

Survey Study of Members of the Canadian Orthopaedic Association on the Natural History and Treatment of Anterior Cruciate Ligament Injury

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INTRODUCTION

Objective: To describe current preferences and opinions of members of the Canadian Orthopaedic Association (COA) pertaining to anterior cruciate ligament (ACL) reconstruction.

Design: Survey study.

Participants: All orthopedic surgeon members of the COA residing in Canada were invited to participate.

Main Outcome Measures: The primary measure was a survey completed via an Internet-based survey manager. It was composed of 30 questions on the natural history of ACL-injured knees, and surgical and postsurgical treatment choices.

Results: Two hundred eighty-three surgeons (50%) responded to the survey. One hundred forty-four performed ACL reconstruction in the past year. In terms of natural history, the only area of agreement was that hamstring and quadriceps strength affects function in ACL-deficient knees (92%). A majority of surgeons indicated preference for hamstring autograft (73%), transtibial versus anteromedial portal for establishment of the femoral tunnel (70% vs 28%), and promotion of full weight bearing and range of motion immediately after surgery (72% and 75%, respectively). The most frequent surgeon-reported complication was tunnel widening (10%). A greater proportion of high-volume surgeons permitted earlier return to sport ($P < 0.008$).

Conclusions: In the rapidly evolving area of ACL reconstruction, no recent surveys of opinions and preferences of Canadian orthopedic surgeons have been published. In addition to providing information from a Canadian perspective, the findings from this study will allow surgeons to evaluate a range of treatment decisions based on the general opinions of their colleagues and also highlight areas of dissimilarity that can be targeted for more extensive research.

Key Words: ligament, knee, reconstruction, anterior cruciate ligament, survey

(*Clin J Sport Med* 2011;21:249–258)

Submitted for publication October 18, 2010; accepted March 9, 2011.

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The authors report no conflict of interest.

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The natural history of anterior cruciate ligament (ACL) rupture remains controversial as are issues related to surgical management and rehabilitation.^{1–4} With the rapidly evolving nature of ACL injury management, periodic assessment of surgeon attitudes and practice is pertinent.

There are a small number of studies describing surgical practice in the treatment of ACL injury.^{1,5,6} Marx et al¹ surveyed members of the American Academy of Orthopaedic Surgeons (AAOS) in 1998 and 1999 to quantify agreement among American orthopedic surgeons on the natural history and treatment of ACL injury. Variation was seen particularly regarding the following issues: (1) ACL-deficient patients can participate in all recreational sports activities, (2) ACL reconstruction reduces the rate of arthrosis, and (3) the use of braces in the postoperative period is advocated. A more recent survey of the AAOS members conducted in 2006 identified shifts in opinion from the 1998 to 1999 survey.⁷ For example, in 1998 to 1999, bone-patellar tendon-bone (BPTB) autograft was commonly preferred (79%) followed by hamstring tendon autograft (12%) and allografts (8%). In 2006, BPTB was preferred by only 46% of surgeons, hamstring autografts by 32%, and allografts by 22%. These findings emphasize the rapidly evolving nature of ACL injury management.

A less comprehensive survey was conducted among Canadian surgeons 15 years ago with emphasis on general management of patients of different ages (eg, surgery or conservative treatment) and chronic versus acute injury.⁵ Given the dynamic nature of ACL injury management demonstrated in previous survey studies, it seems timely to conduct a detailed and more extensive survey of Canadian surgeons in this area.

The primary goal of our study was to conduct a survey of Canadian orthopaedic surgeons to gain an understanding of preferences and opinions regarding the natural history and treatment of ACL injuries. The secondary goal was to compare our findings with those of previous surveys in both Canada and the United States and to highlight temporal shifts and geographic differences in opinion.

METHODS

Study Subjects

This study received approval from the University of Manitoba Health Research Ethics Board before the

