Trauma Monthly 2026; 31(2): 1750-1756

10.30491/tm.2026.561246.1906

Trauma Monthly

Case Report

Development of A Novel Antibiotic-Loaded Cemented Dynamic Hip Screw Using Silicone Mold for Treating Infected Intertrochanteric Fracture: A Case Report

Ismaeil Garivani[1], Negin Armide[2], Mohamad Amin Younessi Heravi[3*]

[1] Department of Orthopedic Surgery, Khatam ol anbia Hospital, North Khorasan University of Medical Sciences, Bojnurd, Iran
[2] Student research committee, School of Medicine, Imam Ali Hospital, North Khorasan University of Medical Sciences, Bojnurd, Iran
[3] Department of Medical Physics and Radiology, North Khorasan University of Medical Sciences, School of Allied Medical Sciences, Bojnurd, Iran

***Corresponding Author**: Mohamad Amin Younessi Heravi, Department of Medical Physics and Radiology, North Khorasan University of Medical Sciences, Bojnurd, Iran. a.younessi7@gmail.com

Received 2025-11-21 ; **Accepted** 2026-01-07; **Online Published** 2026-04-29

Abstract

We report the case of a 71-year-old woman who sustained an intertrochanteric fracture after a simple fall. She initially underwent gamma nail fixation; however, implant failure and deep infection led to multiple revision surgeries. Despite prolonged antibiotic treatment, the infection persisted for eight months, making hardware removal necessary. To maintain stability while treating the infection, we used a custom-made, antibiotic-loaded cemented dynamic hip screw (DHS). This device was fabricated using a specially designed silicone mold. After two months, the infection cleared, allowing definitive reconstruction with a long-stem arthroplasty. The patient recovered well, regained function, and showed no signs of recurrent infection. This case highlights the challenges of managing recurrent implant failure and deep infection in intertrochanteric fractures. Furthermore, the use of cost-effective, reusable silicone molds for fabricating antibiotic-loaded implants appears to be a promising technique for orthopedic infection management.

Keywords: Dynamic hip screw, Silicone mold, Infection, Intertrochanteric fracture.

Introduction

Intertrochanteric fractures are among the most common fractures in elderly patients, and a significant percentage of hip fractures require surgical intervention. Regardless of the type of therapy, these fractures frequently result in decreased quality of life, reduced mobility, increased dependency, and elevated mortality in the year following the injury [1]. The standard treatment for unstable intertrochanteric fractures involves internal fixation, using either intramedullary nailing or a dynamic hip screw (DHS). The DHS, or sliding screw fixation, is a type of orthopedic implant designed for the fixation of specific hip fractures, allowing controlled dynamic sliding of the femoral head component along the construct [2].

Although internal fixation is generally effective, complications such as nonunion, implant failure, or deep infections may still occur, potentially requiring multiple surgeries and prolonged treatment [3]. The management of infected orthopedic implants follows a structured approach that includes implant removal, thorough debridement, systemic and local antibiotic therapy, and staged reconstruction to restore function while ensuring infection eradication [4].

The use of silicone molds to fabricate antibiotic-loaded cemented implants represents an innovative approach in the management of infected hip fractures. Silicone molds offer a simple, cost-effective, and repeatable method for producing a well-shaped, uniformly coated dynamic hip screw with controlled cement thickness. This technique not only improves the implant's mechanical fit and longevity but also provides sustained local antibiotic delivery at the infection site [5].

In this case report, we present a 71-year-old woman with a recurrently infected intertrochanteric fracture following multiple fixation attempts with a gamma nail. Given the chronic nature of the infection and mechanical instability, we used a custom-made, antibiotic-loaded cemented DHS as a temporary stabilization method. This DHS was fabricated using a silicone mold. After the infection was resolved, the patient underwent long-stem arthroplasty, achieving successful functional recovery. This case highlights the importance of a staged approach in managing infected intertrochanteric fractures and introduces a novel method for creating antibiotic-loaded cemented implants using cost-effective, reusable silicone molds.

