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Technical note

The 45 degrees arthroscope: A forgotten scope in knee surgery

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Video Animation

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ABSTRACT

The majority of knee arthroscopic procedures are performed with 30° scope while the 70° arthroscope is mainly used for surgery of posterior compartments. In the arthroscopic armamentarium, another scope, unknown to many surgeons, is also available: the 45° arthroscope. His field of view provides a wider intraoperative view than that of a 30° scope without the characteristic blind spot of a 70° scope. Therefore, the surgeon's orientation is not compromised. because the optic has always an element of forward vision. With these advantages, the 45° scope can be used in all knee surgical procedures without the need for having two scopes sterilized on the surgical table with less risk of contamination and less surgical time. The 45° scope may also be valuable for the arthroscopic surgery of other joints with the same advantages.

1. Introduction

The majority of knee arthroscopic procedures are performed with a 30° scope that may be considered the standard optic by arthroscopic surgeons. At the beginning of the arthroscopic era, beside the 0° scope that the oldest arthroscopic surgeons still remember, the 30° arthroscope was the only scope in the surgeons' armamentariums. Moreover, in the past, the meniscectomy was the only surgical application of the arthroscopy. Today, applications of the arthroscopy have been widely expanded, and almost all surgeries, both in knee and other joints, are performed under direct visualization. In many instances, the 30° arthroscope does not allow visualization of all structures and sometimes it is necessary to switch portals or to change the 30° scope with a 70° scope. The 70° scope has been proposed recently also for the anterior cruciate ligament (ACL) reconstruction allowing an excellent view of the tibial and femoral ACL footprints. In the armamentarium of arthroscopic surgeon another scope is also available: the 45° angled arthroscope. The 45° scope, that many orthopedic surgeons do not know, is available only from a few catalogues. The field of view of 45° scope is about 110° wider than that of 30° scope. By turning around, the 45°scope achieves an almost 300° overview of the joint cavity [1]. Moreover, all angled scopes have image distortion at periphery, the so-called fish-eye view, in which the images at periphery are more curved and compressed. This distortion is more evident if the scope is more angled [2–4]. Another advantage of the 45° scope is that the orientation is not compromised because one element of forward vision is always maintained without the central blind spot of a 70° scope (Fig. 1). The 45° scope is a good compromise between the limits and benefits of a 30° and 70° scope and allows excellent visualization without have to reposition the scope or create accessory portals during different surgical procedures. The purpose of this technical note is to review the procedures in which a 45° arthroscope provides favorable visualization compared to a 30° arthroscope with its improved diagnostic skill and the greater technical ease of the procedure.

2. Technique (video)

2.1. Meniscal surgery

When assessing the medial and lateral meniscus, there are no advantages in terms of visualization from using the 45° scope in comparison with the 30° one. As shown by Morin and Steadman [5], the use of a more angled scope (70°) gives an incremental increase of only 9% of field of view. However, we have found advantages when using the 45° scope during the meniscal surgery for less instruments crowding.

2.2. Posterior compartments

The medial posterior compartment should be inspected during routine knee arthroscopy for the presence of several pathologies located in this compartment. In addition to pathologies such as loose body or synovial disease, the inspection is also indicated in all patients with an ACL-deficient knee due to incidence of specific types of meniscal lesions, such as ramp lesions, that cannot

