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Vascular supply at risk during lateral release of the patella during total knee arthroplasty: A cadaveric study

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ABSTRACT

Introduction: Lateral release to improve patellar tracking is commonly performed during total knee arthroplasty. Blood is supplied to the lateral patella by two main arteries: the superior and inferior lateral genicular arteries. The transverse infrapatellar artery also branches off the lateral inferior genicular artery to supply the inferior half of the patella. Severance of any of these arteries during lateral release can lead to avascular necrosis of the patella. This cadaveric study investigates the lateral vasculature to the patella and whether it can be visualized and preserved during lateral release of the patella.
Materials and methods: This study involved ten cadavers, each of which underwent lateral release of the patella. One senior joint surgeon performed and supervised the incisions and attempted to locate and preserve these vessels. We then quantified the number of cadavers with visualized blood vessels and analysed their location and course to determine whether they could be preserved during lateral release of the patella.
Results: In our study, three of the ten cadavers had an artery that was visible within the incisional plane and preserved. Two were the inferior lateral genicular artery, and one was the superior lateral genicular artery. In the other seven cadavers, no vessels were visualized during the lateral dissection.
Conclusions: These results demonstrate that it is difficult to visualize blood supply to the patella during lateral release. Every attempt should be made to preserve these blood vessels to avoid devascularization to patella in the setting of an already severed medial vascularity due to standard approach to knee replacement.

1. Introduction

The patella is vascularized by a highly anastomotic ring that is supplied by five genicular arteries (inferior medial, inferior lateral, superior lateral, superior medial and middle) and the anterior tibial recurrent artery.[1] The infrapatellar fat pad (of Hoffa) is situated in the anterior compartment of the knee joint, just inferior and posterior to the patella. It is home to a network of anastomoses that contributes to the blood supply of the patella and its surrounding structures. This includes a vertical connection between the superior and inferior genicular arteries on the medial and lateral side of the patella as well as an anastomosis between the anterior tibial recurrent artery and the lateral vertical artery. The two vertical arteries are connected by two to three small horizontal vessels that, along with the transverse infrapatellar vessels arising from the inferior lateral genicular artery, also supply the inferior portion of the patella. This complex network of anastomoses is clinically important as the infrapatellar fat pad is often disrupted during surgery when accessing the knee joint, dissecting for increased visibility, and when performing lateral retinacular release of the patella during total knee arthroplasty.[2]

Total knee arthroplasty is a common, highly efficacious and cost-effective procedure, with an estimated 3.48 million surgeries to be performed in 2030 nationwide.[3–5] The disruption of the blood

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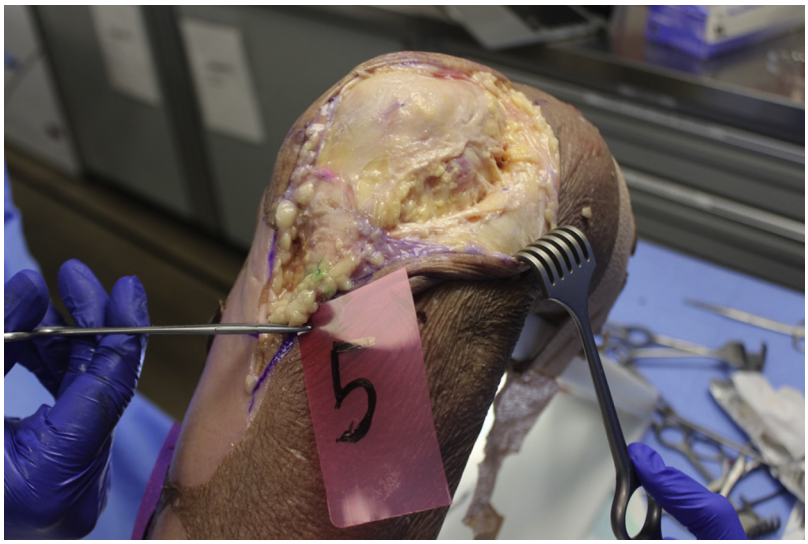