Case report

The present case report was approved by the Ethics Committee of North Khorasan University of Medical Sciences, Bojnurd, Iran (IR.NKUMS.REC.1403.121). Signed informed consent was obtained from the patient before participation in the study. A 71-year-old woman presented with a history of an intertrochanteric fracture, which was caused by a simple fall from standing height two years ago. The patient had a past medical history of prolonged bisphosphonate therapy for osteoporosis, including three years of oral alendronate and two intravenous courses of zoledronic acid. This history raised concern for a pathological fracture, considering the fracture pattern and her history of multiple fractures. She initially underwent internal fixation with a gamma nail. However, one month later, she sustained another fall, which led to implant failure. After that, she underwent revision surgery with a gamma nail replacement. Unfortunately, she subsequently developed a deep surgical site infection, which persisted for eight months despite multiple debridements and antibiotic therapy. After eight months, the gamma nail was removed, and the greater trochanter was excised and replaced with antibiotic-loaded bone cement in an attempt to control the infection. After four months, the patient was referred to our center.

Before surgery, routine laboratory tests and plain radiographs were obtained to assess the extent of infection. At the time of implant removal, samples were sent for culture, and a frozen section smear was performed to evaluate ongoing infection. The patient exhibited persistent wound discharge, elevated inflammatory markers (ESR and CRP), a D-dimer level of 2800, and a positive interleukin-6 test. These findings were consistent with ongoing chronic deep infection, possibly complicated by biofilm formation. Considering the chronic infection, the decision was made to remove the existing bone cement and replace it with an antibiotic-impregnated cemented DHS. We decided to use a cemented DHS for the patient in order to preserve the femoral head and neck, so that the patient would not develop limb shortening. The cemented DHS was fabricated to replicate the standard DHS produced by Synthes (Switzerland). The cement mixture contained 0.5 g gentamicin and 4 g vancomycin per 40 g package of bone cement [6]. Gentamicin and vancomycin were chosen due to their heat stability, broad-spectrum coverage against Gram-negative and Gram-positive organisms, and synergistic effect in cement spacers. One of the screws was cement-coated to ensure strong compression at the fracture site, and this screw was not a lag screw. This DHS was made using a custom-made silicone mold designed for this purpose.

To create the antibiotic-loaded cement-based DHS, a silicone mold was created using a hydraulic press machine (Tondar Machine Co., Iran). The material for the hydraulic press machine is silicone rubber for centrifugal casting (Temcorubber Co., Iran), which is more cost-effective than metals and can be easily fabricated. The device consists of two arms, each connected to a metal plate with a thermostat. The pressing force is applied by pressure to the upper and lower arms. Due to continuous pressure on the rubber, it prevents sponginess and excessive hardness. The top and bottom plates are separately equipped with thermostats with a temperature between 100°C and 180°C. To produce a mold, the DHS prosthesis is fixed inside a metal cylinder, and silicone is placed on it, causing the mold to be made under pressure and at a temperature of 150°C. Since this mold is produced at high temperatures, it can be easily autoclaved like other surgical instruments and used several times. Fig. 1 shows the DHS mold and antibiotic-loaded cement-based DHS made with the silicone mold.

After two months of surgery using a cemented DHS and systemic antibiotics, which were selected based on culture sensitivity (the organism was E. coli, which was sensitive to cefepime and gentamicin), the infection resolved. During the interim period, the patient was allowed only partial weight bearing with a walker, as the cemented DHS does not provide the same biomechanical strength as a conventional DHS. Targeted rehabilitation was performed to strengthen the abductor muscles, which were critical for the final reconstruction. For the final surgery, since the greater trochanter was absent, a long-stem calcar-replacing bipolar prosthesis was selected for final arthroplasty. As the patient had no greater trochanter, a calcar-replacing prosthesis with abductor attachment features was used. The abductor muscles were reattached directly to the implant and secured in place. This allowed for proper positioning of the prosthesis and improved hip stability. After the operation, the patient was able to walk again, and the infection was eradicated. Fig. 2 shows the antibiotic-impregnated cemented DHS, and Fig. 3 shows the radiographic images of the patient at each stage.

