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CLINICAL COMMENTARY

Proximal Tibiofibular Subluxation Relationship to Lateral Knee Pain: A Review of Proximal Tibiofibular Joint Pathologies

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Proximal tibiofibular subluxation is the symptomatic hypermobility of the proximal tibiofibular joint. Pain along the lateral aspect of the knee must be carefully evaluated as the anatomy and biomechanics of this region are very complex. Anatomical variants of the proximal tibiofibular joint may be key to understanding the pathomechanics and, thus, treatment of this joint. The "horizontal" proximal tibiofibular joint has a higher degree of mobility, while the "oblique" joint is relatively immobile to rotational forces on the fibula. Increased fibular external rotation will result in injury to the anterior capsule and ligaments of the proximal tibiofibular joint causing common complaints of "popping" and lateral knee pain. Treatment of proximal tibiofibular subluxation will involve modifications of a patient's activity level and training programs, utilization of a supportive strap, lower leg strengthening, and modifications in the lower kinetic chain biomechanics.

Key Words: *proximal tibiofibular joint, subluxation, supportive strapping*

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The knee has been referred to as the joint of the 80s, with most literature, research, and clinical emphasis placed on the tibiofemoral and patellofemoral joints. The anterior cruciate ligament, meniscii, and articular cartilage have been under the most scrutiny, as clinicians try to develop better evaluative, operative, and rehabilitative techniques. Most clinicians have treated "lateral knee pain," especially in patients who participate in running sports. Diagnoses range from lateral meniscal pathology, iliotibial band syndrome, lateral collateral ligament sprain to lateral knee pain syndrome. The proximal tibiofibular joint is rarely noted or evaluated, either clinically or in the literature, as the cause of lateral knee pain.

Owen, in 1968, stated, "Among the numerous lesions that can cause confusion, the admittedly rare entity of recurrent superior tibiofibular joint dislocation in the young has not been given sufficient prominence" (16). Interestingly, hypermobile or recurrent dislocation of the proximal tibiofibular joint was not among the top 16 lesions that can lead to a misdiagnosis of knee pathologies according to Owen (16). In 1974, Baciu et al stated, "It is likely that a certain proportion of arthrotomies in which no lesion of the external meniscus is found may be explained by the existence of an undetected recurrent superior tibiofibular luxation" (3).

Traumatic dislocation of the proximal tibiofibular joint has been documented (1,7,13,14,16,17,19,20,22), but subluxation of this joint is less recognized (1,7,14,18), with much attention directed toward the preadolescent population. Many of the reported dislocations of the proximal tibiofibular joint were in conjunction with tibia and ankle fractures. Ogden, in 1974, defined subluxation of the proximal tibiofibular joint as "excessive, symptomatic anteroposterior motion without frank dislocation" (13). He believed that the proximal fibula exhibited increased motion laterally, medially, anteriorly, and posteriorly (13). Ogden's review of dislocations and subluxations of the proximal fibula revealed 29 anterolateral dislocations, three posteromedial dislocations, one superior dislocation, and 10 subluxations (13) (Figure 1) (Table 1). Of the 33 dislocations, six cases presented with a history of chronic subluxation prior to dislocation (14).

The authors of this paper believe that this joint has not received sufficient exposure. We believe proximal tibiofibular joint subluxation is not a rare pathology and will attempt to heighten the clinician's awareness of this joint and its pathomechanics.

In a recent screening at the 1994 San Diego Marathon, 22 volunteers with a history of knee pain were examined by a physical therapist (Table 2). Nine of the 22 individuals presented with hypermobility of the

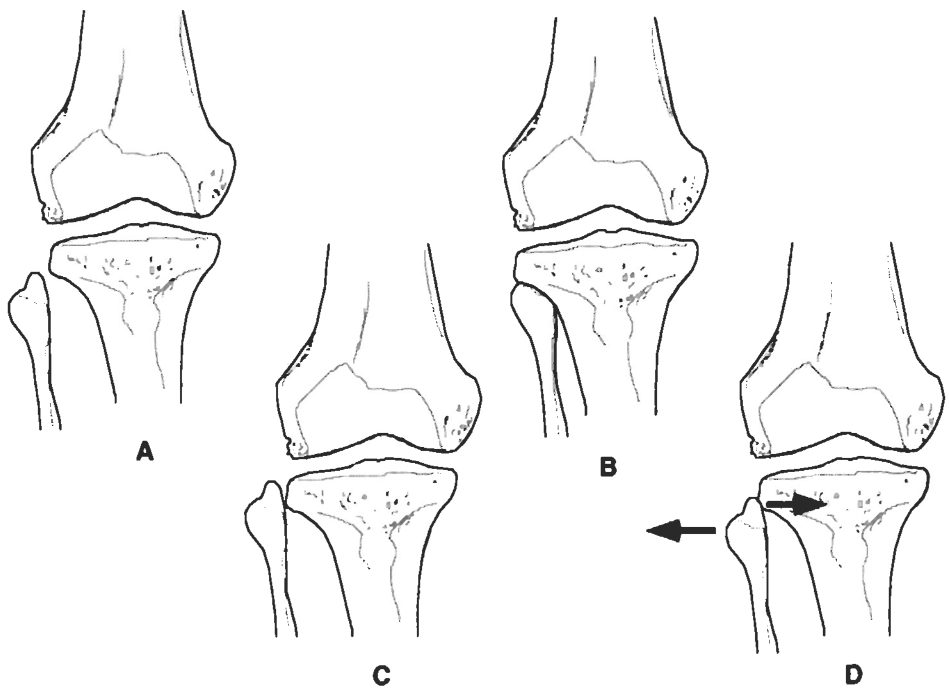

FIGURE 1. *Ogden's classification of proximal tibiofibular joint pathologies: A) anterolateral dislocation, B) posteromedial dislocation, C) superior dislocation, D) subluxation.*

proximal tibiofibular joint on the involved side (Table 3). Seven of the nine individuals had lateral knee pain that forced them to either reduce or completely stop running (Table 4).

