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Research article

Patient recovery after Lisfranc injury

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Abstract: Lisfranc joint injuries occur most frequently following road accidents, but also in military personnel, athletes, horse riders, football players and contact sports participants. Lisfranc injuries occur as a result of direct (crushing the leg by a blunt object) or indirect (twisting the leg) forces acting on the forefoot. Approximately 20% of Lisfranc injuries go unnoticed or are diagnosed late, especially low-energy injuries or purely ligamentous injuries. Severe sequelae such as post-traumatic osteoarthritis and foot deformities can create serious disability.

The paper presents a 19-year-old male patient, diagnosed with a Lisfranc type lesion in the left leg. The patient was functionally assessed postoperatively, during and at the end of the recovery program. During the recovery program, a good progress and evolution of the patient could be observed. Thus, the patient followed the kinetic program initially established by the physical therapist, and it was also possible to observe the increase in joint mobility, stability and muscle strength.

The physical therapy program designed must be preceded by an appropriate assessment and must include techniques adapted to the patient's abilities. An essential condition is a good collaboration between the patient-physiotherapist-orthopedic surgeon, so that complications and relapses can be avoided.

Keywords: Lisfranc, fracture, join, recovery

Introduction

The leg is a complex structure of the human body, due to the anatomical elements that compose it and the functions it has, being made up of 36 bones, 33 joints and 107 ligaments. The functions of the foot include transmitting and distributing the weight of the body, determining its balance and improving locomotor efficiency, through the anatomical arches present on the plantar surface [1].

The Lisfranc joint represents the articulation area of the midfoot with the forefoot and is made up of the five tometatarsal joints. This joint is named after the famous French front surgeon Jasques Lisfranc de Saint-Martin (1787-1847) who was part of Napoleon Bonaparte's army on the Russian front [2, 3].

In 1815 he developed a new technique of amputation at the tarsometatarsal joint without any osteotomy, thus providing a rapid variant for the removal of gangrenous fingers following frostbite. Since that time the tarsometatarsal joint has been known as the Lisfranc joint, and all injuries in areas adjacent to it, whether bony or ligamentous in nature of the tarsometatarsal and intercuneiform complex, are generically considered Lisfranc injuries [1].

A study conducted during 2014-2015 in two Oslo trauma hospitals [4] showed that the overall incidence of Lisfranc injuries, both stable and unstable, was 14/100000 persons per year, while only the incidence of unstable injuries was 6/100000 persons per year. Consulting the literature we found a slight increase in the incidence of Lisfranc lesions in recent years. Some authors cite a study showing an incidence of 1 patient per 55000 people per year with this injury [5], resulting in 0.2% of all injuries occurring in the foot,

worryingly 20% of cases are undiagnosed or diagnosed late [6].

Drawing a parallel between the two studies, Lisfranc lesions are of real interest in the field of medical rehabilitation and physiotherapy, both in terms of prevention and treatment. In order to develop the most effective kinetic plan possible, both the patient's personal history, the heredocolateral history and a good anamnesis showing the deficiencies acquired after the trauma are taken into account.

The multidisciplinary team, consisting of an orthopaedic surgeon and physiotherapist, weighs up the patient's deficits and history and then develops an individualised recovery plan tailored to the patient's needs to regain function of the foot in the most effective and safe way possible [7].

This paper aims to present a kinetic recovery plan, tailored to the patient's needs, while stressing the importance of collaboration between the patient, doctor and physiotherapist in carrying out the recovery programme.

Matherial and Methods

This paper presents the case of a 19-year-old male patient who suffered a left leg injury during a football match. Following investigations, he was diagnosed with: left Lisfranc injury involving all 5 tometatarsal joints - left spatular dislocation, fracture at the base of the left III metatarsal, fracture at the base of the left V metatarsal.

The computer tomography examination showed loss of tarsometatarsal joint congruence with displacement of the metatarsal bases to the lateral side resulting in lateral merginal fracture at the level of metatarsal III, widening of the II-III intermetatarsal space by up to 12 mm, small bone fragment (2.5 mm) adjacent to the medial margin of the base of metatarsal IV avulsion fracture, the appearance described is suggestive of fracture - homolateral type Lisfranc dislocation.

Emergency surgical intervention and closed reduction of the dislocation was performed. In view of the extent of the swelling in the left leg, percutaneous stabilisation with 4 fragments of 2mm Kereshner pins (arthrosynthesis) was chosen. Fig. 1. shows the appearance of the leg after the first surgery. The "stress" test performed under spinal anaesthesia revealed joint instability.

