Demonstration of the Medial Subvastus Knee Exposure for MACI Implantation

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Background: There are several techniques for knee exposure in treating chondral defects with restorative procedures. The medial subvastus knee exposure is often overlooked when choosing the surgical approach. When properly performed, the medial subvastus approach can allow for the treatment of a wide range of pathology while preserving the extensor mechanism.

Indications: We present a case of an active 40-year-old man with persistent left knee pain noted to have a full-thickness medial femoral condylar articular cartilage defect in an otherwise healthy appearing knee.

Technique Description: The rationale and considerations for the medial subvastus knee exposure in treating a chondral defect with an autologous chondrocyte implant are discussed. Careful consideration of the approach, intra-articular exposure, and closure are emphasized to achieve optimal outcomes.

Results: At 18 months postoperative, the patient reported no knee pain with improvements made in Knee injury and Osteoarthritis Outcome Score (KOOS), Lysholm, and International Knee Documentation Committee (IKDC) scores. These results are consistent with our institutions larger cohort of 26 patients undergoing matrix-induced autologous chondrocyte implantation (MACI) using the subvastus approach. These improvements in patient-reported outcomes are maintained at 2 years postoperative and are consistent with other published outcomes of the MACI procedure.

Discussion/Conclusion: Excellent results in addressing chondral pathology about the knee can be achieved by selecting the appropriate surgical access. The subvastus approach has several advantages such as preserving the quadriceps mechanism, improving postoperative quadriceps muscle strength, conservation of the patellar genicular blood supply and possibly reducing postoperative pain that can result in a faster rehabilitation. When performed systematically and carefully, complete exposure of the knee can be achieved to facilitate a wide variety of surgical interventions. In patients undergoing cartilage restoration procedures, the medial subvastus approach should be considered in the surgeon's armamentarium.

Patient Consent Disclosure Statement: The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

Keywords: subvastus; MACI; articular cartilage; knee; autologous chondrocyte implantation

VIDEO TRANSCRIPT

Dr. Deryk Jones here. I am going to describe a demonstration of the medial subvastus exposure for the knee and show an MACI implantation in conjunction with that exposure. I would like to thank my fellow Jordan Grilliot for helping me with this presentation and the Ochsner Sports Medicine Institute.

These are my disclosures.

Today's overview is basically a rationale for the use of the subvastus knee exposure and considerations for the technique. I'll go over medial and lateral contracture releases and some of the stages of releases there, the surgical technique for subvastus approach, the MACI implantation, and then outcomes from the patient that I will demonstrate to you.

So, these are the approaches around the knee. And you can see that you can remove the vastus medialis obliquus or vastus lateralis off the intermuscular septum with

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either approach. And this avoids damaging the extensor mechanism which is really the biggest benefit and preserves the vascularity of the patella. Disadvantages can be insignificant exposures. The extensile nature of these exposures is limited because there can be denervation of the muscle if you go too far proximally. The medial contractures of the knee are complex, and there are stages of releases here. You can see from grades I to IV, there is extensive releasing performed. The interesting finding is that the superficial medial collateral ligament is released as one of the last structures with the pie-crusting move for grade III lesions or full release for grade IV contractures of the knee. In a study by Whiteside, the interesting superficial part of the medial collateral ligament release gives the most bang for the buck versus the posterior portion of the medial collateral ligament release, which does not give as much release or rotational or valgus laxity of the knee as you can see in this slide. Therefore, releasing the anterior portion of the medial collateral ligament demonstrated significant increases in valgus laxity and rotational laxity. However, the posterior portion of the medial collateral ligament did not demonstrate much release.[2,6]

In cases of lateral contracture of the knee, a similar kind of progression, grades I to IV.[1,2,5,6] And once again, we get to the lateral collateral ligament (LCL) initially, but we start to release the gastrocnemius tendon and the posterolateral capsule and arcuate complexes; we get to more complex lesions as you see to the right of the table. This is a demonstration of the ligaments and tendons that can be released. The LCL and popliteus tendon are the most typical releases. But for significant contractures of the knee, you can continue to extend posteriorly to the capsule, leaving, if you can, the anterior portion of the iliotibial band, as you see in this slide to the right.

