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Case report

Open fracture-dislocation of the knee associated with nonunion of the medial femoral condyle and chronic tendon patellar rupture

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Abstract. *Background and aim of work:* The incidence of coronal fractures of the femoral condyle, Hoffa fractures, ranges from 8.7% to 13% of all fractures of the distal femur and are often observed in polytraumas. Hoffa fractures may be misdiagnosed and consequently not properly treated. Reduction and synthesis of this type of fracture should be achieved to avoid complications such as nonunion, pain, functional impairment. The authors present a case of a 5 year old nonunion of a Hoffa fracture of the medial condyle with chronic patellar tendon rupture. *Methods:* Revision surgery consisted of reduction and fixation of the Hoffa fracture with screws associated with bone grafting from the iliac crest. Distalization of the patella by Z-plasty and reconstruction of the patellar tendon with Achille's allograft were also performed. *Results:* Clinical evaluation after 10 months following the end of the treatment showed a complete resolution of pain, almost complete range of motion, good strength and almost complete functionality of the operated limb. *Conclusions:* Mistakes in the diagnosis or treatment of Hoffa fracture can often result nonunion, functional impairment, and persistent pain. To avoid these, the senior authors of this text believe that the correct treatment of acute Hoffa fracture and its potential associated injuries are crucial, according to the concept of early damage control and later synthesis with soft tissue reconstruction. (www.actabiomedica.it)

Key words: Nonunion, Hoffa, synthesis, patellar tendon, patellar distalization.

Introduction

Coronal fractures of the femoral condyle, first described by Hoffa in 1904 are uncommon injuries; although distal femur fractures usually occur in the axial or sagittal plane, Hoffa fractures occurs in the coronal plane (1).

Their incidence ranges from 8.7% to 13% of all fractures of the distal femur and they are commonly isolated (2). In some instance they are associated with other injuries around the knee joint such as fracture-dislocations of the knee that are complex, high-energy, potentially devastating injuries (3). 5–17% of all knee dislocations are open injuries, 14– 44% occur in polytraumas, and in 5% they are bilateral (4,5).

Hoffa fracture associated with a knee dislocation is a very rare event, and associated injuries may include: ipsilateral distal femur fracture, proximal tibia fractures, patella dislocation, patella fracture, and multiligamentous knee injuries in addition to quadriceps tendon or patellar tendon injuries (6).

Chronic ruptures of the patellar tendon are an uncommon event. These ruptures are often difficult to repair because they are generally accompanied by quadriceps muscle retraction and a great amount of scar tissue formation. (6)

Late reconstruction of patellar tendon ruptures usu- ally yields less favorable results than immediate reconstruc- tion. This disparity has been attributed to proximal patella migration, poor tissue quality, and

quadriceps atrophy (7).

The types of treatment used for Hoffa fractures include conservative management and surgical treatment.

Hoffa fracture is usually treated using the principles of intraarticular fracture treatment: by reduction and synthesis and by repair of soft tissue damage (3).

The results of conservative management are poor because this is associated with a risk of displacement of the fracture fragment, nonunion, avascular necrosis and tendency to heal with a valgus and varus deformity (8,11).

For these reasons, both acute fractures and nonunion should be treated with debridement, and open reduction and internal fixation (8).

Although Hoffa fractures and patellar tendon lesions are potentially simultaneously associated in fracture-dislocation of the knee, to our knowledge there is not any report which describes the contemporaneous treatment of these two lesions that are the result of a neglected acute management.

The authors present a rare case of nonunion of Hoffa nonunion associated to an inveterate patellar tendon rupture as a result of a knee fracture- dislocation occurred five year before.

