fortune Journals

Research Article

FORTUNE JOURNAL OF RHEUMATOLOGY

ISSN: 2688-6766

Combination of Trochleoplasty and High Tibial Osteotomy in Patellofemoral Instability Yielding Good Short-Term Results in terms of Pain Relief, Patella Stability and Knee Function

Felix Ferner[1,2*], Jörg Harrer[1], Christoph Lutter[2], Michael Wörner[3], Joerg Dickschas[3,4]

Abstract

Introduction: In many cases patellofemoral instability (PFI) presents a multifactorial issue that often requires a combination of different surgical procedures. In addition to re-balancing relevant soft tissue structures, osseous pathologies must also be addressed. Although, the combination of trochlear dysplasia, increased external tibial torsion or valgus deformity of the knee is rare, it is usually seen in young adolescents and could thus lead to early onset patellofemoral osteoarthritis or persisting PFI. We hypothesize that the combination of trochleoplasty and high tibial osteotomy (HTO) improves patellar stability and functional scores in patients who present with trochlear dysplasia and a tibial axis deviation (valgus deformity or increased external rotation) of a lower extremity.

Methods: 13 consecutive cases were included, where patients who presented with PFI were surgically treated by performing a trochleoplasty in addition to HTO. The following five inclusion criteria had to be met: (1) patients with PFI (2) trochlear dysplasia (Dejour type D), (3) tibial deformity (valgus or increased tibial torsion) of the ipsilateral limb and (4) failure of conservative treatment (5) simultaneous correction femoral and tibial. Preoperative imaging acquired consisted of conventional X-ray studies of the knee (a.p. and lateral) and full weight bearing long leg radiograph a.p. of the lower extremity, as well as a torsional CT scan of the lower extremities and a MRI of the affected knee joint. Surgical procedure consisted of trochleoplasty and HTO (tibial valgus or torsional correction) in addition to soft tissue rebalancing via lateral release. MPFL reconstruction was performed depending on patellar instability, tested intraoperatively. Subjects with previous surgical intervention, follow-up less than 6 months and femoral valgus deformity were excluded from this study. Visual analog scale (VAS), Tegner-score and the Kujala-score were compared pre- and postoperatively. Intra- and postoperative complications were registered.

Results: The study group consisted of 7 male and 6 female procedures with a mean of 20.8 years of age. 6 knees received a tibial varisation osteotomy, 7 knees a high tibial torsional osteotomy, 8 knees a primary MPFL-reconstruction. No intraoperative complication occured. During a mean follow-up time of 24.2 months one patient suffered a deep vein thrombosis and consequent pulmonary embolism. One patient who did not undergo primary MPFL-reconstruction suffered a single event of patella re-dislocation, which remained stable after secondary MPFL-reconstruction. 2 patients without primary MPFL-reconstruction received MPFL-reconstruction secondary simultaneous with hardware removal due to patella subluxation after primary surgery. The Tegner score improved from 3.08 to 4.62, the Kujala score from 65.8 to 88.8, while the VAS decreased from 5.62 preoperatively to 1.77 postoperatively.

Affiliation:

[1]Department of Orthopaedic Surgery, Sana Klinikum Lichtenfels, Lichtenfels, Germany

[2]Department of Orthopaedic Surgery, Rostock University Medical Center, Rostock, Germany

[3]Department of Orthopaedic Surgery, Sozialstiftung Bamberg, Bamberg, Germany

[4]Department of Orthopaedic Surgery, University Medical Center, Erlangen, Germany

***Corresponding author:**
Dr. med. Felix Ferner, Sana Klinikum Lichtenfels, Prof. Arneth Str. 2b, 96215 Lichtenfels, Germany.

Citation: Felix Ferner, Jörg Harrer, Christoph Lutter, Michael Wörner, Joerg Dickschas. Combination of Trochleoplasty and High Tibial Osteotomy in Patellofemoral Instability Yielding Good Short-Term Results in terms of Pain Relief, Patella Stability and Knee Function. Fortune Journal of Rheumatology. 8 (2026): 04-10.

