Lisfranc injuries

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Lisfranc injuries are midfoot fracture dislocations. The mechanism of injury may vary from simple distension to high-energy trauma. An early correct diagnosis is essential. There is no absolute consensus on definitive treatment, however, closed reduction and k-wire fixation should be avoided. Open reduction and internal screw fixation or primary arthrodesis of the medial and middle column, especially in pure ligamentous injuries, are recommended.

Lisfranc injuries are dislocations or fracture dislocations through the tarsometatarsal (TMT) joints. This joint line contributes to the long plantar arch in the sagittal plane. In the coronal plane, the base of the second metatarsal (MT) is recessed proximally (keystone position) (Figure 1). Stability is mostly due to the strong plantar ligaments. The TMT joint line can be divided into three parts in the midfoot and forefoot areas. This classification is based on inherent stability within certain segments. The most mobile column is the lateral one, which consists of the fourth and fifth MTs and the cuboideum. The rigid column is the middle one, consisting of the second and third MTs and middle and lateral cuneiforms. The medial column (first MT and medial cuneiform) is between these two columns affecting stability. The Lisfranc ligament and the ligaments between the cuneiform bones are the only connections between the medial and middle columns. The Lisfranc ligament is a plantar structure between the medial cuneiform and the base of the second MT. This structure connects these two columns while still allowing mobility, which is important during normal gait.

Lisfranc injuries are uncommon, and frequently missed or misdiagnosed, perhaps due to their complex structure. This is often manifested in polytrauma patients. Not all Lisfranc injuries are the same, instead there is a huge variation between different types of Lisfranc injuries. These injuries may be stable but symptomatic or may alternatively result in a highly unstable foot with a poor outcome. So far, the most commonly used classification is by Hardcastle (1): Type A refers to a total incongruity, B to a partial incongruity (B1 medial column and B2, affecting one or more TMT joints of the middle or lateral column) and type C to a divergent injury with the 1st MT displaced medially and the middle and lateral column laterally. The most common trauma patterns in our hospital are foot dis-

Figure 1. Anatomy of the tarsometatarsal (Lisfranc) joint. Note the deep recess of the 2nd ray.

Figure 2. Ecchymosis on the plantar sole of the foot is the sign of severe Lisfranc injury.

Figure 3. 26 years old male who sustained high-energy midfoot Gustilo gr IIIB open injury.

Figure 4. 65 yrs old dentist who sustain a foot distorsion. In primary unit this Lisfranc injury was missed. Note the typical Lisfranc ligament avulsions, distorsion on the medial line between middle cuneiform and base of the 2nd MT and the incongruency of TMT I and II joints.

tortion (indirect injury) or crush injuries. There have recently been reports of high-energy Lisfranc injuries becoming more common (2).

Diagnosis

Suspicion of a foot injury is the single most important step in the diagnosis path. Careful physical examination usually reveals midfoot swelling with pain on palpation in the TMT area. Plantar ecchymosis is a typical sign in more severe injuries (Figure 2). In the worst cases, these injuries are open and severely dislocated making the diagnosis obvious (Figure 3).

Standard radiographs of the foot in AP, lateral and 30-degree oblique views are basic diagnostic tools. Quite often these radiographs are taken non-weight-bearing when the injury is too painful. In AP film, a continuous medial line should be visible between the 2nd MT and the middle cuneiform (Figure 4). A widened space between the 1st and 2nd MTs is also a typical sign. Sometimes, avulsion fracture pieces of the Lisfranc ligament may be seen between the proximal 2nd MT and the medial cuneiform (Figure 3). According to oblique film, congruency of the 3rd, 4th and 5th TMT joints is evaluated and lateral film may show typical dorsal dislocations of the 2nd and 3rd MTs. However, one fourth of these injuries are missed when using only standard radiographs (3,4). A better rate may be obtained by appropriate referral to a radiologist after careful examination and using CT scans (5). In our unit, a CT scan is a basic instrument for these injuries. It gives a more accurate diagnosis and is a good tool for preoperative planning. It may also be helpful for determining associated injuries in the foot. Stress radiographs are used in the late follow-up and perhaps in those cases missed primarily.

