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Presentation and options in management of avulsion fracture fibular head: A prospective study of rare entity

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Abstract
Introduction: Avulsion fracture of the fibular head is a rare entity. Significance of this entity is lies in association with injuries to the ligaments and neurovascular structures attached to it. Presentation of these injuries is quite variable. Management of this injury is still controversial in spite of various available fixation methods. We report various different presentation and options in management of this rarely reported injury.
Material and method: A prospective, single centre study of six patients of fracture fibular head was presented with injury to knee joint. All were male with average age 31 years (range 19-44 years). Left knee joint was involved in the four and right was in the two patients. All cases were of sports injury. Final diagnosis was proved by X-ray, 3D CT and magnetic resonance imaging. Three cases among them had complete avulsion of fibular head, 3 cases had undisplaced fracture fibular head; among one case was complicated by fracture shaft tibia. Patients with complete avulsion were treated by open reduction and fixation by using various methods. Complications and outcome were recorded in follow-up for 6 to 24 months (mean 21 months). Results were evaluated using Lysholm knee scores.
Results: The average Lysholm knee score was 91.33 points. Excellent result (score 95-100) was seen in 1 case, good results (score 84-94) were seen in 3 cases and fair result (score 65-83) was seen in 1 case. The excellent and good result was 83%.
Conclusions: Our study shows that avulsion of fibular head can present from undisplaced fragment to complete avulsion with grade I to III ligamentous injury or/and with peroneal nerve injury. These injuries can manage with various treatment options from conservative to fixation of avulsed fragment by various devices, depending on severity and combined injury.

Key Words: Fibular head avulsion, Fracture proximal fibula, Ligament injury knee, avulsion fracture, suture anchor.

1. Introduction
Avulsion fracture of the proximal fibula is rare entity. Their significance is in association with injuries to the ligaments and neurovascular structures attached to it. The lateral collateral ligament and tendon of the long head of the biceps femoris muscle are attached to the lateral margin of the fibular head. The popliteofibular, arcuate ligaments are attached to the fibular styloid process. These structures provide stability to the lateral aspect of the knee joint, which is vital for optimal knee function[1, 2].These injuries primarily occurred in a motor vehicle accidents, sports events, martial arts, dancing and manual workers who involves in heavy weight lifting. Common mechanism of injury is anteromedial forces directly acting on the knee joint in an extended position can cause an avulsion fracture of the proximal fibula with associated injuries to the posterolateral structures and the cruciate ligaments[3- 6]. The "arcuate" sign is used to describe an avulsed bone fragment related to the insertion site of the arcuate complex, which consists of the fabellofibular, popliteofibular, and arcuate ligaments[7]. The common peroneal nerve is susceptible to injury because of its fixed attachment in the region of the neck of the fibula[1].Presentation of these injuries is quite variable and depends on the amount of energy imparted to the leg, combined fractures; injury to ligaments and neurovascular structures. These fractures should be treated early to prevent capsular scarring

and soft tissue stretching. Anatomic reduction of these fractures is technically difficult. Rigid fixation and early mobilization is necessary for favourable outcome. Current management of these fractures is based on few descriptions in literature. Various surgical methods of fixation for these fractures have been reported[8]. These injuries are treated surgically, especially when associated with other ligamentous injuries. This prospective, single centre study describes presentation and options in management in a rarely reported, fracture of fibular head.

2. Materials and methods

Total 218, sports related injuries were admitted from April 2014 to December 2016, with injury to knee joint, six among them were with fracture of the fibular head. All patients were presented within 72 hrs of injury to reception. Patient's particulars; name, age, sex, dominancy, date and time of incident, exact mode of injury, position while incident were noted. Clinical and initial radiological examination was done on arrival (Table). For the final diagnosis, the X-ray, three-dimensional 3D CT and MRI examination were done for all patients (Figure 1). The surgical indication was complete avulsion fracture of the fibular head, positivity of the dial test, varus stress test and peroneal nerve injury. The mean interval between the time of injury and surgery was 3.5 days (range, 3-4 days) for the patients who require intervention.