Fig. 1.Producing cemented DHS using a silicone mold

Fig.2.Antibiotic-impregnated cemented DHS

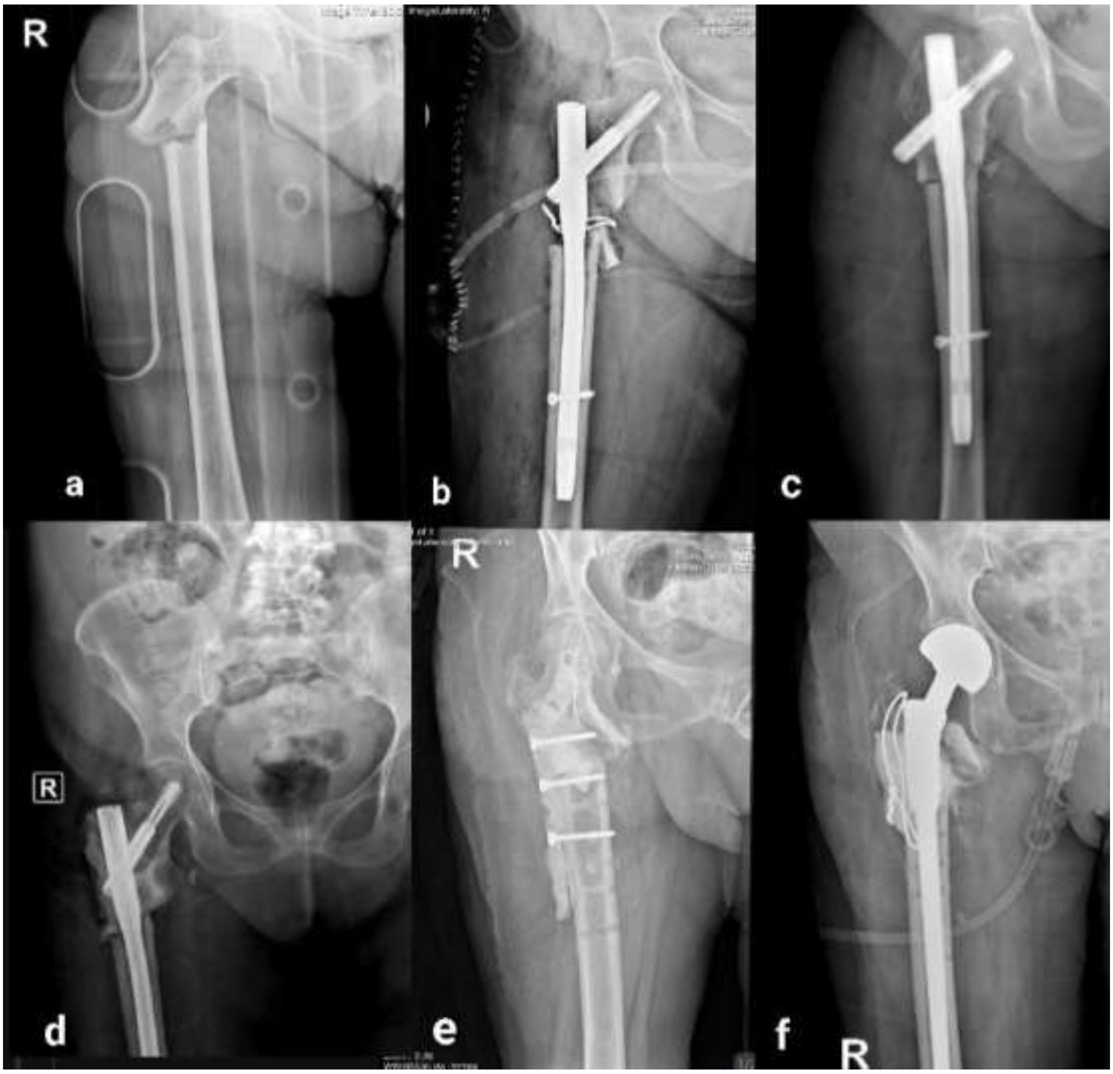

Fig. 3. Radiographic images of the patient at each stage (a) Initial fracture (b) Initial surgery performed by another surgical team (c) First revision with nail and blade correction and wire removal (d) Postoperative infection and referral of the patient for cemented implant treatment(e)Severe infection, removal of all devices, cemented DHS with systemic antibiotic therapy until normalization of laboratory tests (f) Final surgery

Discussion

One of the most frequent hip fractures, particularly in older adults with osteoporotic bones, is an intertrochanteric fracture. Low-energy trauma, such as a minor fall, is frequently the cause [7]. The treatment of osteoporotic fractures in elderly people presents significant challenges. To prevent issues with prolonged recumbency, the goal of surgical care for trochanteric fractures is to return patients to their pre-fracture functional condition as soon as possible[8].

