

Failure of Femoral Neck System Fixation Due to Suboptimal Reduction in a Young Adult With a Garden Type IV Subcapital Fracture: Conversion to Total Hip Arthroplasty. A Case Report

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ABSTRACT

We report the case of a 38-year-old nonsmoking man with a body mass index of 31.1 kg/m² who sustained a low-energy Garden type IV subcapital fracture after a ground-level fall. Radiographs showed a Garden type IV fracture and a neck-shaft angle of 119°. Internal fixation with the *Femoral Neck System* was performed 12 days after injury. Postoperative radiographs revealed suboptimal reduction and off-center screw placement. At 8 months, mechanical failure, loss of fixation, nonunion, and avascular necrosis were documented. Conversion to total hip arthroplasty was performed at 18 months. One month later, the *Harris Hip Score* was 82/100, and the patient had resumed daily activities without complications. **Conclusions:** Suboptimal reduction and off-center implant placement, in the setting of delayed surgery, contributed to implant failure. Even with modern implants, the quality of anatomical reduction remains the most important determinant of successful femoral head preservation in young adults. Conversion to total hip arthroplasty is an effective salvage strategy when internal fixation fails.

Keywords: Femoral neck fracture; Femoral Neck System; suboptimal reduction; total hip arthroplasty; young adult.

Level of Evidence: IV

Fallo de la osteosíntesis con un FNS por reducción subóptima en un adulto joven con una fractura subcapital tipo IV de Garden: conversión a artroplastia total de cadera. Presentación de un caso

RESUMEN

Se presenta el caso de un hombre de 38 años, no fumador, con un índice de masa corporal de 31,1 kg/m² que sufrió una fractura subcapital tipo IV de Garden de baja energía tras una caída de propia altura. En las radiografías, se observó una fractura tipo IV de Garden y un ángulo cervicodiafisario de 119°. Se realizó una osteosíntesis con el *Femoral Neck System* a los 12 días. Las radiografías posoperatorias revelaron una reducción subóptima y una posición no central del tornillo. A los 8 meses, se documentaron fallo mecánico, desanclaje, pseudoartrosis y necrosis avascular. A los 18 meses, se realizó la conversión a artroplastia total de cadera. Al mes, el *Harris Hip Score* era de 82/100 y el paciente se reintegró a las actividades diarias sin complicaciones. **Conclusiones:** La reducción subóptima y la posición no central del implante, en un contexto de retraso quirúrgico, condicionaron el fallo del implante. Incluso con implantes modernos, la calidad de la reducción anatómica es el determinante más importante del éxito de la preservación cefálica en el adulto joven. La conversión a artroplastia total de cadera es una estrategia de rescate efectiva cuando la fijación interna fracasa.

Palabras clave: Fractura de cuello femoral; Femoral Neck System; reducción subóptima; artroplastia total de cadera; adulto joven.

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INTRODUCTION

Coxa vara is defined as a femoral neck–shaft angle below 120° (normal range, 125°–135°).¹ This morphology redistributes forces across the femoral neck and increases the shear component.^{1,2}

In young adults, subcapital fractures following a fall from standing height are uncommon. The patient described here had a neck–shaft angle of 119°, a borderline value interpreted radiographically as apparent coxa vara morphology.^{1,3}

Femoral neck fractures are classified according to the orientation of the fracture line using the Pauwels classification. Pauwels type III fractures have a vertical fracture line (>50°), with predominantly shear forces that increase the risk of instability, nonunion, and fixation failure.^{4,5}

In young patients with Garden type III–IV fractures, the primary goal is to preserve the femoral head through internal fixation, provided that anatomical reduction can be achieved. Reduction is considered suboptimal when there is residual femoral neck shortening >5 mm, rotation of the femoral head fragment, or noncentral positioning of the implant's head element.⁶

The *Femoral Neck System* (FNS) has been proposed as a fixed-angle option that provides rotational stability.^{4,6,7} Its success, however, depends critically on reduction quality and implant positioning. Some multicenter series report a 10% early failure rate in Garden type III–IV fractures with suboptimal reduction.^{5,6,8} Rates of nonunion, avascular necrosis, and fixation failure are not consistently lower than those reported with cannulated screws.⁹

Avascular necrosis of the femoral head results from disruption of the retinacular vessels. The main risk factors are initial displacement (Garden types III–IV), delayed fixation, and inadequate reduction.^{10,11} These factors increase the risk of varus collapse, cut-out, nonunion, and avascular necrosis, potentially requiring conversion to total hip arthroplasty.^{10,11}

We present a case of a low-energy Garden type IV subcapital fracture in a young adult with a borderline neck–shaft angle of 119°. Suboptimal reduction and implant malposition led to FNS failure, followed by nonunion and avascular necrosis requiring conversion to arthroplasty. This case illustrates how severe initial displacement, inadequate reduction, and poor implant positioning can lead to internal fixation failure, emphasizing the importance of not accepting a nonanatomical reduction.

