Geniculate Artery Injury During Primary Total Knee Arthroplasty

Publish date: October 29, 2018
Authors:
Joseph M. Statz, MD Cameron K. Ledford, MD Brian P. Chalmers, MD Michael J. Taunton, MD Tad. M. Mabry, MD and Robert T. Trousdale, MD
Author Affiliation | Disclosures

The authors report no actual or potential conflict of interest in relation to this article.

Address correspondence to: Robert T. Trousdale, MD, Mayo Clinic, 200 First Street SW, Rochester, MN 55905(tel, 507-284-3663; fax, 507-284-8935; email, trousdale.robert@mayo.edu).

Take-Home Points

- During total knee arthroscopy (TKA), 38% of patients will have an injury of a geniculate artery.
- The lateral inferior geniculate artery is most commonly injured, with a rate of injury of 31%.
- The middle geniculate artery is injured 15% of the time.
- The most common time of geniculate artery injury is during bone cutting or removal of the meniscus.
- There is no difference in rate of geniculate artery injury identification with or without the use of a tourniquet.

Major arterial injury associated with total knee arthroplasty (TKA) is a rare and potentially devastating complication. The majority of literature in this context consists of case reports, small case series, and large retrospective studies that have examined the type, location, and mechanism of injury present in these cases. Reported arterial injuries include occlusion, laceration, aneurysm, pseudoaneurysm, and arteriovenous fistula formation in the femoral (believed to be due to the tourniquet around the proximal thigh) and popliteal arteries causing combinations of ischemia and hemorrhage necessitating treatment ranging from endovascular arterial intervention to amputation. In addition, several studies have asserted that the risk of major arterial injury may be increased with tourniquet use, suggesting that tourniquet use should be minimized for routine primary TKAs.

There are very few cases in the literature specifically addressing injury to the more commonly encountered geniculate arteries (GAs). The medial GAs are typically visualized and coagulated during the standard medial parapatellar approach. In addition, if performed, a lateral release can damage the lateral superior and inferior GAs and the middle GA can be cut with posterior cruciate ligament resection. However, the middle and lateral inferior GAs are anecdotally the most difficult to detect and treat intraoperatively, especially after implantation of TKA and deflation of the tourniquet. The potential lack of recognition of such GA injury can result in harmful sequelae, including ischemia of the patella, hemorrhage, and painful pseudoaneurysms. Currently, there are only 2 case reports of lateral inferior GA injury, 2 cases of medial inferior GA injury, and no reports of middle GA injury.
The rate, the timing within surgery, the risk factors, including tourniquet use, and the clinical effects of GA injury are largely unknown. If these factors were better understood, prophylactic measures and/or awareness could be better applied to prevent adverse outcomes, especially in cases of the middle and lateral inferior GAs. The aims of this study are to elucidate the rate and timing of middle and lateral inferior GA injury during primary TKA; determine the factors related to injury, including intraoperative blood loss, postoperative drain output, and tranexamic (TXA) acid use; and investigate any differences in the rate of injury with and without the use of a tourniquet.

Materials and Methods

Patient Demographics and Surgical Technique

From November 2015 to February 2016, 3 surgeons (MJT, TMM, and RTT) at a single institution performed 100 consecutive unilateral primary TKAs and documented the presence or absence and the timing of GA injury. After obtaining approval from our Institutional Review Board, a retrospective study was performed to investigate the prospectively recorded rate of middle and lateral inferior GA injuries occurring during primary TKAs. Patients with a diagnosis of isolated osteoarthritis were included, and those with any previous surgery on the operative knee were excluded. The average age of patients at the time of surgery was 67 years (range, 25-91 years), the average body mass index was 33 kg/m$^2$ (range, 18-54 kg/m$^2$), and there were 63 (63%) female patients.

