

Fixation versus Excision of Osteochondral Fractures after Patellar Dislocations in Adolescent Patients: A Retrospective Cohort Study

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Abstract

Background: Patellar dislocation is one of the most common knee injuries in the adolescent population. It is often combined with osteochondral fracture. The purpose of this study was to compare the outcomes between fixation and excision of osteochondral fractures not involving the bearing surface in adolescent patients with patellar dislocations.

Methods: Patients who underwent surgery for osteochondral fracture following patellar dislocation in our institution from 2007 to 2014 were retrospectively evaluated. Visual analog scale (VAS) of pain and the International Knee Documentation Committee (IKDC) form were used to assess knee pain and function at follow-up. Patient satisfaction was evaluated. Differences in the values of variables among groups were assessed using *t*-test if equal variance or Mann–Whitney *U*-test if not equal variance. The Pearson's Chi-square test was applied for dichotomous variables if expected frequency was >5 or Fisher's exact test was applied if not. A value of $P < 0.05$ was considered statistically significant.

Results: Forty-three patients were included, with the average age of 14.1 ± 2.3 (range, 9.0–17.0) years. Nineteen underwent fixation of osteochondral fractures and 24 did not. The average follow-up time was 28 ± 10 months. There was no significant difference in age, gender, follow-up time, causes of injury, times of dislocation, and location of osteochondral fracture between fixation and excision groups. The fixation group had a significantly longer surgery time (82 ± 14 min) and larger size of osteochondral fracture (2.30 ± 0.70 cm²) than the excision group (43 ± 10 min, 1.88 ± 0.62 cm², respectively, $t = 10.77$, $P < 0.01$ and $t = 0.84$, $P < 0.05$). At the last follow-up, the average IKDC score in the fixation group (82.52 ± 8.71) was significantly lower than that in the excision group (89.51 ± 7.19 , $t = 2.65$, $P < 0.01$). There was no significant difference in VAS of pain and patients' satisfaction. There were 7 (16%) patients with recurrent dislocation.

Conclusion: Excision of osteochondral fractures has equivalent or better outcomes compared to fixation in adolescent patients with patellar dislocations when these fractures do not involve the bearing surface.

Key words: Adolescent; Osteochondral Fracture; Patellar Dislocation

INTRODUCTION

Patellar dislocation is defined as a disruption of a normal patellar position in the trochlear groove. It is one of the most common knee injuries in the adolescent population.^[1] The annual incidence of patellar dislocation is between 5.8 and 7.0/100,000 in the general population but 29/100,000 in 10–17 year-olds.^[2] Patellar dislocation often occurs following a trauma. However, there are some predisposing factors for this injury such as patellofemoral dysplasia, female gender, and family history of dislocation.^[3]

Osteochondral fracture may occur at the time of patellar dislocation or reduction and usually follows the impact between the medial facet of the patella [Figure 1a] and

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Figure 1: Imaging of osteochondral fracture. (a) CT 3D reconstruction image showing osteochondral fracture in the medial facet of patella (circle) and loose body of the osteochondral fragment. (b) Coronal T2-weighted MRI image showing osteochondral fracture in the lateral facet of lateral femoral condyle (short arrow). (c) Sagittal T2-weighted MRI image showing an osteochondral fragment in the knee joint before medial femoral condyle (long arrow). CT 3D: Computed tomography three-dimensional; MRI: Magnetic resonance imaging.

the lateral facet of the lateral femoral condyle [Figure 1b]. These injuries are present in 31–58% of acute patellar dislocation.^[4-7] Treatments for osteochondral fracture in patellar dislocation are varied based on injury pattern and surgeon's and patient's preference, which include internal fixation of osteochondral fragments, surgical removal of loose bodies, microfracture, mosaicplasty, and chondrocyte implantation.^[6,8-10] Some scholars suggest that osteochondral fracture should be amenable to reduction and internal fixation.^[11] However, chondrocytes in osteochondral fragments undergo significant necrosis and apoptosis, which may affect the outcome of fixation procedures.^[12] Furthermore, it was found that the functional outcome of patients undergoing internal fixation was worse than that of patients with fragment excision and microfracture.^[10]

Osteochondral fractures involving the bearing surface of the knee joint should be reduced and fixed. However, fixation of osteochondral fragments outside of the bearing surface may not be necessary. We hypothesized that the fixation of osteochondral fracture in adolescent patients with patellar dislocation was not necessary when the fracture did not involve the bearing surface of the knee. The aim of this study was to compare the outcomes between adolescent patients with and without internal fixation of osteochondral fractures not involving the bearing surface after patellar dislocation.

