Case report

Break in the lag: A unique mode of failure of TFNA® lag screw in an intertrochanteric fracture non-union

Sayantan Saha, FRCS[1] , Zain Habib, MRCS[2], Muhammad Umer Rasool, MRCS[3], Azeem Ahmed, FRCS[4], Rama Mohan, FRCS[5]

[1]*Department of Trauma and Orthopaedics, North Manchester General Hospital, Manchester, United Kingdom.*
[2]*Department of Trauma and Orthopaedics, North Manchester General Hospital, Manchester, United Kingdom.*
[3]*Department of Trauma and Orthopaedics, North Manchester General Hospital, Manchester, United Kingdom.*
[4]*Department of Trauma and Orthopaedics, North Manchester General Hospital, Manchester, United Kingdom*
[5]*Department of Trauma and Orthopaedics, North Manchester General Hospital, Manchester, United Kingdom*

ORCID: Sayantan Saha: https://orcid.org/0000-0002-7858-0637

Abstract

Intertrochanteric or pertrochanteric fractures of the femur are frequently encountered injuries that are often treated surgically to facilitate earlier mobility and improved outcomes. With a significant volume of these being encountered in an elderly population, these needs robust fixation and intramedullary nails (cephalomedullary) are often consider as the treatment of choice. Implant failures though relatively low are however not infrequent.

We describe a case of a 91-year-old lady presenting with cephalic lag screw break through the fenestrations of a Trochanteric Fixation Nail -Advanced (TFNA, DePuy-Synthes®) associated with intertrochanteric fracture non-union, following an unwitnessed ground level fall. This was 11 months after sustaining a proximal femur AO/OTA 31-A2.2 fracture for which she underwent TFNA fixation at a different hospital. Subsequently she underwent broken implant extraction and salvage total hip replacement with bone grafting and made a successful recovery.

The case report highlights a rare type of implant fracture of cephalomedullary nails through the lag screw fenestrations which can be catastrophic and difficult to manage in elderly populations. This also emphasises the need to monitor implants for newer modes of failure and report such cases when encountered for the better understanding of the orthopaedic and trauma community.

Corresponding author

Sayantan Saha
sayantan.saha@mft.nhs.uk

Keywords

Implant failures; intertrochanteric fractures; non-union; TFNA; lag screw breakage

Introduction

With the increase in overall life expectancy, the annual incidence of hip fractures is on the rise, and it is estimated that over 70000 people sustain fractures around the hip per year in the UK[1]. This is one of the leading causes of hospitalisation in elderly population and by 2060, this number is predicted to rise by 100 % compared to 2019.[2] Out of all hip fractures, almost half comprises of the intertrochanteric fracture and are managed by both extramedullary and intramedullary constructs depending on fracture pattern. Cephalomedullary nail (CMN) is an intramedullary device which is widely used for fixation in indicated cases and their popularity have increased due to superior biomechanics and allowing minimally invasive surgery[3-6]. There have been developments depending on the site of entry and design in CMNs broadly categorising them as Proximal Femoral Nail (PFNs) and Trochanteric Fixation Nail (TFNs). Overall, the CMNs have demonstrated a relatively low failure rate but this is quite variable ranging from 0 to 22% owing to multiple contributory factors[7-9]. Complications pertaining to the implant are peri-implant fractures (intra and post operative), implant cut-out, loss of reduction, thigh pain and distal anterior cortical perforation of femur, and implant breakage. CMNs have a reported breakage rate of 1%- 5 %[9-11]. Usually, these have been seen to occur at the nail-screw aperture owing to inherent biomechanical weakness; most of which involves the proximal lag screw aperture and a few involving the distal one. There have been some reports of shaft of the nail breakage above the proximal lag screw aperture. We report a rare case of a proximal fenestrated lag screw breakage at a unique location in a Trochanteric Fixation Nail – Advanced (TFNA – Depuy Synthes®) the setting of intertrochanteric fracture non-union.