Fig 1: Various presentations of fracture fibular head. Plain antero posterior and lateral oblique /lateral radiograph of the knee showing; (A),(B) Undisplaced fracture; (C),(D) Complete avulsion; (D) avulsion with fracture tibia; (E), (F) complete avulsion of styloid process (arrows); (G), (H) 3D CT images. (I), (J) Coronal section of magnetic resonance imaging shows hyper intensity signals in proximal fibula, anterior cruciate ligament and fibular collateral ligament; (K) shows ill defined marrow oedema with focal irregular breach in head of fibula;(L) Coronal section of magnetic resonance imaging shows hyper intensity signals in anterior cruciate and lateral collateral ligament.

2.1 Surgical technique (Figure 3)

All operations were performed using spinal or continuous epidural, combined with spinal anesthesia. Patient was placed in the supine position on the operating table in knee flexion of 30 degrees and the lower limb tourniquet was inflated. A lateral curvilinear incision was made with the incision passing midway between Gerdy's tubercle and the fibular head on the lateral surface of the knee (Figure 3B). The iliotibial band and the biceps femoris tendon were exposed. The peroneal nerve was identified posterior to the biceps tendon. The iliotibial band was incised in line with its fibers beginning at the point where it crosses the lateral femoral epicondyle and proceeding distally. This exposed the insertion point of both the fibular collateral ligament as well as the popliteus tendon on the lateral femoral condyle. The peroneal nerve was explored and freed as it passed beneath the fascia in the anterolateral compartment of the lower leg (Figure 3C; patient 4). Inspection of the other posterolateral corner structures was done. Blunt dissection was carried out around the biceps tendon to mobilize it and aid in reduction of the fragment (Figure 3D). The anchor was then fastened into cortical bone of the distal end without tension (Figure 3E). Four suture tunnels (patient 4), or two suture tunnels (patient 3) were drilled in the avulsed fragment with the help of a 1.5-2.0 mm K-wire. The anchor ties were passed through the suture tunnels. The fragment was then held reduced and the sutures

were tied to each other over the avulsed fragment (Figure 3F). In one case (patient 1) it was fixed by stainless steel and K wire. The fixation was secure and augmented with the surrounding soft tissues around the biceps femoris tendon. Wound was closed in layers.

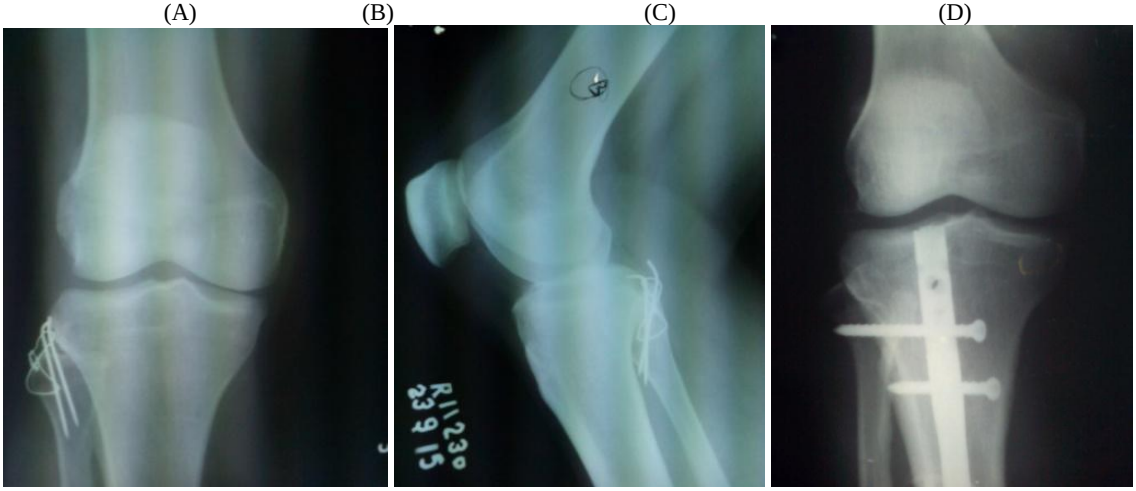
2.2 Postoperative protocol

All patients were placed in an above-knee posterior plaster slab in 10 degree flexion for 3 days followed by in knee immobilizer for 2 weeks. After 2 weeks gentle knee range of motion exercises were started. Partial weight bearing by using walking aid and 90 knee flexion was allowed after 6 weeks followed by full range of motion by 8 weeks. Full weight bearing was allowed after by 12 weeks. Same rehabilitation protocol was used for the patients who were managed conservatively. At final follow-up, all patients were evaluated for knee range of motion, a knee instability test including; Lachman and varus stress tests. Final outcome was measured by Lysholm knee score.