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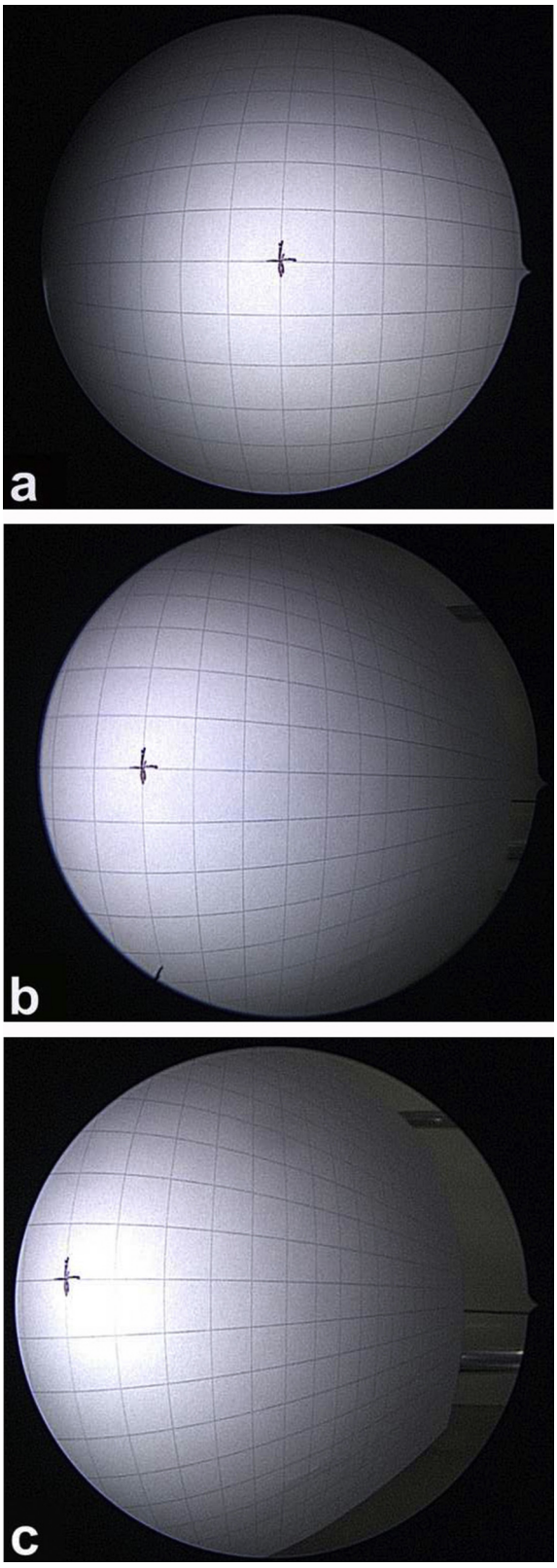

Fig. 1. The arthroscopes are positioned and fixed in the same position during all tests with a Test System® Storz. A squared sheet of paper is maintained at same distance from the tip of the scope. View is shown using (a) a 30° scope, (b) a 45° scope and (c) a 70° scope.