METHODS

Ethical approval

This was a retrospective cohort study approved by the local ethics committee of the institute. The patient consent was waived due to retrospective nature of the study.

Subjects

All adolescent patients (<17.0 years) with osteochondral fracture after patellar dislocation who underwent surgical intervention in our institution between 2007 and 2014 were retrospectively investigated. Inclusion criteria were (1) acute osteochondral fracture, (2) less than 6 weeks after injury, (3) diagnosis based on magnetic resonance imaging (MRI), (4) surgical intervention, (5) age ≤ 17.0 years, (6) follow-up >12 months, and (7) osteochondral fracture not involving the bearing surface of the knee. Exclusion criteria

include (1) osteochondral fracture involving the bearing surface of the knee, (2) surgical history of the ipsilateral knee, and (3) patients without complete demographic data such as times of recurrent dislocation, location and size of osteochondral fracture, and surgery time.

Management

All patients had anterior-posterior and lateral radiographs and MRI scan before surgery [Figure 1b and 1c]. Insall-Salvati index (ISI) was calculated. Patients were identified to have patella alta as the ISI was >1.3 .^[13] Patellar tilt angle (PTA) was measured.^[14] The medial patellofemoral ligament (MPFL) injury was identified based on clinical examination and MRI preoperatively. All patients underwent medial contraction suture and MPFL suture repair. Lateral release was also performed for patients with $>30^\circ$ PTA. All surgeries were performed by the same surgeon. During surgery, osteochondral fractures fragments were removed and the size was measured using a vernier caliper. If the fracture involved any articulating portion of the patellofemoral and femorotibial joint under direct arthroscopic visualization during range of motion, this was considered as the bearing surface involving [Figure 2]. Osteochondral fractures were fixed or not depending in the size, depth, and quality of fragments. If the size was too small (width in any direction <1 cm) and the quality was too bad, fragments were removed and microfracture was performed. While in the fixation group, osteochondral fragments were openly internally fixed using headless compression screws (Headless Compression Screw, Double Medical, China) or bioabsorbable pins (FreedomPin, Inion Oy, USA) [Figure 3]. After surgery, for all patients in both groups, the knee was fixed at 0° extension with a brace for the first 2–3 weeks. Then, passive flexion started and reached to 90° at 4 weeks. Active range of motion started after 6 weeks. Weight bearing in extension was allowed after 2 weeks. Full exercise was allowed after 6 months.

Demographic data and clinical outcome assessment

Demographic data were retrieved from the medical records including age, gender, follow-up time, causes of injury, times of recurrent dislocation, location and size of osteochondral fracture, and surgery time. All patients were asked to return

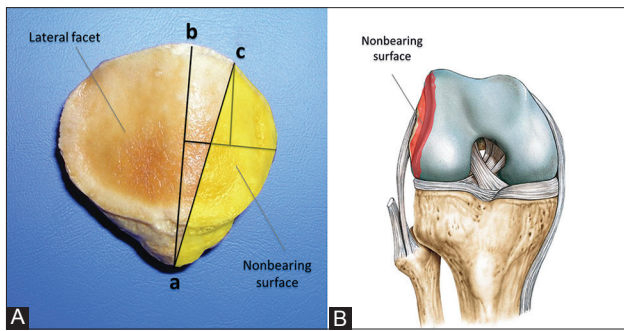


Figure 2: Diagrams of nonbearing surfaces of the patella and the lateral femoral condyle. Line a-b showing the ridge of the patella. (A) Point c is the crossing point of the edge and a parallel line of line a-b. The distance between the two parallel lines is half of the maximum width of medial facet. The area encircled by line a-c and the medial rim is considered as nonbearing surface of the patella (yellow area). The nonbearing surface (red area) of the lateral femoral condyle consists of the lateral facet and the chondral area with a width of 2 mm (B).

to the clinic for follow-up. At every follow-up, visual analog scale (VAS) was used to assess knee pain and the International Knee Documentation Committee (IKDC) form was used to assess knee function. The satisfaction of patients was divided into three grades: poor, good, and excellent based on their own subjective evaluation.

