

Bilateral Sleeve Patella Avulsion: A Case Report and Literature Review

ABSTRACT

Sleeve patella avulsion is rare in children. The bilateral form is exceptional and only few cases are reported in literature. It often goes unnoticed upon initial presentation. MRI is golden standard for a precise description of the lesion. Early diagnosis of patellar sleeve fracture is important for successful treatment.

We present a case of bilateral patellar sleeve fracture in an 11-year-old boy who was diagnosed early and treated surgically with osteosuture in the left knee and a tension band construct in the right one. He regained full and painless active range of motion of bilateral knees within 18 months of his surgery but presented a radiological non-union of the inferior pole of the right patella.

Keywords: sleeve patella avulsion, active extension deficit, patella alta, MRI, surgery

1. INTRODUCTION

Patella fractures are rare in children, occurring in less than 1% of cases. A specific type seen in pediatric patients is the lower pole patella fracture with sleeve avulsion. This involves the tearing of a small bone or cartilaginous fragment from the distal patella, often invisible on X-rays. These fractures typically occur in children aged 8 to 16, with a peak incidence at 13 years, and predominantly affect boys. Bilateral cases are uncommon, and diagnosis can be challenging. Treatment of patella sleeve fracture is mainly surgical. Through a case of bilateral sleeve patellar avulsion and a review of the literature, we present the diagnostic and therapeutic particularities of this condition.

2. CASE PRESENTATION:

We present the case of an 11-year-old boy with no medical problems who was the victim of a sport accident. He felt a crunch when he was running. The patient presented bilateral knee

pain and total functional impotence of both lower limbs. Clinical examination showed edema of both knees, predominantly in the right one (Figure 1).



Figure 1: Clinical appearance of the right knee showing significant edema.

The child was unable to lift his limbs off the bed. Palpation of both knees revealed pain and a discontinuity at the base of insertion of the patellar tendon on the right patella, although no gap was detected upon palpation of the left knee's patellar tendon. Standard radiography of both knees showed soft tissue swelling and bilateral patella alta without any evidence of fracture (Figure 2). Caton Deschamps index was 2,07 in the right knee and 1,93 in the left one.