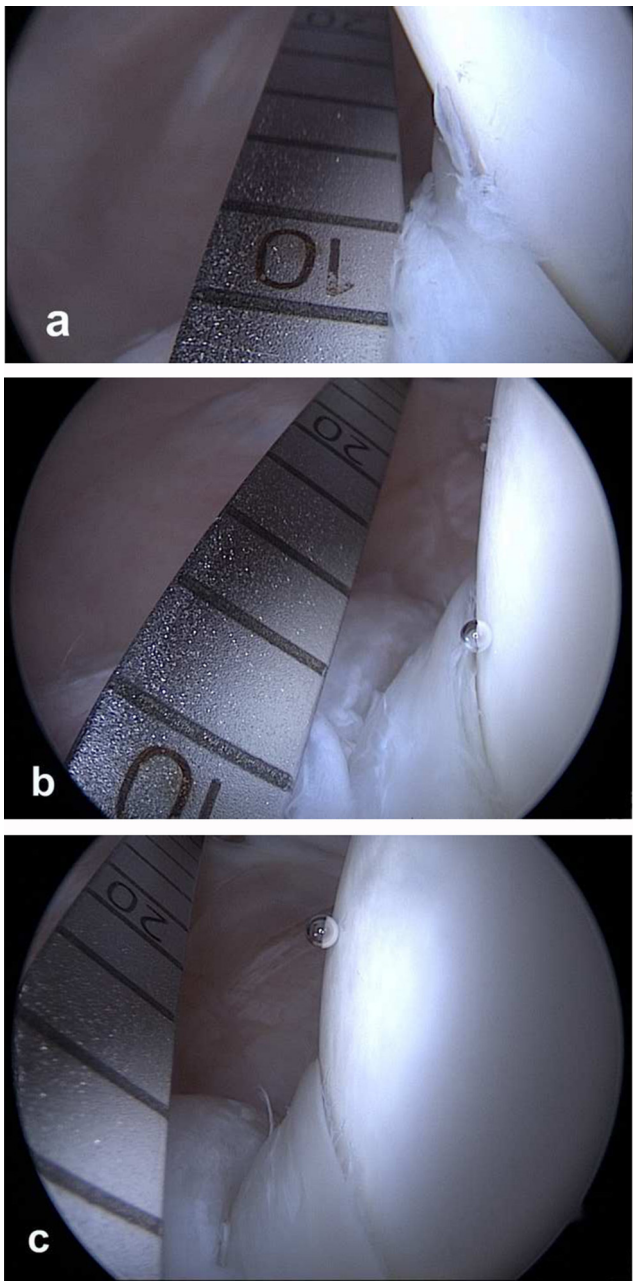

Fig. 2. Ramp lesion of the left knee. A ruler is introduced from the posteromedial portal. View is shown using (a) a 30° scope, (b) a 45° and in (c) a 70° scope.

be visualized arthroscopically from the anterior compartment. Transcondylar notch visualization with a 30° arthroscope provides quick and safe visualization of the medial posterior compartment, but leaves a blind zone of 47% of the posterior compartment [6] that could be reduced to 31% changing to a 70°arthroscope. In their cadaveric study, Morin and Steadman [5] confirmed these findings, showing that a 30° arthroscope has a more limited mean arthroscopic field of view (22%) of posteromedial compartment than the field of view of 70° scope (33%). They therefore advocated to examine this compartment by first viewing with a 30° scope, then viewing with a 70° scope. Unfortunately, these authors did not test the 45° arthroscope, which has the great advantage of enhancing the field of vision and, unlike with the 70° scope, always maintains an element of forward vision, with less confusing orientation and less distortion (Fig. 2). By rotating the 45° scope, it is possible to

