Answer for Reviewer (Reviewer's ID: 05198253):

Question 1: It is recommended that the authors search multiple databases for this disease, some of which are incomplete, such as "Bilateral Floating Knee Injury-Management of a Complex Injury" published in 2019.

Answer: We have looked for and cited the article of "Bilateral Floating Knee Injury-Management of a Complex Injury" to add to our database and enrich our content. Such as:

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Bilateral Floating Knee Injury—Management of a Complex Injury

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ABSTRACT: Floating knee is a flail knee joint resulting from fractures of the shafts or adjacent metaphyses of the femur and ipsilateral tibia. Floating knee injuries may include a combination of diaphyseal, metaphyseal, and intra-articular fractures. Floating knee injuries are a group of complex injuries that require a careful assessment. This injury is generally caused by high-energy trauma with often extensive trauma to the soft tissues. There may also be life-threatening injuries to the head, chest, or abdomen and a high incidence of fat embolism. This complex injury has increased in proportion to population growth, number of motor vehicles on the road, and high-speed traffic. Although the precise incidence of a floating knee is not known, it is a relatively uncommon injury. Bilateral floating knee injuries are extremely rare, and there is only one case report in the literature with bilateral floating knee injuries. We present a case report of a 64-year-old lady who suffered a blunt abdominal injury (hemicolectomy and splenectomy) and bilateral floating knees during road traffic accident. We also offer guidance for the treatment of this complex injury, based on literature review.

KEY WORDS: polytrauma patient, floating knee, damage control

I. INTRODUCTION

The floating knee is a flail knee joint resulting from fractures of the shafts or adjacent metaphyses of the femur and ipsilateral tibia. High-energy trauma due to traffic accidents and falls from heights are the most common causes of this complex injury. We can suspect that most of this kind of trauma is life threatening not only due to the severity of the injury but also because of the high-energy force that has been exerted on the patient during the accident. As a result, severe head, chest, or abdomen injury are common. We present a case of a 64-year-old lady who suffered a blunt abdominal injury and bilateral floating knee injuries during a road traffic accident. There have been many reports of ipsilateral fractures of the tibia and femur. The largest series reported in the literature included 222 patients over an 11-year period.[1] The cases of bilateral floating knees are very rare.[3–6] We will present our case and also attempt to give guidance for the treatment of this complex injury, based on literature review.

II. CASE REPORT PRESENTATION

A 64-year-old female with bilateral femur and tibia fractures and a blunt abdominal injury was transferred to our accident and emergency department after a road traffic accident. The patient was resuscitated according to the advanced trauma life support (ATLS) protocol. Casts were placed on both legs for provisional stabilization. Full-body CT trauma scan revealed splenic rupture, the presence of air and blood in the abdomen, and bilateral subsegmental atelectasis and small pleural effusions. X-rays revealed three fractures: (1) A comminuted fracture of the right femur was observed at the junction between the midshaft and the proximal third. The fracture extended proximally to the lesser trochanter and the distal fragment was medially displaced. (2) A transverse fracture of the distal third of the left femur was observed, with minor comminution. (3) A spiral fracture of the middle to distal third of the right tibia was observed, with a separate undisplaced fracture line extending into the distal intra-articular surface of the tibia. This fracture was an open compound, Gustillo type IIIa fracture. (4) A

fracture of the left distal tibia was also observed. This fracture was also an open compound, Gustillo type IIIa fracture. The patient was urgently taken to surgery for a laparotomy procedure. Splenectomy and right hemicolectomy with ileocolic anastomosis were performed, due to a splenic rupture and a large bowel perforation. The fractures of both femurs and tibias were reduced and provisionally stabilized using external fixation frames (Hoffmann® II External Fixation System Stryker®) (Figs. 1A and 1B and 2A and 2B). The patient was taken to the intensive care unit (ICU). Full blood count, hemoglobin, platelets, and lactate levels were regularly monitored. Definitive surgical fixation of the fractures was planned once the patient was hemodynamically stable and fit to undergo surgery.