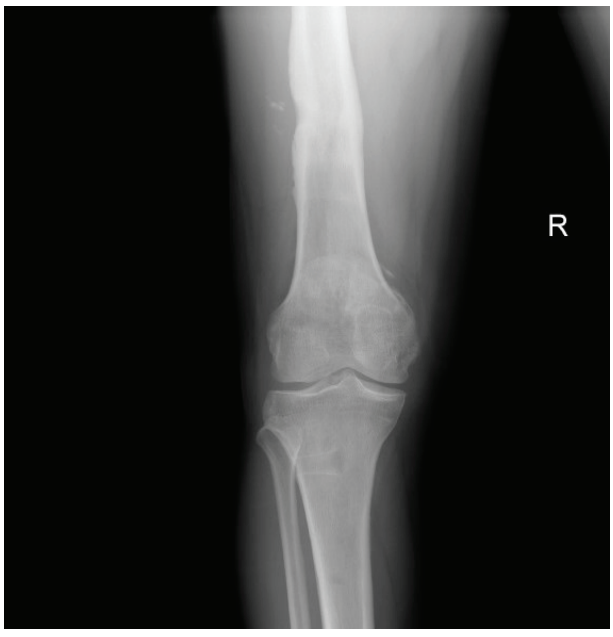

Figure 1. Antero-posterior control x-ray of right knee

Case report

A 48-year-old man of African ethnicity came to our outpatient, complaining of disabling pain, even at rest, and functional impairment of his right lower extremity, associated with limping.

The patient reported high-energy trauma from a motor vehicle accident 5 years before, left hip dislocation with fracture of the anterior pillar of the pelvis and an open fracture-dislocation of the right knee (Gustilo 2).

The early treatment had been performed in another trauma center. It consisted of a total hip revision prosthesis and multiple interventions of his right knee, unfortunately not well reported by the patient.

Failure of the extensor apparatus, associated with a patella rise, was clinically remarkable.

The range of motion (ROM) was 45° with maximum passive and active flexion of 90° and passive and active extension lag of 45°.

There was a slight lateral instability.

X-rays performed showed nonunion of Hoffa fracture of the medial condyle and confirmed the rise of patella (Fig.1).

Caton-Deschamps index was 2.24 (Fig.2).

A CT scan with 3D reconstruction was performed for a more accurate pre- operative planning. (Fig. 3).

The operation was planned with four surgical steps:

- Autologous bone graft harvesting from the iliac crest.
- Reduction and fixation of Hoffa fracture of the medial femoral condyle after placement of bone graft.
- Quadricipital Z-plasty and patella distalization.
- Reconstruction of the patellar tendon with Achille's tendon allograft (6,12).

Surgical technique

First surgical step:

Patient in supine position, incision centered on the iliac crest, and cortico-cancellous graft harvest.

Second surgical step:

Tourniquet at the root of the right lower limb. Medial access centered on the medial epicondyle. Identification and protection of the Hamstrings and medial collateral ligament (Fig. 4,5).

