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# Analysis of the Causes of Osteosynthesis Failure: A Study of 60 Cases Collected at the National Hospital of Niamey, Niger

IDE G[1,5*], Abdoulwahab M[2,5], ALFARI A.A[3,5], ALHASSANE CHAOULANI Chafaatou[1], NANA AICHA Sabiou Aarzika[1], Adamou Harissou[4], Illé S[5, 6]

[1]Traumatology-Orthopedics and Reconstructive Surgery Department, National Hospital of Niamey (Niger)
[2]Traumatology-Orthopedics Department, Niamey General Referral Hospital (Niger)
[3]Physical Medicine and Rehabilitation Department, Niamey General Referral Hospital (Niger)
[4]General and Visceral Surgery Department, Zinder National Hospital, Faculty of Health Sciences, André Salifou University
[5]Faculty of Health Sciences, Abdou Moumouni University, Niamey
[6]Service d'ORL et Chirurgie Cervico-Faciale, Hôpital Général de Référence de Niamey (Niger)

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***Corresponding author:** IDE G
Traumatology-Orthopedics and Reconstructive Surgery Department, National Hospital of Niamey (Niger)

**Abstract** | **Original Research Article**

***Introduction:*** Fractures have become a public health issue in less developed countries. The treatment of fractures is often surgical, through osteosynthesis. With current technological advancements, the problem of osteosynthesis material quality is largely resolved. Despite the quality of the material, osteosynthesis failures still occur, indicating that there are still unresolved issues concerning the mechanical quality of the bone-material interface. The objective of our study is to analyze the causes of these failures by reporting our experience in managing osteosynthesis failures at the National Hospital of Niamey. ***Materials and Methods:*** This was a prospective study conducted at the Traumatology-Orthopedics Department of the National Hospital of Niamey, Niger, over a period of 32 months from March 1, 2022, to October 30, 2024. The study included patients of all ages admitted for osteosynthesis failure and managed in our department during the study period. The parameters studied were epidemiological, clinical, paraclinical, therapeutic, and evolutionary. ***Results:*** Over 32 months, we recorded 60 cases of osteosynthesis failures out of 620 admissions in the department, representing a frequency of 10.33%. There were 42 men (70%) and 18 women (30%), with a male-to-female ratio of 2.33. The age group of 31 to 40 years was the most represented, accounting for 33.33% of the cases (n=20). The average age was 35.13 years ± 1.3, with a range from 9 to 63 years. Road traffic accidents represented 93.34% (n=56) of the circumstances leading to the initial trauma. The fracture involved the pelvic limb in 93.33% (n=56) of cases. The initial fracture site was complex in 53.33% of cases (n=32). The most commonly used osteosynthesis material was the screw plate, used in 53.33% (n=32) of the initial osteosynthesis, followed by the external fixator in 33.33% (n=20). The failure to adhere to osteosynthesis principles was the most common factor in the occurrence of osteosynthesis failure, with 60.00% of cases (n=36). Material rupture was the most frequent type of failure, occurring in 43.33% of cases (n=26), followed by anchor rupture or material detachment from the bone in 33.33% (n=20). Therapeutically, the treatment for the failure in all cases involved osteosynthesis, with the screw plate being the most commonly used material in 50% (n=30), followed by the external fixator in 36.67% (n=22). The therapeutic outcomes were favorable in the vast majority of cases. ***Conclusion:*** Osteosynthesis failures at the National Hospital of Niamey are influenced by multiple factors. Surgical revision is required, and the results are generally good.

**Keywords:** Causes - Failure - Osteosynthesis - National Hospital - Niamey.



## INTRODUCTION

Osteosynthesis is a surgical technique that involves the fixation of a fracture using an exogenous material. Since the early pioneers of bone fixation, such as Lane and Lambotte, followed by Danis and Kuntscher, and more recently Muller and the Swiss school [1], osteosynthesis has undergone remarkable evolution. Current technological advancements have resolved the issue of material quality. Despite the performance of the materials, mechanical failures still occur in the bone-material interface. These failures can compromise the bone healing process. The aim of this study is to analyze the causes of osteosynthesis failure at the National Hospital of Niamey, Niger.

## Materials and Methods

This was a prospective study conducted at the Traumatology-Orthopedics Department of the National Hospital of Niamey, Niger, over a period of 32 months, from March 1, 2022, to October 30, 2024. The study included patients of all ages who were admitted for osteosynthesis failure and managed in our department during the study period. The parameters studied included epidemiological, clinical, paraclinical, therapeutic, and evolutionary factors. The functional outcome obtained after revision surgery was assessed based on the clinical and functional criteria of Olerud and Molander [2] after fracture consolidation. The score obtained allowed for classification of the patients' results as good, fair, or poor. Table I presented the clinical and functional criteria of Olerud and Molander.