Statistical analysis

All the analyses were performed using the Statistical Product and Service Solutions (SPSS version 15.0 for Windows, SPSS Inc., Chicago, IL, USA). The data were expressed as the mean \pm standard deviation (SD) or as a percentage of subjects. Differences in the values of variables among groups were assessed using *t*-test if equal variance or Mann-Whitney *U*-test if not equal variance. The Pearson's Chi-square test was applied for dichotomous variables if expected frequency was >5 or Fisher's exact test was applied if not. A value of $P < 0.05$ was considered statistically significant.

RESULTS

There were 43 consecutive patients who met the inclusion criteria. Nineteen patients were in the fixation group and 24 patients in the excision group. The average age was 14.1 ± 2.3 (range 9.0–17.0) years. The average follow-up time was 28 ± 10 (range 13–56) months. The average time to surgery from injury was 15 ± 9 (range 3–36) days. Patient characteristics are summarized in Table 1. There was no significant difference in age, gender, follow-up time, causes of injury, time to surgery from injury, PTA, ISI, times of dislocation, and location of osteochondral fracture between fixation and excision groups [Table 1]. However, the surgery time in the fixation group (82 ± 14 min) is significantly longer than that in the excision group (43 ± 10 min, $t = 7.35$, $P < 0.01$). All patients were identified to have MPFL injury and underwent MPFL repair. Patella alta (ISI >1.3) was observed in three patients. In 21 patients, the PTA was $>30^\circ$ and lateral release was performed.



Figure 3: Intraoperative view following open reduction and internal fixation of patellar osteochondral fracture with bioabsorbable pins.

The size of osteochondral fractures in the fixation group (2.30 ± 0.70 cm²) was significantly larger than that in the excision group (1.88 ± 0.62 cm², $t = 0.84$, $P < 0.05$) [Table 1]. The numbers of cases with ≤ 2 cm² and >2 cm² osteochondral fractures were compared between the two groups ($P > 0.05$) [Table 2].

At the last follow-up, the average IKDC score was 86.42 ± 8.55 (range 65.52–100.00) in total. The average IKDC score in the fixation group (82.52 ± 8.71 , range 65.52–100.00) was significantly lower than that in the excision group (89.51 ± 7.19 , range 73.56–100.00, $t = 10.77$, $P < 0.01$). The average VAS score of pain was 0.53 ± 0.86 (range 0–3) in total. The average VAS score in the fixation group (0.58 ± 0.96 , range 0–3) was similar to that in the excision group (0.50 ± 0.78 , range 0–3, $U = 0.71$, $P > 0.05$). The satisfaction was poor in four patients, good in 22, and excellent in 17. The good and excellent rate in the fixation group was 89% (17/19) and that in the excision group was 92%. Moreover, it had no significant difference between the two groups ($\chi^2 = 0.81$, $P > 0.05$).

There were no significant differences in the IKDC score between male and female, first dislocations and recurrent dislocations, and ≤ 2 cm² and >2 fractures in each group (all $P > 0.05$) [Figure 4]. For female patients, excision of fractures (90.50 ± 6.62) had significantly higher IKDC score than fixation (81.92 ± 9.66 , $t = 2.70$, $P < 0.01$). For both patients with first dislocation and those with recurrent dislocation, excision (respectively, 80.00 ± 8.00 , 85.31 ± 9.05) also had significantly higher IKDC score than fixation (respectively, 87.64 ± 7.81 , $t = 2.05$, $P < 0.05$; 93.25 ± 3.90 , $t = 1.85$, $P < 0.05$) [Figure 4].

At the last follow-up, there were 7 (16%) patients who had recurrent patellar dislocation: three patients were in the fixation group and four were in the excision group. There was no significant difference between two groups ($\chi^2 = 0.22$, $P > 0.05$). Four (4/7) patients were skeletally mature and underwent MPFL reconstruction and tibial tubercle transfer. Three (3/7) patients were skeletally immature and accepted conservative treatment. During the second surgery, previous

Table 1: Demographic characteristics of all patients with osteochondral fractures after patellar dislocations