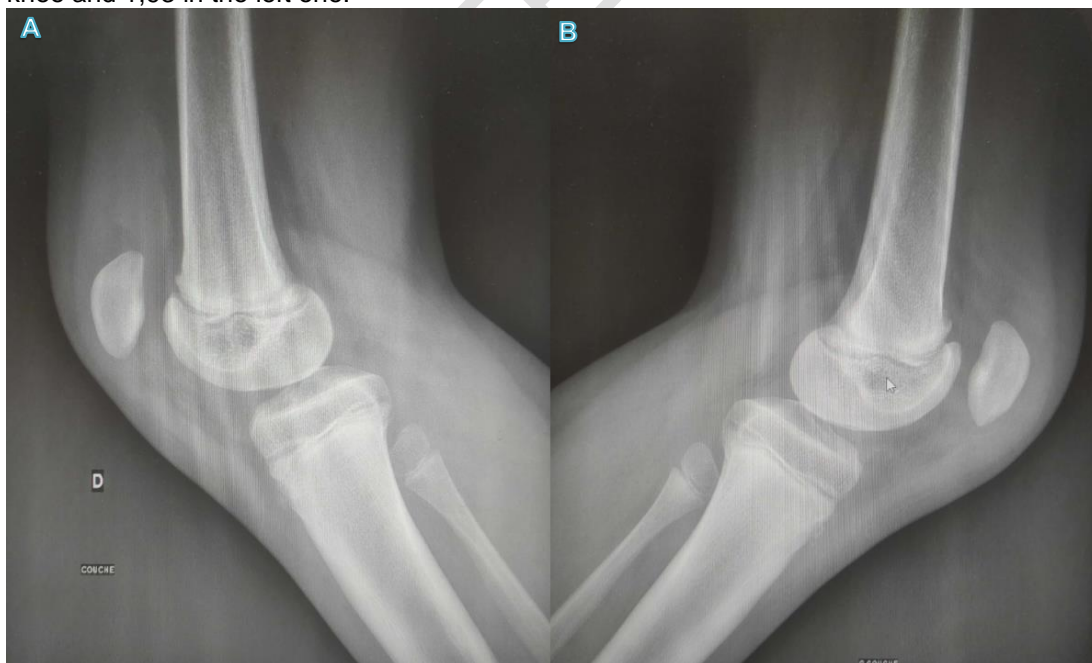


Figure 2: Standard lateral x-ray views of the right (A) and left (B) knees showing patella alta

An ultrasound of both knees was urgently requested and was not conclusive. It showed bilateral joint effusion especially in the right side.

MRI of both knees showed patella sleeve avulsion in the lower pole and extensive hemarthrosis. The gap was 6 mm in the right knee and 2 mm in the left one (Figure 3).

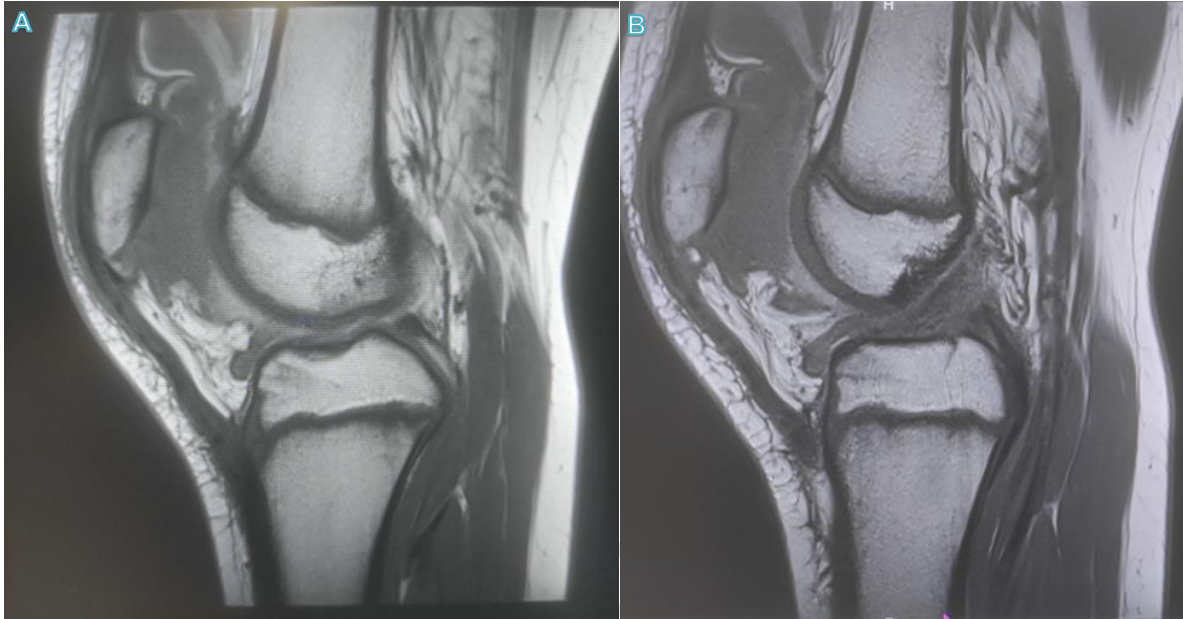


Figure 3: MRI of right (A) and left (B) knee showing patella sleeve avulsion

The child underwent surgery on both knees ten days after the trauma. The patient was positioned supine during the procedure. An anterior approach was used for both knees. On the right side, there was a lower polar separation of the patella. Reinsertion was performed using osteosuture and tension band technique with mersuture and two parallel K-wires (figure 4A). On the left side, an incomplete and less significant lower polar separation was found, which was treated with osteosuture only (figure 4B).