The standard approach for stabilizing diaphyseal long bone fractures is now intramedullary nailing[9]. Infection, compartment syndrome, venous thromboembolic events, fat embolism syndrome, neurovascular damage, and non-union are among the major complications that can significantly affect a patient's functional outcome after intramedullary nailing. Therefore, it is a technically challenging procedure that demands attention to detail and careful planning to achieve the best possible outcome [10,11].

In this case, the patient had recurrent implant failure after two separate fixation attempts, which led to infection. The infection was persistent, with draining sinuses and elevated inflammatory markers (ESR, CRP, IL-6, and D-dimer). These findings suggested a chronic deep infection, so implant removal was necessary. Removing the infected implant is a crucial first step, as biofilms on orthopedic hardware act as bacterial reservoirs and perpetuate chronic infection; this fact is well-supported by current clinical guidelines. The presence of E. coli, a Gram-negative organism with a known capacity for biofilm formation, supported the need for implant removal and thorough debridement [12]. In this case, a single-stage surgery was not considered appropriate due to the heavy wound discharge and chronic infection. A two-stage revision strategy was therefore selected, combining systemic and local antibiotic therapy with staged reconstruction. This approach not only provided better infection control but also allowed a sufficient interval for abductor muscle rehabilitation, which was important for achieving optimal postoperative hip stability.

Systemic antibiotics assist in treating any possible spread of infection. For successfully eradicating persistent bone infections and lowering the chance of recurrence, this combined strategy is regarded as the gold standard [13]. To maintain mechanical stability while addressing the infection, a custom-made antibiotic-loaded cemented DHS was utilized as a temporary spacer. The use of local antibiotic delivery via cement spacers is well-documented in periprosthetic joint infections and infected fracture nonunion, as it ensures high local drug concentrations without systemic toxicity while enhancing bacterial eradication [14].

Traditional treatment for infected intertrochanteric fractures frequently consists of staged debridement followed by refixation or arthroplasty, with the use of antibiotic-loaded spacers such as the PROSTALAC system to prevent infection and preserve joint function. However, these methods often require several surgeries and are not intended for simultaneous fracture repair [15,16]. In contrast, using a silicone mold to construct an antibiotic-loaded cemented dynamic hip screw provides a unique, single-stage treatment that combines mechanical stability with local antibiotic administration, possibly minimizing surgical stages and improving outcomes.

A key innovation in this approach was the fabrication of the cemented DHS using a silicone mold (Fig. 1). These molds were produced using a hydraulic press under high-temperature conditions, which allows precise shaping of the cement implant to mimic standard DHS geometry. The resulting molds are highly durable, autoclavable, and reusable, making them a practical and cost-effective alternative to commercially available prefabricated antibiotic spacers, which can be expensive or unavailable in some countries. Previously, these silicone molds have been shown to be useful and efficient in treating infections of the knee joint; in this case, their successful adaptation to the hip further supports their possible use in a wider range of orthopedic infection circumstances [6]. Unlike commercially available pre-formed spacers or the PROSTALAC system, our method retained the patient's anatomical alignment and femoral head position. This anatomical preservation prevented proximal migration of the femur during the interim period, a common issue in traditional resection arthroplasty or PROSTALAC constructs. Furthermore, the ability to allow partial weight-bearing helped maintain joint mobility and reduced the risk of further muscle atrophy and disuse osteoporosis. This partial weight-bearing protocol was chosen because, although the cemented DHS closely mimicked the anatomy of a standard DHS, its mechanical strength could not be assumed to be as good as that of a standard DHS. By limiting the load, we minimized the risk of mechanical failure while still promoting mobility and muscle activity.

