

# Deep Venous Thrombosis Prophylaxis in Anterior Cruciate Ligament Reconstructive Surgery: What Is the Current State of Practice?

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**Background:** Venous thromboembolism (VTE) is a significant perioperative risk with many common orthopaedic procedures. Currently, there is no standardized recommendation for the use of VTE prophylaxis during anterior cruciate ligament (ACL) reconstruction. This study sought to evaluate the current prophylactic practices of fellowship-trained sports medicine orthopaedic surgeons in the United States.

**Hypothesis:** Very few surgeons use perioperative VTE prophylaxis for ACL reconstructive surgery.

**Study Design:** Survey.

**Methods:** Surveys were emailed to the alumni networks of 4 large ACGME-accredited sports medicine fellowship programs. Questions were focused on their current use of chemical and nonchemical VTE prophylaxis.

**Results:** Surveys were completed by 142 surgeons in the United States, yielding a response rate of 32%. Of those who responded, 50.7% stated that they routinely use chemical prophylaxis, with 95.5% of those using aspirin (acetylsalicylic acid [ASA]). There was no standardized dosing protocol, with respondents using ASA 325 mg once (46%) or twice daily (26%) or ASA 81 mg once (18%) or twice (10%) daily. The most common reason for not including chemical prophylaxis within the reconstruction procedure was that it is unnecessary given the low risk of VTE. Physicians also based their prophylaxis regimen more on their own clinical experience than concern for litigation.

**Conclusion:** Half of all sports medicine fellowship-trained surgeons surveyed routinely use chemical VTE prophylaxis after ACL reconstruction, with more than 90% of those using ASA. Of those using ASA, there was no prevailing dosing protocol. For those not using chemical prophylaxis, the most important reason was that it was felt to be unnecessary due to the risks outweighing the benefits. Those who do not regularly use chemical prophylaxis would be willing to, however, if a patient had a personal or family history of clotting disorder or is currently on birth control. Additionally, clinical experience was the primary driver for a current prophylaxis protocol.

**Clinical Relevance:** This survey study evaluating the use of VTE prophylaxis with ACL reconstruction lends clinical insight to the current practice of a large, geographically diverse group of fellowship-trained sports medicine orthopaedic surgeons in the United States.

**Keywords:** ACL; anterior cruciate ligament reconstruction; deep venous thrombosis; venous thromboembolism; prophylaxis

**A**nterior cruciate ligament (ACL) ruptures are common knee injuries, especially in athletes. It has been estimated that approximately 250,000 ACL injuries occur per year in the United States.<sup>3</sup> As such, ACL reconstruction is a common

orthopaedic procedure performed in the relatively young and athletic population. As with any procedure, there are risks of perioperative complications with ACL reconstruction, including infection, anesthetic risks, and deep venous thrombosis (DVT).

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Venous thromboembolism (VTE) is a significant perioperative risk with many common orthopaedic procedures.<sup>1,5,8,13</sup> ACL reconstruction carries a risk of developing symptomatic and asymptomatic DVT. A previous systematic review reported the risks of developing asymptomatic DVT, symptomatic DVT, and pulmonary embolism (PE) after ACL reconstruction were 8.4%, 2.3%, and 0.2%, respectively.<sup>5</sup> Janssen et al<sup>8</sup> found the rate of developing symptomatic DVT after ACL reconstruction to be 2.1%; that for PE was only 0.1%. Although this is a relatively low incidence, the morbidity can be significant with VTE. Consequently, surgeons continually weigh the risk of thromboembolic events with potential undesired consequences of chemical DVT prophylaxis, including bleeding and wound complications.

Currently, there is no standardized recommendation for the use of DVT prophylaxis in ACL reconstructive surgery. This study evaluated the current perioperative practices of fellowship-trained sports medicine orthopaedic surgeons throughout the United States. The hypothesis was that very few surgeons use perioperative DVT prophylaxis after ACL reconstructive surgery.