All TKAs were performed through a medial parapatellar approach with a posterior-stabilized, cemented design, and each patient received a postoperative surgical drain. One of the 3 lead surgeons (TMM) in this study used a tourniquet from the time of incision until the completion of cementation, and the other 2 (MJT and RTT) predominantly used the tourniquet only during cementation. To elucidate any differences in GA injury between these 2 methods of tourniquet use, the patients were categorized into 2 groups based on tourniquet use. Group 1 included patients in whom a tourniquet was used to maintain a bloodless surgical field from the time of incision until the completion of cementation, and Group 2 included patients in whom tourniquet use was more selective (ie, applied only during cementation). Group 1 comprised 31% (31/100) of patients, while Group 2 comprised 67% (67/100) of patients; no tourniquet was used in 2% (2/100) of cases. In addition, TXA was used in 98% (98/100) of patients: 84 patients received intravenous (IV) and 14 received topical TXA administration.

Analysis of Geniculate Artery Injury

The senior authors critically evaluated the GA during the primary TKAs and documented the presence or absence of injury in the operative reports. GA injury was reported if there was intraoperative visualization of pulsatile bleeding or visualization of arterial lumen in the anatomic areas of the middle and lateral inferior GAs. At 3 separate occasions during the operation, the surgeon looked specifically for pulsatile bleeding or arterial lumen in the areas of the middle and lateral inferior GAs, including after all the femoral and tibial bone cuts were completed, immediately before preparing to cement (before the tourniquet was inflated if there was not one inflated from the start of the procedure), and immediately after the tourniquet was deflated (Figure 1). All bleeding GAs that were visualized were effectively coagulated by cautery. Details regarding the use of TXA (topical or IV), intraoperative blood loss, postsurgical drain output for 24 hours after surgery, and blood transfusion were collected from the patients’ medical records (Table 1).
Statistical Methods

Statistical analysis was performed using the JMP software version 10.0.0 (SAS Institute, Inc). The overall rate of GA injury was determined, including the rates of GA injury based on location, time point, and method of diagnosis (pulsatile bleeding or arterial lumen visualization). If >1 GA injury occurred in the same knee, only 1 GA injury was calculated for the overall rate; however, each injury was specified separately when calculating the injury rate for the specific GA. Intraoperative blood loss, postoperative drain output, and the use of TXA were compared between cases in which a GA injury was detected and those in which it was not detected. Before conducting the retrospective review, a power analysis determined that we would require 100 patients to detect a difference in GA injury between Groups 1 and 2 (33 in Group 1 and 67 in Group 2), assuming a 30% rate in Group 1 and a 5% rate of GA injury in Group 2 using Fisher’s exact test. The Fisher’s exact test was used to compare categorical variables, and the Wilcoxon rank sum test was used to compare continuous variables. An alpha value of .05 was considered as statistically significant.

Results

Rate of Geniculate Artery Injury

The overall rate of any GA injury was 38% (38/100). Lateral inferior GA injury was more frequently detected than middle GA injury (31% vs 15% of TKAs, respectively; Table 2). Among the 31 lateral inferior GA injuries, 14 were identified as pulsatile bleeding, 7 as lumen visualizations, and 6 as both pulsatile bleeding and lumen visualization; 4 were detected by methods not recorded in the operative report. Of the lateral inferior GA injuries, 11 were identified after the bone cuts, 7 during meniscus removal, 3 during exposure, 1 after tourniquet deflation, and 9 at a time not recorded in the operative report. Of the 15 middle GA injuries, 9 were identified as pulsatile bleeding, 2 as lumen visualizations, and 4 as both pulsatile bleeding and lumen visualization. In addition, 7 of these GA injuries were identified after the bone cuts, 3 during cruciate removal, 1 after meniscus removal, 1 during exposure, and 3 at a time not recorded in the operative report (Table 3).

Factors Associated with Geniculate Artery Injury

Mean intraoperative estimated blood loss was 186 mL (standard deviation [SD], 111; range 50–500 mL) in those with a GA injury versus 147 mL (range, 82.25–400 mL) in those without injury (P = .14). Postoperative drain output in the 24 hours after surgery was 467 mL (SD 253, range 100–1105 mL) versus 502 mL (SD 378, range 75–1980 mL) in TKAs with and without GA injury, respectively (P = .82). Total estimated blood loss (combined intraoperative blood loss and 24-hour postoperative drain output) was 613 mL (SD 252, range 150–1105 mL) in TKAs with GA injury versus 620 mL (SD 393, range 75–2130 mL) without injury (P = .44) (Table 4). Overall, there was no statistical difference in blood loss, drain output, or combined output when analyzed according to lateral inferior or middle GA injury (P = .24-.82) (Table 5 and Table 6). No patients required blood transfusion postoperatively after TKA.