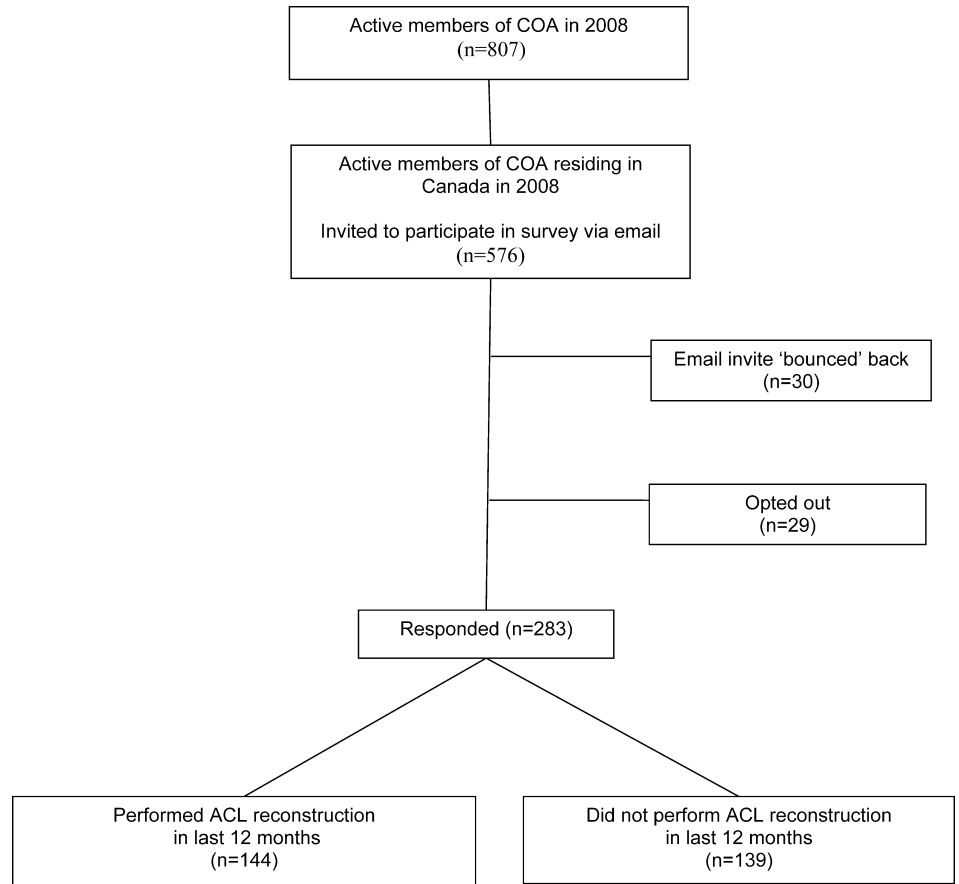


FIGURE 1. Flow diagram of the COA surgeons' response to survey.

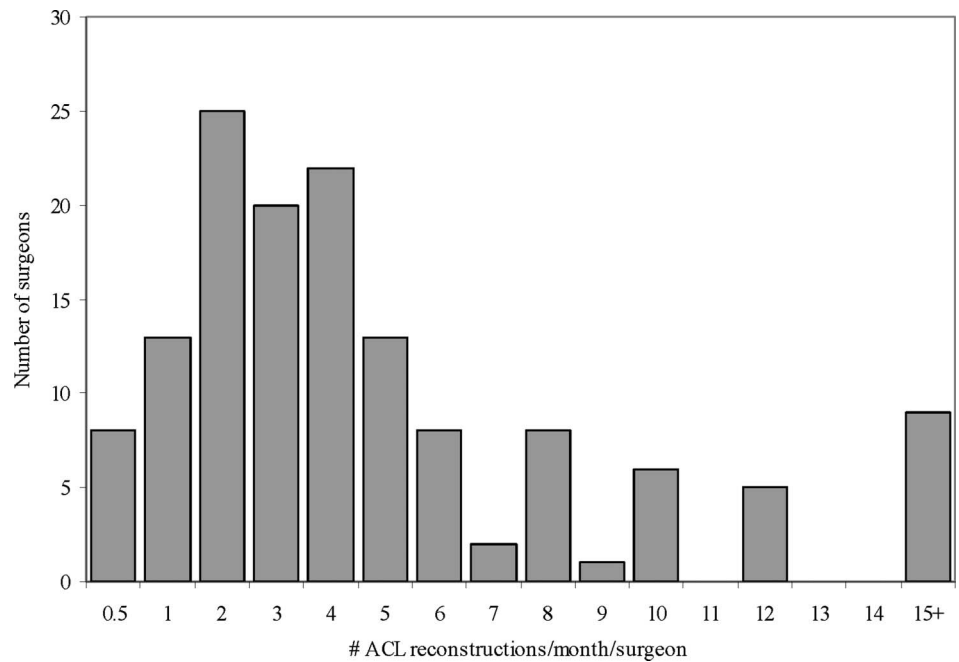


FIGURE 2. Frequency distribution of the number of surgeons performing ACL reconstructions per month.

TABLE 1. Percentage of Surgeons Choosing Each Response on 5-Point Likert Scale Regarding Statements on Natural History and Related Clinical Recommendations

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	P (HV vs LV)
Clinical agreement						
Hamstring and quadricep strength affects function in ACL-deficient knees	0.8 (1)	1.6 (2)	5.6 (7)	60.0 (75)	32.0 (40)	0.469
No clinical agreement						
ACL disruption is associated with increased rate of arthrosis	2.4 (3)	10.3 (13)	11.9 (15)	46.8 (59)	28.6 (36)	0.812
ACL reconstruction reduces the rate of arthrosis in ACL-deficient knees	1.6 (2)	31.2 (39)	29.6 (37)	31.2 (39)	6.4 (8)	0.286
ACL-deficient, ligamentously lax individuals are more symptomatic	0 (0)	14.4 (18)	21.6 (27)	49.6 (62)	14.4 (18.8)	0.130
Patients with ACL-deficient knees who have not had surgery are able to participate in recreational sporting activities	14.4 (18)	52.0 (65)	16.8 (21)	15.2 (19)	1.6 (2)	0.571
Patients awaiting surgery are able to participate in recreational sporting activities	4.8 (6)	36.8 (46)	24.8 (31)	32.0 (40)	1.6 (2)	0.189
Bracing is useful for the ACL-deficient knee treated nonoperatively	1.6 (2)	10.5 (13)	11.3 (14)	66.9 (83)	9.7 (12)	0.383

Values in parentheses indicate the number of respondents.

commencement of any study activities. Of the more than 800 members of the Canadian Orthopaedic Association (COA), all the 576 orthopedic surgeons listed as “active members” and “residing in Canada” were invited to take part in an Internet-based survey.

Survey Design

Expanding on a previously published survey, the current survey comprised 30 questions regarding indications for ACL reconstruction, natural history of ACL-injured knees, surgical technique, and postoperative approach: 19 multiple-choice, 8 requiring numeric or text responses, and 3 containing a series of statements for which respondents indicated agreement or disagreement on a 5-point Likert scale.¹ The survey was trialed on 5 fellowship-trained orthopedic sports medicine surgeons not involved in the study, revised, and distributed.

Survey Distribution

An e-mail invitation was distributed via SurveyMonkey.com (Palo Alto, California) with a link to the survey. Surgeons were asked if they performed ACL reconstruction surgery within the past 12 months. If so, they were asked to complete the remaining survey questions. Reminder e-mails were sent out 1 month and 3 months after the initial e-mail.