Received: February 07, 2026
Accepted: February 19, 2026
Published: February 25, 2026

Conclusions: This multi-case study shows that the combined surgical procedure consisting of trochleoplasty and HTO improves patellofemoral stability and knee function while provoking a low rate of intra- and postoperative complications. The rare number of individuals suffering from PFI due to trochlear dysplasia and tibial valgus or increased external rotation deformity can be safely treated in a single surgical setting yielding good clinical results in terms of pain relief, functional scores, and patellar stability, while primary MPFL-reconstruction yields a better patella stability.

Keywords: Patellofemoral instability; Knee osteotomy; Trochleoplasty; High tibial osteotomy.

Introduction

Patellofemoral instability (PFI) is a multifactorial disorder influenced by a dysbalance of soft tissue structures as well as certain osseous pathologies [2, 8, 24, 25, 30]. In patients who suffer from recurrent dislocation of the patella, it is of utmost importance to analyze and detect any osseous pathologies, as it is common for affected individuals to exhibit a combination risk factors and deformities [1, 16, 27]. Frosch et al. introduced a classification that identifies several types of osseous disorders [15]. Surgical treatment is known to yield good results for each deformity [4, 10, 13, 19]. However, a small percentage of patients complaining of persisting PFI can be found within each subgroup. In a review study by Leclerc et al., patella re-dislocation after trochleoplasty occurred in 2.4% of subjects [18]. A meta-analysis including a total of 192 knees, shows that the combination of reconstruction of the medial patellofemoral ligament (MPFL) and simultaneous trochleoplasty yields a better outcome than merely carrying out a trochleoplasty [23]. Patients who have undergone sole MPFL-reconstruction and present with residual instability postoperatively, most commonly also display severe trochlear dysplasia [17]. With this is mind, additional surgical procedures must be considered in patients with PFI due to severe trochlear dysplasia and coexisting elevation of the tibial tuberosity trochlear groove (TTTG) distance. Additional tibial deformities must be excluded in patients with PFI and trochlear dysplasia. Trochleoplasty by itself may not sufficiently address other underlying, more complex deformities. As a first step, tibial deformities must be detected by systematically analyzing the frontal and rotational axes of the lower limbs during clinical examination. Should any abnormalities be observed (e.g., increased tibial external rotation, increased femoral internal rotation or valgus deformity of the knee) further diagnostics should consist of specific radiograph imaging studies (full-weight-bearing long leg ap of the lower extremities, as well as a torsional CT scan). Taking into consideration the classification of Frosch et al. [15]. pathologies to be ruled out are a patella alta (type 3b), lateralization of the tibial tuberosity (type 3c), valgus deformity of the knee (type 3d) and torsional deformity (type 3e). A systematic approach is paramount, as it allows to detect and properly treat the rare combination of trochlear dysplasia (type 4) and tibial deformities (type 3d / 3e).

Treating patients suffering from PFI by performing a trochleoplasty with simultaneous osteotomy of the tibial tuberosity is a well-established treatment option [6, 12] however, no literature can be found on treating these patients with the combination of trochleoplasty and high tibial osteotomy (HTO) [31]. We therefore hypothesized that the combination of sulcus-deepening trochleoplasty in addition to HTO is able to properly stabilize the patellofemoral joint, reduce pain and improve knee function in patients with PFI due to severe trochlear dysplasia and tibial deformity.

Material and Methods

Inclusion criteria and imaging

In a retrospective data analysis, we recorded all patients who were surgically treated with simultaneous trochleoplasty and HTO (medial closed wedge and high tibial torsional osteotomy) during January 2018 and June 2021. Inclusion criteria consisted of unsatisfactory conservative treatment results in patients with PFI who also exhibited trochlear dysplasia Dejour type D, as well as tibial deformity (tibial valgus or increased external tibial torsion) [7]. Inclusion and exclusion criteria are summarized in table 1.

