;45:29-33.
14. Phisitkul P, James SL, Wolf BR, et al. MCL injuries of the knee: current concepts review. *Iowa Orthop J* 2006;26:77-90.
15. Miyamoto RG, Bosco JA, Sherman OH. Treatment of medial collateral ligament injuries. *J Am Acad Orthop Surg* 2009;17:152-61.
16. Wijdicks CA, Griffith CJ, Johansen S, et al. Injuries to the medial collateral ligament and associated medial structures of the knee. *J Bone Joint Surg Am* 2010;92:1266-80.
17. Stefancin JJ, Parker RD. First-time traumatic patellar dislocation: asystematic review. *Clin Orthop Relat Res* 2007; (455):93-101.
18. Smith TO, Davies L, Donell ST. Immobilization regime following lateral patellar dislocation: a systematic review and meta-analysis of the current evidence base. *Eur J Trauma Emerg Surg* 2010;36:353-60.
19. Heightman AJ. Articulating knee injuries: placing proper emphasis on the recognition & stabilization of severely dislocated knees. *JEMS* 2004;29:46-55.
20. Lobenhoffer P. Treatment of multiple ligament injuries in the knee. *Orthopade* 2002;31:770-7.
21. Sahai VS, Ward MS, Zmijowskyj T, et al. Quantifying the iceberg effect for injury: using comprehensive community health data. *Can J Public Health* 2005;96:328-32.

22. Jarvinen M, Kannus P, Johnson RJ. How to treat knee ligament injuries? *Ann Chir Gynaecol* 1991;80:134-40.
23. Guse TR, Steiner ME. The importance of motion. *Sports Med Arthrosc Rev* 1996;4:16-25.
24. Patel RV, Haddad FS. Diagnosis and immediate care of soft tissue knee injuries. *Hosp Med* 2002;63:170-1.
25. Perryman JR, Hershman EB. The acute management of soft tissue injuries of the knee. *Orthop Clin North Am* 2002;33:575-85.
26. Brown J. Soft tissue injuries of the knee. *Surgery (Oxford)* 2004;22:40-4.
27. Smith A, Moran C. Soft tissue injuries of the knee. *Surgery* 2006; 24:376-381. (repeat from 26?)
28. Dillman DA. Mail and telephone surveys: the total design method. New York (NY): John Wiley & Sons; 1978.
29. Kitchenham B, Pflieger SL. Principles of survey research: part 5: populations and samples. *SIGSOFT Softw.Eng.Notes* 2002;27:17-20.
30. Kitchenham BA, Pflieger SL. Principles of survey research part 2: Designing a survey. *SIGSOFT Softw.Eng.Notes* 2002;27:18-20.
31. Kitchenham BA, Pflieger SL. Principles of survey research: Part 3: constructing a survey instrument. *SIGSOFT Softw.Eng.Notes* 2002;27:20-4.
32. Kitchenham B, Pflieger SL. Principles of survey research part 4: questionnaire evaluation. *SIGSOFT Softw.Eng.Notes* 2002;27:20-3.
33. Cosgarea AJ, Sebastianelli WJ, DeHaven KE. Prevention of arthrofibrosis after anterior cruciate ligament reconstruction using the central third patellar tendon autograft. *Am J Sports Med* 1995;23:87-92.
34. Bray RC, Smith JA, Eng MK, et al. Vascular response of the meniscus to injury: effects of immobilization. *J Orthop Res* 2001;19:384-90.
35. Beynnon BD, Good L, Risberg MA. The effect of bracing on proprioception of knees with anterior cruciate ligament injury. *J Orthop Sports Phys Ther* 2002;32:11-5.
36. Mayr HO, Weig TG, Plitz W. Arthrofibrosis following ACL reconstruction — reasons and outcome. *Arch Orthop Trauma Surg* 2004;124:518-22.
37. Linko E, Harilainen A, Malmivaara A, et al. Surgical versus conservative interventions for anterior cruciate ligament ruptures in adults. *Cochrane Database Syst Rev* 2005;(2):CD001356.
38. Trees AH, Howe TE, Dixon J, et al. Exercise for treating isolated anterior cruciate ligament injuries in adults. *Cochrane Database Syst Rev* 2005;(4):CD005316.

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