Responses were deidentified using study numbers and were kept separate from the names/e-mails of the respondents.

Data Analysis

Frequency distributions were generated for all questions. Questions allowed for multiple responses, so the sum of all response percentages to a question occasionally exceeded 100%. Consistent with Marx et al,¹ a minimum 80% agreement in choice of response was selected a priori as “clinical agreement” for this study. Statistical comparisons of responses were made between “high-volume” (HV) and “low-volume” (LV) ACL surgeons using χ^2 analyses. Based on the number of ACL reconstructions performed per month determined by self-report, the HV group was defined as the fourth quartile of responses or the 25% of surgeons performing the most ACL reconstructions per month. The LV group was represented by the first quartile of responses or the 25% of surgeons performing the least number of ACL reconstructions per month. Significance level for all comparisons was $P < 0.05$.

RESULTS

Respondents

A diagram depicting the outcome of the e-mail invitation to participate in the survey is presented in Figure 1. Two

TABLE 2. Percentage of Surgeons Choosing Each Response on 5-Point Likert Scale Regarding Statements on Positive Factors Influencing the Decision to Proceed With ACL Reconstruction

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	P (HV vs LV)
Clinical agreement						
Giving way with activities of daily living	2.4 (3)	0.8 (1)	1.6 (2)	22.4 (28)	72.8 (91)	0.469
Giving way with sporting activities only	0.8 (1)	1.6 (2)	8.0 (10)	68.0 (85)	21.6 (27)	0.297
High-demand activity	1.6 (2)	0.8 (1)	4.8 (6)	53.6 (67)	39.2 (49)	0.100
Repairable meniscal tear	1.6 (2)	2.4 (3)	10.4 (13)	43.2 (54)	42.4 (53)	0.330
No clinical agreement						
Open growth plates	15.2 (19)	28.0 (35)	24.0 (30)	22.4 (28)	10.4 (13)	0.932
Female sex	7.2 (9)	16.0 (20)	51.2 (64)	22.4 (28)	3.2 (4)	0.710
Recurrent swelling of the knee	2.4 (3)	8.8 (11)	32.0 (40)	43.2 (54)	13.6 (17)	0.744
Older than 40 years	5.6 (7)	20.2 (25)	54.8 (68)	19.4 (24)	0.0 (0)	0.535

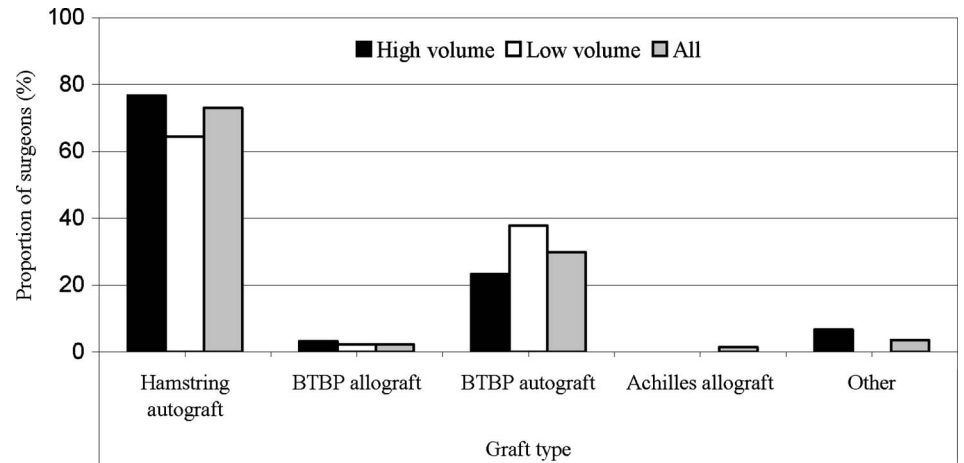


FIGURE 3. Preferred tissue type used for ACL reconstruction.

hundred eighty-three of the 576 COA members (49%) listed as “active” and “residing in Canada” responded to the survey. It is estimated that the COA membership represents approximately 80% of surgeons practicing in Canada (Cynthia Vezina, Manager, Communications & Membership Services, Canadian Orthopaedic Association, oral communication, January 2011). Therefore, the response rate for the current study, based on all orthopedic surgeons in Canada, was an estimated 39%. One hundred forty-four respondents (51%) indicated that they performed ACL reconstruction within the past 12 months, and the remaining 139 (49%) said they did not.

A frequency distribution of surgeons by the number of ACL reconstructions performed per month is presented in Figure 2 with 45 surgeons in the LV group and 32 in the HV group (adjusted to the number of participants most closely representing each quartile). Respondents reported performing a mean of 5.6 ACL reconstructions in the past month (range, 0 to 20) with LV and HV surgeons indicating a mean of 1.4 and 14.4 ACL reconstructions per month, respectively ($P < 0.001$).

Average time spent in surgical practice was 13.2 years, and time spent in surgeons’ current area of practice was 12.4 years. There was no statistical difference in the number of years in current practice between the LV and HV groups ($P = 0.196$).

Natural History

Ratings, from strongly disagree to strongly agree, of a series of statements regarding natural history and related clinical recommendations are presented in Table 1. The criterion for “clinical agreement” was met for only 1 statement with 115 of 125 surgeons (92%) agreeing or strongly agreeing, which was, “hamstring and quadriceps strength affects function in ACL-deficient knees.” No statistical differences were found between the HV and LV groups.