Proximal tibiofibular subluxation is the symptomatic hypermobility of the proximal tibiofibular joint. The authors believe the pathology of the proximal tibiofibular subluxation involves the anatomical variants of the proximal tibiofibular joint, the biomechanical axis of the ankle, and training program errors. The continuum of proximal tibiofibular subluxation pathology, if not properly diagnosed, may lead to chronic dislocation of the proximal tibiofibular joint. This paper will review the anatomy, biomechanics, etiology and pathology, evaluation procedures, and past and present treatment techniques of the proximal tibiofibular joint.

Number of Cases	Age (years)	Gender	Medical History
6	8–14	Males (3) Females (3)	*
1	27	Male	Ehler's-Danlos Syndrome
3	>40	Males (3)	*

* *Seven out of the 10 cases presented with generalized ligamentous hyperlaxity.*

TABLE 1. *Ages, gender, and medical histories of 10 cases of subluxation without history of dislocation (13).*

ANATOMY

The proximal tibiofibular joint is an arthrodial plane joint composed of the tibial facet located on the posterolateral aspect of the rim of the tibial condyle and the fibular facet on the medial upper surfaces of the head of the fibula (8,9). A fibrous capsule surrounds the articulation with two prominent ligaments, the anterior superior tibiofibular ligament and the posterior superior tibiofibular ligament, providing additional stability. The anterior superior tibiofibular ligament, the thicker and stronger of the two, consists of two to three flat bands, while the posterior superior tibiofibular ligament is a single broad band (8,12) (Figure 2). The synovial membrane lines the articulation and, in some instances, is continuous with the popliteus bursa, which communicates with the knee joint (8,12). Eichenblat and Nathan's study of 50 cadaveric knees revealed six specimens in which the proximal tibiofibular joint communicated with the tibiofemoral joint through the subpopliteal recess. In these cases, the articular cartilage of the tibiofemoral joint was continuous with the articular cartilage of the proximal tibiofibular joint (5).

There is considerable variation in the size and inclination of the proximal tibiofibular joint. Barnett and Napier (4) defined three types of joints in 1952. Type I has a tibial articular surface that is large, planar, and circular in shape. The inclination of the joint is nearly horizontal. Forty-one of the 152 specimens (9

A) Swelling over proximal tibiofibular joint?
Yes: R L No:___
B) Pain with compression of proximal tibiofibular joint?
Yes: R L No:___
C) Pain with palpation of peroneal nerve?
Yes: R L No:___
D) Hypermobile fibular head motion?
Yes: R L No:___
If hyper then: anterior > posterior
posterior > anterior
E) Varus stress test at 0°
Painful
Yes: R L No:___
Laxity
Yes: R L No:___

TABLE 2. *1994 San Diego Marathon screening form.*

Test	Yes	No
Swelling over proximal tibiofibular joint	0	9
Pain with compression of proximal tibiofibular joint	3	6
Pain with palpation of peroneal nerve	3	6
Hypermobile fibular head motion*	9	0
Varus stress test at 0°		
Painful	2	7
Laxity	6	3

* *Hypermobility of the proximal tibiofibular joint presented with anterolateral motion greater than posteromedial motion in all nine subjects.*

TABLE 3. *Results from 1994 San Diego Marathon screening of nine subjects with hypermobile proximal tibiofibular joint on the involved side.*

Subject	Number of Miles a Week	Modifications
1	35–40	None
2	0	Unable to run
3	0	Plays basketball
4	25	Decreased mileage/ hills
5	0	Unable to run
6	25	80–85 miles regularly
7	25	Decreased pace
8	0	Unable to run
9	30	50 miles regularly

TABLE 4. *Modifications in running program of nine subjects with hypermobility of the proximal tibiofibular joint on the involved side.*

fresh amputations and 143 cadaver knees) that they studied were classified as Type I and had surface areas greater than 20 square millimeters. Type II joints have moderately large tibial articular surfaces that are elliptical in shape. Forty specimens demonstrated this variation with an increased incidence of communication between the proximal tibiofibular and tibiofemoral joints through the synovial bursa (popliteus bursa). Type III proximal tibiofibular joints have smaller, planar, and irregular articular surfaces. Forty-two specimens were included in this classification with articular surface areas less than 15 square millimeters. Type III joints have greater inclination to the horizontal plane than Type I. The remaining 29 specimens could not be categorized into any of the three types (4).

Ogden (13,15), in 1974, developed a simpler classification of the proximal tibiofibular joint. He studied 84 specimens (50 cadaveric knees, 4 fresh autopsies, and 30 dried bone tibiafibula units) and classified two types of joints: "horizontal" and "oblique" (Figure 3). Ogden arbitrarily assigned 20° of inclination from the horizontal plane as the division between the two groups. The "horizontal" joint is planar, slightly concave, circular in shape, and is found behind a projection of the lateral edge of the tibia. The cross-sectional area of the "horizontal" joint articular surface averages 26 square millimeters. The "oblique" joint has a smaller articular surface averaging between 10 and 20 square millimeters. The surface area of the "oblique" joints is also more variable, as one-half of the surface areas are planar, and the other half are either slightly convex or concave. The inclination of the oblique joint ranges from 20 to 76° with an inverse correlation between the angle of inclination and articular surface area: the greater the inclination of the oblique joint, the smaller the surface area (13,15).

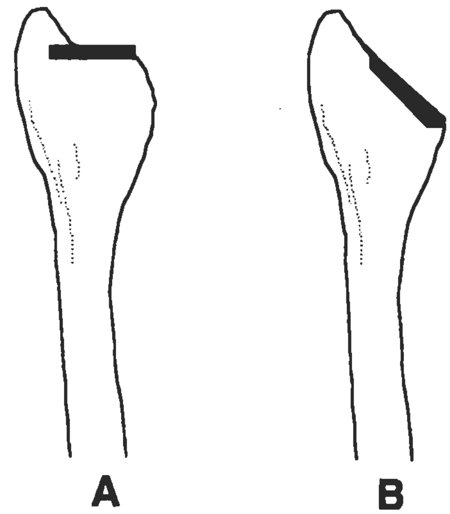

FIGURE 3. *Proximal tibiofibular joint: A) "horizontal" joint, B) "oblique" joint.*