On postoperative day 8, the fracture of the left femur and the left tibia were fixed using a retrograde

FIG. 1: Fixation of the right and left tibia using external fixation (Hoffmann type II External Fixation, Stryker®)

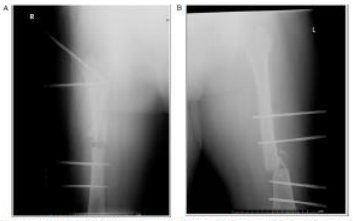

FIG. 2: Fixation of the right and left femur using external fixation (Hoffmann type II External Fixation, Stryker®)

intramedullary femoral nail (Expert Retrograde Femoral Nail (RFN) DePuy Synthes®) and a tibial nail (Expert Tibial Nail (ETN) DePuy Synthes®), respectively (Figs. 3 and 4). The anesthetist was not willing to proceed with the definitive fixation of the right side, so the patient was taken back to the ICU. The wounds of the right and left tibias were debrided.

On postoperative day 11, the patient was taken back to ICU, and the fractures of the right femur and right tibia were fixed using a proximal femoral nail PFNA®, Synthes®, and a distal tibial plate Synthes®

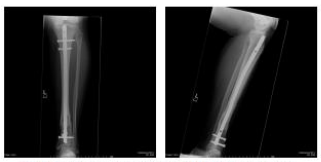

FIG. 3: Anteroposterior and lateral radiograph of the left tibia after definitive fixation

FIG. 4: Anteroposterior radiograph of the left femur after definitive fixation with a retrograde intramedullary nail

(Figs. 5 and 6). Physiotherapy and mobilization were started as soon as possible after surgery. Patient was followed regularly until bony union (clinical and radiological). Functional assessment and final outcome were measured using the Karlstrom's criteria after bony union.

III. DISCUSSION

Blake and McBryde have described a classification system regarding the floating knee injury.[1] In type 1 injury, which is characterized as the true floating knee, the joint is completely isolated and not involved with either shaft fractured. A type 2 is characterized as a variant floating knee. This type involves one or more joints with either shaft fractured. The injury is classified as type 2A when the knee joint is involved or as type 2B when the hip or ankle joints are involved. In our case patient, a type 1 and type 2B floating knee injuries on the left and right limbs respectively, were present. The fracture of the right tibia extended into the ankle joint.

Several factors can contribute to the final outcome in a floating knee injury. Yokoyama et al. conducted a retrospective study on how and which contributing factors influence the functional outcome of floating knee injuries. They found significant correlations between the functional result and the following factors: soft-tissue injuries of the tibia, the fracture pattern of both fractures, the combination of open or closed injuries in each fracture, the injury severity score, the existence of neurovascular injuries, the presence of double femoral fractures, the treatment methods, and operating time. The severity of damage to the knee joint and open injuries in the thigh were significant factors contributing to the functional outcome in floating knee injuries.[2] Several authors have suggested that intraarticular involvement of the fractures, high skeletal injury scores, and severity of soft-tissue injury are significant indicators of poor outcomes.[8–11] Hsu et al. suggested a

FIG. 5: Anteroposterior and lateral radiographs of the right femur with evidence of fracture healing

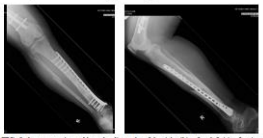

FIG. 6: Anteroposterior and lateral radiographs of the right tibia after definitive fixation

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preoperative scoring system that could contribute to the prognosis of the final outcome. According to this system, the patient's age, smoking status at the time of injury, injury severity scores, open fractures, segmental fractures, and comminution of the fractures must be taken into consideration.[1]