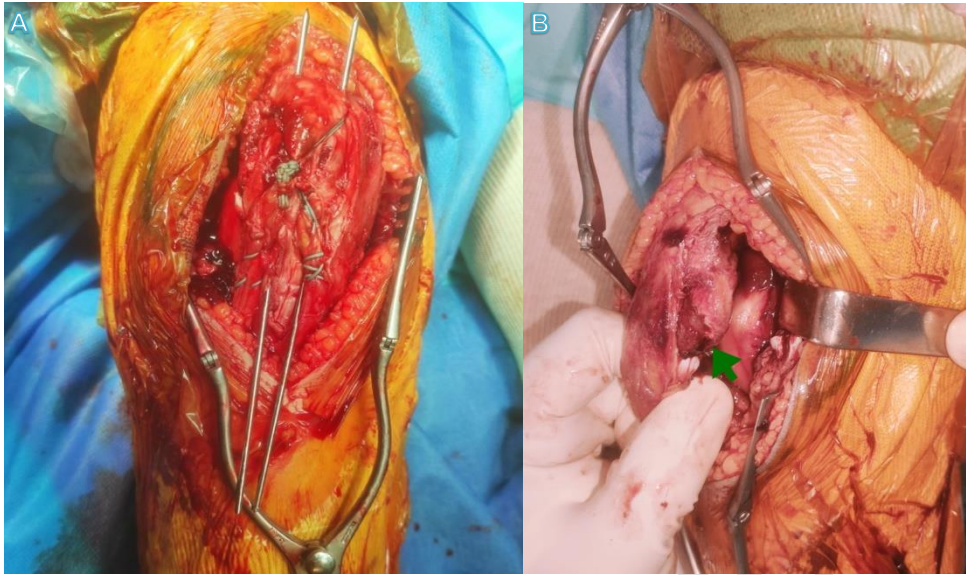


Figure 4. Intraoperative photo showing reinsertion by osteosuture and K wires of patella sleeve avulsion of the right knee (figure A) and a clinical photo showing the incomplete separation of the inferior pole of the left knee (green arrow) (figure B)

Both knees were immobilized by two splints in extension for four weeks. Weight bearing was allowed in the immediate post-operative period. Rehabilitation began 2 weeks postoperatively. Three months post-surgery, the child experienced no pain but exhibited arthrogenic muscle inhibition with an active knee extension deficit in the right knee. Eighteen months after the surgical intervention, the child had made a complete recovery without pain. However, standard radiography revealed a nonunion in the inferior pole of the right patella.

3. DISCUSSION

The incidence of patellar fractures in children is low (1 to 6.5%). Only 5% occur at one of the two poles in the form of an avulsion fracture [2, 3]. Bilateral sleeve fractures of the patella are extremely rare.

Patella sleeve avulsion is specific to children under 16 years old. It occurs mainly in boys. The sex ratio is approximately 3:1 [4].

This anomaly occurs acutely and is often the result of an indirect mechanism (brutal eccentric contraction of the quadriceps muscle) following a jump, for example [1]. This mechanism was responsible for bilateral avulsion rupture in our case (Table 1).

Table 1. showing cases of bilateral sleeve patella avulsion in literature compared to our case

Cases reports	Gender + age	Mechanism	Treatment
---------------	--------------	-----------	-----------

Usami S et al. 2023 [5]	Male 11 year-old	Feeling crack when he performed a take-off jump while playing tag	ORIF : suture anchors
Tangjiang Li and al. 2022 [6]	Female 10 year-old	Falling on her knees while running	Kirshner wires + cerclage with stainless-steel wire
Jia-Yi Shao and al. 2020 [7]	Male 13 year-old	Feeling weakness in both knees + falling in the ground while running	Three transosseous tunnels + orthocord suture
Shazaan F Hushmendi and al. 2017 [8]	Female 9 year-old	Falling with hyperflexed knees while running	Fiber wire suture
Stephen Paul Guy and al. 2011 [9]	Male 11 year-old	Jumping vertically straight up and down while playing on the trampoline	Three transosseous tunnels + cerclage wire
Our case. 2024	Male 11 years old	Feeling a crunch while running	Osteosuture + pins

The main clinical presentation is pain and deficit of active extension of the knee. Palpation may show an ascension of the patella or a depression in its lower pole.