Table 1: Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
PFI	History of previous operations
Failure of conservative treatment	Follow-up less than 6 months
Dysplasia of trochlea type D	Femoral valgus deformity
Tibial deformity (Tibial valgus with mMPTA >92° or increased external torsion tibially with tibial torsion >43°)	
Simultaneous correction femoral and tibial	

Preoperative imaging consisted of conventional radiographs of the knee joint in 3 planes (antero-posterior, lateral, and tangential projection of the patella), full-weight-bearing long leg ap. of the lower extremities and a torsional CT scan. Long leg analysis of the frontal plane was performed according to the method of Paley [22]. Torsional values were computed according to the method of Waidelich by utilization of digital planning software (Medicad Hectec GmbH, Altdorf, Germany) [29]. Recorded values included femoral and tibial torsion, as well as TTTG distance [22, 29]. MRI imaging studies were obtained in all cases in order to evaluate for cartilage lesions, determine trochlear shape, and to further rule out intraarticular pathologies. Mechanical femorotibial axis,

JLCA (joint line conversion angle), mMPTA (mechanical medial proximal tibial angle) and mLDFA (mechanical lateral distal femoral angle) were measured on full-weight-bearing long leg a.p. radiographs. Femoral and tibial torsional values measured on CT scan were compared to physiological values according to Waidelich. HTO was indicated in tibial valgus deformity with a mechanical valgus axis of more than 4 degrees and mMPTA greater than 92 degrees or a tibial external rotation deviation of more than 10 degrees. In the case of tibial varisation osteotomy, the surgeon aimed for a postoperative femorotibial mechanical axis 0 degree. In respect to high tibial torsional osteotomies, the postoperative goal was a torsional value of 33 degrees according to the normal value of Waidelich. Preoperative VAS, Tegner activity score and Kujala score were obtained. The study was approved by the institutional review board and all patients provided written informed consent.

Surgical procedure

All surgical procedures were performed by two board-certified orthopedic knee surgeons within our department. Trochleoplasties were performed according to the technique of Bereiter through a lateral approach to the knee joint [28]. Deepening of the trochlea was obtained by chisel and the osteochondral flap fixated by an absorbable 3 mm vicryl band fixated transosseously by three swivelock anchors (Arthrex Inc., Naples, Florida, USA) (figure 1).

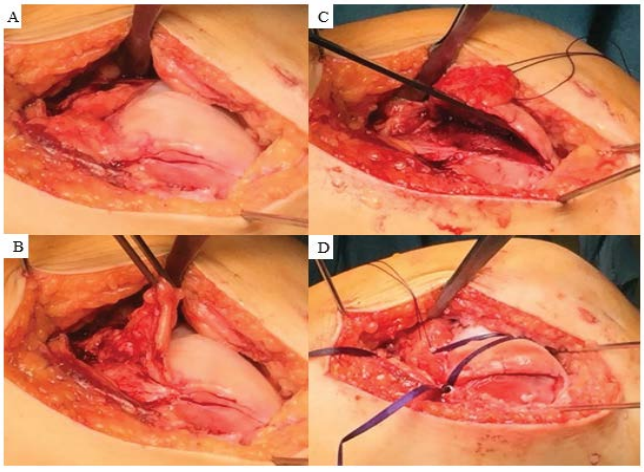

Figure 1: Lateral approach to the knee joint with a type D trochlea dysplasia (A). Osteochondral flap is prepared with a chissel (B). Sulcus deepening of the trochlea is achieved with a chissel (C) and osteochondral flap is fixed with a V-shaped vicryl band (D).

For HTO we used either one of two techniques depending on the underlying pathology: In torsional HTO we used a lateral approach according to the technique of Strecker [26]. The osteotomy was carried out biplanar with the main osteotomy running parallel to the knee joint line and 90 degrees to the mechanical axis of the tibia, as well as a vertical osteotomy above the tibial tuberosity (figure 2).

Fixation of the corrected axis was achieved by a manually bent 5-hole DC-Plate (DePuy Synthes, West Chester, Pennsylvania, USA). For varisation osteotomies we chose a medial approach to the tibial head, performed as a subtractive biplanar osteotomy with two oblique osteotomies meeting in projection to the proximal tibiofibular joint (according to the medial open wedge technique); a lateral hinge granting more stability and less risk of delayed union. The vertical osteotomy performed proximal to the tibial tuberosity (figure 3).