Characteristics	Total (n = 43)	Fixation group (n = 19)	Excision group (n = 24)	Statistics	P
Age (year), mean (range)	14.1 (9.0–17.0)	13.9 (9.0–17.0)	14.2 (10.0–17.0)	-0.385*	0.702
Gender, n (%)					
Male	13 (30)	8 (42)	5 (21)	2.275†	0.131
Female	30 (70)	11 (58)	19 (79)		
Follow-up (month), mean (range)	28 (13–56)	25 (13–36)	31 (13–56)	-1.237‡	0.216
Causes of injury, n (%)					
Direct trauma	20 (47)	8 (42)	12 (50)	0.266†	0.606
Twisting injury	23 (53)	11 (58)	12 (50)		
Time to surgery from injury (day), mean (range)	15 (3–36)	14 (3–36)	16 (3–32)	0.882*	0.383
PTA (°), mean (range)	26.84 (3.45–38.40)	25.17 (3.45–38.40)	27.25 (3.86–35.79)	0.449*	0.656
ISI, mean (range)	1.08 (0.84–1.46)	1.05 (0.84–1.36)	1.10 (0.88–1.46)	0.536‡	0.704
Times of dislocation, n (%)					
First	26 (60)	10 (53)	16 (67)	0.874†	0.350
Recurrent	17 (40)	9 (47)	8 (33)		
Location of osteochondral fracture, n (%)					
Medial patellar facet	28 (65)	14 (74)	14 (58)	0.703†	0.703
Lateral femoral condyle	11 (26)	3 (16)	8 (33)		
Both	4 (9)	2 (10)	2 (9)		
Fracture size (cm ²), mean (range)	2.07 (0.96–4.14)	2.30 (1.40–4.14)	1.88 (0.96–3.42)	0.841*	0.045
Surgery duration (min), mean (range)	60 (29–116)	82 (59–116)	43 (29–68)	10.767*	<0.01

**t*-test; † χ^2 test; ‡Mann-Whitney *U*-test. ISI: Insall-Salvati Index; PTA: Patellar tilt angle.

Table 2: Comparison of cases with ≤ 2 cm² and > 2 cm² osteochondral fractures between the fixation group and the excision group

Size of fractures	Fixation group (n = 19)	Excision group (n = 24)	χ^2	P
≤ 2 cm ² , n	8	14	3.751	0.290
> 2 cm ² , n	11	10		

osteochondral fracture was found to have been healed in 3/4 patients, but cracking delineation of cartilage injury was still observed. In the other one patient, osteochondral defect and fibrocartilage filling were observed. Lasting knee pain was identified in four patients in the fixation group and two patients in the excision group. There was no patient who had infection or knee stiffness.

DISCUSSION

In this study, we reviewed a series of 43 adolescent patients with osteochondral fracture that did not involve the bearing surface after patellar dislocation and compared the outcomes of patients undergoing internal fixation with that of patients without fixation. Results showed that patients in the excision group had significantly shorter surgery duration and higher IKDC score after surgery than those in the fixation group.

Osteochondral fracture is a common injury following patellar dislocation, of which the incidence is reported from 31% to 58% of acute patellar dislocation.^[4-7] An ideal decision of treating the osteochondral fracture should be made according to injury pattern including the location and the size of fracture and whether bearing surface is involved or not. Osteochondral fractures that involve the bearing surface should be treated

by surgical reduction and fixation as far as possible because they may lead to traumatic arthritis.^[11,15] When osteochondral fragments are too small to be fixed back, alternative methods have to be considered such as microfracture, mosaicplasty, and chondrocyte implantation.^[11,15]

However, if the fracture is big enough to be fixed but does not involve the bearing surface, whether it will be fixed or removed should be considered. There is no doubt that fixation can restore the normal patellofemoral articulation and decrease the risk of long-term osteoarthritis. However, Lee *et al.*^[10] found that patients undergoing internal fixation of osteochondral fragments got worse outcomes than those with fragment excision and microfracture although the fixation group had a larger size of osteochondral fracture. In this study, we observed a similar result that patients in the fixation group had significantly lower IKDC score than those in the excision group. How does such an interesting result come? First, Hembree *et al.*^[12] analyzed cell viability of 29 osteochondral fragments from injured joints and observed that chondrocytes in osteochondral fragment had significant necrosis and apoptosis, which might affect the outcome of fixation procedures. In Nomura and Inoue's study,^[16] fibrillation of osteochondral fragment after reattachment was observed in one patient in the second-look arthroscopy. In this study, osteochondral defect and fibrocartilage filling were observed in one patient who had fixation of osteochondral fracture. These may result from necrosis and apoptosis of chondrocytes in osteochondral fragments. Consequently, we think that the necrosis and apoptosis of chondrocytes in osteochondral fragments will have a negative effect on the outcome of fixation. From this perspective, the reduction and fixation of osteochondral fracture equals to osteochondral