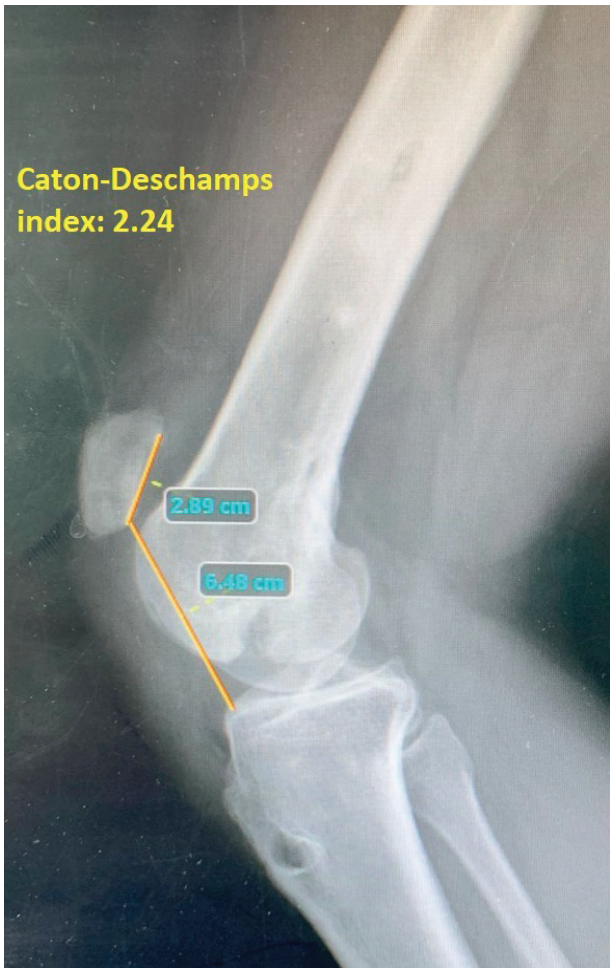

Figure 2. Latero-lateral x-ray of the right knee; Caton- Deschamps index: 2.24

Capsulotomy, cruentation and lavage of the nonunion surfaces; filling of nonunion site with previously harvested autologous bone graft (Fig. 6). Reduction and fixation in compression with 4 headless 3.5 screws (Fig. 7).

Third surgical step: Anterior incision on the quadriceps tendon and extensive dislocation of adhesions. Intra-operative fluoroscopic control with comparison of the contralateral limb confirms significant rise of the right patella. Later a Z-type quadricipital plasty was performed (Fig. 8).

Fourth surgical step:

The patellar tendon appeared completely degenerated. The synthetic ligament used in previous reconstruction, appeared to be invaded by abundant adherent fibrotic tissue. Removal of the fibrotic tissue and the synthetic ligament.

Figure 3. Pre-op CT with 3D reconstruction

Figure 4. Medial approach

A medial and lateral retinacular release was performed followed by a Z-type quadricipital plasty. The Z-plasty was repaired using resorbable suture. A guide pin was placed in the patella from the inferior to the superior pole with fluoroscopic check.