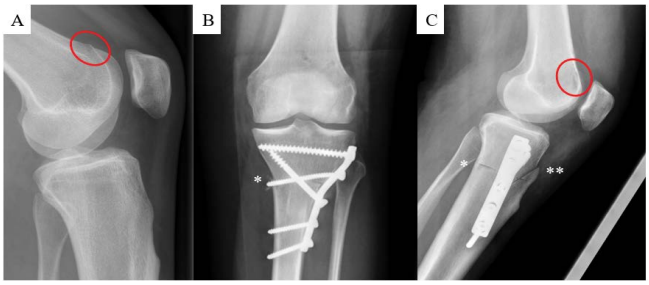

Figure 2: (A) Dysplasia of the trochlea is shown by lateral radiograph of the knee and femoral "bump" is marked (red circle). Postoperative X-ray documents main osteotomy level (*) and vertical cut superior to tibial tubercle (**) on ap- view (B) and lateral view (C). Fixation is achieved by an individually bended 5-whole DC-Plate with the typical pattern of screws.

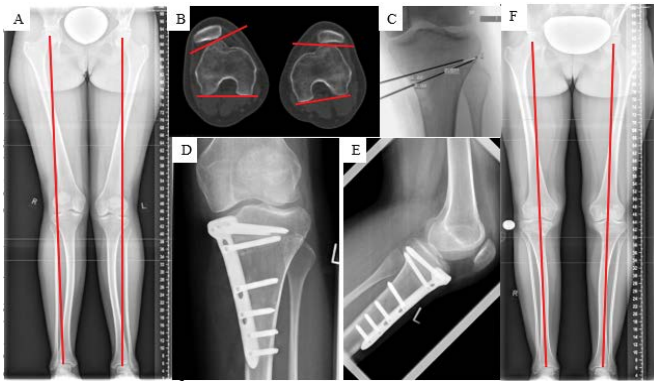

Figure 3: Full weight bearing radiograph is documenting preoperative femorotibial valgus deformity (A) and type D dysplasia of the femoral trochlea with a pathological trochlea inclination angle (B). Intraoperatively angle of tibial subtractive correction osteotomy is measured by k-wires (C). Fixation is obtained by angle stable internal plate fixateur (D). After correction and hardware removal on both sides full weight bearing radiograph shows straight legs on both sides (F).

Fixation was achieved by locking plate (Tomofix medial proximal tibia, DePuy Synthes, West Chester, Pennsylvania, USA). After completion of plate fixation, elongated anterior fibers of the medial collateral ligament (MCL) were shortened by sutures. All patients underwent arthroscopy of the knee joint prior to osseous correction [21]. In all cases osseous correction was combined with re-balancing of the soft tissue by release of the lateral retinaculum and if indicated,

Ferner F, et al., Fortune J Rheumatol 2026
DOI:10.26502/fjr.26880052

reconstruction of the MPFL, which was performed according to the technique of Fink, using a quadriceps tendon autograft [11]. MPFL-reconstruction was performed depending on the surgeon's intraoperative evaluation of patellofemoral stability. Subjects who presented with fourth degree cartilage lesions of the retropatellar surface (size of defect 1 - 2 cm^2) received cartilage repair treatment during the same procedure by subchondral drilling combined with autologous matrix induced chondrogenesis (AMIC Chondro gide, Geistlich Biomaterials, Baden-Baden, Germany). Cartilage lesions were assessed in preoperative MRI studies and confirmed arthroscopically. VAS, Tegner activity score and Kuala score were obtained pre- and postoperatively at follow-up examination. Follow-up time was recorded.

Postoperative treatment

Prior to discharging the patient, we obtained postoperative AP and lateral radiographs of the knee, and a full-weight-bearing long leg radiograph. Active flexion of the knee was limited to 60 degrees wearing a knee brace for 4 weeks, followed by a subsequent two weeks of 90-degree flexion limitation. Knee extension was limited at no point in time. All patients were restricted to partial weight bearing with 20 kg for 6 weeks postoperatively. Patients were re-evaluated at 6 weeks postoperatively for radiological control studies and permitted to gradually move to full weight bearing over the course of two weeks with no limits on range of motion.

Data acquisition

Demographic data of all patients were recorded. A follow-up visit at 6 months confirmed proper bone healing. The healing process was considered complete if the patient achieved full weight bearing, had no complaints of pain, and the osteotomy site was fully ossified on conventional radiographs. Patients who had undergone surgical treatment between 2018 and 2020 were invited for a follow-up interview and further clinical examination in the timeframe from July to December 2021. All surgical procedures were documented, and complications were recorded until the day of this last follow-up. Pain levels were recorded by visual analoge scale (VAS) preoperatively and postoperatively at the last follow-up. Tegner activity scale and Kuala score was used to monitor knee function. A reoccurring patella dislocation or subluxation was registered separately.