Indications for ACL Reconstruction

Exceeding the threshold for clinical agreement, surgeons agreed or strongly agreed that giving way with activities of daily living (95.2%), giving way with sporting events (89.6%), and high-demand activity (92.8%) were positive factors influencing the decision to perform an ACL reconstruction (Table 2). Eighty-five percent (107 of 125) of surgeons also agreed that

repairable meniscal tear is an indication for surgery. There were no differences between HV and LV groups.

Surgical Technique

Although not at the threshold of “clinical agreement,” a majority of surgeons (100 of 137) indicated preference for hamstring autograft (73%, Figure 3). Bone-patellar tendon-bone autograft was preferred by 41 surgeons (29.9%), and allografts or artificial graft tissue (specified in “Other”) was chosen by 10 (7.3%). There were no differences between HV and LV groups ($P = 0.279$).

The preferred method for ACL reconstruction was single incision chosen by 118 of 137 surgeons (86.1%) representing clinical agreement (Figure 4A). There was no difference between HV and LV groups ($P = 0.163$). There was a range of opinion regarding incorporation of the remnant ACL stump in the reconstruction, with 62 of 137 surgeons (45.3%) indicating they never choose this option, whereas 52 (38%) indicated they sometimes do (Figure 4B). Significantly more HV surgeons indicated “incorporating the ACL stump” than LV surgeons ($P = 0.031$). Eighty-nine surgeons (of 137; 65%) indicated only performing a notchplasty if there is impingement with 31 (22.6%) always performing this technique and 14 (10.2%) never performing this technique (Figure 4C). There was no difference between HV and LV groups with respect to performing a notchplasty ($P = 0.123$).

Seventy-four of 137 respondents (54%) indicated performing a single bundle reconstruction, whereas 56 (41%) and 7 (5%) respondents preferred double bundle-single tunnel and double bundle-double tunnel methods, respectively. In the survey, we did not provide a definition as to what was meant by each of these categories and realize in hindsight that “double bundle-single tunnel” may have been interpreted to mean any of the following: doubled semitendinosus/gracilis (STG) graft into a single tunnel, a quadrupled STG graft into a single tunnel, or a double-bundle STG graft in which each of 2 bundles is independently tensioned and inserted into a single tunnel. Thus, the proportion of respondents for each option described above may not be an accurate representation of surgeon opinion. No differences between HV and LV groups were found ($P = 0.766$).

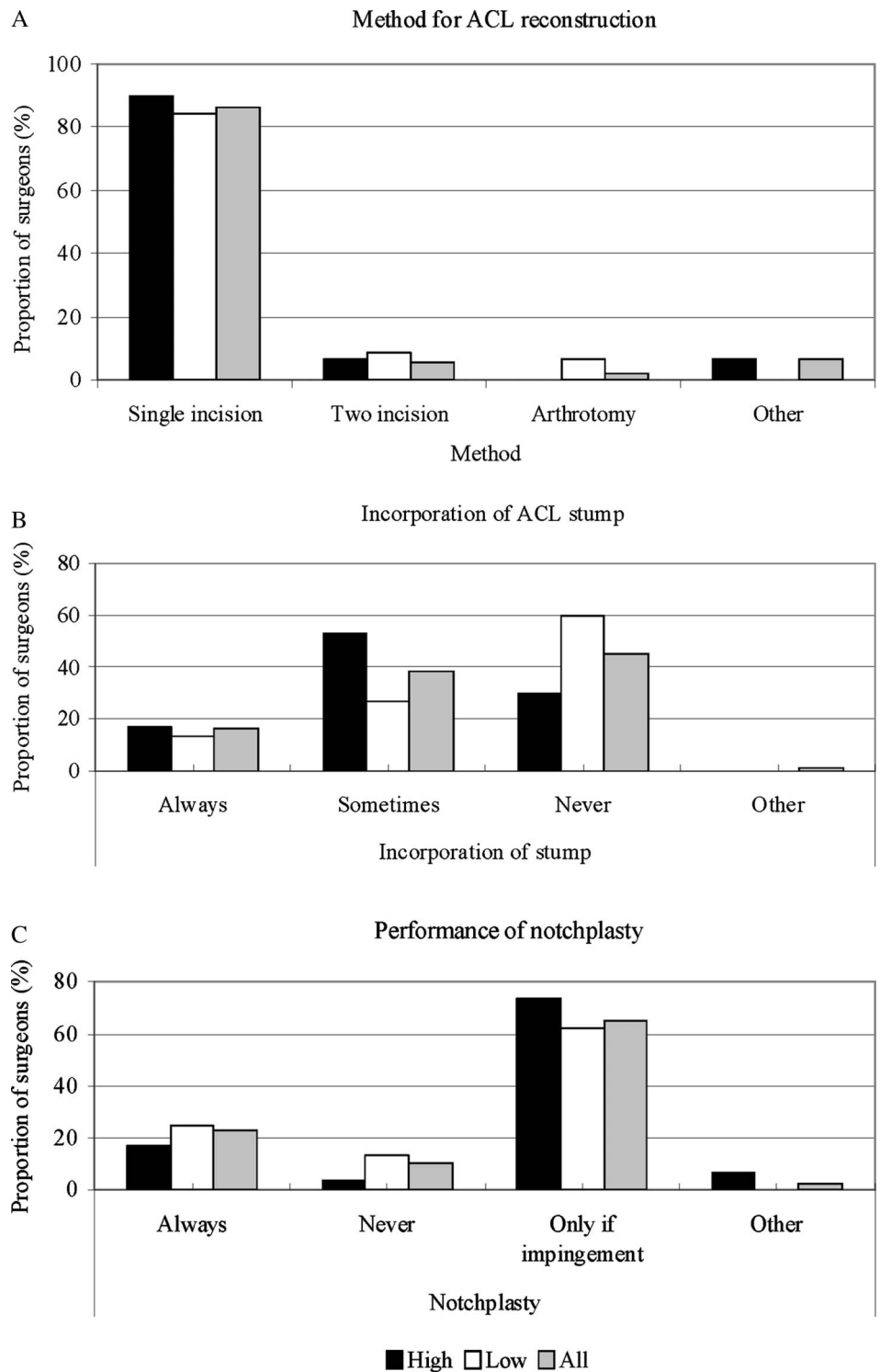


FIGURE 4. Surgical approaches to reconstruction. A, Method for ACL reconstruction. B, Incorporation of ACL stump. C, Performance of notchplasty.