CASE REPORT

A 38-year-old male motorcycle taxi driver with a body mass index of 31.1 kg/m² and no smoking history presented with left hip pain and loss of function lasting 3 days after a ground-level fall. The patient provided informed consent for publication of the case and images.

Clinical examination revealed limb shortening, external rotation, and pain on movement, with no neurovascular deficit.

Radiographs showed a Garden type IV subcapital fracture with a neck–shaft angle of 119°, a borderline value interpreted as radiographically apparent coxa vara morphology (Figure 1). The fracture line was vertical (Pauwels type III) (Figure 2).

Internal fixation with the FNS was performed 12 days after the injury under spinal anesthesia. The implant was selected for its fixed-angle design and rotational stability in fractures subjected predominantly to shear forces. Closed reduction was performed under fluoroscopic guidance in two planes. Shortening and rotation persisted, preventing an optimal reduction. Nevertheless, the reduction obtained was accepted and fixation was completed.

Postoperative radiographs confirmed suboptimal reduction, with residual femoral neck shortening >5 mm, rotation of the femoral head fragment, and noncentral positioning of the main screw (Figures 3 and 4).

At 8 months, mechanical failure of the FNS was documented, with cut-out, nonunion (absence of union and sclerosis of the fracture margins), and avascular necrosis (loss of femoral head sphericity and subchondral collapse) (Figures 5 and 6).

At 18 months, conversion to a complex primary total hip arthroplasty was performed through a posterolateral (Gibson) approach. A 52-mm uncemented acetabular cup with two screws, an 11-mm uncemented stem, and a 36-mm ceramic head were implanted without intraoperative complications. Radiographs confirmed satisfactory component positioning (Figures 7 and 8).

One month after arthroplasty, limb length had been restored, the Harris Hip Score was 82/100, and the patient had resumed his daily activities without complications.

Figure 1. Anteroposterior pelvic radiograph showing a left femoral neck–shaft angle of approximately 119° (borderline value). Relative femoral neck shortening and an altered head–shaft relationship are consistent with a Garden type IV subcapital fracture and posterior wall comminution.



Figure 2. Lateral radiograph of the left hip showing posterior rotation and sagittal shortening of the femoral head fragment, loss of the spherical head contour, and irregular subchondral cortical lines. These findings support the interpretation of mechanical instability and a low-energy fracture.

Figure 3. Anteroposterior radiograph of the left hip after internal fixation with the *Femoral Neck System*. Femoral neck shortening and rotation of the femoral head fragment about the transverse axis indicate suboptimal reduction.



Figure 4. Lateral radiograph of the left hip after internal fixation. The main screw lies markedly anterior to the sagittal center of the femoral head. The head is rotated posteriorly, and the neck appears shortened.



Figure 5. Follow-up anteroposterior radiograph of the left hip after internal fixation. Femoral neck shortening, loss of center-center positioning of the head screw, and changes in femoral head morphology (sclerosis/collapse) are consistent with mechanical failure of the *Femoral Neck System* and progression toward nonunion/necrosis.



Figure 6. Follow-up lateral radiograph of the left hip showing posterior migration of the main screw and posterior rotation of the femoral head fragment, with partial cut-out through the posterosuperior pole of the femoral head. These findings are consistent with loss of femoral head support and implant failure.



Figure 7. Anteroposterior pelvic radiograph showing the left total hip prosthesis. The acetabular component is appropriately positioned and secured with two superior screws. The prosthetic head is centered in the cup, and the femoral stem is aligned within the canal. There is no evidence of dislocation, periprosthetic fracture, or immediate postoperative radiolucencies around the implant.