Statistical analysis

Microsoft Excel was used for data collection while statistical analyses were performed with SigmaStat software (SystatSoftware Inc., San Jose, CA, USA). Data were expressed as mean (range; standard deviation) and p-values < 0.05 were considered statistically significant. A Rank-sum test or t-test was used to determine the difference between pre- and postoperative values of VAS and knee scores (Tegner and Kuala activity scores), depending on normal distribution.

Results

13 procedures in 11 patients were recorded; a summary of the demographic data is shown in table 2. Complete data acquisition including the final follow-up investigation was achieved in all cases. During two procedures additional retropatellar cartilage repair (AMIC) was performed. In 8 of the 13 procedures a primary MPFL-reconstruction was performed. There was no occurrence of intraoperative complications in all 13 procedures. All osteotomy sites showed complete bone healing after 6 months. Two major complications were identified: One patient who did not undergo primary MPFL-reconstruction suffered a re-dislocation of the patella, while another suffered a deep vein thrombosis of the lower extremity with subsequent pulmonary embolism. At the time of follow-up, 6 knees had undergone hardware removal due to soft tissue irritation. Five of these six procedures were tibial varisation osteotomies where the locking plates caused soft tissue irritation. In 3 of 5 cases without primary MPFL-reconstructions, patellofemoral instability persisted (one re-dislocation, 2 knees with subluxations). All three knees received secondary MPFL reconstruction as well as hardware removal and showed no further instability after revision surgery.

Table 2: Distribution of age and gender, surgical technique, operation time and follow-up.

sex	age (MV, range; SD)	MPFL reconstruction	tibial varisation	tibial torsional osteotomy	time of operation in min (MV, range; SD)	follow-up time in months (MV, range; SD)
6 female, 7 male	20.8 (17-33; 4.5)	n=8	n=6	n=7	148 (120-224; 31.2)	24,2 (6-47; 12.3)

Mean overall follow-up time was 24.2 months (range 6 – 47; SD 12.3). Mean value for VAS decreased from 5.62 (range 1-8; SD 1.85) preoperatively to 1.77 (range 0-5; SD 1.36) postoperatively. Kujala score improved from 65.3 (range 40-82; SD 12.9) to 88.8 (range 71-96; SD 7.58) and Tegner activity scale from 3.08 (range 1-6; SD 1.44) to 4.62 (range 3-6; SD 1.04). All P-values showed a statistically significant improvement from the time of preoperative to postoperative assessment; boxplots of the results are depicted in figure 4.

Ferner F, et al., Fortune J Rheumatol 2026
DOI:10.26502/fjr.26880052

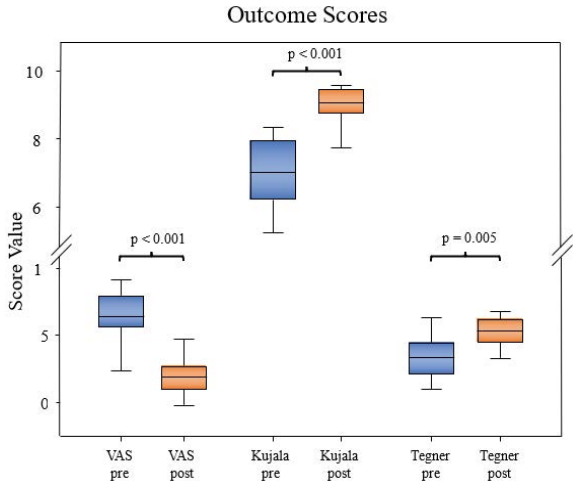

Figure 4: Values for VAS scale, Kujala score and Tegner activity pre- (pre) and postoperatively (post) including p-values are depicted.

