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Review Article: Proximal Tibiofibular Joint Dislocation.

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NF co-authored the case report.
JM performed the literature review.
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Running Title:
Proximal Tibiofibular Joint Dislocation.

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Isolated Proximal Tibiofibular Joint Dislocation.

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Abstract:

Proximal tibiofibular joint (PTFJ) dislocations are relatively rare injuries and this paper provides an up to date review and practical management approach for the assessment and management of these cases. Isolated PTFJ dislocations are a rare injury, accounting for less than 1% of all knee injuries. Thus, there does not appear to be a clear consensus on definitive management and post-reduction care in the literature. This paper provides a review of the literature, anatomical analysis of the PTFJ in the dislocated state, and a technique for reduction. In the majority of cases, PTFJ dislocations are an injury that can be identified with simple imaging modalities and treated in the emergency department with manipulation under procedural sedation.

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Key words:

Tibiofibular joint, dislocation

Case Report:

A previously fit and well 19-year-old male presented to the Emergency Department with pain to his lower left leg, sustained during an AFL game. He had a pain score of 8/10 and was also complaining of altered sensation in the toes of his left foot. He was immediately assessed by one of the authors, a nurse practitioner (NF).

Mechanism of injury

He had been tackled from behind, falling forwards and landing with his knee in hyperflexion, the entire weight of his opponent also falling on top of him. He experienced immediate pain and swelling to the proximal, lateral lower leg, but managed to weight bear and limp from the field.

Examination

A tender deformity was noted to his left proximal fibula area. His left knee was being held in full extension, with pain limiting flexion to approximately 30 degrees. The left ankle was tender at the lateral malleolus, as was the midfoot, and there were no signs of swelling or bruising. Sensation was intact other than slightly altered light touch to the lateral surface of the mid and distal third of his left lower leg.

Management

A differential diagnosis of proximal fibula fracture or dislocation was made and the patient was given analgesia and sent for x-rays, including a comparative x-ray of the right knee. No fractures were seen, and anterior dislocation of the fibula head was confirmed (Figure 2).

Consent was obtained for reduction, and also for video recording of the procedure (Video link PTFJ) and after sedating the patient, a closed reduction was performed by two of the authors (NC and NF).

Repeat x-rays confirmed reduction, and a post-reduction examination showed resolution of the altered sensation. The patient was provided with crutches and discharged with his knee in a Zimmer splint. Arrangements were made for him

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to be followed up with an MRI scan and orthopaedic outpatient clinic review.

The MRI scan of the knee showed a high grade posterior tibiofibular ligament tear, with no fracture or meniscal tear seen, and the posterolateral corner structures intact. Examination of the patient's knee did not exhibit clinical instability at the time of his orthopaedic review.

Literature Search:

Key words: *tibiofibular joint, dislocation.*
A systematic literature search was performed in preparing this review. The database searches included Medline OVID and PubMed. The reference lists of key articles and case reports were also reviewed for appropriate publications. Exclusion criteria included non-English articles; paediatric cases (<18 years of age) and associated lower limb fractures. The aforementioned criteria were selected in order to focus on isolated proximal tibiofibular joint (PTFJ) dislocations. A total number of 29 cases were selected for isolated PTFJ dislocations and included this review.

Proximal tibiofibular joint (PTFJ) anatomy:

The PTFJ is a synovial joint between the lateral condyle of the tibia and the head of the fibula. The joint is reinforced with an articular capsule, which is strengthened further by the anterior and posterior tibiofibular ligaments. In 10% of the population the synovial membrane of the PTFJ communicates with the knee joint via the sub-popliteal recess and thus these injuries can occasionally present with localised knee joint effusions (1). In addition, the PTFJ is supported by the lateral collateral ligament (LCL) of the knee and tendon of biceps femoris in knee extension (2, 3).

Ogden (1974) described two anatomical classifications of the PTFJ in their case series; 'horizontal' and 'oblique'. The 'horizontal' joint is described as a circular or planar articular surface, which can be slightly concave. The 'oblique' joint has a smaller but more variable articular surface associated with a steeper inclination of the articular surface (4).

Proximal tibiofibular joint (PTFJ) disruption:

PTFJ dislocations are typically associated with sporting injuries or high impact accidents resulting in multiple traumas (4-7). In high impact accidents,

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associated injuries such as tibial shaft fractures are seen, however for this review, we will focus on isolated PTFJ dislocations (6).