**Table I: Clinical and Functional Criteria of Olerud and Molander**

| Parameters | Importance | Score |
|---|---|---|
| Pain | None | 25 |
| | During walking on uneven terrain | 20 |
| | During walking on flat terrain | 10 |
| | During indoor walking | 5 |
| | Constant and severe | 0 |
| Stiffness | None | 10 |
| | Stiff | 0 |
| Swelling | None | 10 |
| | Only in the evening | 5 |
| | Constant | 0 |
| Climbing Stairs | No problem | 10 |
| | Asymmetrical | 5 |
| | Impossible | 0 |
| Running | Possible | 5 |
| | Impossible | 0 |
| Jumping | Possible | 5 |
| | Impossible | 0 |
| Squatting | No problem | 5 |
| | Impossible | 0 |
| Walking Aid | None | 15 |
| | Bandage or ankle brace | 10 |
| | Cane or crutch | 0 |
| Work or Daily Activities | Same as before the accident | 20 |
| | Less intensive | 15 |
| | Modified or part-time work | 10 |
| | Severe incapacity | 0 |

- **Good:** Patients presenting satisfactory reduction, no pelvic limb length discrepancy, no moderate callus, no pain, and no limitation of joint ranges (knee and ankle).
- **Average:** Patients presenting mild pain, moderate callus, unsatisfactory reduction, moderate limitation of joint ranges (knee and ankle) after six (6) months of treatment.
- **Poor:** Patients with malunion, persistent pain, nonunion, pelvic limb length discrepancy, delayed union, limitation of joint ranges (knee and ankle), chronic osteitis, after six months of treatment.

## Results

In 32 months, we recorded 60 cases of osteosynthesis failure out of 620 admissions in the department, with a frequency of 10.33%. There were 42 men (70%) and 18 women (30%), with a male-to-female ratio of 2.33. The age group most represented was 31 to 40 years, accounting for 33.33% of the cases (n=20). The average age was 35.13 years ± 1.3, with extremes ranging from 9 to 63 years.

Road traffic accidents represented 93.34% (n=56) of the circumstances leading to the initial trauma. The fracture involved the pelvic limb in 93.33% (n=56) of cases. The fracture was open in 56.66% (n=34). The femur was the most common site of fracture, accounting for 53.33% (n=32). The fracture site was complex in 53.33% of the cases (n=32). The screw plate was the most commonly used osteosynthesis material initially, in 53.33% (n=32), followed by the external fixator in 33.33% (n=20). Figure 1 shows the characteristics of the initial osteosynthesis material used.

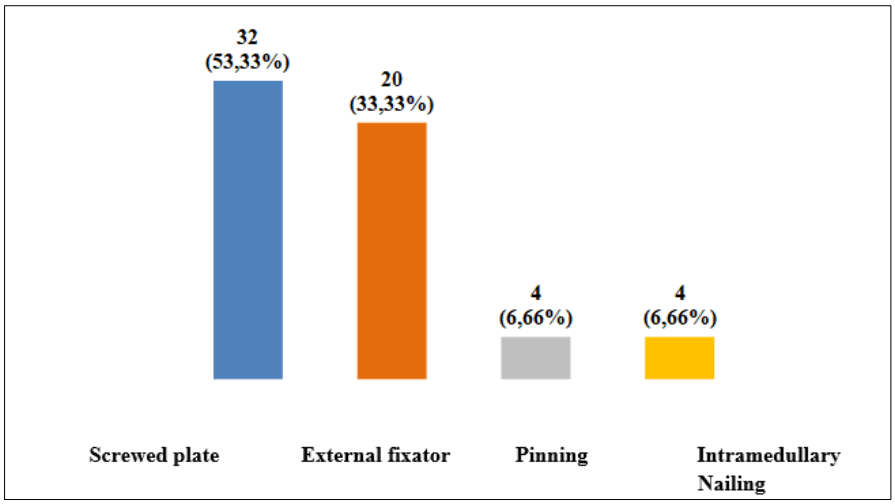


**Figure 1: Distribution of patients according to the type of initial osteosynthesis material**

In 73.33% (n=44) of cases, the failure occurred within the first 3 months after osteosynthesis. Intrinsic factors related to the fractures were the most represented, with 56.66% (n=34) of fractures being open and 53.33% (n=32) being complex. Among the extrinsic factors, the failure to adhere to osteosynthesis principles was the most common factor leading to osteosynthesis failure, accounting for 60.00% (n=36) of cases, and resulted in infection at the surgical site in 53.33% (n=32) of cases. This was followed by non-compliance with postoperative instructions by patients in 35.00% (n=28), with early weight-bearing being the most common issue, found in 23.33% (n=14). Lastly, the very unstable nature of the initial fracture site was noted in 26.66% (n=16) of cases, with complex fracture sites being the most frequent at 23.33% (n=14). Table III reports the causes of osteosynthesis failure.