## METHODS

After approval from our institutional review board, an online anonymous survey was developed and emailed to the alumni networks of 4 large ACGME-accredited sports medicine fellowship programs (Kerlan-Jobe Orthopaedic Clinic, the Hospital for Special Surgery, Cleveland Clinic, and Rush University). These 4 alumni networks were chosen because of their long institutional history, large alumni networks, and their geographic diversity, with 1 west coast (California), 1 east coast (New York), and 2 Midwest (Illinois and Ohio) program locations.

Emails were sent directly to the alumni of each program between November and December 2016. The survey (see the appendix, available in the online version of this article) consisted of 12 questions related to DVT prophylaxis and ACL surgery. The first 3 questions were related to demographics and included questions evaluating whether the respondents had Certification of Added Qualifications in sports medicine, how long they had been in practice, and how many ACL reconstructions they perform each year.

Respondents were then asked 9 questions about their current treatment methods with regard to DVT prophylaxis. Questions included the routine use of chemical prophylaxis for ACL reconstruction, type of prophylaxis used, and timing of chemical prophylaxis. Those who routinely gave aspirin for DVT prophylaxis were also asked what dosing protocol they employed. Questions also evaluated nonchemical prophylaxis methods employed, reasons for not using chemical prophylaxis, and whether there are special clinical circumstances in which chemical prophylaxis would be used. Finally, respondents were asked what they have based their treatment regimen on.

Microsoft Excel (Microsoft Corporation) software was used to record survey data and to perform the statistical analysis.

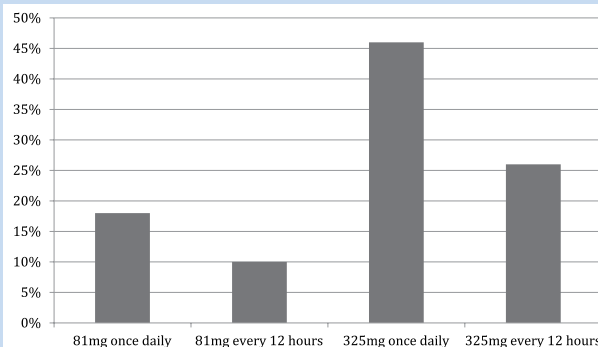


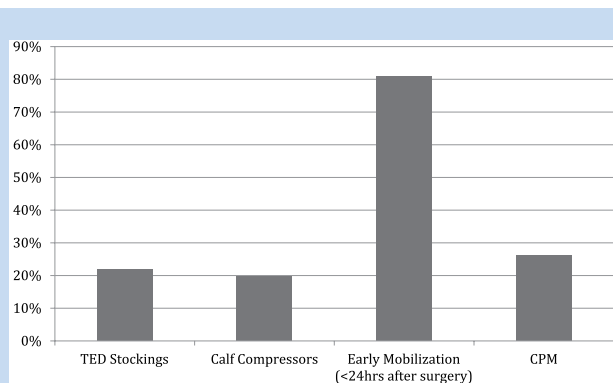
Figure 1. Aspirin-dosing protocol employed by those respondents who use aspirin for deep venous thrombosis prophylaxis.

## RESULTS

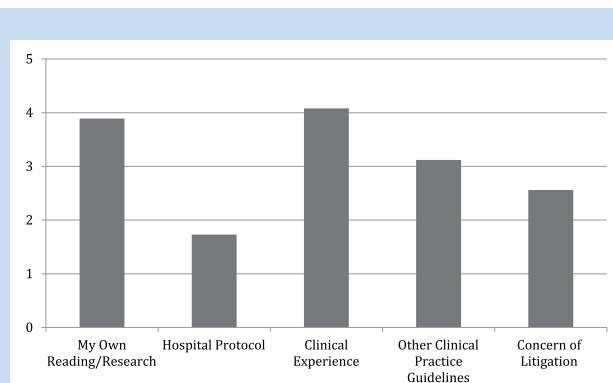
Surveys were sent to 444 surgeons. The survey was completed by a total of 142 surgeons, yielding a response rate of 32%. Of the respondents, 97.2% considered themselves fellowship-trained orthopaedic surgeons, and 57.5% had board certification in sports medicine. The mean number of years in practice after fellowship training was 15.1 years (range, 1–46 years). Of those who responded, 13.4% performed more than 100 ACL reconstructions each year, 28.2% performed between 50 and 100 reconstructions each year, 44.4% performed between 20 and 50 reconstructions each year, and 14% performed between 0 and 20 reconstructions each year.