IV administration of TXA was associated with a 37% (31/84) rate of GA injury, whereas topical TXA administration was associated with a 43% (6/14) rate of GA injury (P = .77). The rate of overall or isolated GA injury was not significantly different (P = .35–1.0) between IV and topical TXA administration (Table 7). In addition, total combined output was not significantly different (P = .1032) when comparing GA injury and noninjury in the subgroup analysis based on TXA use (IV or topical); however, topical administration was associated with lower intraoperative blood loss than IV administration (P = .0489), whereas IV administration was associated with lower
24-hour postoperative drain output than topical administration ($P = .0169$). There was no difference in blood loss, 24-hour drain output, or total output between those who did and did not sustain a GA injury in the group of patients who received IV TXA administration (Table 8, $P = .2118-.7091$). The same was true for those receiving topical TXA administration (Table 9, $P = .0912-.9485$).

**Tourniquet Use**

Comparison between Groups 1 (tourniquet use) and 2 (selective tourniquet use) revealed similar rates of overall and specific GA injury, intraoperative blood loss, and 24-hour postoperative drain output (Table 10). Group 1 demonstrated a 29% (9/31) rate of any GA injury versus 40% (27/67) in Group 2 ($P = .37$). For the specific lateral inferior GA injury, there was an equivalent rate of injury at 29% (9/31 in Group 1, 20/67 in Group 2; $P = 1.0$). Similarly, Group 1 patients had a 10% (3/31) rate of middle GA injury compared to 16% (11/67) in Group 2 patients ($P = .53$). Intraoperative estimated blood loss was lower in Group 1 (140 mL; range 25–400 mL) than in Group 2 (171 mL; range 40–500 mL) ($P = .07$), whereas the average 24-hour postoperative drain output was similar for Groups 1 (484 mL; range 75–1800 mL) and 2 (488 mL; range 100–1980 mL) ($P = .46$). Total estimated output was slightly less for Group 1 (593 mL; range 75–1900 mL) than for Group 2 (626 mL; range 125–1310 mL) ($P = .38$). A post hoc power analysis showed that with these rates of GA injury in Groups 1 and 2 and given a 2:1 ratio of the number of patients in Group 2 versus Group 1, a total of 185 patients in Group 1 and 370 patients in Group 2 would be needed to detect a statistically significant difference ($P < .05$) with a power of 80%.

**Discussion**

Major arterial injury associated with TKA is a well-known, rare, and potentially devastating complication. However, the rate of injury to smaller periarticular vessels and the clinical significance of such injury have not been studied. The present study found a high rate of GA injury but no clinically significant difference in intraoperative blood loss or postoperative drain output between patients with GA injury (which was identified and managed with cautery) and those without GA injury. In addition, tourniquet use did not affect the rate of injury or the associated blood loss. To our knowledge, this is the first study that has critically evaluated the rate of GA injury occurring during TKA.

The overall rate of GA injury occurring during primary TKA was 38% with a higher predominance of lateral inferior than middle GA injury (31% vs 15%). Anatomically, it would follow that the lateral GA could be injured at a higher rate as it courses on top of the lateral meniscus, thus being susceptible to injury during cutting of the tibial plateau and meniscectomy. In addition, because the meniscectomy is performed longitudinally along the course of the artery, it may also be potentially lacerated in multiple locations and lengthwise. In theory, there should be a 100% rate of middle GA injury during posterior-stabilized TKA as this artery runs through the cruciate ligaments, which are resected during these cases. However, vessel injury was defined in this study as the visualization of pulsatile bleeding or vessel lumen. It is probable that in the cases in which injury to the middle GA was not visualized, it was cut but simultaneously cauterized. Thus, a lower rate (15%) of injury was detected. Nonetheless, these results still suggest that these periarticular arteries are injured at a higher rate; therefore, it is important for surgeons to specifically identify these injuries intraoperatively and adequately cauterize these vessels. As long as these arteries are cauterized, additional blood loss and potential vascular pseudoaneurysms should be prevented.