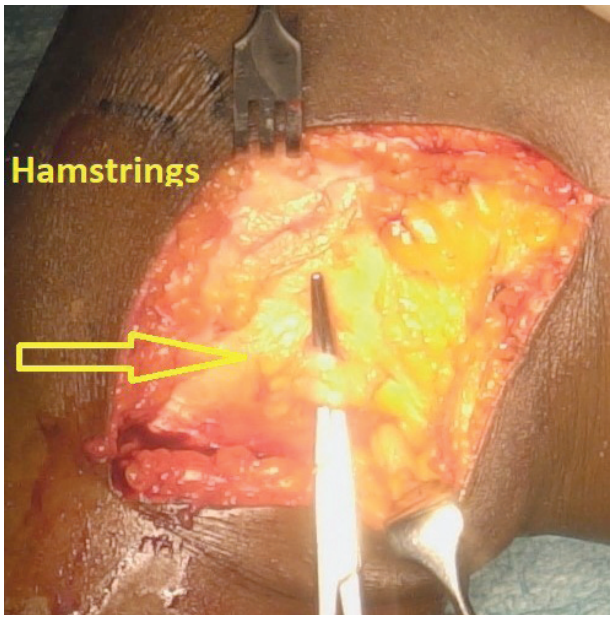

Figure 5. Hamstrings Identification

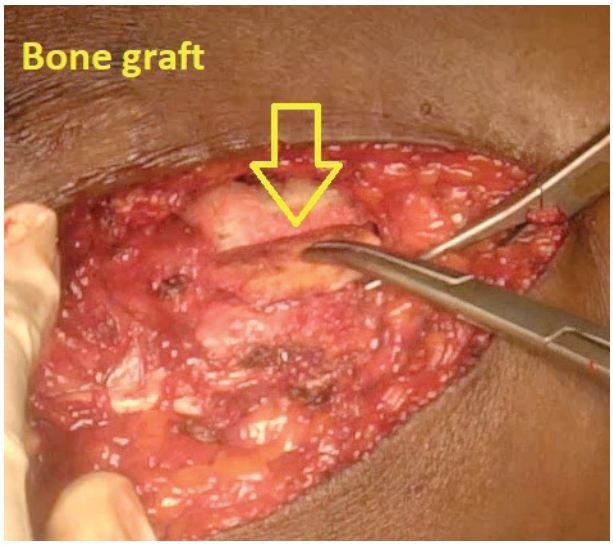

Figure 6. Bone graft insertion

An 8-mm tunnel in the central portion of the patella was created using a reamer. The Achille's allograft, was then inserted to reconstruct the patellar tendon. The bone plug was inserted in a previous prepared bone wedge into the anterior tibial tuberosity and then fixed with two half-threaded (3.5 mm) screws with washers. By applying the right straining to the patella, authors were able to achieve its normal position as confirmed with intraoperative anteroposterior and lateral fluoroscopic images.

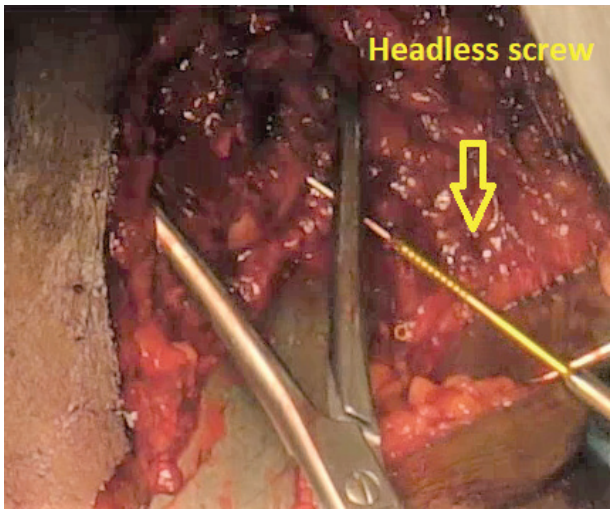

Figure 7. Reduction and synthesis with headless screws

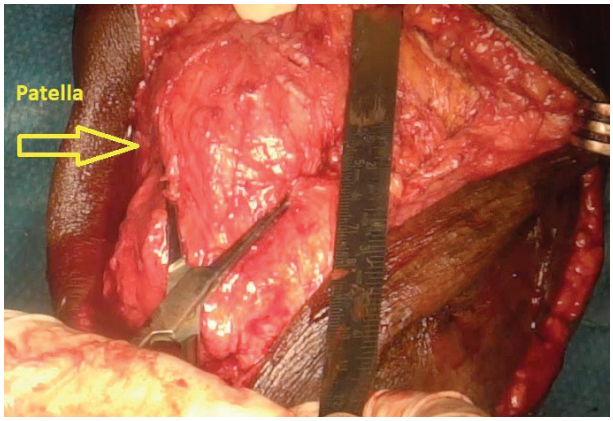

Figure 8. Patellar distalization

The allograft, previously split into two branches, was ready for insertion into the patella and retinaculum. The first branch was passed through the patellar tunnel and retrieved through the quadriceps tendon; the second branch was passed medially and was sutured over the medial retinaculum of the patella. In this way a stabilization of the medial patellofemoral ligament (MPFL) was also performed (Fig.10,11,12,13).

Post-operative X-rays (Fig.14) showed a good reduction and fixation of the nonunion and distalization of the patella with a Caton-Deschamps index similar to the contralateral one (Fig. 15).