The clinical presentation of isolated PTFJ dislocation is often sudden onset of lateral knee pain with a prominent fibula head on palpation. Often there is mild localised swelling and the range of movement of the knee joint is reduced. Weight bearing status post-injury appears to be variable between case reports.

Ogden (1974) proposed a classification system for disruption of the PTFJ (Figure 1):

- *Subluxation (Type 1):* proximal fibula shows increased movement in all directions
- *Anterolateral dislocation (Type 2):* lateral and anterior displacement of the proximal fibula head
- *Posteromedial dislocation (Type 3):* posterior and medial displacement of the proximal fibula head
- *Superior dislocation (Type 4):* upward displacement of the fibula head

In the case reports of isolated PTFJ dislocation reviewed here, all presentations were consistent with anterolateral dislocation (Table 1). This finding is influenced by the selection of isolated dislocations and exclusion of associated lower limb fractures, as typically cases of posteromedial or superior PTFJ dislocation are associated with high impact injuries that result in associated injuries and lower limb fractures (4-6). Common peroneal injury should always be looked for as it may occur with types 2,3, and 4 (1).

Mechanism of dislocation:

The mechanism of anterolateral proximal tibiofibular joint dislocation most commonly follows a fall with the following anatomical positions occurring at the point of dislocation – ankle inversion, foot plantar flexed, and knee flexed or hyper-flexed (8).

Ankle and foot

Inversion/eversion and plantarflexion/dorsiflexion occur over the talo-calcaneo-navicular joint, and the subtalar joint. These movements take place around an oblique axis with the cervical ligament forming the axis of rotation. Inversion and plantarflexion occur together to varying extents, with eversion and dorsiflexion similarly paired.

At the point of dislocation (ankle inversion and foot plantar flexed), the mortise joint of the ankle is at its loosest, with maximal ankle inversion possible (Figure

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3). With the talus also inverted, the distal fibula can move a small amount inferiorly, pulled by the strong distal ligaments (anterior talofibular and calcaneofibular) attached to the fibula. In contrast, with eversion and dorsiflexion, the mortise joint of the ankle is locked and the articular surface of the distal fibula sits firmly on the lateral malleolar surface of the talus. This surface flares inferiorly and laterally and, with dorsiflexion, the fibula malleolus externally rotates, and this rotation is then also transmitted to the proximal fibula. At the point of dislocation, the peroneus longus and brevis, the extensor digitorum longus, and the extensor hallucis longus provide anteriorly directed pulling forces to the proximal fibula.

Knee

The fibular head sits in slight external rotation when the ankle is inverted.(9) With the knee flexed, the tibia can move in external or internal rotation. If the tibia is in external rotation at the point of injury, the fibular head is pushed laterally and anteriorly. (2, 9) The biceps femoris tendon and lateral collateral ligament are flexed so provide no support to the fibular head in this position.

Anatomical variants of the tibiofibular joint

The horizontal type averages 2 square millimetres of joint surface and has a greater capacity for rotation. The oblique type averages 17 square millimetres, has less capacity for rotation, and may therefore be more predisposed to dislocation given the precipitant position and forces. (4)

Factors contributing towards PTFJ dislocation include:

- Fibula position – externally rotated throughout, the head is pushed laterally and anteriorly by the tibia in when the knee is flexed.
- Lack of support structures – when the ankle mortise is unlocked and inferior movement of the fibula is permitted, the biceps femoris and medial collateral ligaments are flexed, providing no support.
- Muscular forces – anterior and inferior forces on the proximal fibula are exerted directly by the peroneus longus and brevis, the extensor digitorum longus, and the extensor hallucis longus.
- Ligamentous – inferior forces on the proximal fibula are transmitted through the fibular shaft via stretched ligaments (anterior talofibular and calcaneofibular) acting at the lateral malleolus.
- Anatomical variant – oblique type of tibiofibular joint.

Imaging:

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X-ray is the first line imaging modality for cases of suspected PTFJ dislocation. Antero-posterior (AP) and lateral films are recommended given that subtle features on AP imaging can lead to a misdiagnosis. X-ray films should be viewed with caution as oblique views and anatomical joint variants can influence the position of the fibula head and affect image interpretation (10). A number of case studies have demonstrated the risks of misdiagnosis with unilateral lower limb imaging and thus we would advocate for bilateral knee imaging to allow direct comparison in clinical practice (11, 12).