Case presentation

A nonagenarian (91 years-old) lady was brought in by ambulance with a history of unwitnessed fall at home after tripping over followed by pain in her Right hip and inability to weight bear. X-rays (**Fig 1a**) confirmed an implant failure of the cephalic fenestrated portion in the lag screw of the TFNA implant in the backdrop of possible non-union of previously sustained pertrochanteric fracture and proximal migration of femur with broken part of the screw inside the joint. Clinical examination revealed that the patient was unable to do an active straight leg raise on the side and movements around the hip elicited pain. She mentioned of having aching pain along her hip and thigh for the last 2-3 months and gradually worsening mobility. Following her index surgery (done at a nearby tertiary care hospital), she was able to walk indoors with the help a frame until recently but did not go outside and relied on family and carers for day-to-day activities. A CT scan **(Fig 1b)** was done that confirmed the non-union with loss of fixation and breakage of the lag screw that appeared to have failed through the fenestrated threads. The intraarticular broken part of screw had been eroding the acetabulum leaving a defect in the superolateral dome.

11 months back she sustained an intertrochanteric fracture of the Right femur (AO/OTA 31-A2.2) **(Fig 2)** fracture of the femur extending to just below the lesser trochanter following a fall from standing height and underwent closed reduction and long TFNA fixation at a different hospital. On reviewing the intraoperative images **(Fig 3**) and notes, it was noted that on account of a pre-existing distal femur locking plate (for an old united distal femur fracture) the surgeons were unable to fix distal locking screws through the nail due to plate position. This was concluded with only proximal lag screw abandoning distal fixation, to avoid further complications from pro-

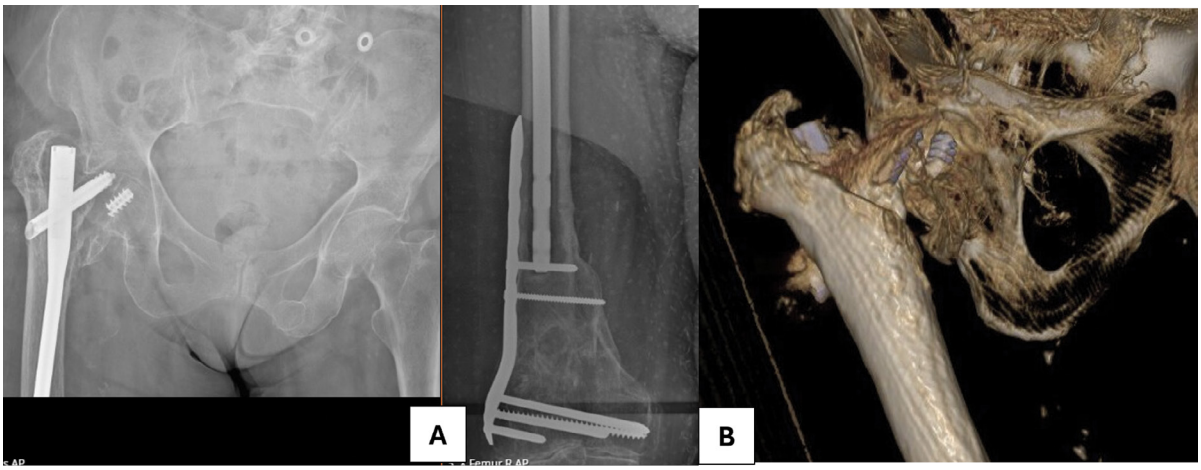

Figure 1: *A) X-rays showing Broken lag screw of TFNA with non-union (AP of the pelvis with hips and AP of distal femur). B) CT scan confirming non-union with the broken screw seen eroding the acetabulum.*

longed anaesthetic and surgical time in an elderly frail patient. She was then discharged home from the hospital and was able to manage weightbearing with the help of a frame. There were no records of any subsequent follow ups or any X-rays in the system (PACS) and possibly she was lost to follow up as deemed from the collateral history obtained from the patient's daughter.

Following a local multidisciplinary discussion involving hip surgeons, orthogeriatric medical team, patient and family members, she underwent a revision surgery for removal of the broken implant, a dual mobility total hip replacement and bone grafting for the acetabular defect **(Fig 4)**. Inspection of the explanted hardware confirmed the unusual failure pattern **(Fig 5)** through the threaded region.