Eichenblat and Nathan (5) developed a classification system in their 1983 study of the fibula, tibia, and proximal tibiofibular joint in 489 dry bones, 50 cadaveric knees, and one clinical case. The type of joints were classified into seven categories: plane (33.55%), trochoid (29.57%), double trochoid (22.59%), condylar (4.65%), saddle (2.32%), trochlear (.86%), and ball and socket (.67%). A majority of the trochoid had concave fibular (82%) and convex tibial (78%) articular surfaces. The contour of the proximal tibiofibular joint articular surfaces were described as elliptical, circular, irregular, triangle, or kidney shaped. Mean surface area of the fibular articulating surface was 112 square millimeters (SD = 33.31), while the tibial articulating surface was 95.9 square millimeters (SD = 22.11). Joint inclination ranged from 5 to 60° on the fibula ($\bar{X}$ = 25°) and 5 to 80° on the tibia ($\bar{X}$ = 25°). An interesting finding by the authors was the absence of articular facets on 10 fibula heads and 12 tibias, which sug-

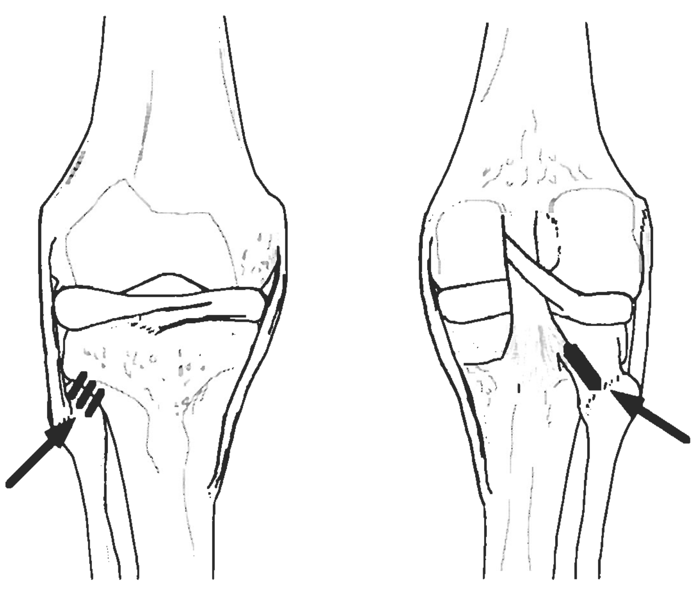

FIGURE 2. *Proximal tibiofibular joint ligaments: A) anterior, B) posterior.*

gests that the proximal tibiofibular joint can be a syndesmosis joint similar to the distal tibiofibular joint (5).

The lateral collateral ligament and interosseous membrane are associated structures that provide stability to the proximal tibiofibular joint. The lateral collateral ligament originates from the lateral epicondyle of the femur and runs distally to the head of the fibula, anterior to the styloid process (12). The interosseous membrane runs obliquely between the borders of the tibia and fibula. Oval apertures in the superior and distal aspects of the interosseous membrane allow the passage of the anterior tibial vessels and the anterior peroneal vessels, respectively (8).

The neurology of the lateral aspect of the knee is important to review as a number of the case studies involving the proximal tibiofibular joint were not diagnosed until the patient developed foot drop (14,16). The common peroneal nerve or lateral popliteal nerve is in close proximity to the proximal tibiofibular joint as it passes posteriorly over the head of the fibula. While in the popliteal fossa, the common peroneal nerve gives off genicular branches: the lateral sural cutaneous nerve and a sural communicating nerve. The genicular nerves innervate the tibiofemoral and proximal tibiofibular joints. The lateral sural cutaneous nerve supplies the skin along the calf with the sural communicating nerve joining the sural nerve to supply the lateral aspect of the ankle and foot. The common peroneal nerve is palpable along the lateral aspect of the fibula as it wraps around the fibular neck before diving beneath the peroneus longus muscle. The nerve then divides into the superficial and deep peroneal nerves (12). The deep branch innervates the tibialis anterior, extensor hallicus longus, extensor digitorum longus, peroneus tertius, and extensor digitorum brevis. The superficial peroneal nerve innervates the peroneus longus and brevis (10).

In reviewing the myology of the lower extremity, it is important to note that the flexor hallucis longus, extensor digitorum longus, peroneus tertius, extensor hallucis longus, tibialis posterior, peroneus longus, peroneus brevis, and soleus all have some fibers originating from the fibula (10). Of particular interest is the insertion of the biceps femoris on the anterior and lateral sides of the fibula. The tendon of the biceps femoris is actually split by the insertion of the lateral collateral ligament on the head of the fibula (12).

The distal tibiofibular joint, which is a syndesmosis joint, is stabilized by the anterior inferior tibiofibular ligament, posterior inferior tibiofibular ligament, transverse ligament (located under the posterior inferior tibiofibular ligament), and inferior interosseous ligament (8). This distal joint may be the key in the successful treatment of proximal tibiofibular subluxation.

BIOMECHANICS

The anatomical variants and the fact that this joint has not drawn the attention of clinicians may explain why the function of the proximal tibiofibular joint is not better understood. Basmajian described the proximal tibiofibular joint as an "accommodatory joint" designed to give a little play to the fibula and to protect it from breaking (5). Ogden defined the primary function of the joint as: *A*) dissipation of torsional stresses applied at the ankle, *B*) dissipation of lateral tibial bending moments, and *C*) tensile, rather than compressive weight bearing (15). Lambert hypothesized that one-sixth of static load applied at the ankle was transmitted along the fibula (11). Evans and Band's study supported the tensile hypothesis. They reported that the proximal fibula was involved in tensile forces rather than compressive ones. They also reported that the proximal and middle one-third of the fibula had greater tensile strength than the femur (6).