A majority of surgeons preferred transtibial (95 of 136 or 69.6%) versus the anteromedial (38 or 27.9%) portal for the establishment of the femoral tunnel (Figure 5A). Low-volume surgeons were more likely to use the transtibial portal to create the femoral tunnel, whereas HV surgeons used the

anteromedial portal ($P = 0.008$). Selection of position in the notch was evenly divided between 10 o'clock and 11 o'clock (61 and 59 of 136 responses, respectively; Figure 5B).

Suspensory fixation was the preferred method for fixation on the femoral side (70 of 136 or 51.5%; Figure 6A), with 90

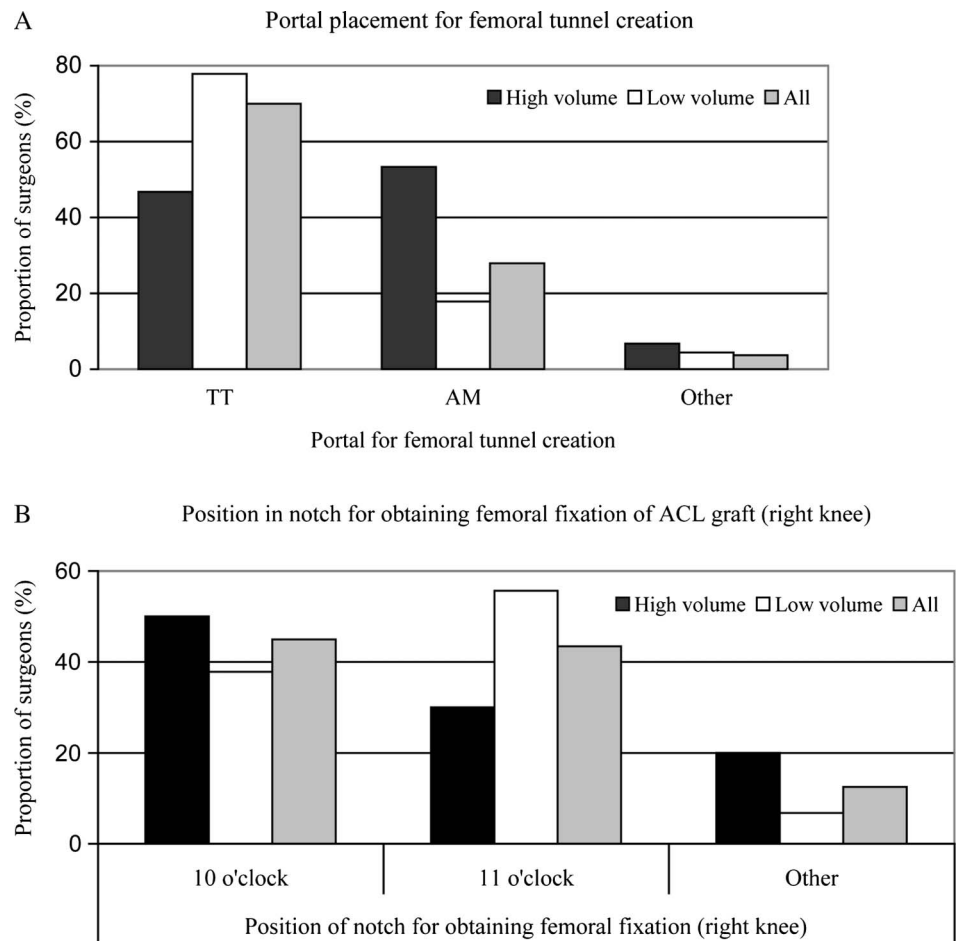


FIGURE 5. Portal placement (A) and position (B) in notch (right knee) for femoral tunnel.

degrees of knee flexion being the position of choice for obtaining graft fixation on the femoral side (82 of 136 surgeons or 60.3%; Figure 6B). For graft fixation on the tibial side, bioabsorbable screw and knee flexion at 30 degrees were the most commonly selected methods [107 of 136 (63.2%) and 54 of 136 (39.7%), respectively; Figures 6C, 6D]. There was no difference between HV and LV groups with respect to femoral or tibial fixation methods ($P = 0.115$ and $P = 0.137$, respectively). Differences between HV and LV surgeons were noted in preferred position of knee flexion for both femoral and tibial fixations ($P = 0.029$ and $P = 0.015$, respectively). Two-thirds (30 of 45) of surgeons in the LV group preferred knee flexion at 90 degrees for femoral fixation. Ninety degrees was most commonly chosen in the HV group but by a smaller proportion (36.7%) of surgeons. “Other” was the most prevalent other option in the HV group (33%). For tibial fixation, 30 degrees and 0 degrees flexion were most commonly chosen by both the LV and HV groups; however, a greater proportion of the LV group preferred 30 degrees, whereas surgeons in the HV group were evenly distributed between the 2 options.

Manual tensioning was most preferred for fixation on the tibial side, by 111 of 136 surgeons (81.6%). High-volume

surgeons were more likely to use a graft tensioner compared with manual tensioning ($P = 0.018$).