Discussion

Intramedullary /cephalomedullary devices (TFNA) are the preferred modality of fixation for any unstable intertrochanteric fractures[12]. The National Institute of Clinical Excellence (NICE – provides national clinical guidelines and advice to improve healthcare in the United Kingdom) has categorically specified that intramedullary devices (IM nail) should be only used in subtrochanteric and reverse obliquity pattern fractures of the proximal femur and extramedullary devices (Sliding hip screws/SHS) for other patterns (AO/OTA 31A1 and A2 fractures)[13]. They have cited no added benefits of IM nails over SHS in these fracture patterns in terms of clinical outcomes and adverse effects for the patients[13,14] but contributing to a substantially high treatment costs with IM nail[13]. However, in this case (31A2) it can be argued by the index surgeons that due to an incompetent lateral wall (thickness <20.5mm), the fracture could be deemed an unstable pattern and hence the rationale for using a long nail (TFNA).

Ample reports of IM nail failures have been described in literature, with the most common pattern involving the aperture of the cephalic lag screw. The cited reasons are biomechanical weakness (narrowing of the cross-sectional area at this location)[15], improper clinical techniques like implant notching due to eccentric drilling contributing to a fatigue failure[16,17]. However, the pattern of failure in this case of non-union is quite unique and our extensive literature search revealed only a single case like ours reported from a US university hospital[18] in 2022. As is the case with any non-union after surgery, certain factors which are often interconnected contributes to failure. Early IM nail failures could be from improper insertion techniques leading to notching at the proximal screw aperture[17] versus mid to late failures which could be the result of poor biology, inadequate

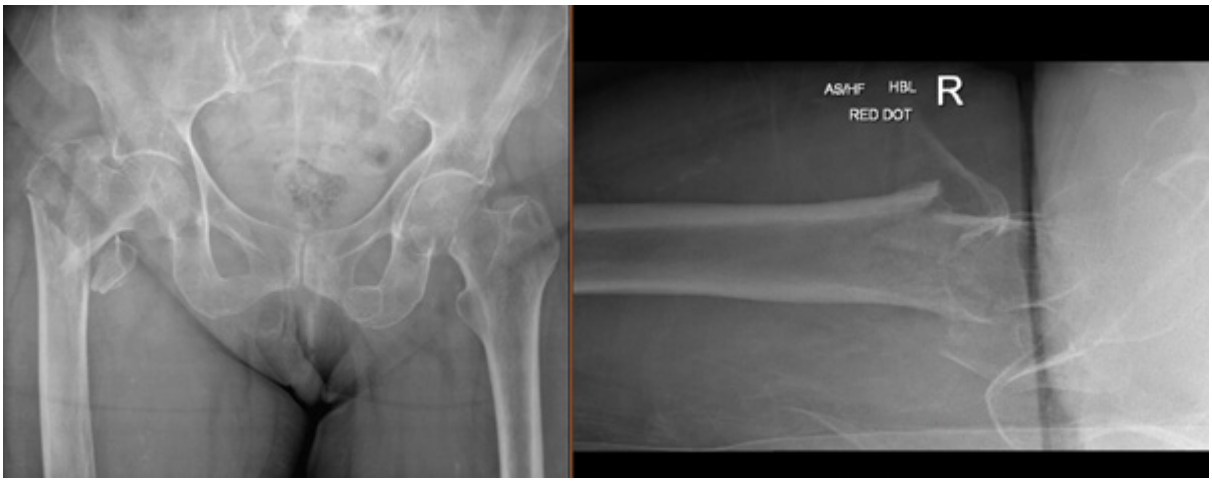

Figure 2: *X-rays of the initial Intertrochanteric fracture of the Right femur (AP and lateral views).*