The normal movements of the proximal tibiofibular joint are believed to be in an anterolateral and posteromedial direction, as the joint does not sit in a true sagittal plane. With a review of the anatomical variants, it is easy to see that there are also biomechanical variants. As the knee moves into extension in an open kinetic chain position, the fibular head is pulled posterior as the lateral collateral ligament and biceps femoris become taut. Knee flexion produces an anterior movement due to the relaxation of the lateral collateral ligament and biceps femoris tendon (15). These movements may differ in a closed kinetic chain position due to movements occuring at the distal tibiofibular and talocural joints. Andersen (1) and Moore (12) describe the fibula as laterally or externally rotating with dorsiflexion of the ankle joint. Ogden's fluoroscopic studies also demonstrated fibular rotation with ankle dorsiflexion, and in addition, he found that there appeared to be more external rotation in the horizontal type than in the oblique type of proximal tibiofibular joint (15). Barnett and Napier described the rotation of the horizontal joint as movement similar to rotation at the radio-humeral joint (4).

When the ankle is dorsiflexed, the medial aspect of the talus remains coplanar, while the lateral side rotates, changing the inclination of the dorsiflexion axis. The fibula must externally rotate to allow for the rotation of the talus (4). Barnett and Napier correlated a relationship between the anatomical shape of the proximal tibiofibular joint and progressive ranges of dorsiflexion of the ankle. They described Type I (horizontal) joints as having large, freely moving articulations which are associated with a high dorsiflexion axis inclination in the ankle. Type III (oblique) joints, conversely, are small immobile joints associated with low inclination of the dorsiflexion axis.

The proximal tibiofibular joint may be involved in the lateral stability of the tibiofemoral joint, as the lateral collateral ligament attaches distally to the fibular head.

ETIOLOGY AND PATHOLOGY

Anterolateral dislocation, posteromedial dislocation, superior dislocation, and subluxation have been described as pathologies of the proximal tibiofibular joint (13). Mechanisms of injury reported in the literature include twisting injuries, slipping injuries where the patient lands on his knee which is flexed under his body, multiple traumas, and parachute landings (13). Anterolateral dislocations of the proximal tibiofibular joint usually occur during athletic activities and are often associated with fractures of the tibia and fracture-dislocation of the ankle or hip. Ogden's description of the mechanism of injury for an anterolateral dislocation provides the best understanding of the traumatic pathomechanics of the proximal tibiofibular joint (13). He describes: *A*) sudden inversion and plantar flexion of the foot that causes tension in the peroneal muscle group, extensor digitorum longus, and extensor hallucis longus; *B*) simultaneous flexion of the knee with relaxing of the biceps tendon and lateral collateral ligament; and *C*) concomitant twisting of the body, transmitting the twist along the femur to the tibia, causing a relative external rotatory torque of the tibia on the foot, which is already fixed in inversion. The combination of B and C spring the proximal end of the fibula out laterally, at which point the violently contracting muscles from A pull the fibula forward (13).

The continuum of proximal tibiofibular subluxation pathology, if not properly diagnosed, may lead to chronic dislocation of the proximal tibiofibular joint.

Posteromedial dislocations have been documented in two cases where both patients caught their knees between motor vehicle bumpers (13). A superior dislocation was described in an 8-year-old boy who had a 2-cm shortened healing of a tibial fracture (13). Subluxations, on the other hand, are associated with generalized ligamentous laxity, muscular dystrophy, or are posttraumatic following dislocation (1,13).

In a study of four fresh cadeveric knees, Ogden tested fibular rotation. Moderate forces (specific amounts not available in the literature) were applied in a lateral and rotatory direction on Steinmann pins placed in the fibula. This failed to dislocate the proximal end of the fibula. The joint capsule was then transected, the forces were reapplied, and again, the proximal tibiofibular joint would not dislocate. The knee was then placed in a minimum of 80° of flexion, which allowed anterolateral dislocation when the same forces were applied. Once dislocated, the anterolateral position of the fibular head remained even with extension of the knee as the lateral collateral ligament maintained the dislocation. With the knee flexed, the anterolateral dislocation could be manually reduced. Lastly, Ogden transected the lateral collateral ligament, allowing the biceps femoris tendon to remain attached to the head of the fibula. Anterolateral dislocation was reproduced easily with lateral and rotatory pressure and could be reduced even with the knee in extension (13).

In 1974, Ogden evaluated the plane of the joint and its relationship to the pathomechanics of the proximal tibiofibular joint. He discovered that over 70% of the subluxations and dislocations had an oblique proximal tibiofibular joint. His hypothesis was the oblique proximal tibiofibular joint was less tolerant to the rotation of the fibula than a horizontal proximal tibiofibular joint (13). Barnett and Napier described a similar finding when they measured the rotation of the fibula in a freshly amputated lower leg (4). They placed indicator pins into the shafts of the fibula and tibia, dorsiflexed the ankle, and recorded 3° of fibular lateral rotation. The proximal tibiofibular joint was then dissected to reveal large flat articular surfaces. Barnett and Napier's conclusion was that individuals with immobile, oblique proximal tibiofibular joints do not tolerate increased torsional stress in the fibula caused by dorsiflexion of the ankle beyond normal ranges (4).

Pathologies of the proximal tibiofibular joint can involve the anterior and posterior capsular ligaments and possibly the lateral collateral ligament. Injury to these soft tissue structures will allow the functional structures and biomechanics of the lower kinetic chain to influence movements at the proximal tibiofibular joint (13, 14). Errors in a person's training program may influence these functional structures and biomechanics of the lower kinetic chain, as histories from many of the patients with proximal tibiofibular subluxation revealed increasing running mileage after a period of not running.

The authors hypothesize that a number of our patients' proximal tibiofibular joints do not tolerate increases in fibula rotation secondary to trauma, overuse, or biomechanical variation of the talocural joint. The pathology of proximal tibiofibular subluxation appears to involve the anterior capsule and anterior ligament of the proximal tibiofibular joint. These anterior structures may be stretched as a result of excessive fibular rotation. Once stretched, the functional forces of the biceps femoris and soleus maintain the proximal tibiofibular joint in a relative posterior, externally rotated position. It is important to understand the pathomechanics of the proximal tibiofibular joint, as early recognition may save the patient from needless surgeries and treatment. Dislocations can develop into chronic subluxations, and chronic subluxation may lead to dislocations.