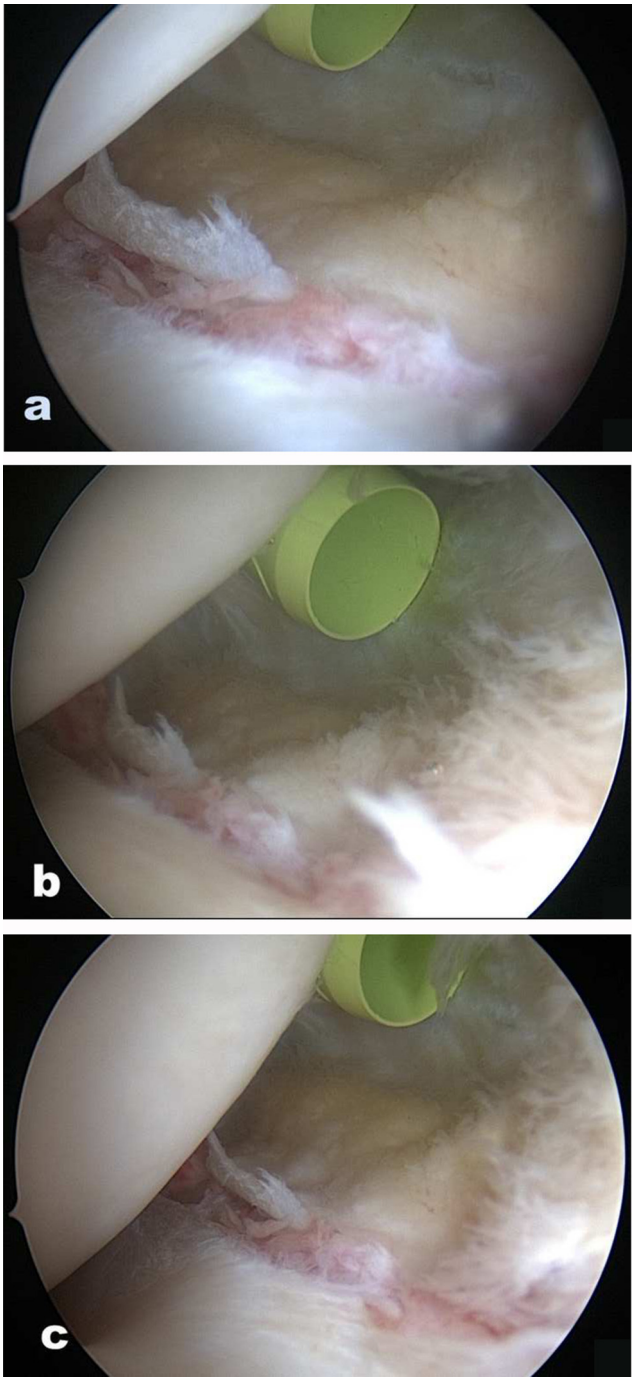

Fig. 3. Tear of the superior popliteomeniscal fascicle. The arthroscope is introduced from the anteromedial portal with the right knee in a figure-4 position. A cannula is placed at posterolateral portal. View is shown using (a) a 30° scope, (b) a 45° and in (c) a 70° scope.