3. Results

All were male with average age 31 years (range 19-44 years). Left knee joint was involved in the four and right was in the two patients. All cases were of sports injury and fresh closed fractures. Four patients have sustained injury to knee while playing football and in other two patients, mechanism of injury was a collision with players in basketball. All cases had knee varus and/or rotary history of trauma. The clinical symptoms and physical findings of all patients were evaluated (Table). Patient 1, sustained avulsion of styloid process of fibula with grade- II varus stress test, grade- I posterior cruciate ligament injury, required open reduction. Fixation of styloid process was done with stainless steel and k wire. Patient 3, sustained complete avulsion of fibular head with grade- III varus stress test, grade -I anterior cruciate ligament injury required open reduction. Avulsed fragment was fixed by one 3.5 mm suture anchor. Patient 4, sustained complete avulsion of fibular head with grade III varus stress test and had peroneal nerve injury. Exploration was done .Common peroneal nerve found to be intact. Avulsed fragment was fixed with two, 3.5 mm suture anchor. Patient 6, sustained undisplaced fracture fibular head and was complicated with fracture shaft tibia. Internal fixation of tibia was done. Patient; 2, 5, had undisplaced fracture fibular head with grade I anterior cruciate ligament was managed conservatively. The mean operation time was 85 .0 minutes (range 80-90 minutes). Intraoperative blood loss was 150-250 ml (mean 266.0 ml). Intraoperative or postoperative complications such as neuronal injury, fixation failure or infection were not found. Five patients were returned for clinical and radiographic follow-up at a minimum of 2 years, other one (patient 6) was followed up to 6 month (mean 21 months) (Figure 2). Common peroneal nerve injury was recovered completely in 24 weeks. All patients were regained full range of motion without flexion contracture. Lateral instability and fixation loosening was not observed in any surgical intervened patient. Grade I posterior cruciate and anterior cruciate ligament instability was observed in patient 1, and in patient 3, respectively. Bone union was achieved in 6 – 12 months in all patients. The mean time to achieve bone union was 7.6 month. A final follow up, according to the Lysholm's scoring system; the results were excellent in 2 cases, good in 3 cases, and fair in 1 case. The score showed a mean value of 91.33 points (range, 88-95 points).

(A) (B) (C) (D)



(E) (F) (G)

Fig. 2: Clinical and radiographic follow-up of fracture fibular head. Plain antero posterior and lateral oblique /lateral views showing; (A),(B) Undisplaced fracture fibular head with plaster slab in situ ; (C),(D) Reduced avulsed fragment with suture anchor in situ; (E),(F) Reduced avulsed fragment with stainless steel and K wire in situ; (G) Undisplaced fracture of fibular head with implant in situ used for fracture tibia; (H) to (K) Outcome at follow up.