EVALUATION

A complete subjective and objective evaluation is the critical key to recognizing proximal tibiofibular subluxation because the history, signs, and symptoms of lateral knee pain can be very misleading. Current literature provides little subjective information, objective measurements, and special tests to aid the clinician in the evaluation of proximal tibiofibular subluxation. We have found the patient's history may reveal no specific mechanism of injury or report of forced knee flexion with the lower leg in an internally rotated position. Many of our current patients reported running increased mileage with no change in terrain. Most patients report more discomfort after running the first 2–3 miles and with running downhill. There is little pain associated with activities of daily living. The location of the pain is generally along the lateral aspect of the knee, radiating proximally into the region of the iliotibial band and medially into the patellofemoral joint. The patient specifically grabs around the lateral head of the gastrocnemius, noting pain along the posterolateral joint line of the knee. The patient will also complain of "swelling which disappears" and "a click somewhere in front" (16). Transient parathesias over the fibular head may be noted. Progressive peroneal nerve symptoms, which include foot drop, are usually seen in older patients and are more common with dislocations (14), but must not be overlooked in the chronic subluxation of the proximal tibiofibular joint. From the subjective perspective, it is easy to understand why the proximal tibiofibular joint may be missed when evaluating pathologies causing lateral knee pain, as symptoms and mechanism of injury are vague.

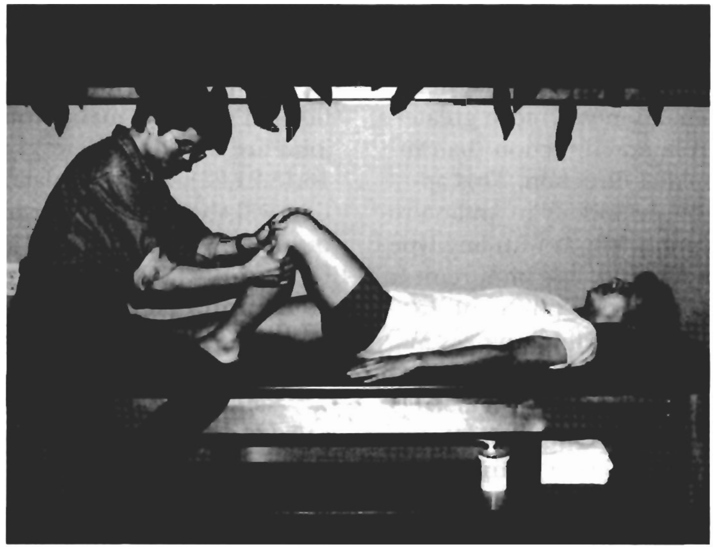

FIGURE 4. *Patient positioning for proximal tibiofibular joint play testing.*

Inspection of the knee will reveal a prominent fibular head in anterolateral dislocations (1,13). In proximal tibiofibular subluxation, the patient may exhibit a sulcus over the lateral tibial plateau. This change is very subtle and may not be present all the time. There is no apparent swelling over the proximal tibiofibular joint, but palpation of the fibular neck (peroneal nerve) and compression of the proximal tibiofibular joint may be painful. Quadriceps tone appears within normal limits when compared with the uninvolved side. Range of motion may be limited and painful into flexion in the acute cases of subluxation. Patients describe a "catch" or "pinch" in the posterolateral region of the knee with flexion. Knee extension is usually not limited by proximal tibiofibular joint dysfunction, but may be limited by pain secondary to the pull of the biceps femoris. Varus stress test of the knee can be positive with increased gaping and pain noted with testing compared with the uninvolved knee.

FIGURE 5. *Hand positioning for proximal tibiofibular joint play testing.*

Sijbrandij (18) described a passive joint play test of the proximal tibiofibular joint. With the patient in a supine position and the knee flexed to 90°, the fibular head is held between the thumb and index finger (Figures 4 and 5). The muscles of the leg must be relaxed, especially the biceps femoris. The examiner moves the fibular head anteriorly and laterally. On release, it returns with a click to its original position. Dislocation or subluxation can easily be visible as the fibular head can translate 1–1½ cm as compared with the uninvolved side (18). This examination is not usually painful. If the examiner does not grab part of the lateral head of the gastrocnemius, then the patient may note some tenderness and may not relax the biceps femoris. In the authors' experience, the fibular head of patients with proximal tibiofibular subluxation will move greater in an anterolateral direction than in a posteromedial direction. This appears as a hypermobility in an anterolateral direction, but as with any type of joint play testing, it is important to recognize the starting point and to determine if the starting point is in the midrange or neutral position. Ogden noted that the fibular head can be quite mobile until adolescence; thus, side-to-side comparison is imperative (14). The Radulescu sign, reported by Baciu et al in 1974, can also determine the stability of the proximal tibiofibular joint. The patient lies prone with the knee flexed to 90°. The examiner places one hand on the thigh, and the other hand holds the patient's foot in a plantar flexed position. The examiner applies an internal rotation force on the lower leg. Observing an abnormal excursion of the fibular head in an anterior and lateral direction represents a positive test (3).

The strap is placed approximately 1 cm below the fibular head and is applied so that the free end is pulled from posterior to anterior.

Joint mobility testing must also be performed on the ankle joint, especially the inferior tibiofibular joint. Barnett and Napier's description of the ankle dorsiflexion axis and its relationship to the proximal tibiofibular joint (4) illustrates how the distal tibiofibular joint may play an important part in the etiology and, thus, treatment of proximal tibiofibular subluxation.

Radiographic studies of dislocations of the proximal tibiofibular joint are well documented (1,3,13,14, 16,18,21,22). An anterolateral dislocation will show a lateral displacement of the fibular head in the anteroposterior view and an anterior displacement in the lateral view. The opposite is true for a posteromedial dislocation (18).