Treatment

In case of a crush injury, initial management is primary closed reduction, or open in case of an open fracture, and evaluation of the soft tissues. Evaluation of compartment syndrome is difficult. However, if this is suspected, fasciotomies should be performed. After this, primary treatment, either definitive treatment or spanning ex-fix with later definitive treatment, is chosen.

Most of the Lisfranc injuries are, however, low-en-

ergy injuries and primary reduction and soft tissue care are hardly ever needed. The need for operative treatment is not as obvious as with high-energy injuries. Displacement of more than 2 mm is often claimed as a criterion for operative treatment, although the evidence for this is quite weak. On the other hand, injuries less than 2 mm, especially with dorsal displacement (plantar ligament intact) with no sign of clear instability, should be treated conservatively. However, a re-check for stability within the first 2 weeks, for example by stress radiographs, should be performed. If stability is maintained, conservative treatment can be continued. This treatment is normally performed using a short leg cast for 6 weeks. After that weight bearing should be evaluated case by case. Pure ligamentous injuries are theoretically more unstable and may need partial weight bearing for up to 3 months.

If operative treatment is chosen, the timing depends purely on the soft tissue status. There is a wide time range, but most injuries are treated within the second week after the injury (2,6). The main goal in operative treatment is to restore the alignment of the foot in addition to the careful restoration of the TMT joint. This can only be achieved by open reduction and internal fixation (ORIF) (6–10). ORIF is normally performed by one or two dorsal longitudinal incisions, with some surgeons preferring one horizontal incision. For the medial and central columns, screw fixation is commonly accepted and k-wire should be used only in the 4th and 5th TMT joints, if needed at all (6–9,11). The direction of the screws, especially for the 2nd TMT joint, depends on the fracture pattern. For a more benign injury type, a fixation from the medial cuneiform to the base of the 2nd MT may be appropriate, while the 2nd TMT joint is left without screw penetration (Figure 5). For more severe injuries, affecting all the three columns, trans TMT screw fixation may provide more stability. 3.5mm to 4.5mm screws, either cannulated or solid, may be used. These types of screw fixations allow a stable situation to be maintained for the period of time needed for ligamentous healing. Some authors have suggested medial plate fixation instead of trans-articular screws to avoid articular damage (12). In our clinic, we have reserved locking plates solely for patients with neuropathy and for cases where, in addition to TMT dislocation, a severe proximal MT fracture is present and single transarticular screw fixation is not possible.

There is no consensus on whether the hardware should be removed or not. In addition, the possible timing of removal is unclear. In the AO Foot and Ankle Course 2008, there was a poll on when to remove the screws: One third of the participants suggested removal after 3 months, one third between 6 and 12 months and one third never. In a current study by Canadian colleagues, hardware removal was required only for few patients (2). The removal rate of medial plate fixations was 50% in the study by Wilson et al (12). According to the paper by Ly and Coetzee there was a loss of correction, increasing deformity in 94% of the study population after the screws were removed at 6.75 months postoperatively (9). In addition, there is very little movement biomechanically in the 2nd and 3rd TMT joints, especially after injury. These data suggest that there is no urgency to remove the screws, if any need at all, regarding the central column. I personally remove the screws after approximately six months in two cases: Screw across the 1st TMT joint or screw between the medial cuneiform and the base of the 2nd MT. In both these lines there is more movement, leading to later screw loosening. K-wires are normally removed within 6 to 12 weeks postoperatively.

Figure 5. Medial column dislocation to medial side was treated with ORIF without transarticular screws.