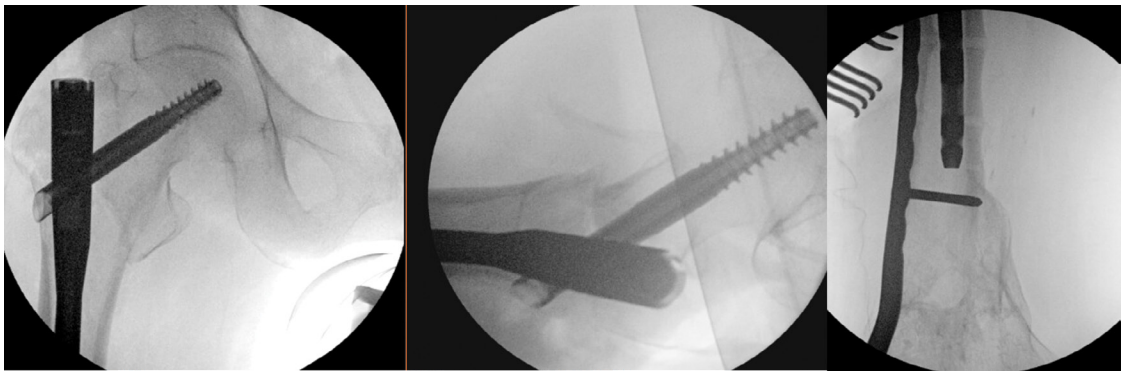

Figure 3: *Intraoperative fluoroscopy images of the index surgery – AP and Lateral of Right hip, AP of distal femur.*

reduction, further trauma, etc. Any implant has an endurance limit that determines the number of cycles that it can withstand before failure (fatigue). Therefore, literature often describes this as a race between bone healing and implant endurance. In the setting of a non-union, once the endurance limit of a particular implant is exceeded, it is bound to fail. Hence, the rational and philosophy of proper reduction and adequate fixation. In this case, lack of any distal locking screws (usually 2 screws are recommended) in an unstable pattern fracture could be the contributing factor of non-union. Added to that, poor biology could be contributory but that is to be expected in any frailty fractures around the hip in a nonagenarian. The index surgeons could put forward an argument that due to the preexisting plate blocking the insertion of distal locking screws compounded by patient's frailty and implications of prolonged surgical time, they had to take the decision at that moment. It is not ideal to comment about someone else's decision without being present at the scene. However, in hindsight, an alternative mode of fixation could have been considered including but not limited to a shorter nail that could allow distal locking screws to be passed.

But the reason why this case is worth discussing is not because of non-union and the contributing reasons, but because of pattern and location of implant failure. The DePuy- Synthes® TFN- Advanced (TFNA) proximal femur nailing comes with helical blades and lag screws for cephalic fixation with both solid and fenestrated options. The fenestrated screws allow for cement augmen-

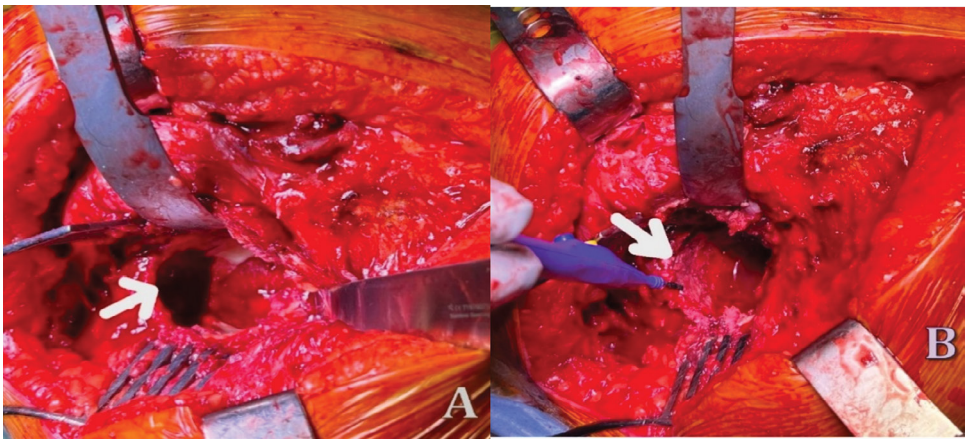

Figure 4: *Intraoperative clinical images of the acetabular defect (A- before, B- after bone grafting).*