Radiographic studies on proximal tibiofibular joint subluxations are not well documented and are not included in the standard plain X-ray films of the knee. Veth et al, in 1984, described a special projection created by 30–90° of internal rotation of the lower leg (21). This view would demonstrate a change in the distance of the medial aspect of the fibular head and the lateral aspect of the tibia plateau. Rotation varies with the position of the proximal tibiofibular joint. Veth et al's study of 26 patients revealed: 10 patients were diagnosed with proximal tibiofibular instability based on standard X-ray films and clinical exam; nine patients were diagnosed with proximal tibiofibular joint instability with the addition of the special rotation projection; one patient had high suggestive history, but neither clinical exam or X-ray films could confirm a diagnosis; and six patients had a suggestive history, showed dislocation on standard films, no dislocation on the special rotation projection, and stopped having symptoms in a few weeks after their evaluation. Of the 19 patients with positive proximal tibiofibular joint instabilities, 13 patients were diagnosed with an anterolateral dislocation, four with posteromedial dislocations, one with a superior dislocation, and one with proximal tibiofibular joint subluxation.

The joint space of the proximal tibiofibular joint is visible in an oblique radiographic view. Reproducibility of the oblique view is very difficult secondary to changes in fibular rotation which occurs at various degrees of ankle dorsiflexion and plantar flexion and the anatomical variants of the proximal tibiofibular joint. Further research with radiographic, magnetic resonance imaging (MRI), and fluoroscopic techniques of the proximal tibiofibular joint is recommended.

Baciu et al and Sijbrandij reported the signs and symptoms of proximal tibiofibular joint pathologies can resemble the symptomatology of external meniscus pathology (3,18). Thus, a complete and comprehensive evaluation is essential in the assessment of proximal tibiofibular subluxation.

TREATMENT

Anterolateral dislocations are almost always treated with closed reduction. After successful reduction, the knee is then immobilized in extension or slight flexion for 2 to 3 weeks (13). Ogden reported 14 cases of anterolateral dislocation treated with closed reduction. Six of the 14 patients were totally asymptomatic at 9 to 44 months follow-up. The remaining eight patients complained of recurring pain and insecurity within 6 months. Four of the eight patients were treated with arthrodesis of the proximal tibiofibular joint, while the other four patients had resection of the fibular head (13).

Posteromedial dislocations are treated with operative intervention if persistent symptoms remain with conservative care (1). Surgical treatment includes open reduction and a repair of the capsule and lateral collateral ligament. The proximal tibiofibular joint is temporarily fixed with a Steinmann pin, placed below the joint (13).

Ogden suggests immobilization for 2 to 3 weeks in a cylinder cast for acute subluxation of the proximal tibiofibular joint presenting with pain on direct palpation of the fibular head (14). In six cases of chronic instability, four patients had an arthrodesis of the proximal tibiofibular joint and two patients had fibular head resection. On follow-up, one of the four arthrodesis patients was lost at 2 months as he had broken the screw. The three remaining patients with follow-ups from 3 to 17 years all demonstrated solid fusions. Unfortunately, all of the patients complained of pain, discomfort, and instability of the ankle. Ogden felt this was secondary to the limited fibula rotation as a result of the proximal arthrodesis (14). Two of these three arthrodesis patients underwent a resection of the proximal fibula head. At 2 and 7 years follow-up, these patients had no recurrent knee symptoms or complaints of ankle pain or instability. These results coincide with the two patients of the original six who had the fibular head resection without any type of arthrodesis (14).

From Ogden's reports, fibular head resection would be the surgical technique of choice. Unfortunately, Ogden does not discuss his patients' activities of daily living and athletic status. In 1986, Giachino described a repair of the proximal tibiofibular joint capsule utilizing a strip of biceps femoris tendon and deep fascia from the anterior compartment of the lower leg (7). His results on two case studies demonstrated excellent results with one patient returning to semi-professional football 3 months postoperatively (7). In a recent article, Shapiro et al described another technique for reconstructing the proximal tibiofibular joint with a graft from the iliotibial band. A 4-month single case study follow-up was reported with normal range of motion and no evidence of recurrent proximal tibiofibular joint dislocation (17). In nonoperative treatment techniques, Sijbrandij (18) and Turco and Spinella (20) refer to the use of a supportive bandage for the proximal tibiofibular joint if the patient had pain during sporting activities. Turco and Spinella describe the supportive strap as being similiar to a tennis elbow strap, but they do not report how or where to apply the strap (20).

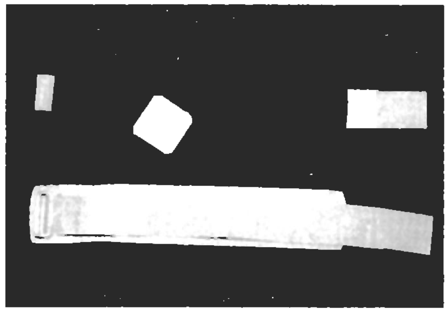

FIGURE 6. *Modified Universal Forearm Support (Smith & Nephew DonJoy Inc., Carlsbad, CA).*

Reviewing the literature on treatment of proximal tibiofibular joint pathologies does not provide the clinician or patient with many alternatives. The current treatment approach taken by the authors for proximal tibiofibular subluxation utilizes a supportive strap combined with a lower extremity strengthening program. A Universal Forearm Support (Smith & Nephew DonJoy Inc., Carlsbad, CA) is modified by removing the felt pad as it can be irritating to the patient (Figures 6 and 7). The strap is placed approximately 1 cm below the fibular head and is applied so that the free end is pulled from posterior to anterior, with the "D" ring lying just posterior to the fibula (Figure 8 A–C). The patient is instructed in the correct positioning and is made aware of signs of peroneal nerve irritation. The patient is instructed to wear the strap for activities as per symptoms. Many patients with increased hypermobility of the proximal tibiofibular joint have reported wearing their strap during working hours in addition to sport activities. Lateral gastrocnemius pain is reported by some patients during the first 2–3 days while utilizing the strap. This pain appears to be specific to the lateral head of the gastrocnemius and subsides with time. The authors have attributed this pain to a change in the patient's gait pattern, although further research is warranted on this hypothesis.