In the postoperative period, the patient was im- mobilized for 30 days in a femoral malleolar cast flexed at 10°; the patient walked with crutches, without weight-bearing on the operated limb. After 30 days

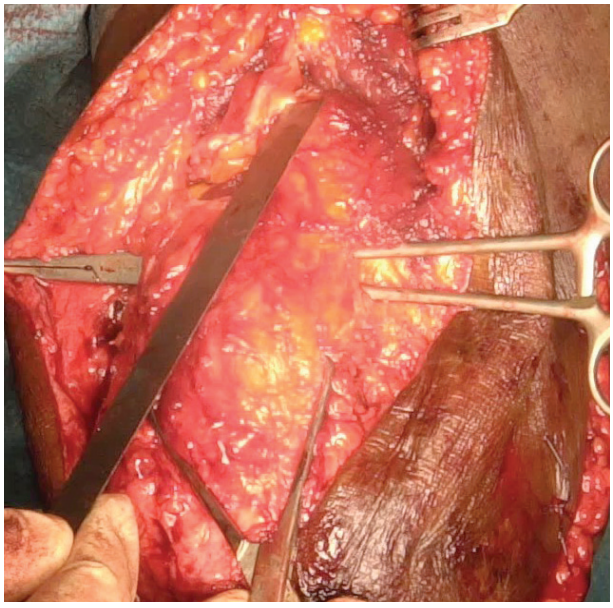

Figure 9. Preparation for Z quadricipital plasty and for allograft passage.

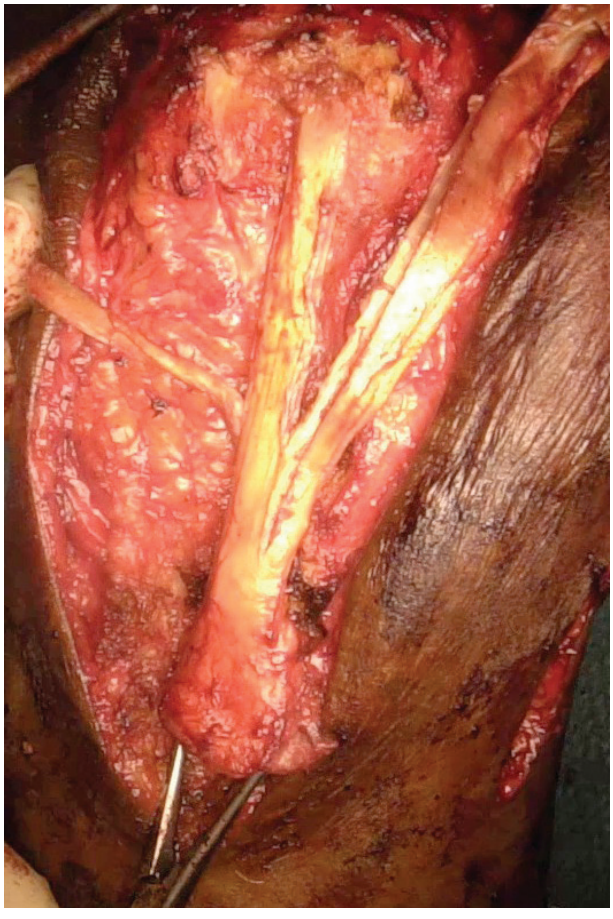

Figure 10. Positioning of the tendon graft

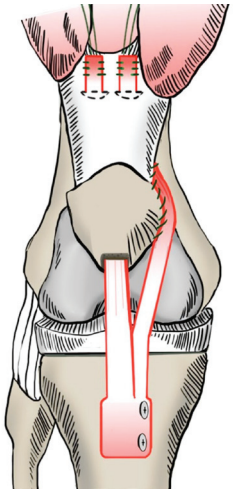

Figure 11. Fixation of the tendon allograft with two half- treaded screws with two washers (image from Lamberti et al. 2016)