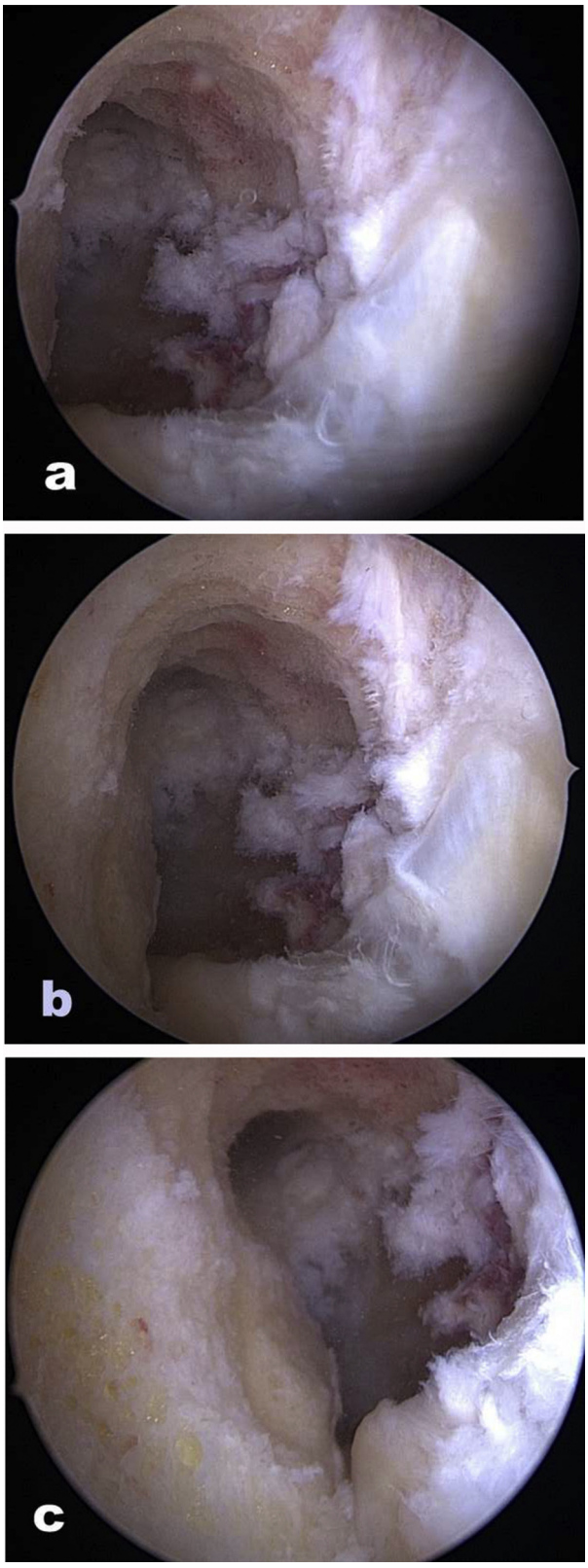

Fig. 4. View from the anterolateral portal of femoral tunnel for ACL reconstruction, (left knee). View is shown using a 30° scope (a), a 45° (b) and a 70° scope (c).

obtain good visualization of the entire posterior compartment, from the superior capsular insertion to the capsular meniscal reflection. All of the meniscocapsular junction can be easily visualized, providing an optimal view of any lesions located at this site.

Regarding the lateral compartment, the lateral meniscus can be adequately inspected both with a 30° and a 45° arthroscope (Fig. 3). The posterolateral compartment is safely and easily inspected through standard anterolateral portal with the 30° arthroscope. Lubowitz et al. [7] performed transcondylar notch views in 100 consecutive knee arthroscopies and found that posterolateral visualization was achieved in 100% of the procedures (and in 93% on the first try) with a 4% rate of mild iatrogenic cartilage damage. Although the 30°

