Simultaneous Bilateral Knee Varus Stress Radiographic Technique

Técnica radiográfica de estresse em varo bilateral simultâneo

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Abstract

Varus stress radiographs are reported as an effective and cost-beneficial diagnostic and decision-making tool for lateral knee injuries, both in the acute and chronic settings. The opening of the lateral compartment is reported to vary according to the number of structures injured, helping to differentiate isolated fibular collateral ligament injury from grade-III posterolateral corner injury. The conventional technique requires the physician or another healthcare provider to apply manual varus stress while obtaining the radiograph on one knee at a time. The present study aimed to describe, in detail, the preferred method of the authors to assess the opening of the lateral compartment in both knees simultaneously, which also avoids the need for the examiner to be present in the imaging room.

Keywords

► knee  ► fractures  ► stress  ► radiography

Palavras-chave

► joelho  ► fraturas  ► estresse  ► radiografia

Introduction

The posterolateral corner is an important knee ligamentous structure to knee stability, preventing posterior translation and varus/external rotation.1 Injuries of this knee ligamentous complex were considered rare injuries in the past, however, a better understanding of the anatomy and better diagnostic resources are suggesting that the real incidence of these injuries are higher.2 A prospective study estimates that these lesions are presented in 16% of all ligament knee injuries and 9.1% of all acute knee injuries with hemarthrosis.3 Due to the severe consequences of untreated injuries, the correct diagnosis and treatment of these ligament injuries are essential to avoid future sequelae. A thorough physical examination combined with associated imaging techniques are essential to correctly
diagnose these injuries. The purpose of this technical note is to describe in detail our preferred varus stress radiographic technique to evaluate these injuries.

**Technique**

Following physical examination of the knee, the patients who would benefit from varus stress radiographs are selected. The patient is brought to the radiographic room and placed in supine position. Following this, the patient is asked to extend the limbs and, place both knees and ankles together. During this period the patient is asked to relax both limbs. A Velcro belt is used at the supramalleolar site, keeping both medial malleolus in contact with each other (Fig. 1). During this period, it is important to check the anatomic position of the limbs is correct by ensuring that both patellas are perpendicular to the radiographic table. Following this, attention is then turned to the knee.

**Soft Wedge Positioning**

Once the Velcro strip is placed around the ankles, at the supramalleolar level, a soft wedge (Fig. 2) is used to apply the varus stress on the knee. Ensuring the correct positioning of the limbs, the soft wedge (made of Ethylene vinyl acetate) is gently placed between the knees that were in close contact. The smaller aspect of the wedge (tip) is directed proximally, while the base of the wedge should remain at the tibial tuberosity level. The physician must ensure that the medial malleoli are in contact and the Velcro belt did not change the position. When inserting the soft wedge between the thighs, the limbs tend to abduct; however, the Velcro belt placed around the ankles avoid the limb displacement. The result vector is a varus stress performed simultaneously in both knees (Fig. 3). This test is able to detect lateral laxity simultaneously and bilateral, taking only one radiographic (Fig. 4). This technique can be performed with the knee in flexion or extension, removing the soft pad on the popliteal fossa to perform in extension. Once all
the previous steps are performed, the physician must ensure that both patellas are at the same level. Following this, the radiographic tube is placed 1 m from the radiographic cassette and centered on both patellas and the image is acquired.

Advantages and disadvantages of our technique is presented in Table 1, while Table 2 shows the pearls and pitfalls of this technique.

Discussion

Magnetic resonance images (MRI) have an important role in the diagnosis of knee ligament injuries. However, this imaging modality is limited when considering the evaluation of the posterolateral corner of the knee due to its complex anatomy of the ligamentous structures of the posterolateral corner. Varus stress radiographs are an objective and reliable imaging technique for evaluating posterolateral corner injury.

When using stress radiographs due to interpatient variability, a comparison with the contralateral side is important to evaluate the side-to-side difference. While cadaveric studies such as LaPrade et al. have described objective measurements for lateral compartment opening associated with both isolated FCL, 2.7 mm, and combined PLC injuries, 4.0 mm, there is a relative paucity of data in regards to clinical studies evaluating varus stress radiographs. James et al. performed a systematic review evaluating the use stress radiography for the diagnosis of knee ligament injuries, which looked at numerous stress techniques, including four varus stress techniques. They concluded more clinical studies were needed to establish diagnostic gapping benchmarks. They also were unable to find any consensus on superiority of varus stress radiographs when compared with other diagnostic tests.

Gwathmey et al. correlated the results of varus stress radiographs with MRI findings in patients with posterolateral corner injuries and found that stress radiographs were consistent with the severity of the injuries described on the MRI. In patients with a MRI demonstrating a partial lesion of the posterolateral corner the varus opening was 12.8 mm and those with complete lesions the varus opening increased to 18.6 mm. Furthermore, the authors reported that stress radiographs were essential during the evaluation of partial tears to this complex, becoming a complementary tool for stabilization decision.

Our technique, described in details, is a reliable and cost-effective technique for varus stress test. This technique includes the advantages of less radiation exposure due to the fact that both knees are evaluated at the same time and with the same force applied. Furthermore, there is no necessity for another healthcare provider to be in the X-ray room to apply the stress, thereby decreasing the radiation to health care employees.

Final Remarks

In conclusion, varus radiographs are an important diagnostic and decision making tool in a knee with multi-ligamentous or lateral complex injury, both in acute and chronic settings. While further studies need to be done to evaluate efficacy, we believe that our technique is reliable and cost-effective and

Table 1 Advantages and disadvantages of our technique

| Advantages                        | Disadvantages                                      |
|-----------------------------------|---------------------------------------------------|
| Does not require an additional healthcare professional to apply the stress force | Needs further studies to confirm the efficacy of this technique |
| Decreases the need of radiographs due to the evaluation of both knees at the same time | Must be changed in patients with immobilization/external fixation in the leg |
| Side to side difference can be compared, ensuring that the same force was applied | May not be possible to evaluate the knees bilaterally in extreme obese patients |
| Easy and cost-effective technique |                                                  |
| Can be performed both at extension and 20–30 degrees of flexion |                                                  |

Table 2 Pearls and pitfalls of our technique

| Pearls                                                                 | Pitfalls                                      |
|-----------------------------------------------------------------------|-----------------------------------------------|
| Use the soft pad under the popliteal fossa to achieve the knee flexion | Radiographs in internal rotation may cause differences in the measurements |
| Ensure that the rotation and level of the limbs are correct            |                                               |
| The correct position of the soft wedge and the Velcro belt is key to reproduce the varus stress |                                               |

Fig. 4 The final bilateral simultaneous varus stress radiograph is showed in this picture. The soft wedge placed between the knees and the Velcro belt at the supramalleolar level produce a varus stress in both knees at the same time, requiring just one radiograph to evaluate side to side difference in the lateral compartment. The yellow arrows show the lateral gapping. R, right; L, left.
has additional advantages compared with conventional varus stress techniques previously described in the literature.

Conflicts of Interest
The authors declare no conflicts of interest.

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