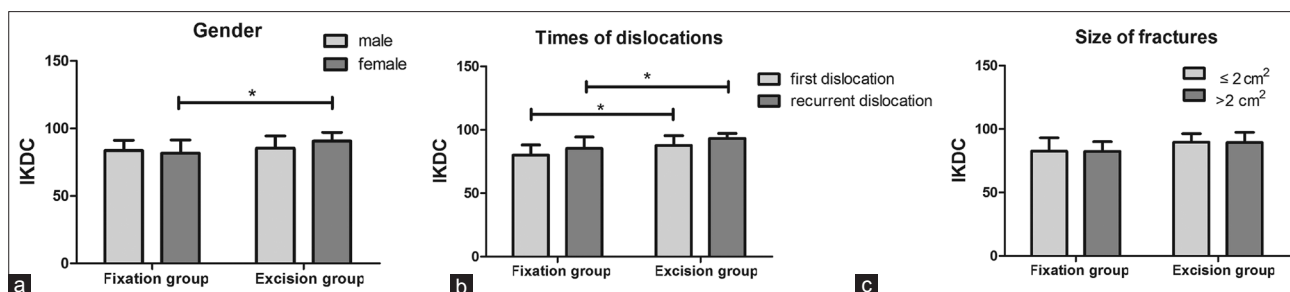


Figure 4: Comparisons of the IKDC score at the last follow-up between different gender (a), the first dislocations and the recurrent dislocations (b), the $\leq 2 \text{ cm}^2$ and $> 2 \text{ cm}^2$ fractures (c) in fixation group ($n = 19$) and excision group ($n = 24$), respectively ($*P < 0.05$). IKDC: International Knee Documentation Committee.

autograft. Furthermore, common fixation techniques of osteochondral fractures include suture,^[17] headless metal screws,^[10] and bioabsorbable pins.^[18] All these techniques have further damage to cartilage of fragments and can hardly achieve rigid fixation, which will possibly lead to worse outcomes and lower function scores. Finally, the result of this study showed that fixation of osteochondral fracture significantly increased the surgery time, which would increase more surgery trauma and the risk of infection. Based on all these evidence, we think that removal of osteochondral fragments which do not involve bearing surface after patellar dislocation should be considered as an option before other better-fixation techniques.

Patellar dislocation occurs most commonly in adolescent patients, many of whom are skeletally immature.^[1] The best method to treat patellar dislocation remains a subject of debate. Nonsurgical treatment is traditionally advocated for patients with primary patellar dislocation.^[19] Several authors have reported good or excellent functional outcomes and few recurrent dislocations after arthroscopic medial plication.^[20,21] Previous cadaveric studies have demonstrated the location of MPFL femoral attachment close to the physis.^[22,23] There is a risk of physeal injury during MPFL reconstruction. It has been reported that physeal injury after ligament reconstruction induced growth alteration and significant knee deformity.^[24,25] In this study, contraction of the medial retinaculum and MPFL repair but not MPFL reconstruction were performed to treat skeletally immature patients with patellar dislocation. Results show that 16% of patients had recurrent dislocation during an average follow-up of 28 months.

There were some limitations to this study. First, this study was a retrospective cohort study in which patients were not randomly divided into the fixation or excision group. Second, those patients with small osteochondral fractures that were difficult to be fixed back were also included in the excision group, which induced that the average size of osteochondral fragments in the fixation group (2.30 cm^2) was significantly larger than that in the excision group (1.88 cm^2 , $P = 0.045$). Furthermore, whether fixations of osteochondral fractures were done or not was not blind to the evaluator, which might lead to assessment bias. Finally, the follow-up was relatively short term with an average of 28 months as the most important assessment of osteoarthritis

was a long-term consequence. Yet, we believe that our results are still of interest, and further follow-up on this patient cohort is ongoing.