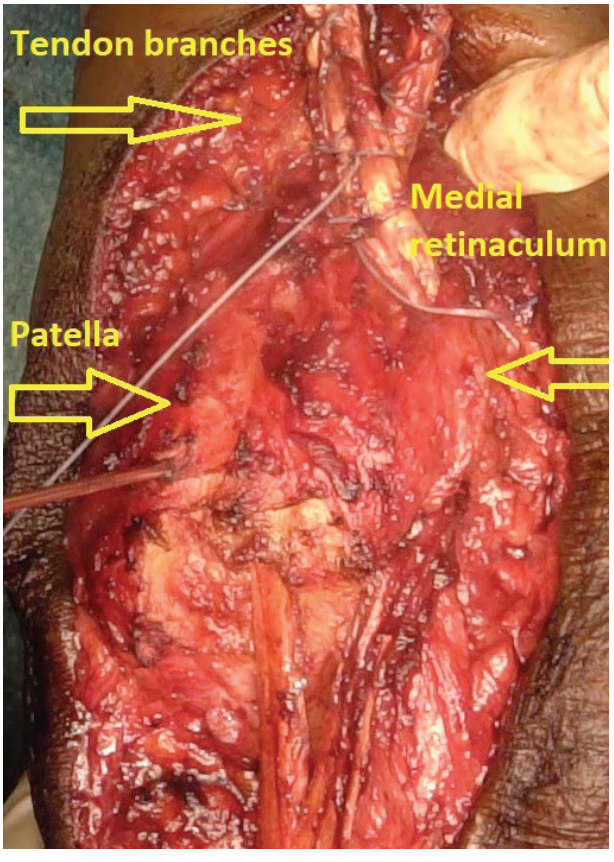

Figure 12. Passage of the two tendon's branches

Figure 13. Final construct

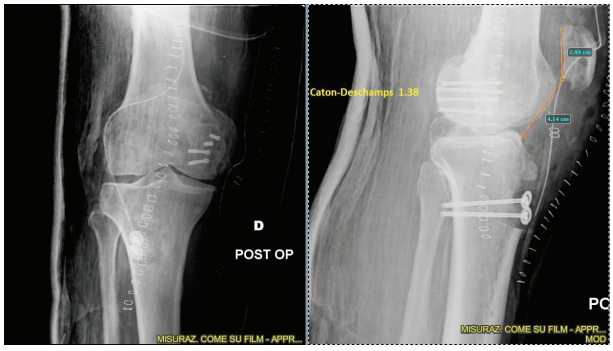

Figure 14. Post-operative X ray: Caton-Deschamps Index: 1.38

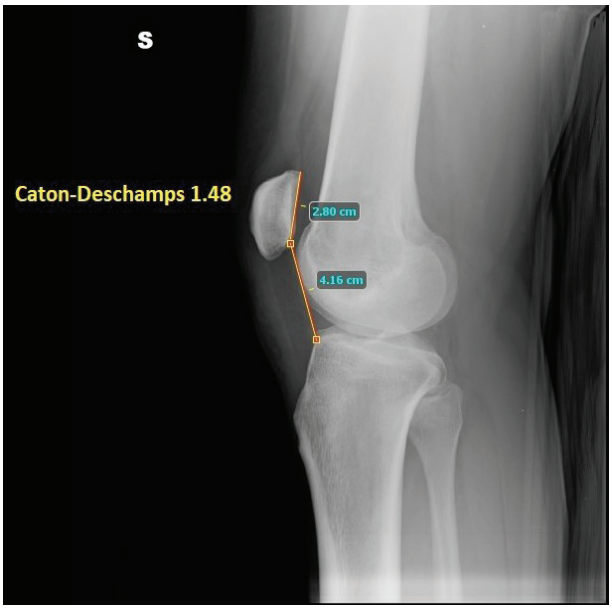

Figure 15. Contralateral X ray for patellar height

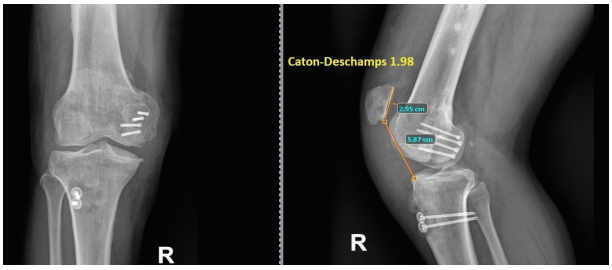

Figure 16. Post-operative follow-up X-ray after 10 months

Figure 17. Maximum flexion and extension lag

X-rays were performed and a partial weight- bearing (30%) with crutches was allowed. Physiotherapy for gradual ROM recovery was also started.