Recently there has been further discussion on primary arthrodesis on the 1st TMT and in the central column (2nd and 3rd TMTs) in particular. Early fusion may be well-tolerated because the primary requirement in that area of the foot is stability. Kuo et al (6) and Mulier et al (13) have suggested that there might be subgroups within this injury, which may benefit from primary arthrodesis (ligamentous inju-

ry and severe injuries). However, patients with total arthrodesis (TMT 1-5) did worse than patients with partial arthrodesis (TMT 1-3) according to Mulier's non-randomized study (n=28) (13). Leaving the 4th and 5th TMT joints free was assessed important in offering some adaptation of the lateral forefoot during gait. In the prospective, randomized study by Ly and Coetzee (9), a better short and medium-term outcome (follow-up time 42.5 months) was obtained using primary arthrodesis of the medial two or three rays (n=21) than by ORIF (n=20) in ligamentous Lisfranc injuries. Patients with primary arthrodesis reported a significantly better outcome, evaluated according to the American Orthopaedic Foot and Ankle Society midfoot scale (AOFAS) and the postoperative activity level. In addition to severe Lisfranc, we have also treated patients with severe soft tissue injuries with primary arthrodesis and soft tissue reconstruction. The idea is to achieve good primary stability and to restore the alignment of the foot while avoiding the need to revisit the injury area through the reconstructed soft tissue later on.

It is commonly recommended to use a short leg cast with non-weight-bearing postoperatively for approximately six weeks. Partial weight bearing, slowly advancing to full weight bearing, is suggested for up to 10 weeks postoperatively.

Outcome and controversies

Despite the appropriate primary treatment (conservative or ORIF), symptomatic osteoarthrosis develops in some patients. Arthrodesis with or without correction of the alignment of the foot is reserved as a salvage procedure in case of either painful osteoarthrosis or failed primary treatment (14,15). According to Minnesota material, seven out of 20 patients treated with ORIF needed conversion to arthrodesis within 42.5 months of the follow-up (9). A fairly high rate (approximately 22% to 40%) of osteoarthrosis was also reported by Kuo and Mulier (6,13). Patients with a purely ligamentous injury treated by ORIF seem to have a greater risk of osteoarthrosis (6). According to this material, 40% of the patients with a ligamentous injury had posttraumatic osteoarthrosis while the corresponding rate for patients with a fracture dislocation was 18%. It is postulated that healing of the ligaments and capsules after a pure ligamentous injury provide insufficient strength to maintain the initial reduction. In addition, a high prevalence of posttraumatic osteoarthrosis was found in patients with non-anatomical reduction (6).

A functional outcome such as the American Orthopaedic Foot Ankle Society midfoot score has been assessed in few papers and reported most commonly within different scores. In the randomized prospective study by Ly and Coetzee (9), the authors reported 69 points for the ORIF group and 88 points for the primary arthrodesis group. In a retrospective material by Kuo (6), the average AOFAS midfoot score was 77, including late salvage arthrodesis. When the primary reduction in their material was satisfactory the score was 82.1 points compared with 70.6 points with non-anatomical reduction, p=0.05. In the material reported by Schepers et al (16), in which 50% of patients were treated conservatively, the median score for AOFAS was 72. They also reported an SF-36 median score of101, indicating that the quality of life after a Lisfranc injury had returned to a normal level compared to the general population. In this article, an altered gait in the injury side was assessed using a pedobarographic analysis. On the other hand, high scores of AOFAS (mean 81, range 40-100) were reported by O'Connor after mainly K-wire fixation, but the follow-up rate was low (67%) and some of the information was collected using a telephone inquiry (17). These numbers are in line with the publication by Mulier et al (13) where two thirds of patients with partial arthrodesis and the ORIF group received an excellent or good score. Only one third of the patients with total arthrodesis gained excellent or good results. For these patients, the major complaint was stiffness and pain, in addition 3 out of 6 of these patients had reflector sympathetic dystrophy (RSD). The corresponding values concerning RSD were 0 out of 6 for partial arthrodesis and 2 out of 6 for the ORIF group.

Conclusion

The literature of Lisfranc joint injuries is scanty. There is one prospective randomized study comparing two different operative methods with a relatively small number of patients. Thus, very strong conclusions and recommendations cannot be made. However, according to the current evidence and expert opinions, patients with slight dorsal and lateral displacement may be treated conservatively, although they require careful follow-up. Patients with fracture dislocations are treated with ORIF and screws should be removed only after careful evaluation after a longer follow-up. Pa-

tients with pure ligamentous injuries may enjoy a better outcome using primary arthrodesis of the 1st, 2nd and 3rd TMT joints. In our clinic, we have also used arthrodesis in patients with a severe soft tissue injury needing soft tissue reconstruction.

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