Fig. 1. Postoperative leg appearance.

Radiological control showed resumption of normal joint relationships in the left leg (Fig. 2.).

Fig. 2. Radiological examination of the left leg.

Three days postoperatively the patient was discharged with a series of recommendations from the doctor:

- No left lower limb support for three months;
- Move as needed with subaxillary crutches;
- Prophylaxis of deep vein thrombosis with Clexane 0.6 ml/day for 30 days, Endolex 1 tablet/day for 30 days;
- Keep splint on and leg prolapsed until return to clinic for reoperation;
- Analgesic and anti-inflammatory medication with Vimovo 500 mg x2/day, for 7 days, Paracetamol 500 mg x2/day, for 7 days.

Postoperative evolution was favorable, so the patient returns after 3 weeks postoperatively for open arthrosynthesis. Surgical intervention and intercuneal and metatarso-cuneal arthrosynthesis with 4 x 3.5 cm stainless steel screws is performed. Following positive response to treatment, showing major signs of improvement (Fig. 3.), the patient is discharged.

Fig. 3. Appearance of the leg after second surgery.

On discharge he receives a new set of recommendations as follows:

- Maintain the gambo-podal splint for 3 weeks, then present to hospital for suture ablation;
- Maintain the affected limb in a prone position (on a cushion);
- No left lower limb support for 6 weeks;
- Move using subaxillary crutches;
- Prophylaxis of deep vein thrombosis with Clexane, 0.6 ml/day for 30 days;
- Analgesic medication as needed;
- Maintain mobility of joints adjacent to the immobilised segment;
- Maintain strength and muscle tone of the non-immobilised lower limb and upper body during immobilisation;
- After removal of the gambo-podal splint, kinesiotherapy begins.

After removal of the plaster cast, the patient presents to the rehabilitation centre to start physiotherapy. Establishing the recovery programme is a complex process, starting with a thorough patient history, followed by a series of assessments such as visual analogue scale, osteoarticular assessment and muscle testing at each stage of the recovery process, as well as tests aimed at testing each major muscle in the affected area to determine the degree of damage after immobilisation.

The result of applying the visual analogue scale (VAS) was a score of 8 as the threshold of pain following immobilisation of the affected segment.

We performed joint testing for plantar flexion, dorsal flexion, eversion and inversion movements using the gonimeter. The first measurement was performed on the healthy lower limb, this being a real landmark in the recovery of the affected limb. Subsequently the left limb was also examined and the differences were considerable (Table 1.). We compared the values obtained with the biomechanical reference intervals to observe the degree of post-mobilisation sequelae

Table 1. Range of motion values at the ankle joint upon inclusion in the rehabilitation program.

Movement	Average normal values	The right lower limb (unaffected)	The left lower limb (affected)
Dorsal flexion	20°-25°	22°	13°
Plantar flexion	40°-45°	45°	35°
Eversion	10°-15°	12°	8°
Inversion	20°	25°	15°

Muscle testing was performed by muscle group for each anatomical movement of the ankle joint: plantar flexion, dorsal flexion, eversion and inversion.

The right lower limb was tested first, being the unaffected limb, in order to have a clear objective, namely to regain the muscle strength of the affected limb at least up to the values of the healthy one. Despite the fact that during the period of immobilisation the healthy limb was worked on to maintain muscle tone and strength, muscle deficits were found. We continued with the left lower limb, being the affected one, and the test results are shown in the table below (Table 2.)

Table 2. Muscle testing values at the ankle level upon inclusion in the rehabilitation

program.

Movement	Normal value	The right lower limb (unaffected)	The left lower limb (affected)
Dorsal flexion	F5	+F5	-F3
Plantar flexion	F5	-F5	+F3
Eversion	F5	+F5	+F4
Inversion	F5	+F4	-F2

In order to develop the Lisfranc post-injury recovery programme, we took into account the identification of the injuries, the impairments, their severity and the impact of the injury on the patient's daily activities. Thus in Fig. 4. We can observe the degree of muscular atophy of the left lower limb, consequence of the prolonged immobilization in plaster apparatus.

Fig. 4. Muscular atrophy of the left lower limb after removal of the cast.

At the basis of the rehabilitation plan are the objectives of the programme, which are discussed with the whole multidisciplinary team in the presence of the patient. They must be achievable, useful to the patient, and the patient must understand the purpose of each step, with the ultimate goal being to regain walking without sequelae and awkward positions.