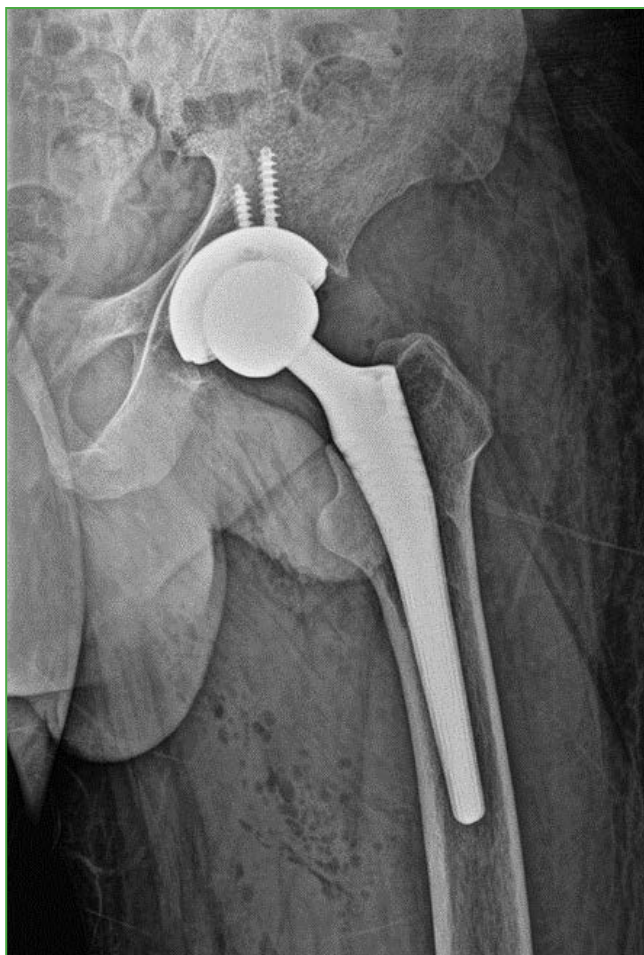


Figure 8. Lateral radiograph of the left hip after total hip arthroplasty, confirming appropriate cup orientation with the liner in functional anteversion, a centered head, and a well-positioned femoral stem. No signs of loosening or early postoperative complications are present.

DISCUSSION

A low-energy subcapital fracture in a young adult is uncommon. This patient had a borderline neck–shaft angle of 119°, a radiographic finding consistent with apparent coxa vara morphology.^{1,3}

In young patients with completely displaced intracapsular fractures (Garden type IV), the primary goal is to preserve the femoral head through internal fixation, provided that anatomical reduction and stable fixation can be achieved.^{10,11} Success depends critically on several concurrent factors: time to surgery, reduction quality, and implant positioning.^{6,9}

Surgery was performed 12 days after the initial injury. Although the evidence on the precise effect of delayed surgery on avascular necrosis is not entirely consistent, most series agree that displaced femoral neck fractures in young adults should be treated urgently, ideally within the first 24 hours, to minimize the risk of nonunion and avascular necrosis.^{12,13} A 12-day delay falls well outside this recommended window and represents an additional risk factor.¹²

The FNS offers theoretical biomechanical advantages over cannulated screws, including rotational stability and a fixed-angle design.^{4,5} However, recent publications indicate that these advantages do not consistently translate into fewer serious complications when reduction is nonanatomical. A comparative meta-analysis concluded that, although the FNS may be associated with shorter time to union and less femoral neck shortening, rates of nonunion, avascular necrosis, and fixation failure are similar to those reported with cannulated screws.^{8,9} Multicenter series have identified initial displacement (Garden types III–IV), suboptimal reduction, a large tip–apex distance, and excessive device sliding as the main predictors of early FNS failure.^{5,6,8}

In this case, immediate postoperative radiographs showed nonanatomical reduction, with residual femoral neck shortening and rotation of the femoral head fragment, together with noncentral positioning of the main FNS screw. These technical findings, combined with the 12-day surgical delay and initial Garden type IV displacement, provide a multifactorial explanation for the mechanical failure, cut-out, nonunion, and avascular necrosis documented at 8 months.⁵⁻⁹

When internal fixation fails and femoral head viability is lost in a young patient, conversion to total hip arthroplasty offers a predictable and effective salvage strategy. Available series report high rates of reoperation and conversion to arthroplasty after failed internal fixation in young adults. They also show that arthroplasty provides better medium-term functional outcomes than repeated attempts at internal fixation in this setting.^{10,11,14}

This case is noteworthy because several unusual factors occurred in a single patient: a low-energy Garden type IV subcapital fracture in a young nonsmoking adult with a borderline neck–shaft angle, delayed treatment at 12 days using a modern fixed-angle implant (FNS), suboptimal reduction, and noncentral positioning of the implant's head element. This combination led to mechanical failure and the need for conversion to total hip arthroplasty 18 months after the initial injury.

The main lesson from this case is that, even with advanced fixation devices such as the FNS, anatomical reduction and correct implant positioning remain the most important technical determinants of successful femoral head preservation in young patients. Suboptimal reduction should not be accepted. Surgical delay may increase biomechanical risk, but failure is primarily explained by the reduction and fixation technique. When these factors coexist and avascular necrosis or nonunion develops, conversion to total hip arthroplasty is a valid salvage option with good short-term functional outcomes.

CONCLUSIONS

A low-energy Garden type IV subcapital fracture in a young adult carries a high risk of complications. FNS failure occurred in the setting of delayed surgery, suboptimal reduction, and noncentral implant positioning. The latter two were identified as the main technical factors.

Successful femoral head preservation depends primarily on anatomical reduction and correct fixation. When fixation fails and femoral head viability is lost, conversion to total hip arthroplasty is an effective salvage strategy.

This case reinforces that reduction quality remains the most important technical determinant of success, even with modern fixed-angle implants.

Use of artificial intelligence

ChatGPT (OpenAI) was used as a supporting tool to improve the wording and clarity of the manuscript, contributing approximately 20% of the text editing. Before submission, the authors reviewed, verified, and approved all content for accuracy and originality and accepted full scientific responsibility for it.

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