These are the studies showing the most common releases around the knee for varus or valgus instability-type problems or contracture-type problems.[1,2,5,6] You can see that the posteromedial medial collateral ligament is the most commonly released structure for varus knees while as you see to the right, the popliteus tendon and iliotibial band can be the most common release for valgus-type knees.

So, the patient we are going to talk about today is a 40-year-old man presented to my physician's assistant with 3 months of left knee pain. He had no known injury. He had pain with squatting, occasional popping sensations in the knee, and tenderness along the medial femoral condyle (MFC) of the left knee. Normal alignment, as you can see in the radiographs on the right and good range of motion (ROM) with mild quadriceps atrophy on the left side.

These are the preoperative radiographs, and you can see that there is no significant joint space narrowing. Very minimal KL (Kellgren Lawrence) findings consistent with KL 0 type scores were observed. So, the man looks like a good patient for a possible cartilage implantation procedure. He had 8 weeks of physical therapy and nonsteroidals with no relief. We recommended an unloader brace, but the patient declined. A magnetic resonance imaging (MRI) was then ordered, and we were not able to obtain baseline outcome measures by the physician's assistant at that time.

These are the MRIs we obtained preoperatively. So, looks pretty good, but you can see a hint along the MFC of a lesion. As you get closer, you can see an area of involvement of the MFC directly in the central weight-bearing (WB) zone which we did pick up. There is some meniscus pathology as well which was read by the radiologist. As a result, we took him to arthroscopic treatment. When we looked at arthroscopy, we saw a large grade IV lesion which extends both medially and laterally and has some poor containment centrally that is worrisome. There was a concomitant meniscus tear laterally. The patient looked good with no significant pathology in the lateral compartment.

At 7 weeks, the patient came back after the arthroscopic procedure and felt great. He went on a hiking trip, did not use the unloader brace as we previously recommended, and as expected, came back with significant pain. Prior to the hike, this is the postarthroscopy score. So, he has doing quite well on all outcomes measures for KOOS as well as the IKDC and Lysholm scores.

We took him to an operative procedure as a result of the increasing pain after the hiking incident. And you can see, we made a medial-based incision. With the knee extended, it is approximately 6 cm in length. With flexion, it increases to 8 cm in length. You can see postoperatively an incision about 6-cm along the medial aspect of the knee and 8 cm with flexion of the knee. This lengthens the incision as you see here when we flex the knee, and this is a typical exposure. By maintaining the knee in flexion, what we are doing is maintaining the vastus medialis oblique (VMO) fascia in tension. And by doing that, we then can have a VMO fascia that is intact. It is very important in this exposure to maintain that vastus medialis obliquus fascia because that will protect the muscle which is the point of our procedure using this approach. Metzenbaum scissors show the area of release that I will perform using a bovie cautery. And here I am using a bovie cautery release under the VMO fascia. And this is going to then allow us to expose the intermuscular septum which will release that VMO and tissue off the intermuscular septum.

So, as we release that tissue, we see that if you do it appropriately, you release that medial retinaculum. You can actually see the medial patellofemoral ligament, which is demonstrated here by this arrow, which is a thickening of that capsule. A very thin structure but very powerful structure that is important in stabilizing the subluxation of the knee, preventing subluxation of the knee laterally. You can see the capsule has been released there. And we see that medial patellofemoral ligament (MPFL) shows up, and the intermuscular septum as you can see to the left that is where we are releasing the vastus medialis obliquus muscle. After we have done that in line with the incision, we then release the MPFL and medial quadriceps tendon femoral ligament (MQTFL) structures. The medial quadriceps tendon-femoral ligament is released as well. And by doing that, you will feel a pop as the quadriceps is then allowed to release laterally. We then tag these edges with sutures. This allows us to really localize where we are going to replace these structures at the end of the procedure.

A very important part of the actual stabilization of the knee is done after releases have been performed which are extensive to expose the femoral condyle. So bovie cautery is being used between the tagging sutures that we just placed, and we are releasing directly along the patellar tendon structure through the capsule. Now in cases of total knee replacement obviously you can go straight to the bone. But in cases such as this where we are going to perform a biologic procedure, it is very important to maintain the medial meniscus structure anteriorly. So, releasing the bovie cautery, but I am taking very good care distally to release directly along the capsule but maintain the meniscus structure intact. It is very important to see that.