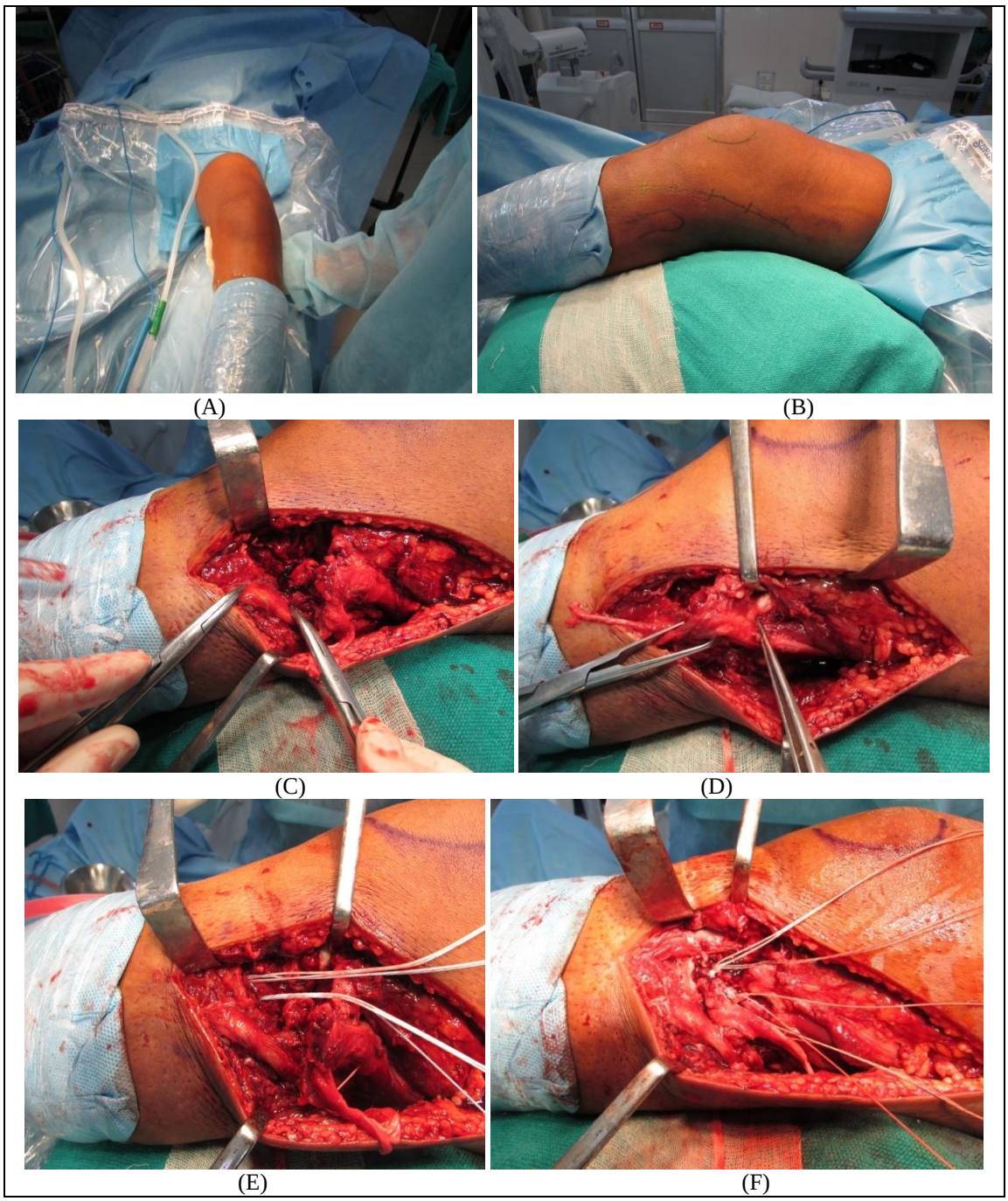


Fig 3; (A) Clinical photograph showing grade III varus stress test under anaesthesia. (B) Clinical photograph showing patient position with knee flexion of 30 degrees. Intraoperative photograph; (C) shows the avulsion fracture of the fibular head and lateral collateral ligament injury; (D) shows reduction of the avulsed fragment; (E) shows, 2 suture anchors fastened into cortical bone of distal end with 4 ties; (F) shows avulsed fragment was reduced and the sutures were tied.

Table 1

Patient No	Age/Sex/Side	Presentation/Clinical examination	Combined injury	Management	Outcome (Lysholm score)
1.	37/M/Right	Pain and swelling, inability to bear weight. Brusies over posterolateral aspect, effusion. varus stress test-Grade II LCL Lachman test –Grade I PCL	Grade I PCL	ORIF + stainless steel and K wire.	90
2.	19/M/Left	Pain and swelling , Restriction of knee Flexion.varus stress test -Grade I LCL Lachman test -ve	-	Plaster slab	95
3.	31/M/Left	Pain and swelling , inability to bear weight fully/ Bruises over anteromedial leg and posterolateral aspect of knee ,effusion,varus stress test-Grade III LCL Lachman test -Grade I ACL	Grade I ACL	ORIF + 01 Suture Anchor of 3.5 mm.	90
4.	26/M/Left	Pain and swelling , inability to bear weight, restriction of knee movements. Brusies over anteromedial and posterolateral aspect around knee ,effusion, foot drop, hypoesthesia along CPN distribution. varus stress test-Grade III LCL Lachman test -ve	CPN traction neuropraxia.	ORIF +02 Suture Anchor of 3.5 mm.	90
5.	29/M/Left	Pain and swelling, inability to bear weight fully. Restriction of knee Flexion/extension varus stress test -Grade I LCL Lachman test -Grade I ACL	Grade I ACL	Plaster slab.	95
6.	44/M/Right	Pain and swelling , inability to bear weight Restriction of knee Flexion. varus stress test-Grade I LCL Lachman test -ve	Fracture shaft of Tibia Grade I ACL	Plaster slab, Internal fixation of tibia.	88

Abbreviations: M-male; LCL-lateral collateral ligament; ACL-anterior cruciate ligament; PCL-posterior cruciate ligament; CPN-common peroneal nerve.