**Table III: Distribution of patients according to the causes of osteosynthesis failure**

| **Osteosynthesis Failure Factors** | | | | **Number (n)** | **Percentage (%)** |
|---|---|---|---|---|---|
| **Failure to adhere to initial osteosynthesis principles** | | **Number (n)** | **Percentage (%)** | **36** | **45.00** |
| | Infection of the surgical site | 32 | 53.33 | | |
| | Principle of execution | 4 | 6.66 | | |
| **Inappropriate patient behavior after initial osteosynthesis** | Early weight-bearing | 14 | 23.33 | **28** | **35.00** |
| | Osteoporosis | 10 | 16.66 | | |
| | Fall | 4 | 6.66 | | |
| **Very unstable nature of the initial fracture site** | Complex | 14 | 23.33 | **16** | **20.00** |
| | Simple | 2 | 3.33 | | |
| **Total** | | **60** | **100%** | **60** | **100%** |

The rupture of the material was the most frequent type of failure, occurring in 43.33% of cases (n=26). Figure 1 shows osteosynthesis of a subtrochanteric fracture with a screwed plate and the plate rupture at 5 months.

**Figure 1: Osteosynthesis of a subtrochanteric fracture with a screwed plate and plate rupture at 5 months**

**Figure 2: shows osteosynthesis of a femur fracture with a screwe plate and the plate rupture at 4 months**

Figure 2 shows material detachment from the bone.

The rupture of the material is followed by anchorage failure or material detachment from the bone in 33.33% (n=20) of cases.

**Figure 3: Subtrochanteric fracture treated with a screwed plate, showing screw detachment at 3 months**

A material deformation was found in 23.33% of cases (n=14). Table IV shows the distribution of patients according to the type of failure.

**Table IV: Distribution of patients according to the type of failure**

| Failure Type | Number (n) | Percentage (%) |
|---|---|---|
| Material rupture | 26 | 43.34 |
| Anchorage rupture or detachment of osteosynthesis material | 20 | 33.33 |
| Material deformation | 14 | 23.33 |
| **Total** | **60** | **100.00** |

Clinically, after the procedure, pain was observed in 52 patients, accounting for 86.67% of cases, and functional impairment in 36.67% of cases (n=22).

In terms of therapy, the treatment in all cases involved osteosynthesis, with the screwed plate being the most commonly used material in 50% (n=30) of cases, followed by the external fixator in 36.67% (n=22). Table

V shows the distribution of patients according to the material used during the revision.

**Table V: Distribution of patients according to the type of osteosynthesis during the revision**

| Type of Osteosynthesis in Revision | Number (n) | Percentage (%) |
|---|---|---|
| Screwed plate | 30 | 50.00 |
| External fixator | 22 | 36.67 |
| Nailing | 6 | 10.00 |
| Pinning | 2 | 3.33 |
| **Total** | **60** | **100.00** |

The average length of hospitalization was 10.22 days, with a range of 4 to 25 days. According to the clinical and functional criteria of Olerud and Molander, therapeutic outcomes were good in 93.33% (n=56) and fair in 4 cases (6.67%).

## DISCUSSION

Osteosynthesis failure is common in our practice and affects 10.33% of our patients. Our result is comparable to that of A. D. Batchom [3] in Cameroon in 2021 with 12%, lower than that of Benoit [4], who found 18%, but higher than that of Riemer [5], who reported 7%. The diversity of results can be explained by differences in technical platforms, the nature of the fractures, and the experience of the surgeons. Seventy percent (70.00%) of our patients were male, with a male-to-female ratio of 2.33. The male predominance observed in our study was also reported by Cissé L [5] in Mali in 2020, Mutombo DP *et al.,* [6] in Congo in 1993, Moyikoua A [7] in Congo in 1993, and Dembélé T [8] in Mali in 2008, with respective rates of 73.1%, 80.7%, 90.4%, and 79.4%. This male predominance could be explained by the fact that, in countries like Niger, men are more likely to go out to earn a living for their families, use two-wheeled vehicles more often, and are thus more exposed than women to road traffic accidents, which often result in complex and/or open fractures that lead to instability and infection, contributing to osteosynthesis failure. The average age of our patients was 35.13 years, with a range from 9 to 63 years. Those under 40 years represented 63.33%. Our results are comparable to those of Mutombo DP *et al.,* [6] in Congo in 1993, who found a very high failure rate in the age group of 10 to 40 years, in contrast to the study by Ndyisaba *et al.,* [9] in Burundi in 1992, which found a high frequency in people over 65 years of age. In our study, road traffic accidents were the leading cause of the initial trauma, accounting for 93.94%. This rate is similar to that reported by Camara C [4] in Mali in 2011, with 96.97%. This can be explained by the high number of two-wheeled vehicles and poor road traffic behavior.