In our case, the child couldn't do active extension of his right and left knee and presented a loss of continuity in the inferior pole of his right patella.

Standard knee radiography can show knee effusion, patella alta and sometimes bone tearing which is not detected in our case.

Ultrasound may be useful in the absence of a radiographically visible fracture fragment. It can show cartilaginous lesion and estimate the degree of separation which was not the case in our situation. Visualization of soft-tissue all around can show edema, fluid, and hyperemia.

MRI is the golden standard for positive diagnosis and allows a better description of the chondral lesion. In our case, we were able to visualize clearly the bilateral sleeve avulsion and to calculate the displacement.

It is necessary to know the differential diagnoses such as Sinding-Larsen-Johansson disease characterized by chronic pain at the lower pole of the patella [4], Osgood Schlatter disease characterized by pain at the insertion of the patellar tendon on the anterior tibial tuberosity [10] and avulsion fracture of the tibial tubercle occurring in adolescents at the end of growth [11].

Prompt diagnosis of a patellar sleeve fracture is essential, as failure to do so can result in ectopic bone formation, knee instability, and quadriceps atrophy and weakness, leading to reduced knee extension [12].

Non-operative treatment is based on cast immobilization in extension and indicated for fractures with displacement of less than 2 mm noted on standard radiographs [13]. Surgical treatment is indicated in cases of fractures with displacement greater than 2 mm, the presence of extensor lag or joint incongruity [14].

The goal of surgical treatment is to restore tension of the extensor mechanism and to have good joint congruence.

However, Surgical management may be associated with complications, such as nonunion, patella alta, ischemic necrosis of the patella and wound infection [15]. In our case, despite good knee mobility, radiological imaging at the 18-month follow-up revealed a nonunion in the inferior pole of the right patella.

Different techniques were used like suture anchor and transosseous tunnel repair associated or not with partial patellectomy and tendon advancement [16].

Literature has shown that suture anchor construct has greater resistance to gap formation, greater peak force to failure, reduced incision size and reduced operative time compared to transosseous techniques [17, 18].

Some studies used absorbable intraosseous suture anchors with cerclage [19]. Cerclage technique reinforces suture, adds additional strength to resist displacement forces and allows early mobility [19]. In our case, we did a tension band in the right patella with K wires and mersuture to strengthen our osteosutures.

Through a controlled laboratory study realized on 2021, anchors fixation showed similar strength profiles and less tendon gapping with cyclic loading compared to transosseous

sutures in the treatment of comminuted fracture of the distal pole of the patellar by partial patellectomy and patellar tendon advancement [16].

The functional prognosis is generally good or even excellent if the diagnosis was made early and adequate surgical treatment was initiated quickly [16].

We propose this algorithm to clarify the initial diagnosis and management of sleeve patella avulsion fracture in children (Figure 5).