Postoperative Protocol

As shown in Figure 7, immediate weight bearing and immediate full range of motion were permitted by a majority of surgeons [98 of 136 (72.1%) and 101 of 136 (74.8%), respectively]. Many surgeons [69 of 135 (51.5%)] did not recommend the use of a postoperative brace or chose the use for less than 6 weeks (42 surgeons or 31.1%; Figure 8A). Sixty-one of 135 surgeons (45.2%) did not recommend the use of a functional brace, whereas 36 surgeons (26.7%) recommended the use for 9 to 12 months (Figure 8B). Duration of recommended physiotherapy was evenly distributed between 6 to 12 weeks and 12 to 24 weeks [52 of 135 (38.5%) for each choice; Figure 9A]. Time allotted until full resumption of sports was most often 6 to 9 months (76 of 135 surgeons or 56.3%; Figure 9B). There were no differences between LV and HV surgeons with respect to weight bearing ($P = 0.196$), range of motion ($P = 0.679$), physiotherapy ($P = 0.327$), or bracing ($P = 0.833$). However, LV surgeons allowed resumption of sports equally at 6 to 9 months or 9 to 12 months, whereas HV surgeons favored return to sport at 6 to 9 months ($P < 0.008$).

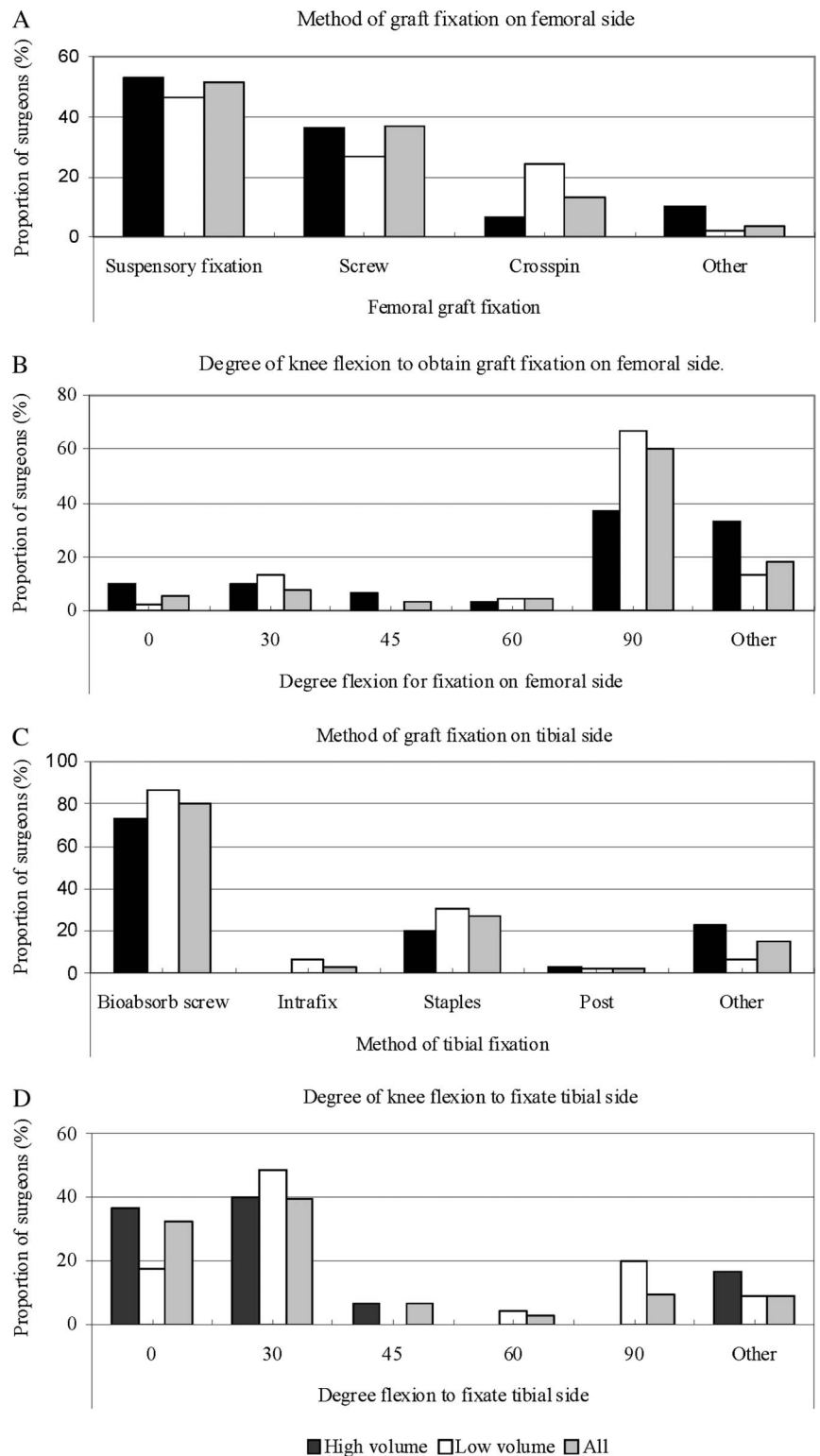


FIGURE 6. Method (A, C) and angle (B, D) of graft fixation on femoral and tibial sides.