On the lesion level, the injury was located in the lower limb in 93.00% of patients. The predominance of lower limb injuries has been reported by most authors, including Gogoua G [10] in Côte d'Ivoire in 2006, Moyikoua A [7] in Congo in 1993, and Banane S [11] in Morocco in 2017, with rates of 96.15%, 79%, and 63.64%, respectively. This could be explained by the fact that these limbs are highly exposed to impacts.

In our study, osteosynthesis using a screwed plate was the technique most prone to failure, with a rate of 53.33%. Our rate is higher than that reported by A D Batchom [3] in Cameroon in 2021 and Dembélé T [8] in Mali in 2008, who found failure rates of 40% and 35.3%, respectively, but lower than that of Moyikoua A [7] in Congo in 1993, who reported a failure rate of 77.3% for screwed plate osteosynthesis. This could be explained by the fact that screwed plate osteosynthesis is the most commonly used technique, requiring significant periosteal stripping, which disrupts bone healing and does not allow for early weight-bearing.

The most common factors determining failure in our series were related to non-compliance with osteosynthesis principles, accounting for 45.00% of cases. This rate is lower than that reported by Gogoua [10] in Côte d'Ivoire in 2006 (50%) but higher than those reported by Traoré M *et al.,* [12] in 2017 and Essadki *et al.,* [13] in 2000, who found rates of 19.04% and 6.45%, respectively. Among the factors related to non-compliance with principles, the main factor was the failure to respect conditions preventing surgical site infections, which accounted for 53.33% of cases. Our result is significantly higher than those reported by Gogoua G [10] in Côte d'Ivoire in 2006, Dembélé T [8] in Mali in 2008, Mutombo DP *et al.,* [6] in Congo in 1993, and IDE G *et al.,* [14] in Niger in 2018, who found rates of 38%, 26.5%, 19%, and 9.56%, respectively. The relatively high frequency of surgical site infections could be partly explained by endogenous factors (related to the patient) and exogenous factors (linked to precarious working conditions in Africa).

Among the patient-related factors, early weight-bearing was the most represented, accounting for 23.33%. This rate is lower than those reported by Essadki *et al.,* [13] in 2000 (54%) and Gogoua G [10] in Côte d'Ivoire in 2006 (61%). This could be explained by the young age of our study population, as younger patients tend to disregard postoperative instructions.

In our series, 23.33% of failures occurred in cases of complex fractures. Our results are lower than those of Moyikoua A [7], who reported a predominance of complex fractures in 54% of cases. This could be

attributed to the instability of complex fracture sites, where osteosynthesis hardware is subjected to significant stress due to the lack of interfragmentary contact.

The most common type of failure in our series was plate breakage, occurring in 43.34% of cases. This rate is lower than that reported by Banane S [5] (51%) but higher than those found by Traoré M *et al.,* [12] in 2017 and Gogoua G [10] in Côte d'Ivoire in 2006, who reported rates of 28.5% and 20%, respectively. Our result could be explained by the high rate of screwed plate use among young patients who do not adhere to postoperative guidelines.

In our study, screwed plate osteosynthesis was the most commonly used bone fixation method in revision surgeries, accounting for 50% (n=30) of cases, followed by external fixation due to surgical site infections (36.67%). Intramedullary nailing was used in only 10.00% of cases.

The evaluation of our patients' management using the Olerud and Molander functional score was generally satisfactory. Patients were classified as "good" in 93.33% (n=56) of cases and "fairly good" in 6.67% (n=4) of cases. These excellent results in our series could be attributed to the early management of our patients and the judicious choice of revision hardware.

## Conclusion

Hardware failures are common at the National Hospital of Niamey. They primarily affect young adult males who are victims of road traffic accidents. The occurrence of hardware failure is multifactorial, with factors related to non-compliance with osteosynthesis principles being the most frequently encountered. The treatment was exclusively surgical, and revision surgery using a screwed plate was a widely used therapeutic approach. The results were good in the vast majority of cases.

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