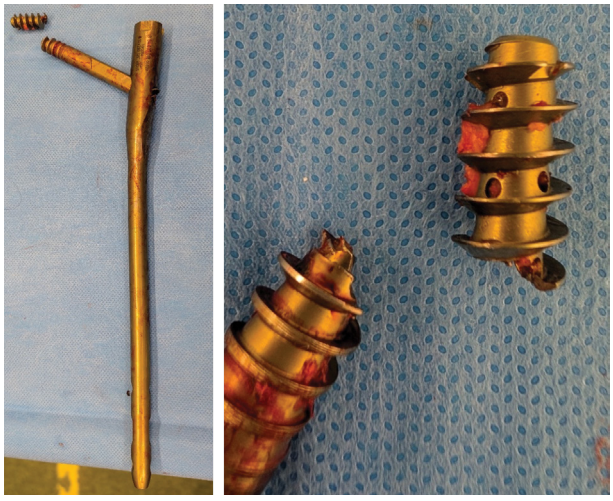

Figure 5: *Explanted implant showing break through the thread fenestrations.*

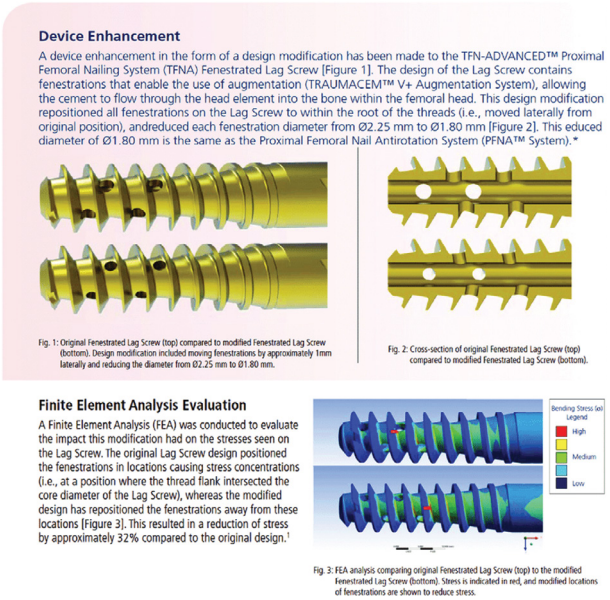

Figure 6: *Description of the design changes in the lag screw of TFNA (provided by DePuy-Synthes).*

tation in case of poor bone stock in the neck and head of femur for better purchase. In regular practice, cement augmentation is rarely used in such fractures but most of the hospitals in the NHS using this system usually stocks the fenestrated options as confirmed with the implant representative from the company. This raised a clinical question and discussion about the fact that whether a solid non-fenestrated screw would have failed at the same location? The implant would have failed in any case in the setting of a non-union, but perhaps at a different more usual location (like the proximal aperture at the nail-screw interface). In that scenario, the broken portion of screw might not have eroded the acetabulum creating the defect since it would have been embedded inside the femoral neck bone. So, a nail removal and a hemiarthroplasty wound have sufficed for the patient instead of a total hip replacement which did carry the risk of increased operative time and complications in an elderly frail patient.

As with any implant failures, this was reported to the manufacturer (DePuy-Synthes) in compliance with the hospital policy. Upon review of the literature from the previously reported case[18],