In this study, patients in the excision group had significantly shorter surgery time and higher IKDC score after surgery than those in the fixation group. We concluded that if osteochondral fractures following patellar dislocations do not involve the bearing surface and are smaller than 2 cm^2 , removal of these fragments could be considered as an option.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Fithian DC, Paxton EW, Stone ML, Silva P, Davis DK, Elias DA, *et al.* Epidemiology and natural history of acute patellar dislocation. *Am J Sports Med* 2004;32:1114-21. doi: 10.1177/0363546503260788.
- Hsiao M, Owens BD, Burks R, Sturdivant RX, Cameron KL. Incidence of acute traumatic patellar dislocation among active-duty United States military service members. *Am J Sports Med* 2010;38:1997-2004. doi: 10.1177/0363546510371423.
- Colvin AC, West RV. Patellar instability. *J Bone Joint Surg Am* 2008;90:2751-62. doi: 10.2106/jbjs.h.00211.
- Nomura E, Inoue M, Kurimura M. Chondral and osteochondral injuries associated with acute patellar dislocation. *Arthroscopy* 2003;19:717-21. doi: 10.1016/s0749-8063(03)00401-8.
- Elias DA, White LM, Fithian DC. Acute lateral patellar dislocation at MR imaging: Injury patterns of medial patellar soft-tissue restraints and osteochondral injuries of the inferomedial patella. *Radiology* 2002;225:736-43. doi: 10.1148/radiol.2253011578.
- Seeley MA, Knesek M, Vanderhave KL. Osteochondral injury after acute patellar dislocation in children and adolescents. *J Pediatr Orthop* 2013;33:511-8. doi: 10.1097/bpo.0b013e318288b7a0.
- Stanitski CL, Paletta GA Jr. Articular cartilage injury with acute patellar dislocation in adolescents. Arthroscopic and radiographic correlation. *Am J Sports Med* 1998;26:52-5. doi: 10.1177/03635465980260012501.
- Gudas R, Simonaityte R, Cekanaukas E, Tamosiūnas R. A prospective, randomized clinical study of osteochondral autologous transplantation versus microfracture for the treatment of osteochondritis dissecans in the knee joint in children. *J Pediatr Orthop* 2009;29:741-8. doi: 10.1097/bpo.0b013e3181b8f6c7.
- Knutsen G, Engebretsen L, Ludvigsen TC, Drogset JO, Grøntvedt T,