The major goals set were:

- Decrease swelling and pain in the foot;
- Restoring joint mobility by reducing the functional disability caused by post-timobilisation joint stiffness;
- Restoring muscle balance by toning muscles, using isometric contractions and progressive resistance exercises, and by coordination exercises, support on the affected muscle and regaining balance;
- Restoring the arches of the foot, especially the plantar arch, by reducing the sequelae of ligaments and aponeurosis that have developed during the period of immobilisation;
- Resumption of walking steps, with correction of the antalgic positions that have been acquired;
- Toning the whole body musculature;
- Maintaining an appropriate weight status;
- Socio-professional reintegration of the patient;

The physiotherapy sessions begin with local ankle and foot massage, with an

analgesic, hyperempathetic, relaxing role. This approach allows us to prepare the affected area for physiotherapy by warming the soft tissues, thus facilitating movement. The massage techniques are carried out carefully, using gentle movements such as effleurage, friction and traction being introduced gradually according to the patient's progress.

In the first sessions, only passive mobilisations are performed, carried out by the therapist and purely assisted. In carrying them out, the physiological movements of the ankle and forefoot joints are followed, with the aim of facilitating movement by reducing the joint stiffness that occurs during immobilisation, thus reducing the oedema present.

Gradually, passive-active, active and active mobilisations with resistance from both the therapist and with the help of elastic bands are introduced into the rehabilitation programme, which are also carried out in the proximal areas of the affected lower limb.

As I said, the main objective is the resumption of walking, and to increase mobility and regain the arches of the foot I have resorted to a series of exercises using balls of different sizes and textures, sticks of varying thickness. We performed rolling the ball back and forth, from sitting, left-right movements and finally circumduction movements. Afterwards the patient was asked to perform pressures on the ball during rolling, the last stage of complexity being from orthostasis to espalier. With a simple towel lying on the floor, the patient in a sitting position performs dorsal flexion, while trying to pull the towel with his fingers, acetabulating the plantar arch.

Level gaps and thresholds made of materials that allow deformation, air-cushioned pedals, imitating car pedals, were used. Each stage of the gait was analysed from a biomechanical point of view and translated into exercises that facilitate the performance of the exercises. Following this stage, a retest is performed to make sure that our patient is ready for bipodal support. The result being satisfactory, we continue with exercises on the espalier, heel-tilt deadlifts.

Walking is introduced gradually, under the strict supervision of the physiotherapist, initially with support from the physiotherapist, without maximum load, depending on the pain felt by the patient these parameters may change. We made an obstacle circuit, adapted to the needs and stage of recovery, in which we introduced obstacles of different heights, objects to remove and lines that the patient must follow. In order to achieve our desired goal we used various materials from the sphere of balance exercises, balance balls, with or without striations, balance platforms with varying surfaces of contact with the ground thus increasing the level of difficulty, and finally to use a platform on springs in four points of support. After a while we can add walking on a treadmill, where the speed of rolling and incline are controlled by the physiotherapist, depending on the patient's stage and progress.

During the rehabilitation programme, we also introduced proprioceptive neuromuscular facilitation techniques, which consisted of slow initiation techniques, repeated contractions, slow inversion, slow inversion with opposition, rhythmic stabilisation and stretching techniques.

It is worth noting that high intensity work is done on the limb in deficit, sometimes exclusively with it, to increase the strength and muscle mass of the affected groups to the level of the healthy limb.

We decided to design the exercises with materials that can be easily purchased by the patient, at a minimal cost, or replace them with similar materials that can also be found at home. Accordingly active mobilizations with resistance were performed with elastic bands, which at home can also be replaced by towels or lightly elastic textile materials, mobility exercises were performed with balls of different sizes and level differences, which can be replaced with thresholds. This is why a large part of the exercises in orthostasis are performed with one's own weight, to be easily reproducible.

Results and Discussion

Following the Lisfranc lesion, the patient underwent a long and difficult recovery period, at the end of which he achieved a satisfactory outcome. The recovery program was individualized, well structured, tailored to the patient's needs, following the established objectives, the exercises were carried out progressively, undergoing some modifications following the evaluation during the sessions.

The rehabilitation process ended with a reassessment of the functions tested on inclusion in the programme, which consisted of a visual analogue scale, assessment of the joint and muscle balance. The values obtained were entered in Table 3. and Table 4. together with the normal baseline values and those obtained after the initial testing.

Table 3. Ankle range of motion values at inclusion and at the end of the rehabilitation programme.