The effect of GA injury on intraoperative blood loss, 24-hour postoperative drain output, and total estimated blood loss showed no significant clinical findings in the present study cohort. In addition, examining the injury rate and blood loss based on TXA use also revealed no detrimental clinical associations. Although GA injury could...
Inherently be associated with higher levels of blood loss and drain output, it is important to note that all GA injuries were also effectively coagulated, thus explaining the indifferent results. Accordingly, it should be recommended to surgeons performing primary TKAs to carefully evaluate for GA injury to prevent excessive blood loss or painful pseudoaneurysms. However, there is also a potential for beta error in this study in which a true difference did exist but no statistical difference was found due to the study being underpowered.

Full or selective tourniquet use during TKA did not appear to have any effect on the rate of GA injury, intraoperative blood loss, or 24-hour postoperative drain output. The similarity between GA injury rates perhaps further indicates an equivalent ability to detect these injuries between these two methods because of operative inspection for such injuries. With regard to intraoperative blood loss and drain output, the present findings are similar to previous studies demonstrating equivocal results despite variable tourniquet utilization in TKA.\textsuperscript{15,30} However, these results differ from those of Harvey and colleagues\textsuperscript{31}, who demonstrated that blood loss inversely correlated with intraoperative tourniquet time. There are risks and benefits related to the use of both full and selective tourniquet methods, but either method does not appear to be advantageous in decreasing the rate of GA injury.

Although this is the first study to investigate the rates of GA injury and the potential clinical effects, there are limitations to this research. First, the study was retrospective in nature despite the fact that the data were collected prospectively. Only acute perioperative follow-up was performed, and thus, we were unable to evaluate longer term effects of GA injury on TKA outcomes. Furthermore, this study is potentially prone to beta error. As discussed above, 185 patients in Group 1 and 370 patients in Group 2 would be needed to detect a statistical difference in the rate of GA injury based on the rates found in this study. This study could also have been underpowered to identify differences in other aspects, such as differences in blood loss and drain. Furthermore, the data collected regarding intraoperative blood loss are estimated data and can be variable. Finally, visualization of vessel lumen and pulsatile bleeding is not a validated method to diagnose GA injuries, and potential injuries may have been missed. Despite such disadvantages, the strengths of this study include the concise results in consecutive patients, the generalizability of the data as multiple surgeons participated, and its first report of nonmajor periarticular artery injury.

**Conclusions**

There is a relatively high rate of GA injury, with injury to the lateral GA being visualized more often than injury to the middle GA. The majority of GA injuries occur around the time of bone cuts and meniscectomy, and tourniquet use does not affect the rate of injury. To reduce intraoperative blood loss and postoperative drain output, surgeons should identify and coagulate GA injuries routinely during primary TKA.

**Key Info**

**Figures/Tables**

Figures / Tables:
Table 1. Operative Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number</td>
<td>100 (100%)</td>
</tr>
<tr>
<td>Intraoperative blood loss (mL)</td>
<td>160 (25-500)</td>
</tr>
<tr>
<td>Drain output 1st 24 hours (mL)</td>
<td>488 (75-1980)</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>618 (75-2130)</td>
</tr>
<tr>
<td>Use of TXA</td>
<td>98 (98%)</td>
</tr>
<tr>
<td>Topical TXA</td>
<td>84 (84%)</td>
</tr>
<tr>
<td>IV TXA</td>
<td>14 (14%)</td>
</tr>
<tr>
<td>Tourniquet entire procedure</td>
<td>31 (31%)</td>
</tr>
</tbody>
</table>

Operative variables other than geniculate artery injury. Data presented as mean (range) or n (%). TXA = tranexamic acid.