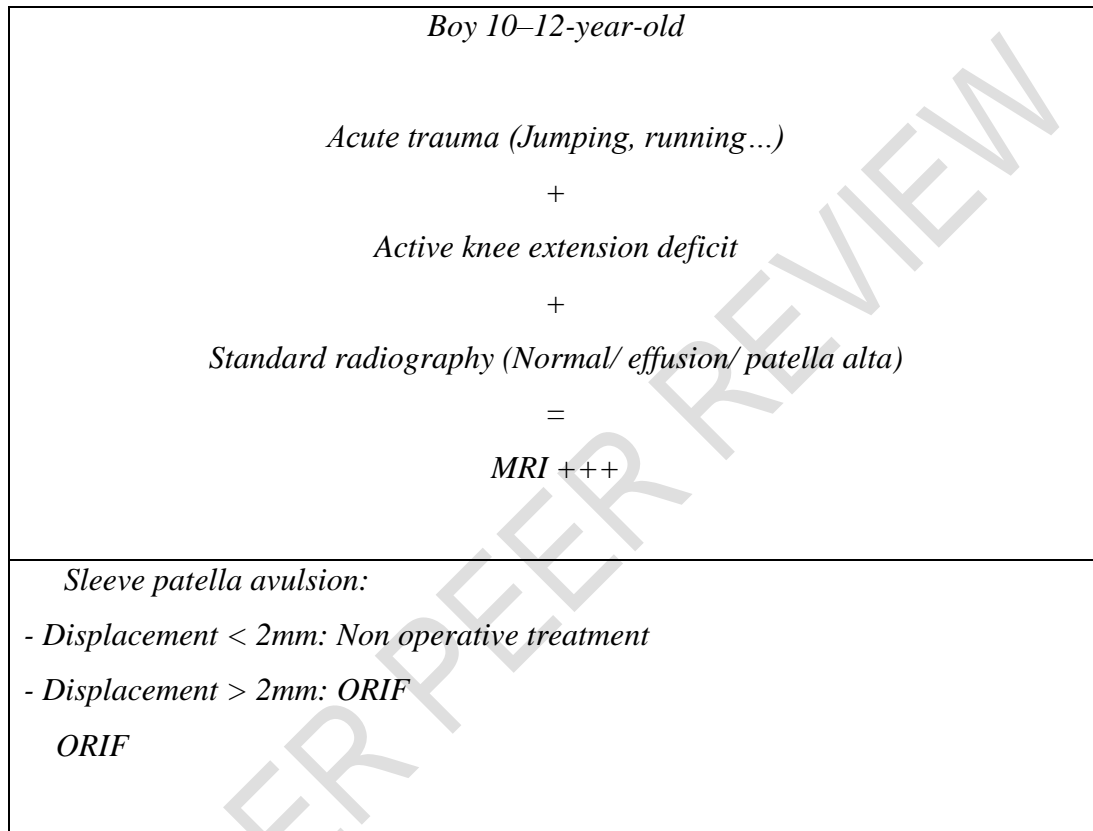


Figure 5. Diagnostic and therapeutic simple algorithm of sleeve patella avulsion

CONCLUSION

Patella sleeve fracture is a diagnosis that requires a high index of suspicion, especially in children who presented acute knee pain preceded by an eccentric contracture of the quadriceps muscle. It is important to make this diagnosis promptly and act accordingly, because a delay or misdiagnosis will result in severe permanent disability to the affected child. Open reduction internal fixation (ORIF) is generally recommended because it yields good functional results.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