Floating knee injuries in polytrauma patients are complex injuries, and optimal timing for definite fixation and stabilization is a very important issue. In several studies in the literature, patients presented with good results after early definitive fixation, whereas other studies have reported a lower complication rate when a staged protocol was followed.[10-14] Most studies though, tend to agree that early definitive fracture stabilization is associated with shorter ventilation times, shorter intensive care unit stay, and fewer pulmonary complications.[10-14] Stabilization of long bone fractures during the first 24 hours is considered the "gold standard" for a polytrauma patient. A staged approach using damage-control orthopedic (DCO) surgery is also recommended for the timing of definitive fracture fixation. Currently, understanding of the secondary "hit phenomenon" that primary definitive fixation can cause to the polytrauma patient is increasing.[15] Clinical decision making regarding the optimal time for definitive stabilization of the fractures should take into consideration several parameters that indicate a stable clinical condition. Hemorrhagic shock, hypothermia, soft-tissue injuries to the extremities and lungs, and coagulopathy are factors relevant to the patients' clinical course. Lactate levels have been used as a marker for tissue hypoperfusion. Lactate values > 2.5 mmol/L are considered important threshold levels for polytrauma patients. Inflammatory mediators, such as interleukin-6, are also believed to have important clinical relevance to the patients' clinical course. We did not monitor the IL-6 value in our case because it is not included in the standard laboratory tests of our hospital. We did, however, take into consideration all of the aforementioned factors before proceeding to the definitive fixation of the fractures.

Pape et al. performed a retrospective cohort study at a level I trauma center. The patient's injuries and clinical outcomes were studied. The purpose of their study was to investigate the changes in the management and outcome of femoral shaft fractures in polytrauma patients, from early total care to DCO surgery. The authors reported a significant reduction in the incidence of general systemic complications regardless of the type of femur fixation that was used when comparing the time periods that early total care (ETC) and DCO protocols were applied. Considering the lower complication rate despite higher injury severity compared with the ETC period, the introduction of DCO appears to be an adequate alternative for patients at high risk of developing post-traumatic systemic complications such as acute respiratory distress syndrome and multiple organ failure.[16]

Achieving a rotational alignment in floating knee injuries can become difficult and challenging. Controlling the rotation of the shaft with an intramedullary nail is more difficult than using a plate fixation. Malrotation of a femoral shaft fracture is not just a cosmetic problem. Internal and external rotation causes malalignment and malorientation in the frontal plane, depending on the level of the fracture and the magnitude of malrotation. External rotation of any degree at the proximal fourth, midshaft, and distal fourth causes a posterior shift of the weight-bearing axis in the sagittal plane.[17] In our case, there was a difficulty in aligning the femur to the axis. The left tibia and femur were very well aligned following the fixation. However, the right femur was fixed at a few degrees of external rotation. The reason for that external rotation is that during the definitive fixation of the right femur and tibia (postoperative day 11), we proceeded with the definitive fixation of the right femur first (using a proximal femoral nail). The fact that there was also an ipsilateral tibial fracture made it very difficult to achieve the right alignment. We should have fixed the right tibia before proceeding to the fixation of the right femur. This would have made our femoral fixation easier and more accurate. Some recommendations can be used intraoperatively to achieve the correct alignment. Anteroposterior views of the lesser trochanter intraoperatively using the C-arm can be helpful estimating internal or external rotation of the femoral shaft (i.e., larger area of the lesser trochanter indicates external rotation and smaller area indicates internal rotation). Tornetta et

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al. described a method of estimating rotation using fluoroscopy. In their study, a lateral image of the femoral neck and an image of the posterior femur condyles aligned were used. In this approach, the difference in the inclination of the position of the C-arm reflects the angle of anteversion.[18]

The functional outcome following floating knee injuries can be measured by the Karstrom-Olerud criteria. These evaluation criteria are the following: subjective symptoms from the thigh or the leg, subjective symptoms from the knee or the ankle joint, walking ability, return to pre-injury work and sports, rotational or angulation deformity, and shortening and restricted joint mobility of the hip knee or ankle joint.[7] In our case, the patient is now walking independently without any support. She has a good range of motion in the ankle, hip, and knee joints bilaterally. She complains of intermittent pain in the left knee but does not require any analgesia. Her knees are stable, and there is no ligamentous injury. She has retired from her job (i.e., she was working as a nurse before the injury), but she has returned to most of her preinjury activities, including traveling. All of her fractures have healed successfully. There was a delayed union in the fracture of the right tibia, but the fracture eventually healed after 12 months.