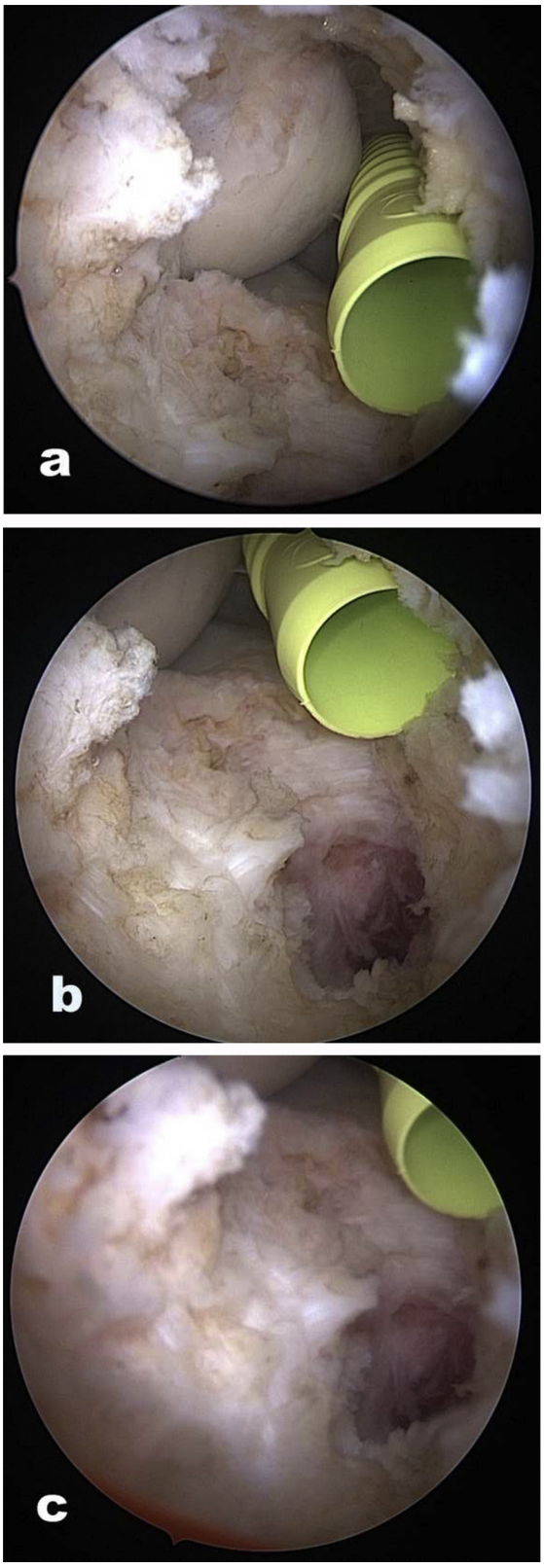

Fig. 5. Transeptal reconstruction of the PCL in right knee. View of the tibial tunnel with the arthroscopes introduced through a cannula at the posterolateral portal. A cannula is placed at the posterolateral portal. View is shown using a 30° scope (a), a 45°(b) and a 70° scope (c).

scope may be adequate for most situations in the lateral compartment, the 45° scope enhances the field of view during inspection of the popliteus hiatus and of popliteomeniscal fasciculi.

2.3. Anterior cruciate ligament

Complete visualization of the ACL native attachments is key to creating proper femoral tunnels. Regardless of which technique is used for the ACL reconstruction, anatomical placement of the graft in the center of the respective tunnels is mandatory. In order to provide for the limits of a 30° arthroscope, alternative techniques have been proposed, such as to switch the portal of the arthroscope from lateral to medial, or to use a 70° arthroscope for the femoral tunnel mainly with recent techniques that focus on independent femoral tunnel preparation [8,9]. But the change from 30° to 70° arthroscope needs a rapid switching and a quick-change camera drape if used. With the 45° scope, femoral tunnel preparation and graft passage can be performed with excellent visualization from the anterolateral portal without repositioning of the scope or creation of accessory portals. Furthermore, the depth and walls of the femoral tunnel can be easily inspected from the anterolateral portal with the 45° scope, (Fig. 4). Okazaki et al. [10] demonstrated both with a simulator and in vivo that a 45° arthroscope can increase visualization of the femoral ACL footprint. In vivo, these authors used image software to show that from the anterolateral portal, the area of lateral intercondylar notch is 48% larger in the view provided by the 45° scope than in the view provided by the 30° scope. The tibial ACL insertion is also easily inspected with the 45° scope, using a bird's-eye view similar to that achieved with a 70° scope.

2.4. Posterior cruciate ligament

Proper visualization of the insertion of the posterior cruciate ligament (PCL) is mandatory during posterior cruciate ligament surgery: arthroscopic repair of avulsion fractures involving the posterior attachment and for PCL reconstructions. Poor visualization can lead to neurovascular injuries, malpositioning of tibial tunnels, and ultimately, failure of the ligament reconstruction The 45° scope allows complete visualization of the tibial footprint of the ligament without the need to shift the scope to a posteromedial portal. Similar to the 70° scope, the 45° scope allows the surgeon to simultaneously introduce instrumentation under direct view from the posterior compartment, (Fig. 5). Moreover, the 45° scope gives a panoramic view of the entire femoral footprint of the native ligament and the meniscofemoral ligaments.

3. Discussion

Unknown to many surgeons, the 45° scope combines the optical benefits of both the 30° and 70° scopes. The intraoperative view is greatly optimized with the 45° scope; the rotating field of view is wider than that provided by a 30° scope and it lacks the characteristic blind spot of a 70° scope. Moreover, because the 45° optic always has an element of forward vision, the surgeon's orientation is not compromised. The learning curve with the 45° scope is short, and after few procedures, surgeons are able familiarize themselves with its use. With these advantages, the 45° optics can be used in all knee surgical procedures without the need for two scopes sterilized on the surgical table. This reduces the cost. All procedures can be carried out with only one scope and without changing the drapes, leading to a decreased risk of contamination and less surgical time. The 45° scope may also be valuable for the arthroscopic surgery of other joints with the same advantages.

Disclosure of interest

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Authors' contribution

NA.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.otsr.2019.02.003.

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