Discussion

The most important finding of this study was the fact that patients suffering from PFI who are presented with femoral (trochlear dysplasia) as well as tibial deformity (valgus or increased external rotation) can be successfully treated in a single surgical session. In this case series of 13 surgically treated knees we witnessed a significant improvement in knee function (Kujala score and Tegner activity scale) and pain levels (VAS) while observing a few major complications. We observed one non-surgical (deep vein thrombosis with subsequent pulmonary embolism) and one surgical complication (re-dislocation of the patella). Patella dislocation (1 knee) or -subluxation (2 knees) only occurred in cases where primary MPFL-reconstruction was not performed. The patellofemoral joint remained stable after secondary MPFL-reconstruction. Hence, we conclude that osseous corrections should be accompanied by primary soft tissue balancing. This consists of a release of the lateral retinaculum and reconstruction of the MPFL. It is well documented that MPFL-reconstruction is an important factor in patients with PFI who undergo trochleoplasty [23]. Dividing the surgical procedures (trochleoplasty, HTO, MPFL-reconstruction) into two surgical sessions to shorten operating time and possibly preventing intraoperative complications can be considered. However, with no recorded intraoperative complications and a high rate of patella dislocation/-subluxation (3 of 5) when primary MPFL-reconstruction was not performed, our study supports an "all-in-one approach". Further research into a higher number of cases is needed to verify this statement.

Current literature does not provide any information on the simultaneous procedure of trochleoplasty and HTO. The combination of trochleoplasty and femoral derotation osteotomy was described by Biedert et al. [5]. In his one-session approach he documented good results in a series of 9 cases. He found a significant improvement in knee function and patella stability with a mean follow-up period of 2.1 years. In a meta-analysis Balcarek et al. found that trochleoplasty in addition to extensor apparatus balancing is superior to sole MPFL-reconstruction regarding the rate of re-dislocation in patients with PFI [3]. In terms of knee function, both groups showed comparable results with an improvement of 26.4 and 26.2 points with respect to the Kujala score. These scores are in line with the score improvement of 23.5 points within this study.

Surgical therapy aims to achieve two goals in patients suffering from PFI: 1) stabilization of the patellofemoral joint and 2) improvement of patellofemoral malalignement in order to relief pressure and pain within the patellofemoral joint, as well as prevent cartilage damage and patellofemoral osteoarthritis (PFOA). The first goal is easily achieved and evaluated, while the second goal is much more difficult to attain. In an extensive review of 1000 cases during a follow-up time from 1-25 years Leclerc et al. found 27 % to display signs of PFOA after having undergone trochleoplasty [18]. Tibiofemoral malalignment and pathological trochlea morphology are known to be associated with PFOA [20, 32]. Femorotibial valgus deformity, increased tibial external rotation and sever trochlear dysplasia are well-documented causes of patellofemoral malalignment and known risk factors for development of PFOA [9, 10, 14]. The authors of this study recommend treating all underlying pathologies in patients with PFI in order to prevent further damage to the patellofemoral cartilage, even though PFOA may not yet be present in adolescents. A strong argument for the combination of several surgical procedures performed during one surgical session is the fact that postoperative management essentially needs no amendment; consequently, the patient undergoes only one period of partial weight baring and limitation of range of motion and their associated drawbacks (loss of muscle strength, incapacity to work, etc). Longer follow-up investigation is necessary to monitor the time of onset and development of PFOA within this patient group.

Hardware removal was considered as a minor complication within this study. In none of the six knees, where hardware was removed, a severe soft tissue problem could be observed clinically. All patients showed complete bone healing at the osteotomy site. One female patient (22 years of age) suffered a deep vein thrombosis with subsequent pulmonary embolism, which was treated successfully by therapeutic-dose anticoagulation and compression stockings. In this patient we detected the following risk factors: obesity (BMI 32), smoking, usage of an oral contraceptive and an operating time of 113 minutes. Such risk factors must be assessed in advance and addressed when possible.

Limitations

Due to lack of comparison with a control group, this

study is not able to show the outcome with trochleoplasty in absence of HTO. Further research is necessary with greater case numbers and a control group for direct comparison of different combinations of surgical treatments. Our study includes two different types of HTO due to an overall low number of cases. Future studies must investigate whether there is any significant difference performing a varisation HTO opposed to a derotational HTO. With our present case numbers, no such comparison was carried out.