Proprioception exercises with balance boards and mini-tramps are initiated in the early phases of rehabilitation as long as there is no increase in the subjective report of pain. Increased attention is placed on lateral and rotatory movements. Isokinetic velocity spectrum training is utilized to strengthen the peroneal longus and brevis (Table 5). The an-

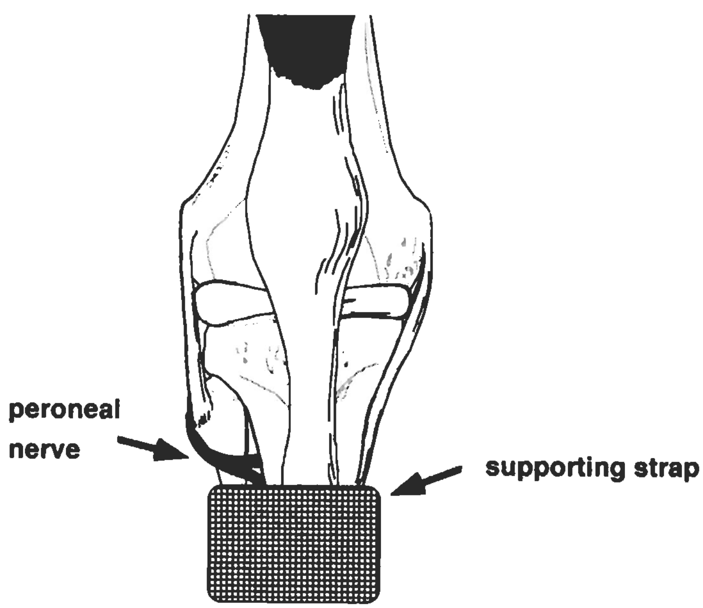

FIGURE 7. *Positioning of strap for proximal tibiofibular subluxation. The brace is placed 1 cm below the fibular head.*

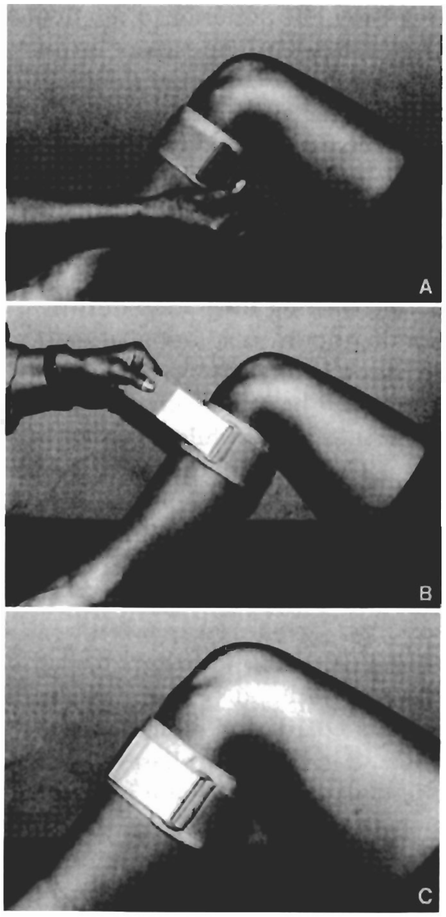

FIGURE 8. *A–C) Apply the strap, pulling from a posterolateral to anteromedial position.*

terior fibular insertion of these muscles may provide functional stability to the proximal tibiofibular joint. Therapeutic exercise for strengthening the extensor digitorum longus and extensor hallucis longus is encouraged, as these muscles may assist

Sets	Speed (°/sec)	Repetitions	Rest Times (seconds)
1	120	20	10
2	150	20	10
3	180	20	10
4	240	20	10
5	270	30	10
6	300	30	10
7	240	20	10
8	180	20	10

TABLE 5. *Isokinetic velocity spectrum training program for the lower leg. Ankle inversion/eversion and plantar flexion/dorsiflexion motions follow the same protocol.*

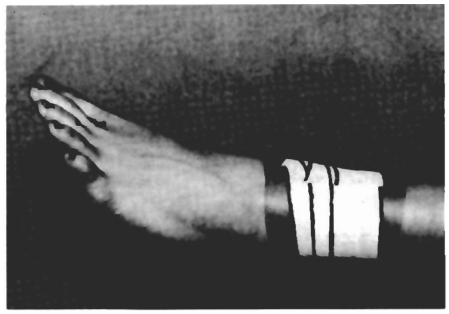

FIGURE 9. *Circular tape application for hypermobility of the distal tibiofibular syndesmosis.*

in proximal tibiofibular joint stabilization. Stretching of the biceps femoris and soleus muscles is promoted, while strengthening is not encouraged, as these muscle groups produce posterior excursion of the proximal tibiofibular joint and increase the complaints of pain. It is very important that an accurate diagnosis has been made, as strengthening the anterior lower leg muscles in a patient with an anterolateral dislocation may increase the proximal tibiofibular joint instability and increase the patient's symptoms. Utilization of the strap for therapeutic exercise (involving the biceps femoris and soleus) can reduce the patient's symptoms. Further research on the effects of lower extremity musculature on the proximal tibiofibular joint is warranted.

Recently, the authors have been utilizing tape circulars around the lower leg along with the proximal strap. The circulars are used with patients who have a reduction in their symptoms with the proximal strap but still complain of proximal tibiofibular joint pain (Figure 9). Most of these patients also demonstrate instability of the inferior tibiofibular and talocural joints. Skin Prep (Smith & Nephew DonJoy Inc., Carlsbad, CA) is applied first to an area approximately 10 cm proximal to the malleoli, followed by the application of one to two layers of Pre-Wrap (Smith & Nephew DonJoy Inc., Carlsbad, CA). Three to four circulars of 1-inch Speed Wrap (Smith & Nephew DonJoy Inc., Carlsbad, CA) are applied with moderate tension over the Pre-Wrap, while the patient's ankle is passively plantar flexed. It is important not to apply the tape too tight and to monitor the tape for skin irritation along the Achilles tendon.

Unfortunately, most of the treatment guidelines presented here are on short-term case studies. Our patients' subjective reports of decreased symptoms and increased functional status, however, have been very positive, particularly with the patients that have undergone a number of surgical interventions with no change in symptoms.