Fig. 1. Picture of Dissection Showing Lateral Release.
This image shows the anatomy of the knee that was visualized in our study and the incisions that were made to perform the lateral release.

supply to the patella during this procedure can be responsible for poor surgical outcomes leading to osteonecrosis, stress fractures, and loosening of patellar components.[6–8] Patellofemoral complications occur in 5% of total knee arthroplasties and represent 50% of the complications.[9] The incidence of avascular necrosis in lateral retinacular release during total knee arthroplasty has been debated. One study performed by Cameron *et al.* showed a 5% incidence of avascular necrosis during lateral release of the patella. This study evaluated 160 total knee replacements with lateral retinacular release and eight of these cases resulted in avascular necrosis of the patella.[10] Because of its dual blood supply, the inferior patella is at less risk of avascular necrosis than the superior patella.[2]

The primary goal of this cadaveric study was to assess both the ability of an experienced surgeon to assess the position of the patella's lateral vasculature by naked eye and to preserve the visualized vessels when performing a lateral retinacular release for patellar maltracking. This study aims to evaluate how often vasculature lies within the incisional plane, and how often it can be preserved when it is visualized.

2. Methods

This study was done in a cadaver lab in May 2017. Ten fresh-frozen above-knee cadaver specimens underwent lateral release of the patella using a surgically accurate incision and careful dissection to mimic an intraoperative release during total knee arthroplasty. One senior joint surgeon performed and supervised each procedure with great care, while attempting to visualize, identify, and preserve any blood vessels coursing to the patella that could be seen with the naked eye. This dissection can be seen in Fig. 1. Upon completion of the dissections, pictures were taken, and each specimen was thoroughly analysed. The preserved and identified vessels were recorded and quantified, and any damaged

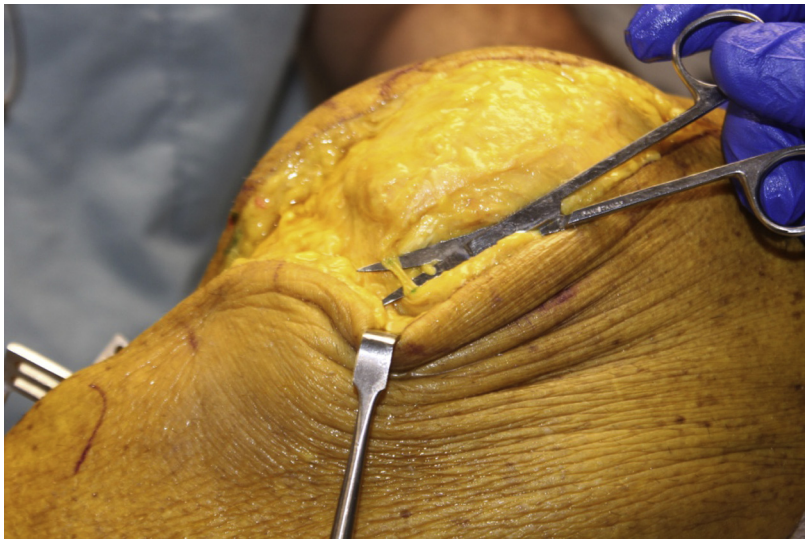

Fig. 2. Inferior Lateral Genicular Artery.
This image shows the inferior lateral genicular artery after it was exposed during the procedure.