Results

At final follow-up, after 10 months, the patient showed A ROM of his knee of 110°. The passive and active maximum flexion were 120°. The passive and active extension lag were 10°.

There was a persistent slight lateral instability and the residual deficit of extension was associated with chronic hypotrophy/retraction of quadriceps muscle.

The patient had no longer limping and no longer referred pain, nor at rest, nor during walking (Fig. 17,18,19).

X-rays at this follow-up (Fig.16) showed the consolidation of the nonunion but a significant increase of the Caton-Deschamps index compared to the post-operative value.

Figure 18. Final outcome

Figure 19. Final functional result

Discussion

The case that the authors have described is remarkable for its rarity: it is reported a simultaneous treatment of Hoffa's nonunion of the medial condyle associated with a chronic lesion of the patellar tendon and unavoidable rise of the patella.

Hoffa fracture is an uncommon clinical entity typically seen in adults after high-energy traumas. Nonunion of a Hoffa fracture appears to be even more uncommon (11).

Some case reports have suggested that cases of nonunion of Hoffa fractures should be treated with open reduction and internal fixation (8,9,10).

Hoffa fracture is inherently unstable, and non-operative management can lead to non-union as described by Jiang et al. (11). In the above described case report a non-union was developed in the posteromedial part of the knee and here proliferating osteophytes caused a painful impingement.

Due to this condition, which caused a complete alteration of the biomechanics, the knee was not able to provide sufficient movement for daily life activities which were limited only to small movements associated with severe pain, even at rest. Actually, the knee was almost in ankylosis.

The association of the chronic patellar tendon in- jury worsened the biomechanical alteration of the knee. Indeed, the abundant scar formation, quadriceps muscle atrophy and retraction and patella rise, as described by McNally et al (13), justified the patient's symptoms.

Although the mechanism determining Hoffa fracture has not yet been clarified, in a context of high- energy trauma, as a car incident, it is thought that when the knee is flexed > 90° both a torsional and tan- gential force occurred on the knee, is responsible for the fracture mechanism (2).

In this setting, with a lower degree of knee flexion, the extensor apparatus is damaged below the patella (patellar tendon); at higher angles, the quadriceps tendon is torn (2).

Following the medial approach and isolation of the nonunion site, its debridement and bone grafting, it was decided to synthesize the fracture with half threaded screws (13).

Regarding the treatment of chronic patellar tendon injury and subsequent extensor apparatus failure, the authors decided to use an Achilles tendon allograft as described by Lamberti et al. and McNally, et al. and Falconiero, et al. (6,12,14).

A quadricipital Z-plasty and a patellar tendon reconstruction were also performed. The authors decided to split the tendon allograft in two slices, one passed through the patellar bone, and the other passed through the medial retinaculum in order to further stabilize the patella and to achieve a better patello-femoral tracking (12,6).

For evaluation of patella height, the Caton-Deschamps index was used.

Patellar distalization was not performed according to the standard values of Caton-Deschamps index, but in relation to the height of the contralateral patella.

Subjects of African ethnicity, indeed, congenitally have an average higher patella than subjects of Caucasian ethnicity (15).

In the case described, although the Caton-Deschamps index has increased again at final follow-up the patient had no longer pain.

The authors supposed that this is due to consolidation of medial condyle nonunion.

Really, Hoffa nonunion could have affected the biomechanics and tracking of the knee.

Chronic quadriceps retraction and abundant scar tissue led to a partial, new proximal migration of the patella, without significant complaints.