Case Study

A 30-year-old female presented in our clinic with complaints of pain along the lateral aspect of her right

While backpacking, the patient noted pain while carrying a 40-lb load after the first 10 miles and particularly on the downhill trails.

knee. The patient reported pain with running and backpacking. She especially noted the pain with running after approximately 8 minutes and particularly while running downhill. While backpacking, the patient noted pain while carrying a 40-lb load after the first 10 miles and particularly on downhill trails. She also noted pain along the lateral aspect of her right knee when she would try to sit with her right leg over the left. The patient reported the onset of right knee pain 8 years ago during a 10K race. She completed the race, but noted severe lateral knee pain, which caused her to walk with an antalgic gait for 2 to 3 weeks. The patient reported she has not attempted to run in the last 3 months and has significantly decreased her running time and distance in past years. The patient does report that she has continued to cycle, roller blade, snow ski, and lift weights without the right lateral knee pain.

The objective examination revealed a hypermobility of the proximal tibiofibular joint on the right. Palpation of the proximal tibiofibular joint demonstrated tenderness with compression. No apparent effusion was noted in the proximal tibiofibular joint or tibiofemoral joint. Pain was reported with palpation of the peroneal nerve along the fibular neck, but not along the lateral tibiofemoral joint line. Parathesia was noted over the fibular head on the right with light touch when compared with the left. Ligamentous testing appeared within normal limits and equal bilaterally except for a slight increase in the laxity of the lateral collateral ligament on the right. The patient denied any pain associated with the varus testing. McMurray's and modified McMurray's tests were negative. The patient had not had previous X-rays or MRI testing.

The patient was instructed in the use and application of the modified Universal Forearm Support (Smith & Nephew DonJoy Inc., Carlsbad, CA). In the first attempt at running, the patient ran pain free for 18 minutes and reported cardiovascular strain as the reason she stopped her exercise. The next day, however, the patient reported severe posterolateral leg pain. She complained of pain with calf stretching and active heel raises at the lateral head of the gastrocnemius. The patient felt the pain was secondary to delayed onset muscle soreness. She applied ice two times a day along with easy gastrocnemius stretching in the first 48 hours, after which the pain was completely resolved. The patient denied swelling in the knee. After 6 weeks of utilizing the strap for running, the patient reports she is running 45 minutes without any complaint of right lateral knee pain.

SUMMARY

Baciu et al, in 1974, stated, "Recognition and adequate treatment of recurrent superior tibiofibular luxation represent an important element of differential diagnosis in the pathology of the knee" (2). The proximal tibiofibular joint, like all synovial joints, is vulnerable to dysfunction of both the static and dynamic structures. Pain along the lateral aspect of the knee must be carefully evaluated as the anatomy and biomechanics of this region are very complex and variable. Treatment of proximal tibiofibular subluxation will involve modification of patients' activity level and training programs, utilization of a supportive strap, lower extremity strengthening and stretching, and modifications in the lower kinetic chain biomechanics. JOSPT

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REFERENCES

1. *Andersen K: Dislocation of the superior tibiofibular joint. Injury 16(7):494–498, 1985*
2. *Andrish JT: The leg—Proximal tibiofibular joint. In: DeLee JC, Drez D (eds), Orthopaedic Sports Medicine Principles and Practice, pp 1622–1625. Philadelphia: W.B. Saunders Company, 1994*
3. *Baciu CC, Tudor A, Olaru I: Recurrent luxation of the superior tibiofibular joint in the adult. Acta Orthop Scand 45:772–777, 1974*
4. *Barnett CH, Napier JR: The axis of rotation at the ankle joint in man. Its influence upon the form of the talus and the mobility of the fibula. J Anat 86: 1–9, 1952*
5. *Eichenblat M, Nathan H: The proximal tibio fibular joint. An anatomical study with clinical and pathological considerations. Int Orthop 7:31–39, 1983*
6. *Evans FG, Band S: Studies on the Anatomy and Function of Bone and Joints, New York, NY: Springer-Verlag, 1966*
7. *Giachino AA: Recurrent dislocations of the proximal tibiofibular joint. J Bone Joint Surg 68A(7):1104–1105, 1986*
8. *Gray H: The Classic Collector's Edition—Gray's Anatomy, New York, NY: Bounty Books, 1977*
9. *Kapandji IA: The Physiology of the Joints, Vol 2: Lower Limb (5th Ed), pp 162–165. New York, NY: Churchill Livingstone Inc., 1987*
10. *Kendall FP, McCreary EK: Muscles—Testing and Function (3rd Ed), Baltimore, MD: Williams & Wilkins, 1983*
11. *Lambert KL: The weight bearing function of the fibula. J Bone Joint Surg 53A(3):507–513, 1971*
12. *Moore KL: Clinically Oriented Anatomy, Baltimore, MD: Williams & Wilkins, 1980*
13. *Ogden JA: Subluxation and dislocation of the proximal tibiofibular joint. J Bone Joint Surg 56A(1):145–154, 1974*
14. *Ogden JA: Subluxation of the proximal tibiofibular joint. Clin Orthop 101: 192–197, 1974*
15. *Ogden JA: The anatomy and function of the proximal tibiofibular joint. Clin Orthop 101:186–191, 1974*
16. *Owen R: Recurrent dislocation of the superior tibiofibular joint. A diagnostic pitfall in knee joint derangement. J Bone Joint Surg 50B(2):342–345, 1968*
17. *Shapiro GS, Fanton GS, Dillingham MF: Reconstruction for recurrent dislocation of the proximal tibiofibular joint. Orthop Rev 22(11):1229–1232, 1993*
18. *Sijbrandij S: Instability of the proximal tibiofibular joint. Acta Orthop Scand 49:621–626, 1978*
19. *Thomason PA, Linson MA: Isolated dislocation of the proximal tibiofibular joint. J Trauma 26(2):192–195, 1986*
20. *Turco VJ, Spinella AJ: Anterolateral dislocation of the head of the fibula in sports. Am J Sports Med 13(4): 209–215, 1985*
21. *Veth RPH, Kingma LM, Nielsen HKL: The abnormal proximal tibiofibular joint. Arch Orthop Trauma Surg 102: 167–171, 1984*
22. *Veth RPH, Klasen HJ, Kingma LM: Traumatic instability of the proximal tibiofibular joint. Injury 13(2):159–164, 1981*