Surgeons were also asked to report on their own complications related to ACL reconstruction. Based on 134 responses, surgeons indicated that the proportion of patients to return to previous level of activity was on average 82.3%, with

a failure rate (continued instability or graft failure) of 6.3%. Tunnel widening (9.8%) and graft failure (4.4%) affected the greatest proportion of patients based on 114 responses. There were no differences between HV and LV groups with respect to

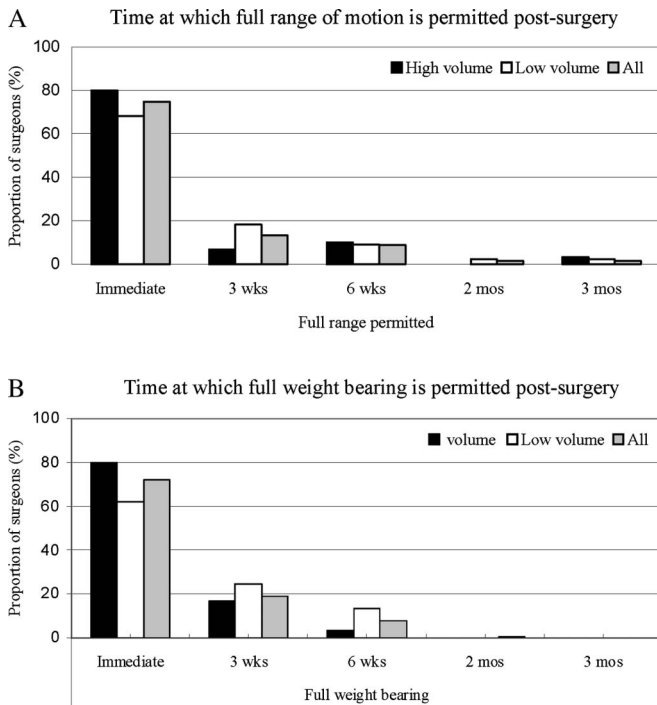


FIGURE 7. Postsurgery range of motion (A) and weight bearing (B) restrictions.

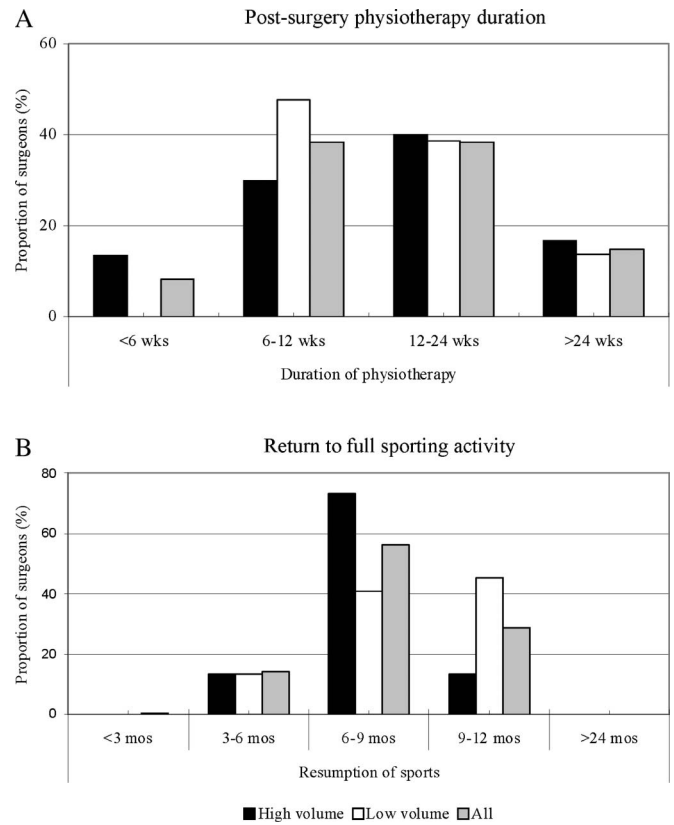


FIGURE 9. Recommended duration of postsurgery physiotherapy (A) and time of return to full sport activity (B).

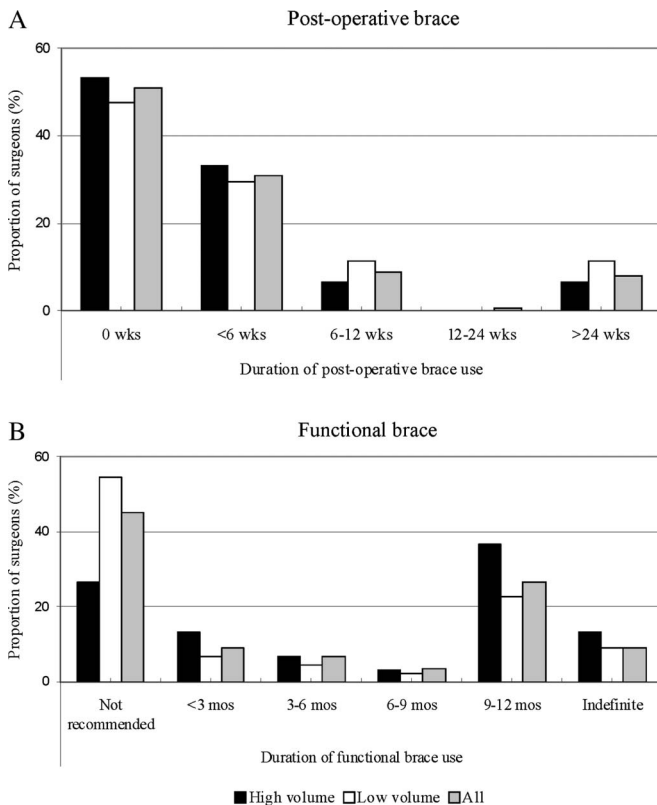


FIGURE 8. Recommended duration of postoperative (A) and functional (B) brace use.

estimated proportion of patients who returned to activity ($P = 0.374$). There was no difference between groups with respect to the estimated proportion of patients impacted by tunnel widening ($P = 0.264$) or graft failure ($P = 0.778$).