Conclusion

The results of this multi-case series show that simultaneous trochleoplasty and HTO within one surgical session is a safe approach in treating patients with PFI and coexisting trochlear dysplasia and deformity of the proximal tibia (valgus- or external rotational deformity). Due to the high rate of patella re-dislocation/-subluxation when primary MPFL-reconstruction was not performed, an osseous correction should be accompanied by primary MPFL-reconstruction during that same surgical session. Significant improvement of knee function (Kujala score and Tegner activity scale) and pain level (VAS) can be achieved within this rare group of patients suffering from PFI with combined femoral and tibial deformity. A thorough clinical examination and specific radiographic analysis must be implemented and obtained in patients presenting with PFI. Detailed knowledge of the underlying pathologies is essential to plan and perform adequate surgical measures, especially in these complex cases.

Conflict of Interest

The Author(s) declare(s) that there is no conflict of interest.

References

1. Ahrend MD, Eisenmann T, Herbst M, et al. Increased tibial tubercle-trochlear groove and patellar height indicate a higher risk of recurrent patellar dislocation following medial reefing. Knee Surg Sports Traumatol Arthrosc 30 (2022): 1404-1413.
2. Balcarek P, Oberthur S, Hopfensitz S, et al. Which patellae are likely to redislocate? Knee Surg Sports Traumatol Arthrosc 22 (2014): 2308-2314.
3. Balcarek P, Rehn S, Howells NR, et al. Results of medial patellofemoral ligament reconstruction compared with trochleoplasty plus individual extensor apparatus balancing in patellar instability caused by severe trochlear dysplasia: a systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc 25 (2017): 3869-3877.
4. Balcarek P, Zimmermann F. Deepening trochleoplasty and medial patellofemoral ligament reconstruction normalize patellotrochlear congruence in severe trochlear dysplasia. Bone Joint J 101 (2019): 325-330.
5. Biedert RM. Combined deepening trochleoplasty and supracondylar external rotation osteotomy for recurrent patellar instability in patients with trochlear dysplasia and increased femoral antetorsion. Knee 27 (2020): 1158-1166.
6. Dean CS, Chahla J, Serra Cruz R, et al. Patellofemoral Joint Reconstruction for Patellar Instability: Medial Patellofemoral Ligament Reconstruction, Trochleoplasty, and Tibial Tubercle Osteotomy. Arthrosc Tech 5 (2016): 169-175.
7. Dejour H, Walch G, Neyret P, Adeleine P. [Dysplasia of the femoral trochlea]. Rev Chir Orthop Reparatrice Appar Mot 76 (1990): 45-54.
8. Dejour H, Walch G, Nove-Josserand L, et al. Factors of patellar instability: an anatomic radiographic study. Knee Surg Sports Traumatol Arthrosc 2 (1994): 19-26.
9. Dickschas J, Ferner F, Lutter C, et al. Patellofemoral dysbalance and genua valga: outcome after femoral varisation osteotomies. Arch Orthop Trauma Surg 138 (2018): 19-25.
10. Dickschas J, Tassika A, Lutter C, et al. Torsional osteotomies of the tibia in patellofemoral dysbalance. Arch Orthop Trauma Surg 137 (2017): 179-185.
11. Fink C, Veselko M, Herbort M, et al. MPFL reconstruction using a quadriceps tendon graft: part 2: operative technique and short term clinical results. Knee 21 (2014): 1175-1179.
12. Floyd ER, Ebert NJ, Carlson GB, et al. Medial Patellofemoral Reconstruction Using Quadriceps Tendon Autograft, Tibial Tubercle Osteotomy, and Sulcus-Deepening Trochleoplasty for Patellar Instability. Arthrosc Tech 10 (2021): 1249-1256.
13. Frings J, Krause M, Akoto R, et al. Clinical Results after Combined Distal Femoral Osteotomy in Patients with Patellar Maltracking and Recurrent Dislocations. J Knee Surg 32 (2019): 924-933.
14. Frings J, Krause M, Akoto R, et al. Combined distal femoral osteotomy (DFO) in genu valgum leads to reliable patellar stabilization and an improvement in knee function. Knee Surg Sports Traumatol Arthrosc 26 (2018): 3572-3581.
15. Frosch KH, Schmeling A. A new classification system of patellar instability and patellar maltracking. Arch Orthop Trauma Surg 136 (2016): 485-497.
16. Imhoff FB, Funke V, Muench LN, et al. The complexity of bony malalignment in patellofemoral disorders: femoral and tibial torsion, trochlear dysplasia, TT-TG distance, and frontal mechanical axis correlate with each

other. Knee Surg Sports Traumatol Arthrosc 28 (2020): 897-904.