This is probably because the removal of adhesions and scar tissue and the reconstruction of the extensor apparatus with strengthening of the medial patellar retinaculum and of MPFL led to a marked improvement of patella-femoral tracking.

In conclusion, mistakes in the diagnosis or treatment of Hoffa fracture can often result nonunion, functional impairment, and persistent pain.

Hoffa fractures with knee simultaneous associated lesions are very rare and could therefore be misdiagnosed; for this reason, they could have dramatic consequences for the patient.

To avoid these, the senior authors of this text believe that the correct treatment of acute Hoffa fracture and its potential associated injuries are crucial, according to the concept of early damage control and later synthesis with soft tissue reconstruction.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

References

1. Jiang YR, Wang ZY, Zhang DB, Gu GS, Twenty-sev- enyear nonunion of a Hoffa fracture in a 46-year-old patient, Chinese journal of traumatology, 2015,18(1), 54-58
2. Zhou Y, Pan Y, Wang Q, Hou Z, Chen W., Hoffa frac- ture of the femoral condyle: Injury mechanism, classifica- tion, diagnosis, and treatment, Medicine, 2019 Feb;98(8)
3. Pathak S, Salunke A, Karn S, et al., Hoffa Fracture with Associated Injuries Around the Knee Joint: An Ap- proach to a Rare Injury, Cureus, April 28, 2020,12(4)
4. Stannard J, Fracture Dislocation of the Knee, J Knee Surg., May, 2016, 29(4):300-2
5. Maslaris A, Brinkmann O , Bungartz M , Krettek C , Jagodzinski M ,Liodakis E , Management of knee dislocation prior to ligament recostruction: what is the current evidence? Update to universal treatment algorithm, Eur J Orthop surg Traumatol, 2018 Aug;28(6):1001-1015
6. Falconiero RP, Pallis, MP, Chronic rupture of a pa- tellar tendon: a technique for recostruction with Achilles allograft, Arthroscopy,1996,Oct;12(5):623-6 .
7. Lewis P, Rue, JP, Bach, B, Chronic Patellar Tendon Rupture – Surgical Reconstruction Technique Using 2 Achilles Tendon Allografts, The Journal of Knee Surgery, 2010, 21(02), 130–135
8. Zhang, P, Zhang, X, Tao, F, Li, Q, Zhou, D, Liu, F ,Sur- gical Treatment and Rehabilitation for Hoffa Fracture Nonunion: Two Case Reports and a Literature Review, Orthopaedic Surgery, 2020,Aug12(4):1327-1331
9. Öztürk, A, Özkan, Y, & Özdemir, R M , Nonunion of a Hoffa fracture in an adult, musculoskeletal, 2009,93(3), 183–185,
10. Chouhan D, Hooda A, Rana A, Non-union lateral femoral condyle Hoffa fracture: a case report, Int J Burns Trauma, 2020, 10(6): 338–344
11. Jiang YR, Wang ZY, Zhang DB, Gu GS, Twenty-sev- enyear nonunion of a Hoffa fracture in a 46-year-old patient, Chinese journal of traumatology, 2015,18 54-58
12. Lamberti, A., Balato, G., Summa, P. P., Rajgopal, A., Vasdev, A., & Baldini, A. , Surgical options for chronic patellar tendon rupture in total knee arthroplasty, Knee Surgery, Sports Traumatology, Arthroscopy, 20116, 26(5)
13. Lu, B., Zhao, S., Luo, Z., Lin, Z., & Zhu, Y., Compression screws and buttress plate versus compression screws only for Hoffa fracture in Chinese patients: a compara-tive study, Journal of International Medical Research, 2019 Jan,47(1):142-151

14. McNally PD, et al, Achilles allograft recostruc- tion of a chronic tendon rupture, Arthroscopy, 1998 Apr,14(3):340-4
15. Karadimas, J. E., Piscopakis, N., & Syrmalis, L., Patella Alta and chondromalacia, International Orthopaedics, 1981,5(4):247-9

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