Table 2. Rates of Geniculate Artery Injury Based on Location and Method

<table>
<thead>
<tr>
<th>Location</th>
<th>Pulsatile Bleeding</th>
<th>Arterial Lumen</th>
<th>Both</th>
<th>Overall Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral inferior GA</td>
<td>14 (14%)</td>
<td>7 (7%)</td>
<td>6 (6%)</td>
<td>31 (31%)</td>
</tr>
<tr>
<td>Middle GA</td>
<td>9 (9%)</td>
<td>2 (2%)</td>
<td>4 (4%)</td>
<td>15 (15%)</td>
</tr>
</tbody>
</table>

Rates of geniculate artery injury based on location and method of diagnosis. Data presented as n (%). There were 4 additional lateral inferior and 9 middle GA injuries identified by a method not specified in the operative report. GA = geniculate artery.
Table 3. Rates of Geniculate Artery Injury Based on Time Point

<table>
<thead>
<tr>
<th>Time</th>
<th>Lateral Inferior GA</th>
<th>Middle GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>After bone cuts</td>
<td>11 (11%)</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>During meniscus removal</td>
<td>7 (7%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>During exposure</td>
<td>3 (3%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>After tourniquet deflation</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>During cruciate removal</td>
<td>0 (0%)</td>
<td>3 (3%)</td>
</tr>
<tr>
<td>Not reported</td>
<td>9 (9%)</td>
<td>3 (3%)</td>
</tr>
</tbody>
</table>

Rates of geniculate artery injury based on time point and method of diagnosis. GA = geniculate artery. Data presented as n (%).

Table 4. Factors Associated with GA Injury

<table>
<thead>
<tr>
<th>Outcome</th>
<th>GA Injury</th>
<th>No GA Injury</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>186 (50-500)</td>
<td>147 (25-400)</td>
<td>.1366</td>
</tr>
<tr>
<td>24-Hour drain output (mL)</td>
<td>467 (100-1105)</td>
<td>502 (75-1980)</td>
<td>.8240</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>613 (150-1105)</td>
<td>620 (75-2130)</td>
<td>.4368</td>
</tr>
</tbody>
</table>

Differences in outcomes based on presence or absence of GA injury. Note that there were no significant differences. Values are reported as average (range). GA = geniculate artery.

Table 5. Factors Associated with LIGA Injury

<table>
<thead>
<tr>
<th>Outcome</th>
<th>LIGA Injury</th>
<th>No LIGA Injury</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>178 (50-400)</td>
<td>153 (25-500)</td>
<td>.2401</td>
</tr>
<tr>
<td>24-Hour drain output (mL)</td>
<td>461 (100-890)</td>
<td>501 (75-1980)</td>
<td>.8187</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>610 (150-1080)</td>
<td>621 (75-2130)</td>
<td>.4165</td>
</tr>
</tbody>
</table>

Differences in outcomes based on presence or absence of LIGA injury. Note that there were no significant differences. Values are reported as average (range). LIGA = lateral inferior geniculate artery.

Table 6. Factors Associated with MGA Injury

<table>
<thead>
<tr>
<th>Outcome</th>
<th>MGA Injury</th>
<th>No MGA Injury</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>190 (75-500)</td>
<td>156 (25-400)</td>
<td>.6225</td>
</tr>
<tr>
<td>24-Hour drain output (mL)</td>
<td>455 (125-1105)</td>
<td>494 (75-1980)</td>
<td>.6428</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>582 (200-1105)</td>
<td>624 (75-2130)</td>
<td>.6535</td>
</tr>
</tbody>
</table>

Differences in outcomes based on presence or absence of MGA injury. Note that there were no significant differences. Values are reported as average (range). MGA = middle geniculate artery.

Table 7. Factors Associated with TXA Injury

<table>
<thead>
<tr>
<th>Outcome</th>
<th>IV TXA (n = 84)</th>
<th>Topical TXA (n = 14)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any GA injury</td>
<td>31 (37%)</td>
<td>6 (43%)</td>
<td>.7683</td>
</tr>
<tr>
<td>LIGA injury</td>
<td>24 (29%)</td>
<td>6 (43%)</td>
<td>.3498</td>
</tr>
<tr>
<td>MGA injury</td>
<td>13 (15%)</td>
<td>2 (14%)</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Blood loss (mL)  170 (25-500)  113 (40-240)  .0489*
24-Hour drain output (mL)  454 (75-1980)  662 (75-1800)  .0169*
Total output (mL)  592 (75-2130)  751 (75-2130)  1032

Differences in outcomes based on presence or absence of MGA injury. Note that there were no significant differences. Values are reported as n (%) or average (range). TXA = tranexamic acid, GA = geniculate artery, LIGA = lateral inferior geniculate artery, MGA = middle geniculate artery. *denotes statistical significance (P < .05).