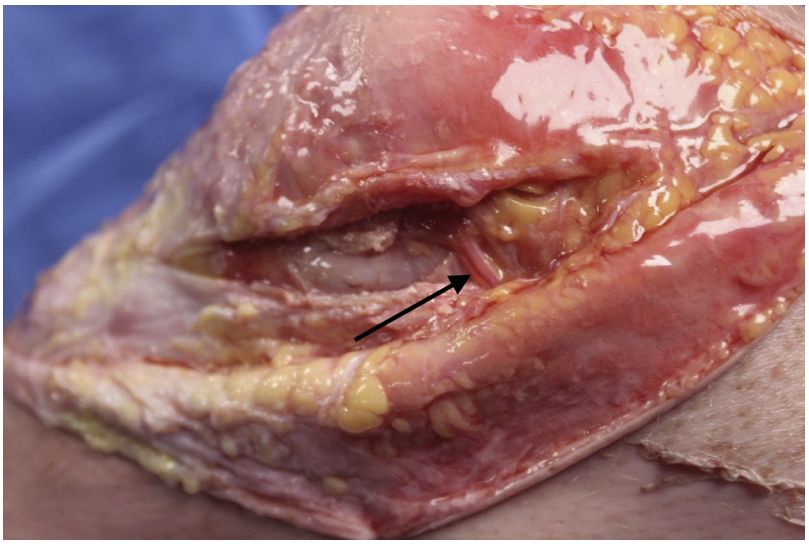

Fig. 3. Superior Lateral Genicular Artery.
This image shows the superior lateral genicular artery after it was exposed during the procedure.

vessels were noted. This data was studied to identify information on the blood vessels present in the incisional plane and the ability of an experienced surgeon to avoid damaging the present vessels.

3. Results

In our study, three of the ten cadavers (30%) had an artery that was visible to the naked eye within the plane of the lateral incision. No cadaver had multiple arteries that could be visualized. Two (20%) of these vessels were the inferior lateral genicular artery, and one (10%) was the superior lateral genicular artery (Figs. 2 and 3). Of these three arteries, all were preserved using careful dissection during lateral release. In the other seven cadavers, no blood vessels to the patella could be visualized by the naked eye within the plane of the lateral dissection.

Demographic information (age, gender, weight) was included for each cadaver specimen. The average age of the specimens was 79.9 years (range, 54–88) with six females (60%) and four males (40%). The average weight of the cadavers was 69.4 kg (range, 47.6–102.5 kg). All the knees on which we did this study were left knees.

4. Discussion

When performing a total knee arthroplasty, it is essential that the surgeon restores the patellar tracking for the optimal function of the knee replacement. Patellar maltracking can lead to chronic pain, decreased range of motion, and difficulty with ambulation.[11] One strategy to improve patellar maltracking during knee replacement is a lateral retinacular release. This frees up the patella from the lateral retinaculum and allows it to track with better alignment along the artificial implant. Because the preferred approach to the joint space in a total knee arthroplasty is the medial parapatellar arthrotomy, the medial genicular vessels are typically disrupted. Therefore, lateral retinacular release must be performed carefully to avoid disruption of the remaining lateral blood supply to the patella.[1]

Lazaro et al. studied the vascular anatomy of the patella in 21 cadavers. In all 21 of these subjects, the superior and inferior lateral genicular arteries were single branches and separated from the anastomotic ring at the superolateral border and the joint line respectively. They also found that transection of the anastomotic ring was avoided both medially and laterally with a tissue cuff greater than 15 mm. Based on these findings they recommended a wider margin, and a lateral incision beginning distal to the superolateral border and ending proximal to the joint line in order to avoid disruption of these vessels.[1]

The results of our study showed that two inferior lateral genicular arteries and one superior lateral genicular artery were visible and within the incisional plane during the lateral retinacular release of the patella in these 10 specimens which we studied. Without caution, these vessels were at risk for transection and the patella at risk for avascular necrosis if due care is not taken to identify and preserve them during the lateral release. These results also suggest that the vascular anatomy of the patella can vary with regards to the arteries and their courses through the lateral retinaculum. This makes it difficult to visualize these vessels predict what structures are at risk and warrants caution during this procedure.predict what structures are at risk

Strength of our study is the fact that this is one of the very few cadaver studies in which the patellar vascular anatomy is studied with regards to the surgical approach during a total knee arthroplasty. A weakness of the study is the limited number of specimens evaluated. Hence the incidence of visible vessels identified during this study may not suggest true incidence in living population that can be visible during actual procedures. It also limited our ability to observe anatomical variations.

5. Conclusions

In conclusion, while it is often difficult to visualize blood supply to the patella during a lateral release of the patella in total knee arthroplasty, the lateral genicular arteries can be preserved when visible to the naked eye. Without caution and proper surgical technique, severance of these vessels may occur, leading to devascularization of the patella. This is particularly important when the medial vascularity has been compromised due to standard approach to knee replacement.

Conflict of interest

None.

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