- Solheim E, *et al.* Autologous chondrocyte implantation compared with microfracture in the knee. A randomized trial. *J Bone Joint Surg Am* 2004;86-A: 455-64. doi: 10.2106/00004623-200403000-00001.
10. Lee BJ, Christino MA, Daniels AH, Hulstyn MJ, Ebersson CP. Adolescent patellar osteochondral fracture following patellar dislocation. *Knee Surg Sports Traumatol Arthrosc* 2013;21:1856-61. doi: 10.1007/s00167-012-2179-z.
 11. Lording T, Lustig S, Servien E, Neyret P. Chondral injury in patellofemoral instability. *Cartilage* 2014;5:136-44. doi: 10.1177/1947603514530142.
 12. Hembree WC, Ward BD, Furman BD, Zura RD, Nichols LA, Guilak F, *et al.* Viability and apoptosis of human chondrocytes in osteochondral fragments following joint trauma. *J Bone Joint Surg Br* 2007;89:1388-95. doi: 10.1302/0301-620x.89b10.18907.
 13. Insall J, Salvati E. Patella position in the normal knee joint. *Radiology* 1971;101:101-4. doi: 10.1148/101.1.101.
 14. Dejour H, Walch G, Nove-Josserand L, Guier C. Factors of patellar instability: An anatomic radiographic study. *Knee Surg Sports Traumatol Arthrosc* 1994;2:19-26. doi: 10.1007/bf01552649.
 15. Duthon VB. Acute traumatic patellar dislocation. *Orthop Traumatol Surg Res* 2015;101:S59-67. doi: 10.1016/j.otsr.2014.12.001.
 16. Nomura E, Inoue M. Second-look arthroscopy of cartilage changes of the patellofemoral joint, especially the patella, following acute and recurrent patellar dislocation. *Osteoarthritis Cartilage* 2005;13:1029-36. doi: 10.1016/j.joca.2005.07.004.
 17. Pritsch M, Velkes S, Levy O, Greental A. Suture fixation of osteochondral fractures of the patella. *J Bone Joint Surg Br* 1995;77:154-5. doi: 10.1016/s1058-2746(96)80117-0.
 18. Walsh SJ, Boyle MJ, Morganti V. Large osteochondral fractures of the lateral femoral condyle in the adolescent: Outcome of bioabsorbable pin fixation. *J Bone Joint Surg Am* 2008;90:1473-8. doi: 10.2106/jbjs.g.00595.
 19. Moström EB, Mikkelsen C, Weidenhielm L, Janarv PM. Long-term follow-up of nonoperatively and operatively treated acute primary patellar dislocation in skeletally immature patients. *ScientificWorldJournal* 2014;2014:473281. doi: 10.1155/2014/473281.
 20. Nam EK, Karzel RP. Mini-open medial reefing and arthroscopic lateral release for the treatment of recurrent patellar dislocation: A medium-term follow-up. *Am J Sports Med* 2005;33:220-30. doi: 10.1177/0363546504267803.
 21. Miller JR, Adamson GJ, Pink MM, Fraipont MJ, Durand P Jr. Arthroscopically assisted medial reefing without routine lateral release for patellar instability. *Am J Sports Med* 2007;35:622-9. doi: 10.1177/0363546506296041.
 22. Baldwin JL. The anatomy of the medial patellofemoral ligament. *Am J Sports Med* 2009;37:2355-61. doi: 10.1177/0363546509339909.
 23. Shea KG, Styhl AC, Jacobs JC Jr., Ganley TJ, Milewski MD, Cannamela PC, *et al.* The relationship of the femoral physis and the medial patellofemoral ligament in children: A Cadaveric study. *Am J Sports Med* 2016;44:2833-7. doi: 10.1177/0363546516656366.
 24. Kocher MS, Saxon HS, Hovis WD, Hawkins RJ. Management and complications of anterior cruciate ligament injuries in skeletally immature patients: Survey of the herodicus society and the ACL study group. *J Pediatr Orthop* 2002;22:452-7. doi: 10.1097/01241398-200207000-00008.
 25. Shea KG, Grimm NL, Belzer JS. Volumetric injury of the distal femoral physis during double-bundle ACL reconstruction in children: A three-dimensional study with use of magnetic resonance imaging. *J Bone Joint Surg Am* 2011;93:1033-8. doi: 10.2106/jbjs.j.01047.

青少年患者髌骨脱位后固定或切除骨软骨骨折块的疗效比较：一项回顾性队列研究

摘要

背景：髌骨脱位在青少年人群中是一种常见的膝关节损伤，通常合并有骨软骨的骨折。本文比较了青少年患者髌骨脱位后未累及负重面的骨软骨骨折块固定或切除治疗的疗效。

方法：我们回顾性分析了2007~2014年间在我院手术治疗的合并有骨软骨骨折的髌骨脱位患者。对符合纳入标准的患者进行随访。随访时，应用视觉模拟评估膝关节疼痛，应用国际膝关节文献委员会（IKDC）评分评估膝关节的功能，同时记录患者的满意度。

结果：共43例患者满足纳入标准，平均年龄 14.1 ± 2.3 （9.0~17.0）岁。平均随访时间 28 ± 10 个月。其中19例行骨软骨骨折块的固定术为固定组，24例行切除术为切除组。两组患者在年龄、性别、随访时间、致伤原因、脱位次数以及骨软骨骨折的位置上均无显著性差异。但是固定组患者的手术时间更长（ 82 ± 14 比 43 ± 10 分钟， $t=10.77$ ， $P < 0.01$ ），骨软骨骨折块面积更大（ 2.30 ± 0.70 比 1.88 ± 0.62 cm²， $t = 0.84$ ， $P < 0.05$ ）。在随访终点，固定组患者的IKDC评分（ 82.52 ± 8.71 ）显著低于切除组（ 89.51 ± 7.19 ， $t=2.65$ ， $P < 0.01$ ）；但是两组之间VAS疼痛评分和患者满意度并无显著差异（均 $P > 0.05$ ）。所有患者中有7（16%）例患者出现再脱位。

结论：对于青少年合并骨软骨骨折的髌骨脱位，如果骨折块未累及负重面，切除比固定骨折块可以获得更好的效果。