DISCUSSION

This study describes areas of agreement and diversity of opinion in ACL reconstruction surgery among active surgeon members of the COA residing in Canada. Clinical agreement thresholds ranging from 60% to 90% have been chosen in previous survey studies with no rationale^{8,9} We chose a minimum 80% agreement in choice of response a priori, as “clinical agreement” consistent with that used in the study of the AAOS members conducted by Marx et al.¹ We agreed that a higher threshold was too severe and that a lower threshold would overstate the number of issues upon which surgeons were in agreement. This threshold is, of course, arbitrary and is only used to highlight areas of consensus. Also, clinical agreement does not imply a good outcome but is simply a representation of what technique the surgeons prefer to use. Responses for 4 indications for ACL reconstruction met our criteria for clinical agreement (giving way with activities of daily living, with sporting events, and with high-demand activity, and having a repairable meniscal tear) (Table 2). These same items were also agreed on by the AAOS members in the previous study conducted by Marx et al.¹ However, in

that same study, the AAOS members indicated that open growth plates, female sex, recurrent swelling, and radiographic evidence of osteoarthritis also influenced their decision to perform ACL reconstruction, whereas the COA members in the current study did not. Surgeons in both the COA and AAOS surveys also agreed that quadriceps and hamstring strength affects function in patients with an ACL-deficient knee.

The current survey was more comprehensive than those conducted previously in that detailed questions regarding surgical technique were included. Clinical agreement was reached with respect to 4 specific techniques: ipsilateral graft harvest, single-incision approach, single-tunnel method, and use of manual tensioning. A notable finding in this study is the preference for using hamstring autograft over BPTB autograft (73% vs 29.9%). This demonstrates a shift from an earlier survey conducted in 1995 in which a sample of COA surgeons indicated a preference for BPTB (63%) over hamstrings (32%).⁵ A shift may also be gradually taking place in the United States, although not as dramatic, with 46% preferring BPTB and 32% preferring hamstrings in 2006 compared with 79.1% BPTB and 12% hamstrings in 1999.^{1,7} Interestingly, this shift occurs in the context of an increasing number of randomized clinical trials and meta-analyses documenting the strengths and limitations of both approaches with no consensus on the merit of choosing one over the other.¹⁰⁻¹³

Use of postoperative and functional bracing following ACL reconstruction remains a controversial issue in the literature, and this is reflected in our findings because approximately half of the surgeons do not recommend bracing, whereas others do, for varying durations. Some studies have found advantages to bracing; however, findings may not be generalizable because braces were often tested in static conditions or in conditions with loading well below normal physiologic conditions.¹⁴ Meanwhile, several studies and reviews conclude that there is no scientific evidence that pain, range of motion, graft stability, or protection from subsequent injury was affected by brace use.¹⁵⁻¹⁸ A focus of ongoing research in other centers on bracing is aimed at identifying particular groups that may benefit from bracing beyond typical use, for example, skiers.¹⁹ As more well-designed studies are conducted in this area, we may see increased consensus on bracing use.

Statistically significant differences between the LV and HV surgeons were identified in some areas. High-volume surgeons favored the implementation of the more recently popularized anteromedial portal to create the femoral tunnel and use of a more aggressive postoperative approach than previously practiced (ie, earlier return to sports). Although there seems to be variations in the surgical technique performed by HV ACL surgeons (eg, ACL stump incorporation, knee angle flexion for femoral fixation), there is no conclusive clinical evidence to support that these particular choices result in improved clinical or biomechanical outcomes.^{20,21}

In previous surveys, results were based only on a random sample of surgeons from the organization of interest (eg, COA, American Shoulder and Elbow Surgeons). In the current study, all members of the largest orthopedic surgery professional association in Canada (eg, COA) meeting study criteria (active and residing in Canada) were invited to participate. A limitation of this

study was that not all active Canadian orthopedic surgeons are members of the COA, introducing the potential for selection bias. As mentioned previously, it is estimated by the COA that their membership represents approximately 80% of surgeons practicing in Canada.⁸ Therefore, we must acknowledge that there may be a lack of generalizability of the current study findings beyond those in the COA. Another limitation of this study was that the overall response rate was 49%, although this rate approximates those of previous surveys in this area.^{1,5,6} Lack of response could have been due to a lack of online computer access or a lack of desire to participate in online surveys. Lack of response may also have been simply due to lack of involvement in ACL injury management.

It is important also to note that this is a self-report survey study and not an observational study. The results are based on surgeons' opinions of what they prefer, but treatment decisions actually made in practice have not been confirmed. Another limitation of this study is that it asks for the surgeon's opinion on each surgical component in isolation of the others. A surgeon's particular preference in 1 surgical technique may maximize positive outcome only when packaged with one or more other specific elements, and this must be taken into account when considering the findings presented herein.

CONCLUSIONS

In the rapidly evolving area of ACL reconstruction, no recent surveys of practices and opinions of orthopedic surgeons have been published. The current survey was more extensive than others conducted to date and invited all practicing orthopedic surgeons who are members of the COA (the largest orthopedic association in Canada) to participate. In addition to providing information from a Canadian perspective, the findings from this study will allow surgeons to evaluate a range of treatment decisions based on the general opinions of their colleagues and also highlight areas of dissimilarity that can be targeted for more extensive research. Surgeons and other health practitioners may also use this information in patient education, advising patients of areas of consensus and areas of uncertainty within Canada, as well as differences in preference between Canada and other countries.

ACKNOWLEDGMENTS

The authors thank the Alexander Gibson Fund at the University of Manitoba and the Pan Am Clinic Foundation for their financial support of this project.

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