4. Discussion

A fibular head avulsion fracture is a rare entity. In a retrospective study of 2318 knee injuries, only 13 sustained this fracture (0.6%) [3]. It was 6, among 218 knee sports injuries in our cases. Mean patient age was 31 years and all were male. The mechanisms of injury were related to sports event in all cases. In other 7 patients study, mean age was 41 years and there were 5 male; 2 female. The mechanisms of injury were a collision with players in baseball, a fall from a 2-m height, and 5 traffic accidents[9].In our experience, severity of injury; from undisplaced fracture fibular head to complete avulsion with injury to ligaments as well as peroneal nerve, was appreciated on clinical presentation and physical examination of the patients (Table) which were later confirmed by 3D CT/MRI evaluation. Bone bruises on the anteromedial condyle of the femur and tibia, meniscus or/and, cruciate ligaments injury are common associated findings in such type of injury[4]. Patient 2 ,5; had undisplaced fracture fibular head with grade 1 posterior and anterior cruciate ligament injury respectively, varus stress test ; grade I, therefore managed without surgery. Such cases have not reported in any published literature. The avulsion of the fibular bony fragment with its attached insertion of the posterolateral corner ligamentous structures is referred to as "arcuate" sign. Although rare, it is highly indicative of posterolateral corner injury[2, 7]. The common peroneal nerve is susceptible to injury due to its limited longitudinal mobility[10]. We had traction neuropraxia of common peroneal nerve with lateral ligament complex injury, supported by Watson-Jones[11]. In a study of six cases having similar injuries, only one had complete common peroneal nerve transaction[12]. In another study of 54 cases of posterolateral corner injuries, only 9 patients had common peroneal nerve palsy of which 7 cases were associated with avulsion of the fibular head [13]; however, there is no mentioning of the common peroneal nerve laceration. In our study, the patient; 1, 3, 4 were surgical intervened due to the presence of complete avulsion of fibular head, grade II/III; varus stress test, and/or peroneal nerve injury. The integrity of the posterolateral corner in each patient was confirmed intraoperatively. Various surgical methods of fixation for these fractures have been reported [9, 14, 15], however; there is still no standard treatment modality. Our one case had avulsion of fibular styloid that was fixed with stainless steel and K wire. We believe that being small fragment it was difficult to drill and it was reliable fixation with strong tension. It may strip surrounding soft tissues, may damage the peroneal nerve and required subsequent removal. However, we did not experience such outcome in our case. In literature, there are no reports showing such type of fixation. In our study in one patient, avulsed fragment was fixed with one suture anchor and in other case it was with 2 of 3.5 mm in size to achieve rigid fixation. There are few studies, among a study of seven cases having similar injuries; they used a bioabsorbable screw-type suture anchor for fixation[9]. Such fixation can deduce the soft tissue dissection, because fewer traumas, provide prees-fit fixation; makes it stable on the cortical bone, and with no need surgery to remove it[16]. However, there is no mentioning of number of suture anchor, required for achieving rigid fixation. In another studies, they were used a locking compression hook plate and non absorbable sutures[15] or a single 4 mm partially threaded screw for fixation[14].Fibular avulsion fractures are commonly complicated with tibial plateau fractures. Our one case had undisplaced fracture fibular head with grade 1 anterior cruciate ligament injury, was intervened surgically for shaft fracture tibia which was unusual, not reported on literature search. We believe it was due to low velocity impact or rotational torque or excessive varus stress. One patient was followed up to 6 month after operation and the others had been followed up for 2 year (mean 21 months). It was, mean 24 month in a study of seven patients[9]. In our study grade I posterior and anterior cruciate ligament instability was observed in 2 patients. In a study, 6 patients among 7, who underwent anterior cruciate ligament reconstruction; lachman and pivot shift tests were less than grade II and of 7 patients, 5 showed grade I and II on varus stress tests[9]. No lateral instability was noted in other report[15] and in our cases. Follow up period was comparable with published reports. Lysholm knee score was a mean value of 91.33 points (range, 88-95 points). In other study a mean value was 91.6 points[9].