In a small number of case reports, the diagnosis of PTFJ dislocation has been confirmed on CT imaging following initial radiographs (Table 1). Of the case reports considered in this review, 24% confirmed PTFJ dislocation on CT. The indications for CT imaging are not well documented, however cases with inconclusive x-ray findings and those of suspected fractures on clinical grounds would warrant further imaging. The availability of CT imaging, particularly in the emergency department setting, may have contributed to the reported trend in CT imaging in the literature.

MRI remains the most sensitive imaging modality available and provides the ability to demonstrate ligamentous and peroneal nerve injury associated with PTFJ dislocation (10, 13). In the setting of PTFJ injury with intact tibiofibular ligaments, CT imaging can be limited as the subtle anterior migration of the fibula head is not always associated with lateral displacement and thus can lead to misdiagnosis (10). Only two cases in the literature progressed to MRI for diagnosis, one following an unsuccessful closed reduction and the other due to the radiation risk of CT in a pregnant patient (10, 14). In practice, it appears MRI is rarely required for diagnosis and should not delay definitive management in cases where x-ray and CT findings are suggestive of PTFJ dislocation.

Management - Reduction of proximal tibiofibular joint dislocation:

Isolated PTFJ dislocations are a rare injury, accounting for less than 1% of all knee injuries (12, 15). Thus, there does not appear to be a clear consensus on definitive management and post-reduction care in the literature. In all the case reports examined, closed PTFJ reduction was attempted initially with either local anaesthetic or intravenous sedation (Table 1). Of the 29 anterolateral PTFJ dislocations reported by Ogden (1974) in his case series, 14 were successfully managed with closed reduction. In the case reports reviewed here, 65% (n=19) were successfully managed with closed reduction (Table 1). It is not clear what factors led to failure of reduction, however the stated technique of dorsiflexion and external rotation of the ankle may result in a 'blocked' anatomical position

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(27). A review of the anatomy of PTFJ dislocation and an alternative anatomically based technique are discussed below.

Anatomy of dislocation and path of reduction

Once dislocated, the fibular head is sitting in an anterolateral position, with the anterior surface of the superior tibia directly behind (Figure 4). From this position, the head must travel inferiorly, laterally, posteriorly and then medially in order to reduce towards the appropriate PTFJ anatomical position.

The obstacles to reduction include:

- The flared lateral aspect of the superior tibia, which provides a bony posterior obstacle. This posterior obstacle is reduced inferiorly due to the shape of the tibia.
- Tension of the lateral collateral ligament and biceps femoris tendon. These stop the descent of the fibular head, and pull the head superiorly and against the anterior surface of the tibia.
- The ankle is no longer in an exaggerated inversion/plantar flexion, so the ability of the distal fibula to move inferiorly is impeded.
- The knee is no longer flexed, resulting in further lateral collateral ligament tension.

Mechanism of reduction

Procedural sedation of the patient is recommended, to facilitate relaxation of the biceps femoris tendon. When ready to proceed with reduction, the knee should be flexed towards 90 degrees, while placing the ankle into inversion and plantar flexion (Figure 5).
Downward pressure should be applied to the fibular head, which can then be guided laterally and posteriorly if required (Figure 6, link to video PTFJ).

Post-reduction care:

Weight-bearing status following closed reduction of a PTFJ dislocation varies between the case reports in the literature. The period of joint immobilisation ranges from immediate weight bearing post-reduction to six weeks of immobilisation (Table 1). A recent review article proposed a recommendation for a period of three weeks of joint immobilisation with a further three weeks of gradual weight-bearing following closed reduction of a PTFJ dislocation (1).

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Where closed reduction has not been achieved, open reduction with manual manipulation and the insertion of a Kirschner wire or cortical screw is the mainstay of treatment described in the literature (Table 1). In such cases, a period of joint immobilisation with plaster case is most commonly suggested for a period of six weeks, however there is significant variability between studies. The indications for selecting Kirschner wire or cortical screw insertion is infrequently reported and outcomes appear to be similar between management options (Table 1).

Conclusion

Given there are limited case series published to date on proximal tibiofibular joint dislocation, it is difficult to draw consensus recommendations between the different management strategies and patient outcomes. Despite this, the overall prognosis of isolated PTFJ dislocations is favourable, with only a small number of case studies reporting residual pain or the presence of functional limitations at follow up examinations (16, 17). The major discrepancy in interpreting outcomes is the differences between duration of follow up across treatment centres, which likely reflects the low incidence of isolated PTFJ dislocation. In the vast majority of cases, it is an injury that can be identified with simple imaging modalities and treated in the emergency department with manipulation under procedural sedation, using the technique described in this paper.

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