REFERENCES

1. Schmidt-Hebbel A, Eggers F, Schütte V, Achtnich A, Imhoff AB. Patellar sleeve avulsion fracture in a patient with Sinding-Larsen-Johansson syndrome: a case report. *BMC Musculoskelet Disord*. 2020 Apr 23;21(1):267. doi: 10.1186/s12891-020-03297-z.
2. Ray JM, Hendrix J. Incidence, mechanism of injury, and treatment of fractures of the patella in children. *J Trauma*. 1992 Apr;32(4):464-7. doi: 10.1097/00005373-199204000-00010.
3. Heckman JD, Alkire CC. Distal patellar pole fractures. A proposed common mechanism of injury. *Am J Sports Med*. 1984 Nov-Dec;12(6):424-8. doi: 10.1177/036354658401200603.
4. Hsieh GH, Pan RY, Lin LC, Wang CC. Sleeve fracture of the patella. *J Med Sci (Taiwan)* 2020;40(2):88–91. DOI: 10.4103/jmedsci.jmedsci_54_19.
5. Usami S, Naraoka T, Sasaki S, Oishi K, Ishibashi Y. Bilateral Sleeve Fracture of the Patella in a Healthy 11-Year-Old Male: A Case Report. *Cureus*. 2023 Dec 11;15(12). doi: 10.7759/cureus.50347.
6. Li T, Xiang M, Lv X, Gan Y and Yu S (2022) Bilateral sleeve fracture of the inferior pole of the patella in children: A case report. *Front. Surg*. 9:970802. doi: 10.3389/fsurg.2022.970802.
7. Shao JY, Yang YP, Ao YF. Chronic bilateral sleeve fracture of the patellae in a healthy child: a case report. *Chin Med J (Engl)*. 2020 Jul 20;133(14):1744-1746. doi: 10.1097/CM9.0000000000000926.
8. Hushmendi SF, Roberts TT, Tran E, Leonard GR (2017) Bilateral Patella Sleeve Avulsions in an Otherwise Healthy Nine-Year-Old Girl: A Case Report and Review of the Literature. *Trauma Cases Rev* 3:049. Doi: 10.23937/2469-5777/1510049.
9. Guy SP, Marciniak JL, Tulwa N, Cohen A. Bilateral sleeve fracture of the inferior poles of the patella in a healthy child: case report and review of the literature. *Adv Orthop*. 2011;2011:428614. doi: 10.4061/2011/428614.
10. Ngissah RKS, Gyeke-Boafo NK, Awere-Kyere LKB. Patella sleeve fracture injury: a case report. *Ghana Med J*. 2021 Mar;55(1):93-95. doi: 10.4314/gmj.v55i1.15.

11. Kushner RL, Massey P. Tibial Tubercle Avulsion. [Updated 2020 Jun 7]. In: Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2020 Jan-. doi: 10.4314/gmj.v55i1.15.
12. Bruijn JD, Sanders RJ, Jansen BR. Ossification in the patellar tendon and patella alta following sports injuries in children. Complications of sleeve fractures after conservative treatment. *Arch Orthop Trauma Surg.* 1993;112(3):157-8. doi: 10.1007/BF00449996.
13. Hunt DM, Somashekar N. A review of sleeve fractures of the patella in children. *Knee.* 2005 Jan;12(1):3-7. doi: 10.1016/j.knee.2004.08.002.
14. Georgiadis AG, Comadoll SM. Patellar sleeve fracture: Open reduction and internal fixation. *J Pediatr Orthop Soc North Am* 2021;3. <https://doi.org/10.55275/JPOSNA-2021-367>.
15. Boushnak MO, Moussa MK, Abed Ali AA, Mohsen ZH, Chamseddine A. Patellar Sleeve Fracture in an Eight-Year-Old Girl. *Cureus.* 2020 Sep 9;12(9).doi: 10.7759/cureus.10345.
16. O'Donnell R, Lemme NJ, Marcaccio S, Walsh DF, Shah KN, Owens BD, DeFroda SF. Suture Anchor Versus Transosseous Tunnel Repair for Inferior Pole Patellar Fractures Treated With Partial Patellectomy and Tendon Advancement: A Biomechanical Study. *Orthop J Sports Med.* 2021 Aug 16;9(8):23259671211022245. doi: 10.1177/23259671211022245.
17. Ettinger M, Dratzidis A, Hurschler C, Brand S, Calliess T, Krettek C, Jagodzinski M, Petri M. Biomechanical properties of suture anchor repair compared with transosseous sutures in patellar tendon ruptures: a cadaveric study. *Am J Sports Med.* 2013 Nov;41(11):2540-4. doi: 10.1177/0363546513500633.
18. Huang W, Wu T, Wei Q, Peng L, Cheng X, Gao G. Suture repair of patellar inferior pole fracture: Transosseous tunnel suture compared with anchor suture. *Exp Ther Med.* 2021 Sep;22(3):998. doi: 10.3892/etm.2021.10430. Epub 2021 Jul 15.
19. Nowell JA, Niu EL. Patellar Sleeve Avulsion Fracture Repair: Suture Anchor Technique With Suture Cerclage Augmentation. *Arthrosc Tech.* 2023 Nov 13;12(12). doi: 10.1016/j.eats.2023.07.045.