Following two months of infection control, the patient underwent definitive reconstruction with long-stem arthroplasty. Radiological and clinical outcomes were favorable, with no signs of reinfection during follow-up. The inflammatory markers remained within the normal range (CRP < 3, ESR < 15 mm/hr, IL-6 negative, D-dimer < 500), supporting successful infection control. This approach was particularly advantageous in cases with compromised bone stock, as long-stem implants bypass weakened bone, ensuring enhanced stability. The use of arthroplasty as a salvage procedure after failed internal fixation is well-supported in the literature, particularly for elderly patients with poor bone quality [17]. The patient's recovery from surgery went smoothly and without any issues. With the aid of physiotherapy, she gradually regained full ambulation and demonstrated consistent improvement in her functional status. Laboratory inflammatory markers were within normal ranges, and follow-up assessments showed no indications of recurrent infection. All of these suggest successful infection eradication and a favorable overall clinical result.

Our staged approach in this case included implant removal, local antibiotic therapy with a custom cemented DHS, and eventual arthroplasty. This method follows best practices in orthopedic infection management. The commonly available approach for infection control in our setting would have been removal of the femoral head and neck, followed by placement of an antibiotic-loaded cement spacer in the acetabulum. However, this technique limits the patient's ability to fully bear weight and often leads to limb shortening, which can complicate subsequent arthroplasty. To overcome these limitations, we proposed the use of a cemented DHS made with a silicone mold. This approach allowed us to both preserve the femoral head and neck and achieve our primary goal of infection control. We maintained standard limb length and partial weight-bearing between surgeries. We also managed to control the infection effectively and affordably.

Similar approaches have been used in some other studies. For example, Rai et al. described a case series in which cement augmentation of dynamic hip screw fixation was applied in osteoporotic intertrochanteric fractures to increase implant stability and decrease screw cut-out. In our patient, instead of metallic fixation with cement augmentation, we employed a completely cemented dynamic hip screw, which allowed infection control [18].

This method holds particular importance in countries like ours, where due to economic and political constraints, access to advanced orthopedic devices is limited. Achieving successful outcomes with minimal cost and locally available resources makes this approach especially valuable in such contexts. We also developed cost-effective, reusable silicone molds for antibiotic-loaded cement implants. This innovation could be useful in other cases as well, and we can consider this as an alternative in settings with limited access to custom implants or industrial-grade spacers. The use of antibiotic-loaded cement implants molded with autoclavable silicone provides a reproducible and accessible alternative to expensive industrial spacers. Further research is needed to optimize treatment protocols, assess long-term cement durability, and evaluate implant integration outcomes.

Limitations

The short follow-up period makes it difficult to assess implant durability and infection recurrence over time. Furthermore, the reproducibility of this approach may be affected by surgeon experience and resource availability. Lastly, its efficacy under greater pressure in heavier patients remains uncertain and requires additional investigation.

Conclusion

This case highlights the challenges of managing recurrent implant failure and deep infection in intertrochanteric fractures. Furthermore, the use of cost-effective, reusable silicone molds for fabricating antibiotic-loaded implants appears to be a promising technique for orthopedic infection management.

Acknowledgments

The authors would like to thank the staff of Khatam ol Anbia Hospital and North Khorasan University of Medical Sciences for their valuable assistance in the management and reporting of this case.

Conflict of Interest Disclosures

No potential conflict of interest relevant to this article was reported.

Funding Sources

No external funding was received.

Authors' Contributions

Ismaeil Garivani was responsible for patient management, surgical treatment, and clinical data collection. Mohamad Amin Younessi Heravi contributed to development of the silicone mold technique, revision of the manuscript, and supervision of the project. Negin Armide contributed to data collection, literature review, and manuscript drafting.

All authors read and approved the final manuscript.

Ethical Statement

This case report was approved by the Ethics Committee of North Khorasan University of Medical Sciences, Bojnurd, Iran (IR.NKUMS.REC.1403.121). Written informed consent was obtained from the patient for publication of this case report.

Declaration of Generative AI and AI-assisted technologies

The authors declare that no generative AI or AI-assisted technologies were used in this manuscript.

References

1. Roth T, Kammerlander C, Gosch M, Luger TJ, Blauth M. Outcome in geriatric fracture patients and how it can be improved. Osteoporos Int. 2010 Dec;21(Suppl 4):S615-9.