<table>
<thead>
<tr>
<th>Outcome</th>
<th>GA Injury</th>
<th>No GA Injury</th>
<th>Difference</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>195 (50-500)</td>
<td>157 (25-400)</td>
<td>38</td>
<td>.2118</td>
</tr>
<tr>
<td>24-Hour drain output (mL)</td>
<td>436 (100-1105)</td>
<td>464 (75-1980)</td>
<td>28</td>
<td>.7091</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>594 (150-1105)</td>
<td>592 (75-2130)</td>
<td>2</td>
<td>.6982</td>
</tr>
</tbody>
</table>

Differences in outcomes of those patients who received IV TXA based on presence or absence of GA injury. Note that there were no significant differences. Values are reported as average (range). GA = geniculate artery, TXA = tranexamic acid.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>GA Injury</th>
<th>No GA Injury</th>
<th>Difference</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>163 (100-250)</td>
<td>84 (40-150)</td>
<td>79</td>
<td>.0912</td>
</tr>
<tr>
<td>24-Hour drain output (mL)</td>
<td>610 (205-890)</td>
<td>701 (415-1800)</td>
<td>91</td>
<td>.9485</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>719 (405-960)</td>
<td>775 (455-1900)</td>
<td>56</td>
<td>.6982</td>
</tr>
</tbody>
</table>

Differences in outcomes based on presence or absence of GA injury. Note that there were no significant differences. Values are reported as average (range). GA = geniculate artery.

<table>
<thead>
<tr>
<th>Injury</th>
<th>Group 1 (n = 31)</th>
<th>Group 2 (n = 67)</th>
<th>Difference</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall GA injury</td>
<td>9 (29%)</td>
<td>27 (40%)</td>
<td>11%</td>
<td>.3687</td>
</tr>
<tr>
<td>Lateral inferior GA</td>
<td>9 (29%)</td>
<td>20 (29%)</td>
<td>0%</td>
<td>1.0</td>
</tr>
<tr>
<td>Middle GA</td>
<td>3 (10%)</td>
<td>11 (16%)</td>
<td>6%</td>
<td>.5382</td>
</tr>
<tr>
<td>Blood loss (mL)</td>
<td>140 (25-400)</td>
<td>171 (40-500)</td>
<td>31</td>
<td>.0661</td>
</tr>
<tr>
<td>24-Hour drain output (mL)</td>
<td>484 (75-1800)</td>
<td>488 (100-1980)</td>
<td>4</td>
<td>.4580</td>
</tr>
<tr>
<td>Total output (mL)</td>
<td>593 (75-1900)</td>
<td>626 (125-2130)</td>
<td>33</td>
<td>.3776</td>
</tr>
</tbody>
</table>

Differences in outcomes separated based on use of a tourniquet for the entire case (Group 1) vs use of a tourniquet only during cementation (Group 2). Note that there were no significant differences. Values are reported as n (%) or average (range). GA = geniculate artery.
References


29. Sharma H, Singh GK, Cavanagh SP, Kay D. Pseudoaneurysm of the inferior medial geniculate artery following primary total knee arthroplasty: delayed presentation with recurrent haemorrhagic episodes.


**Multimedia**

**Product Guide**

- STRATAFIX™ Symmetric PDS™ Plus Knotless Tissue Control Device
- STRATAFIX™ Spiral Knotless Tissue Control Device
- BioComposite SwiveLock Anchor
- BioComposite SwiveLock C, with White/Black TigerTape™ Loop

**Citation**

Joseph M. Statz, MD Cameron K. Ledford, MD Brian P. Chalmers, MD Michael J. Taunton, MD Tad. M. Mabry, MD and Robert T. Trousdale, MD . Geniculate Artery Injury During Primary Total Knee Arthroplasty. Am J Orthop. Publish date: October 29, 2018

Joseph M. Statz, MD