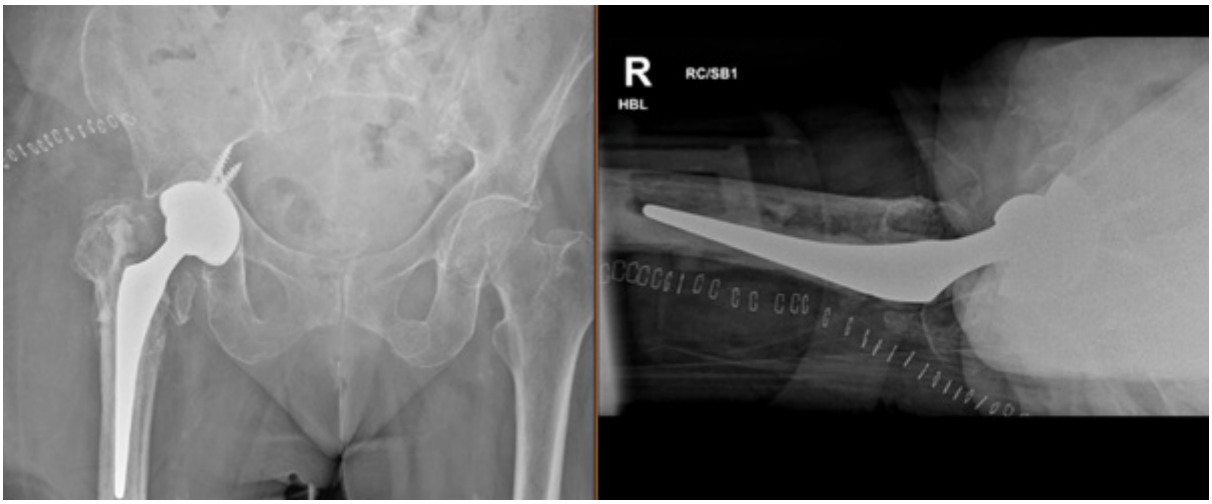

Figure 7: *AP and lateral radiographs following revision dual mobility total hip replacement*

we understand this was discussed with the manufacturer, DePuy-Synthes has made some design improvements to the lag screw to improve fatigue strength **(fig 6)**. It is not clear whether the new design fenestrated lag screw was used in the index surgery or an older one, because of the fact that the surgery was done at a different hospital and confidentiality clauses forbid sharing of these details. Irrespective of this, as a learning from this case, it has been agreed to stock solid non-fenestrated screws at out hospital and to use fenestrated ones only when cement augmentation is planned if indicated on a case-to-case basis.

In this patient, a salvage dual mobility total hip replacement was done **(fig 7)** with an uncemented cup and a cemented stem after explantation of the nail and broken screw. The acetabular defect was deemed to be contained and addressed with bone grafting from freeze-dried femoral head allograft **(fig 4)**. The option of dual mobility cup was decided in view of the poor functioning abductors to reduce any chances of dislocation and further morbidity. Criticism could be raised as to why a longer diaphyseal fitting revision stem was not considered that could avoid stress risers and further fractures of the femur shaft. The rationale behind this complex consideration was to avoid a scenario where a long diaphyseal stem could lead to abutment of the already thinned out distal femoral cortices (from the tip of the IM nail) and inadvertently cause another fracture. We added two extra screws at the proximal aspect of the locking distal femur plate (one unicortical) that were removed during the index surgery. There is a considerable segment of relatively stronger diaphyseal bone in between the tip of the stem and the distal plate that would allow wider stress dissipation unlike a narrow zone in between that could act as stress riser.

There are a few learning points that could be taken from this experience. Unstable proximal femur fractures in elderly osteoporotic bone should be always treated with robust fixation that allows immediate mobility. In cases where preexisting implant(s) complicates the scenario, alternative options should be planned in advance that could avoid a suboptimal fixation and disappointing results. Close and longer follow-up are often warranted in such cases to recognise delayed unions and non-unions early that may avoid a disastrous implant failure and significant morbidity.

Conclusion

With the significant increase in the number of hip fractures in the UK and worldwide that comes with additional comorbidities, it is crucial to optimise index surgery to ensure that patient who are not fit for repeat anaesthesia does not end up going back to the operation theatre. Hence, it is important to recognise and avoid any such rea-

sons during the index surgery that could compromise the longevity of implants and lead to failure. Therefore, constructive criticisms and reviews of revision hip surgeries after implant failures like this case report are important in learning about unique and novel modes of failures which could be rare and thus warrants careful monitoring. Reporting and discussion about new modes of failures in trauma surgery could help the greater academia in circumventing such complications and dealing with them when they arise.

Conflict of Interest

The authors declared no conflicts of interest.