IV. CONCLUSION

The floating knee is a complex injury of the lower limb that is usually associated with heavy trauma from other parts of the body. Life-threatening issues should be addressed first. It is our strong belief that a DCO protocol should be considered in these types of injury, until the patient is fit for final fixation procedures. If possible, intramedullary nailing is the gold standard method of restoration. By following the principles outlined above, very good outcomes may be expected.

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Question 2: Each figures should be labeled "A B C D" and annotated accordingly.

Answer: We have labeled "A B C D" at each figure as following:

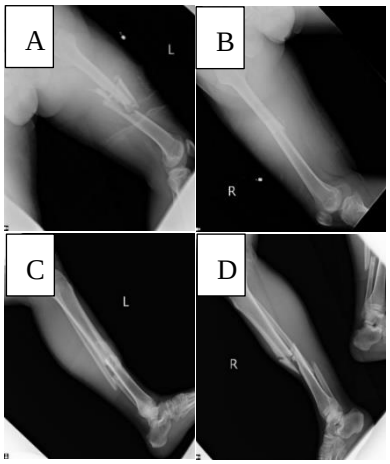

Figure 1: Initial plain radiographs revealed displaced bilateral femoral (A, B), tibial (C, D), and fibular midshaft fractures.

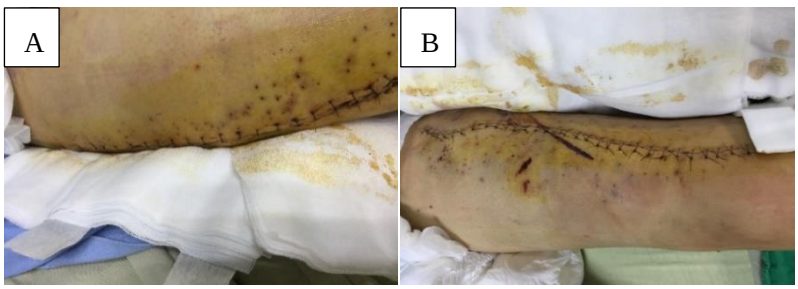

Figure 2: The photographs showed that we punctured hundreds of small holes around the closed wound using an 18-gauge needle in the thigh (A) and leg (B), imitating a Chinese medicine bloodletting method, to allow the accumulated blood in the tissue to flow out

to prevent skin necrosis and compartment syndrome.

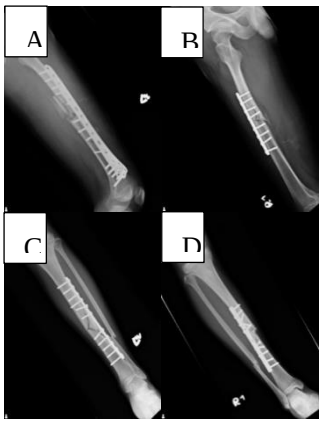

Figure 3: The post-operative X-rays illustrated that patient received the operation of ORIF with one locking plate in the left femoral shaft (A), one broad DCP in right femoral shaft (B), and two narrow DCPs in bilateral tibial shafts (C,D).

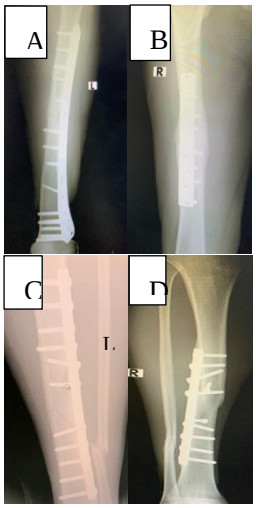

Figure 4: The radiographs revealed bone union of bilateral femoral (A,B) and tibial (C,D) fracture sites at postoperative 13 months.

Question 3: The summary section needs to be reorganized, especially in the conclusion section

Answer: We have reorganized the summary content, including the conclusion.