This shows the release along the medial aspect of the medial meniscus. And the meniscus is directly in at the front. The anterior interval is the area directly in front of the tibial plateau and directly behind the fat pad and insertion of the patellar tendon.[4] That is to the right, where the rake retractor is pulling to the right. And to the left, we are allowing further release of the structures along the medial meniscus region there. As we have done that, we now have exposure of the MFC. We see a very elongated type of lesion. It is very important to have this level of exposure to get easy access using the MACI cutters to provide access to this type of lesion.

This is an oblong shape lesion. We have a rectangular cutter that we are using to demarcate the edges of the lesion. You need enough exposure to allow the rocking maneuver I just showed there to expose that lesion. I am then using a ring curette to remove the damaged cartilage. You can see there is an area of central irregularity that will bleed later on in this case. And we will have to stabilize that as I will show you in a second. We use epinephrine-soaked neuropatties and thrombin spray as well to stabilize this bleeding site while we then make our grafts. We use the same cutter that we used for the preparation of the graft to go ahead and create our graft, and these are the two grafts we used.

In this case, I used two grafts because of the bleeding that I saw there. I wanted to really fill that defect up. It was an oblong shape graft, and so we were worried about shear forces along this graft as well. I used the epinephrine patties to stabilize bleeding. I then used fibrin glue at the base to further stabilize the bleeding, and then I placed my grafts. As once again it is oblong in shape, I wanted to stabilize it with sutures proximally and distally and prevent that from shearing postoperatively. There is no concern for that with a few sutures just around the periphery. It is very easy to place some 6.0 Vicryl sutures around the periphery of this graft to prevent any delamination postoperatively. It is very important to reapproximate the edges of this tissue. That is where the tagging sutures are very helpful. You have done a lot of work prior to this part of the procedure. You want to anatomically reduce this, and there is a double-layer closure that is very important down along the fat pad and parapatellar tendon region to prevent any leakage. Particularly when you are placing any implant such as we placed here or metal, you certainly wouldn't want any leakage from the subarticular area into the knee itself.

You can see by these KOOS scores in this bar demonstration that we have got some impressive improvements in sports and quality of life. This is demonstrated in this bar graph as well. Postoperatively 18 months, these are the radiographs that we saw of this patient. You can see no significant joint space narrowing medially along the left knee, and the patient was doing quite well. Basically, with physical therapy and postoperative on day 1, we use the continuous passive motion (CPM) machine for 6 to 7 hours per day from 0° to 30°, increasing by 15° per week until ROM is obtained by 6 to 7 weeks. Use a stationary bicycle at that time as well. The patient was maintained in toe-touch weight bearing (TTWB), thus locked in extension for the first 4 weeks, advancing to 25% to 50% WB at 4 weeks and full WB by 6 weeks with the use of an unloader brace.

The MACI experience at Ochsner was from 2017 to 2021 in 26 patients for 33 lesions, with 42% involving the MFC, 15% the lateral femoral condyle, 36% on the patella, and 6% on the medial tibial plateau. We assessed pain subscales for frequency and severity, demonstrating 6 and 4 measures preoperatively and then decreasing between 3 and 2 postoperatively at 2 years. We also assessed various outcome measures consisting of IKDC, Lysholm, KOOS subscales, and the Short Form (SF)-12 measure as well. We saw statistically significant improvements at 1-2 years in all outcome measures except for the MSF-12 and PSF-12. Our results were consistent with the results published in the SUMMIT study in 2014.[3] Our KOOS pain and function subscales measured 85 and 70, respectively, at 2 years. And these were consistent with the numbers 83 and 71, published in the SUMMIT study at 2 years using KOOS pain and function subscales.

In summary, we feel the Ochsner experience was positive using the subvastus approach of various sizes, shapes, and locations. Our results mirrored the results published in the SUMMIT study at 2 years, with improvements that were statistically significant in pain and function subscales of the KOOS subscales measures at 2 years. These are consistent with other published literature as well. We feel the subvastus approach can be performed either medially or laterally with the release of the vastus lateralis or vastus medialis oblique off the intermuscular septum with the advantage of maintenance of the quadriceps function and structure and preservation of patella vascularity. There is a slight disadvantage of VMO denervation and less-extensile exposure in certain circumstances using this approach.

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These are my references.[1-6]

Thank you.

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