No prospective data exist regarding results of undisplaced

fracture of fibular head, wire fixation of complete avulsion, no and size of suture anchor required for achieving rigid fixation and mechanism of injury in fracture fibular head with tibia shaft fracture. Our study was not large enough to conclude such datas. We believe this requires longer follow up and large sample size.

5. Conclusion

Our study shows that fracture of fibular head can present from undisplaced fragment to complete avulsion with grade I to III; ligamentous injury or/and with peroneal nerve injury. These injuries can manage with multiple treatment options from conservative to fixation of avulsed fragment by various surgical methods, depending on severity and combined injury.

6. References

1. Ryan W, Mahony N, Delaney M, O'Brien M, Murray P, *et al*. Relationship of the common peroneal nerve and its branches to the head and neck of the fibula. Clin Anat 2003; 16(6):501-505.
2. DeLee JC, Riley MB, Rockwood CA Jr. Acute posterolateral rotatory instability of the knee. Am J Sports Med. 1983; 11(4):199-207.
3. Huang GS, Yu JS, Munshi M, *et al*. Avulsion fracture of the head of the fibula (the "arcuate" sign): MR imaging findings predictive of injuries to the posterolateral ligaments and posterior cruciate ligament. AJR Am J Roentgenol. 2003; 180(2):381-387.
4. Juhng SK, Lee JK, Choi SS, Yoon KH, Roh BS, Won JJ. MR evaluation of the arcuate sign of posterolateral knee instability. AJR Am J Roentgenol. 2002; 178(3):583-588.
5. Lee J, Papakonstantinou O, Brookenthal KR, Trudell D, Resnick DL *et al*. Arcuate sign of posterolateral knee injuries: anatomic, radiographic, and MR imaging data related to patterns of injury published online ahead of print. Skeletal Radiol. 2003; 32(11):619-627.
6. Towne LC, Blazina ME, Marmor L, Lawrence JF. Lateral compartment syndrome of the knee. Clin Orthop Relat Res, 1971; (76):160-168.
7. Shindell R, Walsh WM, Connolly JF. Avulsion fracture of the fibula: the "arcuate sign" of posterolateral knee instability. Nebra Med J, 1984; 69:369–371.
8. Baker CL Jr, Norwood LA, Hughston JC. Acute posterolateral rotatory instability of the knee. J Bone Joint Surg Am, 1983; 65(5):614-618.
9. Oh HK, Kim JH, Lee CS, Singh PK, Wang KH, Nha KW: Isolated avulsion fracture of the fibular head: a new fixation technique using a suture anchor. Orthopedics, 2011; 34:100-104.
10. Demuynck M, Zuker RM. The peroneal nerve: Is repair worthwhile? J Reconstr Microsurg, 1987; 3(3):193-197, 199.
11. Watson-Jones R. Styloid process of the fibula in the knee joint with peroneal nerve palsy. J Bone Joint Surg, 1931; 13:258-260.
12. Bowman AJ Jr, Kilfoyle RM, Broom JS. Varus injury of the knee with common peroneal nerve palsy. J Natl Med Assoc 1984; 76:157-161.
13. Bottomley N, Williams A, Birch R, Noorani A, Lewis A, Lavelle J *et al*. Displacement of the common peroneal nerve in posterolateral corner injuries of the knee. J Bone Joint Surg Br, 2005; 87(9):1225-1226.
14. Ravi Gupta, Jagdeep Singh, Kavin Khatri, Nitin Bither. Common Peroneal Nerve Laceration in Closed Fibular Head Avulsion Fracture: A Case Report. Journal of Orthopaedic Case Reports, 2016; 6(4):23-26.
15. Jong-Min Kim, MD, Byeong-Mun Park, MD, Sang-Hoo Lee, MD, Seung-Ju Jeon, MD, Jun-Beum Shin, MD and Kyeong-Seop Song, MD Surgical Management of Comminuted Avulsion Fracture of the Proximal Fibula with Lateral Collateral Ligament Injury. J Korean Fract Soc. 2013; 26(1):77-80.
16. Chen Nong, Li Zhi, Dong Jian, *et al*. Treatment of injury of triangular ligament of ankle joint with suture anchors. China Journal of Bone and Joint Injury, 2011; 7:235-236.