With regard to DVT prophylaxis, 50.7% of respondents stated that they routinely use chemical prophylaxis. Of those who use chemical prophylaxis, 95.5% use aspirin (acetylsalicylic acid [ASA]), 3.4% use rivaroxaban, and 1.1% use enoxaparin. There was no standardized dosing protocol, with ASA 325 mg being prescribed 1 (46%) or 2 (26%) times daily and ASA 81 mg being prescribed 1 (18%) or 2 (10%) times daily (Figure 1). Those who use chemical prophylaxis were split on when they began chemical therapy, with 50.4% of respondents initiating therapy the day after surgery and 46.2% on the day of surgery. Only 2.5% of surgeons implemented chemical prophylaxis before surgery, and 0.8% stated that they would begin therapy more than 1 day postoperatively. The length of chemical prophylaxis also differed, with 6.9% of respondents stopping chemical prophylaxis when the patient was mobile, 2.5% stopping less than 1 week after surgery, 56% stopping between 1 and 3 weeks postoperatively, and 33.6% stopping after 3 to 6 weeks postoperatively; only 1 respondent recommended ACL reconstruction patients remain on prophylaxis for longer than 6 weeks.

Many physicians used nonchemical DVT prophylaxis methods (Figure 2), with the most common method employed being early mobilization (encouraging activity <24 hours after surgery; 81% of physicians). Other common methods employed included compression stockings (22%), inflatable



**Figure 2. Nonchemical prophylaxis methods used by respondents for deep venous thrombosis. CPM, continuous passive motion.**



**Figure 3. Ranked importance of what physicians base their clinical thromboprophylaxis practice decisions on. Scale: 5 = most important, 1 = least important.**

compression devices (19.6%), and continuous passive motion machines (26%).

The most important reason for not including prophylaxis measures after ACL reconstruction was that it is unnecessary given the low risk of VTE, with a rank of 3.97 out of 5 on the survey scale (1, least important; 5, most important). This was followed closely by mechanical methods being adequate (3.44) and determining prophylaxis to not be safe when evaluating risks/benefits (2.72). Physicians who did not routinely give chemical prophylaxis also responded that they would consider chemical prophylaxis in certain situations, including history of previous blood clot (92.6%); known clotting disorder (87.4%); family history of DVT (47.4%); current use of birth control (44.2%); cancer history (33.7%); obesity (32.6%); smoker (28.4%); age >40 years (20%); concomitant procedures, including posterior cruciate ligament reconstruction, posterior lateral corner reconstruction, and high tibial osteotomy (16.8%); women of childbearing age (12.6%); and corticosteroid use (3.2%).

Physicians strongly favored personal clinical experience and their own reading and research in the decision to use chemical prophylaxis, whereas other clinical practice guidelines, concern for litigation, and hospital protocol ranked much lower (Figure 3).

## DISCUSSION

VTE is a significant perioperative complication occurring after many orthopaedic procedures, especially surgeries involving the knee.<sup>1,2,5,8,13</sup> There is currently no standard recommendation for chemical prophylaxis after ACL reconstruction. This study's findings show that 50% of sports medicine fellowship-trained orthopaedic surgeons in the United States routinely use chemical prophylaxis for perioperative thrombotic risk after ACL reconstruction. The most commonly employed chemical prophylaxis used was ASA, but dosing and length of treatment varied greatly. Furthermore, decision-making for DVT prophylaxis protocols was based predominantly on personal

clinical experience and individual reading/research and less so on fear of litigation or hospital protocols.