2. Socci AR, Casemyr NE, Leslie MP, Baumgaertner MR. Implant options for the treatment of intertrochanteric fractures of the hip: rationale, evidence, and recommendations. Bone Joint J. 2017 Jan;99-B(1):128–33.

3. Lewis SR, Macey R, Eardley WG, Dixon JR, Cook J, Griffin XL. Internal fixation implants for intracapsular hip fractures in older adults. Cochrane Database Syst Rev. 2021 Mar;3(3):CD013409.

4. Zhao K, Zhang J, Li J, Meng H, Wang Z, Zhu Y, et al. Incidence and risk factors of surgical site infection after intertrochanteric fracture surgery: A prospective cohort study. Int Wound J. 2020 Dec;17(6):1871–80.

5. Nguyen QTQ, Vo TH, Phan DT, Truong NKH. Simple and cost-effective way to make mobile antibiotic cement spacer: hand-made silicone mold. SICOT-J. 2023;9:32.

6. Ganji R, Younessi Heravi MA, Aramide N. An innovative approach to produce silicone mold-based antibiotic-loaded knee spacer for infected knee arthroplasty. Arch Bone Jt Surg. 2024;12(11):813-817.

7. Dennison E, Mohamed MA, Cooper C. Epidemiology of osteoporosis. Rheum Dis Clin. 2006;32(4):617–29.

8. Chandan RK, Verma D, Meena RC, Husain J. Evaluation of osteoporotic trochanteric fractures treated with cement-augmented dynamic hip screw. Int J Res Orthop. 2016;2(3):148.

9. Hiesterman TG, Shafiq BX, Cole PA. Intramedullary nailing of extra-articular proximal tibia fractures. J Am Acad Orthop Surg. 2011 Nov;19(11):690–700.

10. Makridis KG, Tosounidis T, Giannoudis P V. Management of infection after intramedullary nailing of long bone fractures: treatment protocols and outcomes. Open Orthop J. 2013;7:219–26.

11. Ricci WM, Gallagher B, Haidukewych GJ. Intramedullary nailing of femoral shaft fractures: current concepts. J Am Acad Orthop Surg. 2009 May;17(5):296–305.

12. McConoughey SJ, Howlin R, Granger JF, Manring MM, Calhoun JH, Shirtliff M, et al. Biofilms in periprosthetic orthopedic infections. Future Microbiol. 2014;9(8):987–1007.

13. Besal R, Adamič P, Beović B, Papst L. Systemic Antimicrobial Treatment of Chronic Osteomyelitis in Adults: A Narrative Review. Antibiot (Basel, Switzerland). 2023;12(6):944.

14. Shahpari O, Mousavian A, Elahpour N, Malahias M-A, Ebrahimzadeh MH, Moradi A. The Use of Antibiotic Impregnated Cement Spacers in the Treatment of Infected Total Joint Replacement: Challenges and Achievements. Arch Bone Jt Surg. 2020 Jan;8(1):11–20.

15. Biring GS, Kostamo T, Garbuz DS, Masri BA, Duncan CP. Two-stage revision arthroplasty of the hip for infection using an interim articulated Prostalac hip spacer: a 10- to 15-year follow-up study. J Bone Joint Surg Br. 2009 Nov;91(11):1431–7.

16. Diwanji SR, Kong IK, Park YH, Cho SG, Song EK, Yoon TR. Two-Stage Reconstruction of Infected Hip Joints. J Arthroplasty [Internet]. 2008;23(5):656–61.

17. Romanò C, Romanò D, Logoluso N, Meani E. Long-Stem versus Short-Stem Preformed Antibiotic-Loaded Cement Spacers for Two-Stage Revision of Infected Total Hip Arthroplasty. Hip Int. 2010 Mar 1;20:26–33.

18. Rai AK, Goel R, Bhatia C, Singh S, Thalanki S, Gondane A. Cement Augmentation of Dynamic Hip Screw to Prevent Screw Cut Out in Osteoporotic Patients with Intertrochanteric Fractures: A Case Series. Hip Pelvis. 2018 Dec;30(4):269–75.