References

1. Royal College of Physicians. A broken hip – three steps to recovery. The 2024 National Hip Fracture Database report on 2023. RCP, 2024.
2. Murphy T, Culliford DJ, Hawley S, Johansen A, Whitehouse MR, Judge A, Matharu GS. Hip fracture projections up to the year 2060: an analysis based on data from the National Hip Fracture Database (NHFD) for England, Wales, and Northern Ireland. Injury. 2024 Nov;55(11):111863. doi: 10.1016/j.injury.2024.111863
3. Curtis MJ, Jinnah RH, Wilson V, Cunningham BW. Proximal femoral fractures: a biomechanical study to compare intramedullary and extramedullary fixation. Injury 1994; 25:99–104.
4. 4. Aros B, Tosteson ANA, Gottlieb DJ, Koval KJ. Is a sliding hip screw or im nail the preferred implant for intertrochanteric fracture fixation? Clin Orthop Relat Res 2008; 466:2827–2832.
5. Forte ML, Virnig BA, Eberly LE, et al. Provider factors associated with intramedullary nail use for intertrochanteric hip fractures. J Bone Joint Surg Am 2010; 95:1105–1114.
6. Anglen JO, Weinstein JN. Nail or plate fixation of intertrochanteric hip fractures: changing pattern of practice. A review of the American Board of Orthopaedic Surgery database. J Bone Jt Surg Am 2008; 90:700–777.
7. Lambers A, Rieger B, Kop A, D'Alessandro P, Yates P. Implant fracture analysis of the TFNA proximal femoral nail. J Bone Jt Surg Am 2019; 101:804–811.
8. Kashigar A, Vincent A, Gunton MJ, Backstein D, Safir O, Kuzyk PRT. Predictors of failure for cephalomedullary nailing of proximal femoral fractures. Bone Jt J 2014; 96-B:1029–1034.
9. Gaebler C, Stanzl-Tschegg S, Tschegg EK, et al. Implant failure of the gamma nail. Injury 1999; 30:91–99.
10. Tantigate D, Riansuwan K, Mahaisavariya B, Sukjaitham K. Breakage of a lag screw of cephalomedullary nail: a technique of removal. Clin Orthop Surg 2015; 7:261–263.
11. Iwakura T, Niikura T, Lee SY, Sakai Y, Nishida K, Kuroda R, Kurosaka M. Breakage of a third generation gamma nail: a case report and review of the literature. Case Rep Orthop. 2013;2013:172352. doi: 10.1155/2013/172352.
12. Nherera L, Trueman P,Horner A, Watson T, Johnstone AJ. Comparison of a twin interlocking derotation and compression screw cephalomedullary nail (InterTAN) with a single screw derotation cephalomedullary nail (proximal femoral nail antirotation): a systematic review and metaanalysis for intertrochanteric frac. J Orthop Surg Res 2018; 13:1–10.
13. https://www.nice.org.uk/guidance/cg124
14. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Parker MJ, Handoll HH. Cochrane Database Syst Rev. 2008;16:0. doi: 10.1002/14651858.CD000093.pub4.
15. von Rüden C, Hungerer S, Augat P, Trapp O, Bühren V, Hierholzer C. Breakage of cephalomedullary nailing in operative treatment of trochanteric and subtrochanteric femoral fractures. Arch Orthop Trauma Surg 2015; 135:179–185.
16. Fine NF, Sexton SA, Williams DH. The learning

curve with a new cephalomedullary femoral nail. Injury 2017; 48:1575–1578.
17. KlimaM. Comparison of early fatigue failure of the TFNa and Gamma 3 cephalomedullary nails in the United States from 2015–2019. J Orthop Trauma 2021; 35:e39–e44.
18. Smidt KP, Perry KJ, Andre LK, Chauvin BJ, Kautz S, Massey PA, Barton RS. Case report: unique failure of a Synthes TFNA fenestrated lag screw in a peritrochanteric nonunion. OTA Int. 2022 Mar 18;5(2):e203. doi: 10.1097/OI9.0000000000000203. PMID: 35919107; PMCID: PMC9278917.

Cite this paper as

Saha S, Habib Z, Rasool MU, Ahmed A, Mohan R. «Break in the lag»: A unique mode of failure of TFNA® lag screw in an intertrochanteric fracture non-union. AOTH. 2025; 76(3):27-34.

DOI

https://doi.org/10.69133/aoth.v76i3.522