The most common reason for not using DVT prophylaxis was that the incidence of VTE was too low to necessitate chemical prophylaxis. Previous studies have evaluated the incidence of VTE after ACL reconstruction with differing results. In the Military Healthcare System database, the incidence of symptomatic VTE after ACL reconstruction was 0.53%.<sup>7</sup> A recently completed systematic review found an incidence rate of DVT of 8.4% (symptomatic and asymptomatic) and PE at 0.2%,<sup>5</sup> and a similar review suggested a total incidence of DVT of 9.7%, symptomatic DVT of 2.1%, and PE of 0.1%.<sup>8</sup> The results of these studies suggest that the rate of DVT is low but not inconsequential. These data suggest that surgeons should continually attempt to evaluate the risk-benefit relationship of chemical prophylaxis and possibly individualize the decision to each patient.

Of those who responded that they were not routinely using chemical prophylaxis, there were specific conditions in which they would modify their use, the most common of these being previous clot, history of clotting disorder, family history of clot, and current use of birth control. A univariate analysis of risk factors of VTE after ACL reconstruction suggested that age >35 years, history of nicotine use, and concomitant high tibial osteotomy or posterior cruciate ligament reconstruction show the greatest risk of VTE.<sup>7</sup> Conversely, the authors found no correlation of risk with sex, body mass index, or race. However, the rate of VTE was significantly greater in those who used tobacco (odds ratio, 1.9;  $P = 0.035$ ).<sup>4</sup> Our results showed only 28.4% of surgeons thought history of tobacco use should necessitate chemical prophylaxis. Similarly, only a small percentage (12.6%-20.0%) of surgeons believe chemical prophylaxis should be added in instances of ACL reconstructions involving concomitant procedures, patient age >40 years, and female sex.

The most common method of chemical prophylaxis (>90% of respondents) was ASA. ASA is an acceptable method of chemoprophylaxis utilized after many different orthopaedic surgeries.<sup>9-11</sup> For example, a 2008 survey of members of the

American Association of Hip and Knee Surgeons showed that approximately 20% of surgeons utilized ASA prophylaxis after total knee arthroplasty, 1 of the highest-risk orthopaedic surgeries for VTE.<sup>11</sup> Although ASA is an accepted method of chemical DVT prophylaxis, its utility with ACL surgery is not well defined.

Clinical experience and self-directed education was the most important factor that drove each individual's current treatment protocol with regard to VTE prophylaxis. Interestingly, concern for litigation was ranked as the most important driving factor by only 8% of surgeons. This again suggests that there are limited information and guidelines regarding prophylaxis after ACL reconstruction to help direct clinical practice.

There are certainly limitations when performing a study of this nature. This survey's content was not previously validated. Another limitation includes a low response rate of 32%. With that said, this rate was similar to that within other published literature.<sup>6,12</sup> Although surveys were sent to alumni networks from large, geographically diverse fellowship programs, this is only a small sample of sports medicine fellowship-trained surgeons in the United States, thus creating the potential for selection bias. As with most survey studies, these data reflect opinions or perceptions of respondents but do give significant information on the current trends among orthopaedic sports surgeons.

## CONCLUSION

Half of all sports medicine fellowship-trained surgeons surveyed routinely use chemical VTE prophylaxis after ACL reconstruction, with more than 90% of those using ASA. Of those using ASA, there was no prevailing dosing protocol. For those not using chemical prophylaxis, the most important reason was that it was felt to be unnecessary due to the risks outweighing the benefits. Those who do not regularly employ chemical prophylaxis would be willing to, however, if the patient had a personal or family history of a clotting disorder or

is currently on birth control. Additionally, clinical experience was the primary driver for current DVT prophylaxis protocols.

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