17. Kita K, Tanaka Y, Toritsuka Y, et al. Factors Affecting the Outcomes of Double-Bundle Medial Patellofemoral Ligament Reconstruction for Recurrent Patellar Dislocations Evaluated by Multivariate Analysis. Am J Sports Med 43 (2015): 2988-2996.
18. Leclerc JT, Dartus J, Labreuche J, et al. Complications and outcomes of trochleoplasty for patellofemoral instability: A systematic review and meta-analysis of 1000 trochleoplasties. Orthop Traumatol Surg Res 107 (2021): 103035.
19. Leite CBG, Santos TP, Giglio PN, et al. Tibial Tubercle Osteotomy with Distalization Is a Safe and Effective Procedure for Patients with Patella Alta and Patellar Instability. Orthop J Sports Med 9 (2021): 2325967120975101.
20. Macri EM, Stefanik JJ, Khan KK, et al. Is Tibiofemoral or Patellofemoral Alignment or Trochlear Morphology Associated with Patellofemoral Osteoarthritis? A Systematic Review. Arthritis Care Res (Hoboken) 68 (2016): 1453-1470.
21. Müller M, Strecker W. Arthroscopy prior to osteotomy around the knee? Arch Orthop Trauma Surg 128 (2008): 1217-1221.
22. Paley D, Herzenberg JE, Tetsworth K, et al. Deformity planning for frontal and sagittal plane corrective osteotomies. Orthop Clin North Am 25 (1994): 425-465.
23. Ren B, Zhang X, Zhang L, et al. Isolated trochleoplasty for recurrent patellar dislocation has lower outcome and higher residual instability compared with combined MPFL and trochleoplasty: a systematic review. Arch Orthop Trauma Surg 139 (2019): 1617-1624.
24. Schmeling A, Frings J, Akoto R, et al. [Patellar dislocation: Causes and treatment]. Unfallchirurg 123 (2020): 969-983.
25. Snow M. Tibial Torsion and Patellofemoral Pain and Instability in the Adult Population: Current Concept Review. Curr Rev Musculoskelet Med 14 (2021): 67-75.
26. Strecker W, Dickschas J. [Torsional osteotomy: Operative treatment of patellofemoral maltracking]. Oper Orthop Traumatol 27 (2015): 505-524.
27. Thompson P, Metcalfe AJ. Current concepts in the surgical management of patellar instability. Knee 26 (2019): 1171-1181.
28. von Knoch F, Bohm T, Burgi ML, et al. Trochleaplasty for recurrent patellar dislocation in association with trochlear dysplasia. A 4- to 14-year follow-up study. J Bone Joint Surg Br 88 (2006): 1331-1335.
29. Waidelich HA, Strecker W, Schneider E. [Computed tomographic torsion-angle and length measurement of the lower extremity. The methods, normal values and radiation load]. Rofo 157 (1992): 245-251.
30. Weber AE, Nathani A, Dines JS, et al. An Algorithmic Approach to the Management of Recurrent Lateral Patellar Dislocation. J Bone Joint Surg Am 98 (2016): 417-427.
31. Wind RJP, Heesterbeek PJC, Wymenga AB. A combined procedure with Bereiter-type trochleoplasty leads to a stable patellofemoral joint at 5-year follow-up. Knee Surg Sports Traumatol Arthrosc 27 (2019): 716-723.
32. Zimmermann F, Milinkovic DD, Balcarek P. Outcomes After Deepening Trochleoplasty and Concomitant Realignment in Patients with Severe Trochlear Dysplasia with Chronic Patellofemoral Pain: Results at 2-Year Follow-up. Orthop J Sports Med 9 (2021): 23259671211010404.

Citation: Felix Ferner, Jörg Harrer, Christoph Lutter, Michael Wörner, Joerg Dickschas. Combination of Trochleoplasty and High Tibial Osteotomy in Patellofemoral Instability Yielding Good Short-Term Results in terms of Pain Relief, Patella Stability and Knee Function. Fortune Journal of Rheumatology. 8 (2026): 04-10.