Abstract  Objective. Twisting injuries occur as a result of differential motion of different tissue types in injuries with some rotational force. These injuries are well described in brain injuries but, to our knowledge, have not been described in the musculoskeletal literature. We correlated the clinical examination and MR findings of 20 patients with twisting injuries of the soft tissues around the knee.

Design and patients. We prospectively followed the clinical courses of 20 patients with knee injuries who had clinical histories and MR findings to suggest twisting injuries of the subcutaneous tissues. Patients with associated internal derangement of the knee (i.e., meniscal tears, ligamentous or bone injuries) were excluded from this study. MR findings to suggest twisting injuries included linear areas of abnormal dark signal on T1-weighted sequences and abnormal bright signal on T2-weighted or short tau inversion recovery (STIR) sequences and/or signal to suggest hemorrhage within the subcutaneous tissues. These MR criteria were adapted from those established for indirect musculotendinous junction injuries.

Results. All 20 patients presented with considerable pain that suggested internal derangement on physical examination by the referring orthopedic surgeons. All presented with injuries associated with rotational force. The patients were placed on a course of protected weight-bearing of the affected extremity for 4 weeks. All patients had pain relief by clinical examination after this period of protected weight-bearing.

Conclusions. Twisting injuries of the soft tissues can result in considerable pain that can be confused with internal derangement of the knee on physical examination. Soft tissue twisting injuries need to be recognized on MR examinations as they may be the cause of the patient’s pain despite no MR evidence of internal derangement of the knee. The demonstration of soft tissue twisting injuries in a patient with severe knee pain but no documented internal derangement on MR examination may allow the orthopedic surgeon to elect for a trial of conservative nonsurgical management.

Keywords  MRI · Knee · Injury · Soft tissues

Introduction

Twisting injuries occur due to differential motion of tissues as a result of some rotational force. Patients with knee injuries commonly describe rotation of the knee at the time of injury. Shearing or twisting injuries are well described in brain injuries. When the cerebral hemispheres are put in motion relative to each other, shearing stresses are produced along the courses of the white matter axons that connect the two hemispheres. As a result
of these stresses, axonal disruption occurs, resulting in diffuse axonal injury or shearing injury [1].

There have been two previous reports in the literature of twisting injuries of the soft tissues. These describe post-traumatic serosanguineous cysts in the soft tissues of the pelvis after pelvic fractures due to high-speed motor vehicle accidents. These patients developed serosanguineous cysts when shearing forces resulted in separation of the skin and subcutaneous fat from the deep fascia and muscles [2, 3].

Indirect muscle injuries have been described with evertational muscle injuries. A muscle strain is a partial or full-thickness disruption of muscle fibers secondary to a tensile injury. The weakest point of the normal musculotendinous unit is at the myotendinous junction, with tears commonly occurring at this location. Muscle strains are painful stress-induced injuries resulting from the application of a single violent force. Muscle strains result in patchy and/or elongated linear areas of abnormal decreased signal within muscles on T1-weighted sequences and abnormal increased signal within muscles on T2-weighted and short tau inversion recovery (STIR) sequences [4, 5, 6].

We have adapted the MR criteria of muscle strain injuries (occurring at the musculotendinous junction) to soft tissue twisting injuries of the knee (occurring at the myofascial junction), as there is a similar mechanism of injury and both injuries occur at the junction of two different tissue types [6, 7].

We describe a series of patients with knee trauma accompanied by some degree of rotational force who were referred for MR examination due to concern about internal derangement of the knee. We correlated the clinical histories, examination and MR findings of 20 patients with twisting injuries of the soft tissues around the knee. We prospectively reviewed the MR knee examinations to determine whether there were any MR findings that are useful in demonstrating twisting injuries of the knee.

Materials and methods

We prospectively reviewed the MR examinations of 83 consecutive patients with clearly documented clinical histories and MR findings to suggest twisting injuries of the soft tissues. Of these, 63 had associated internal derangement on MR examination (i.e., meniscal tears, ligamentous or bone injuries). These 63 patients were excluded from the study. The remaining 20 patients, with clinical histories and MR findings to suggest twisting injuries of the soft tissues around the knee, had no MR-documented internal derangement. These 20 patients had rotational injury of the knee as noted in the patient history documented by the orthopedic surgeon in the clinic notes.

MRI was performed on either a 1.0-T (Magnetom; Siemens, Iselin, N.J.) or a 1.5-T scanner (Signa; General Electric Medical Systems, Milwaukee, Wis.). MR images were obtained in coronal, sagittal and axial planes as follows: sagittal dual echo (TE 20,90/TR 2300), coronal T1-weighted (TE 12/TR 600), coronal turbo inversion recovery (TE 30/ TI 150/ TR 4240), sagittal 3D DESS (TE 9/TR 25.7) and axial T2-weighted FLASH (TE 18/ TR 512). All were obtained with a 16 cm FOV, 4 mm slice thickness (except the 3D DESS, which has an effective slice thickness of 1.94 mm), 2 NEX and a 196×256 matrix.

There were 14 male patients and 6 female patients with soft tissue twisting injuries demonstrated on MRI. MR findings to suggest soft tissue twisting injuries were linear areas of abnormal dark signal on T1-weighted sequences and abnormal bright signal on T2-weighted or STIR sequences and/or linear signal to suggest hemorrhage within the subcutaneous tissues at the myofascial junction. These criteria were adapted from those used to document indirect myotendinous injuries. These linear areas of abnormal signal in the soft tissues differ from the diffuse areas of abnormal signal in the soft tissues that occur with soft tissue impaction injuries.

Results

Of the 20 patients studied, 14 presented with medial-sided pain and six with lateral-sided pain. All had twisting injuries documented in their clinic notes and had pain suggesting internal derangement on physical examination by the referring orthopedic surgeon.

Fourteen patients had linear areas of abnormal signal in the soft tissues medially and six had abnormal signal in the soft tissues laterally (Figs. 1, 2, 3). These sites of abnormal signal correlated with the side of pain.

Despite clinical findings suspicious for internal derangement, none of these 20 patients had MR findings to suggest internal derangement. MR findings of abnormal signal in the soft tissues suggesting twisting injury were described in the MR reports. All 20 patients were placed on a 4-week course of protected weight-bearing of the affected extremity. All 20 had pain relief by clinical examination after this period of protected weight-bearing. Two patients were re-examined by MRI with documented resolution of the MR findings.

Discussion

Twisting injuries can occur with rotational motion resulting in shearing forces that cause separation of the skin and subcutaneous fat from the deep fascia and muscles. There have been previous reports demonstrating the formation of serosanguineous cysts in such locations. Previous reports have also documented soft tissue twisting injuries associated with pelvic fractures [2, 3].

In each of the 20 patients described, the referring orthopedic surgeon felt that the patient had a meniscal tear, bone bruise or chondral injury accounting for the clinical symptoms. In such cases, our orthopedic surgeons refer for MRI to document a meniscal tear or bone bruise. In patients with such clinical presentations, and no MR finding to account for their symptoms, the orthopedic surgeon may undertake arthroscopy in the belief that the patient may have a flap tear of the meniscus (which is