Movement	Tested limb	Normal value	Initial values	Final values
Dorsal flexion	The right lower limb (unaffected)	20°-25°	22°	23°
	The left lower limb (affected)	20°-25°	13°	20°
Plantar flexion	The right lower limb (unaffected)	40°-45°	45°	45°
	The left lower limb (affected)	40°-45°	35°	41°
Eversion	The right lower limb (unaffected)	10°-15°	12°	14°
	The left lower limb (affected)	10°-15°	8°	14°
Inversion	The right lower limb (unaffected)	20°	25°	25°
	The left lower limb (affected)	20°	15°	22°

As for the final pain score assessed by the patient using the visual analogue scale, it was 0 at rest and 1 while walking, a considerable evolution from the initial value of 8.

Table 4. Ankle muscle testing values at inclusion and at the end of the rehabilitation programme.

Movement	Tested limb	Normal value	Initial values	Final values
Dorsal flexion	The right lower limb (unaffected)	+F5	+F5	+F5
	The left lower limb (affected)	+F5	-F3	+F4
Plantar flexion	The right lower limb (unaffected)	+F5	-F5	+F5
	The left lower limb (affected)	+F5	+F3	+F4
Eversion	The right lower limb (unaffected)	+F5	+F5	+F5
	The left lower limb (affected)	+F5	+F4	+F5
Inversion	The right lower limb (unaffected)	+F5	+F4	-F5
	The left lower limb (affected)	+F5	-F2	-F4

At the end of the programme, a series of recommendations were made by the

physiotherapist:

- continue exercising at home at least three times a week;
- gradual reintegration of sports, initially light walks on a straight surface;
- avoid uneven ground;
- walking, integration into sports programmes and sports activities is with the agreement of the physiotherapist;
- maintain an appropriate weight status;

Conclusions

Trauma, whatever its nature, has a considerable impact on the patient, both physically and mentally. The active involvement of the patient in the recovery programme, tests that clearly show the initial, intermediate and final stages, and the patient's desire to recover lost functions are essential in assessing the patient's condition. With the results presented above we can say that at the end of the recovery sessions we have succeeded in the patient's socio-professional reintegration, he gradually resumed his daily activities.

Effective communication between the multidisciplinary team, consisting of physiotherapist and orthopaedic surgeon, was essential in the recovery process of the patient presented. The active lifestyle that the patient had before the trauma, a good medical history followed by the establishment of clear and achievable goals accompanied by a recovery plan in line with them, positively influences the recovery process.

The treatment of this patient was truly challenging, due to the rarity of such cases and their complexity. In addition, some studies show that men are four times more likely than women to suffer a Lisfranc lesion, and these are common in the third decade of life [8], which does not apply to the patient presented aged 19.

Author contributions.

All the authors had the same contribution.

References

1. J. Bliss, S. Albert și M. Nithyananth, „Lisfranc Fracture Dislocation: A Review," *J Foot Ankle Surg (Asia-Pacific),* vol. 10, nr. 1, pp. 38-45, 2023.
2. E. Desmont și L. Chou, „Current concepts rewiew: Lisfranc injuries," *Foot Ankle Int.,* vol. 8, nr. 6, pp. 53-60, 2006.
3. L. Fischer, „Jacques Lisfranc de Saint-Martin (1787-1847)," *Hist Sci Med,* vol. 39, nr. 1, pp. 17-34, 2005.
4. A. Stodle, K. Hvaal, M. Enger și e. all, „Lisfranc injuries: Incidence mechanisms of injury and predictors of instability," *Foot Ankle Surg,* vol. 26, nr. 5, pp. 535-540, 2020.
5. A. Aitken și D. Poulson, „Dislocations of the tarsometatarsal join," *Bone Joint Surg Am,* vol. 45, nr. 2, pp. 46-60, 1968.
6. J. Chen, N. Sagoo și V. Panchbhavi, „The Lisfranc Injury: Aliterature Review of Anatomy, Etiology, Evaluation and Management," *Foot Ankle Spec,* vol. 14, nr. 5, pp. 458-467, 2021.
7. A. Ghiorghiță, R. Baciu, C. Mucileanu, M. Turnea, M. Rotariu și I. Condurache, „Recovery of post-arthrodesis hand function in the interphalan-geal join - Case presentation," *Balneo and PRM Research Jurnal,* vol. 14, nr. 1, p. 545, 2023.
8. M.-O. Inmaculada și R.-M. E. Carlos, „Lisfranc fracture-dislocations: current management," *Efort open reviews,* vol. 4, nr. 4, pp. 430-444, 2019.