CONCLUSION

Simultaneous bilateral floating knee is a extremely rare injury pattern and resulted in severe damage, including bilateral femoral and tibial fractures with involved diaphyseal, metaphyseal, and intra-articular joint and maybe combinated with head, chest, or abdomen injuries, other ligamentous, and soft tissue injuries. The treatment

is challenging, and complications, such as wound infection, deep vein thrombosis, fat embolism syndrome, pulmonary embolism, malunion, nonunion, chronic osteomyelitis, implant failure, knee stiffness, and posttraumatic arthritis, are common. We present a rare case report of a 27-year-old adult who suffered from bilateral floating knees during road traffic accident. We also offer our treatment experience of this complex injury and review past literature.

Question 4: The background section of the body of the article needs to be expanded and has typographical problems.

Answer: We have expanded the article content and and modified the typographical problems. Finally, we have also added a discussion in the last paragraph of this article as following:

The functional outcomes of FK are measured with seven criteria defined by Karlstro¨m and Olerud. The Karlstro¨m-Olerud criteria includes the following: subjective symptoms from thigh or leg, subjective symptoms from knee or ankle joint, walking ability, return to pre-injury work and sports, angulation or rotational deformity or both, shortening and restricted joint mobility of the hip, knee or ankle joint. Scores for each criterion are divided into excellent, good, acceptable and poor[3,34]. Our patient was able to walk independently without external support and was free from bilateral hip, ankle and ankle joints at 4 months postoperatively. He complained of intermittent mild pain in the left calf, but no pain medication was required. He has returned to most of his preinjury activities, including working 6 months after surgery. All of his fractures had healed successfully after 13 months. Patient's bilateral lower limbs were normal function without shortening, rotation and angulation deformity.

Question 5: The article needs to be declared if there are ethical issues and if there is informed consent from patients

Answer: We have offered the patient's informed consent as following:

何實俊　27　男　體外
1603882　急診　外科
107/07/07　15:17

AZK 27

仁愛醫療財團法人
JEN-AI HOSPITAL

手術同意書

一、擬實施之手術（如醫學名詞不清楚，請加上簡要解釋）

1.疾病名稱：兩腿骨，兩脛骨開放性骨折

2.建議手術名稱：金屬內固定術

3.建議手術原因：治療

二、醫師之聲明

1.我已經儘量以病人所能瞭解之方式，解釋這項手術之相關資訊，特別是下列事項：（請打 V）

- ☑需實施手術之原因、手術步驟與範圍、手術之風險及成功率、輸血之可能性
- ☑手術併發症及可能處理方式。
- ☑不實施手術可能之後果及其他可替代之治療方式。
- ☑預期手術後，可能出現之暫時或永久症狀。
- ☑如另有手術相關說明資料，我並已交付病人。

2.我已經給予病人充足時間，詢問下列有關本次手術的問題，並給予答覆：

（1）手術後必須照顧好傷口，因為3個月內[illegible]

（2）可能重複

（3）

手術負責醫師簽名：[illegible]　日期：107年7月7日16時55分

專科別：骨科 [illegible]　（※衛生福利部授予之專科醫師證書科別；若無則免填）

三、病人之聲明

1. 醫師已向我解釋，並且我已經瞭解施行這個手術的必要性、步驟、風險、成功率之相關資訊。
2. 醫師已向我解釋，並且我已經瞭解選擇其他治療方式之風險。
3. 醫師已向我解釋，並且我已經瞭解手術可能預後情況和不進行手術的風險。
4. 我瞭解這個手術必要時可能會輸血。
5. 針對我的情況、手術之進行、治療方式等，我能夠向醫師提出問題和疑慮，並已獲得說明。
6. 我瞭解在手術過程中，如果因治療之必要而切除器官或組織，醫院可能會將它們保留一段時間進行檢查報告，並且在之後會謹慎依法處理。
7. 我瞭解這個手術可能是目前最適當的選擇，但是這個手術無法保證一定能改善病情。

基於上述聲明，我同意進行此手術。

（※若您拿到的是沒有醫師聲明之空白同意書，請勿先在上面簽名同意）

立同意書人簽名：Ha Tien Thanh　關係：病人之兄弟

身分證統一編號/居留證或護照號碼：RC300 44916　電話：0982.580.269

住址：台中市大里區德武路 33號

我☑同意 ☐不同意 手術必要時輸血。（請擇一）　日期：107年7月7日17時02分