

All-Internal Bone Transport for the Treatment of Chronic Osteomyelitis

Vladimir Goldman MD^{1,3}, David Laniado MD^{1,3}, Ran Nir-Paz MD^{2,3}, Yoram A. Weil MD^{1,3}

¹ Department of Orthopaedic Surgery, Hadassah Medical Center, Jerusalem, Israel

² Department of Clinical Microbiology and Infectious Diseases, Hadassah Medical Center, Jerusalem, Israel

³ Faculty of Medicine, Hebrew University of Jerusalem, Jerusalem, Israel

ABSTRACT

INTRODUCTION

Chronic osteomyelitis (CO) following severe trauma is a devastating condition associated with fracture nonunion, substantial morbidity, functional impairment, and, in some cases, limb loss. Eradication of infection typically requires radical resection of all infected bone, often resulting in critical segmental defects. The gold standard has been bone transport using a circular external fixator (CEF); however, this is associated with considerable patient discomfort, pin-tract infections, and other complications.

AIM

We aimed to evaluate the feasibility and outcomes of all-internal bone transport using motorized magnetic intramedullary nails for the management of large segmental defects in patients with chronic post-traumatic osteomyelitis.

METHODS

We describe our preliminary experience in six male patients with chronic post-traumatic CO (five tibiae, one femur), with a mean age of 48 years (range, 38–57). All patients underwent a staged protocol. The first stage involved radical debridement, microbiological sampling, and temporary stabilization with either a cement spacer and intramedullary nail or an external fixator. The second stage, performed 2–6 weeks later, included definitive fixation using either a plate-assisted bone segment transport (PABST) technique with a lengthening nail or a designated bone transport nail following osteotomy. Bone transport was initiated at a rate of 0.6 mm per day.

RESULTS

The average bone defect measured 60 mm (range, 45–80 mm). The mean time from the index procedure to fracture healing was 11 months (range, 6–21 months). Union was achieved in all patients with complete eradication of infection. Infecting organisms included gram-positive cocci in two patients and mixed flora in four. Secondary procedures included docking-site bone grafting, conversion to a standard trauma nail, magnet recharging, and additional debridement. The average number of secondary procedures was three per patient (range, 1–6).

CONCLUSIONS

All-internal bone transport using magnetic intramedullary nails is a promising technique for managing large bone defects associated with chronic osteomyelitis. This approach achieves reliable bone healing and infection eradication while eliminating the discomfort and morbidity associated with external fixators. Nevertheless, the treatment course is prolonged and frequently requires additional procedures.

1 Methods

Preliminary experience in **six male patients** with chronic post-traumatic CO (five tibiae, one femur); mean age 48 years (range, 38–57). All patients underwent a staged protocol:

STAGE 1 — DAY 0

Radical debridement of infected / necrotic bone
Microbiological sampling
Temporary stabilization: cement spacer + IM nail, or external fixator

2–6 weeks

STAGE 2 — BONE TRANSPORT

PABST technique (plate-assisted bone segment transport), or
Designated bone transport nail following osteotomy

BONE TRANSPORT INITIATED

0.6 mm / day

Docking-site consolidation + secondary procedures as required (grafting,
nail exchange, debridement)

UNION + INFECTION ERADICATION

Figure 1. Staged all-internal bone transport protocol using motorized magnetic intramedullary nails.

CIRCULAR EXTERNAL FIXATOR VS. ALL-INTERNAL TRANSPORT

Feature	CEF (gold standard)	All-internal nail
Transport mechanism	External frame	Fully implanted
Pin-tract infection risk	Present	Eliminated
Patient discomfort	Considerable	Substantially reduced

2 Results

The average bone defect measured **60 mm** (range, 45–80 mm). The mean time from the index procedure to fracture healing was **11 months** (range, 6–21). Union was achieved in **all six patients**, with complete eradication of infection in all cases.

Infecting organisms included gram-positive cocci in two patients and mixed flora in four. Secondary procedures — including docking-site bone grafting, conversion to a standard trauma nail, magnet recharging, and additional debridement — were required at an average of **three per patient** (range, 1–6).

TABLE 1 · COHORT & TREATMENT SUMMARY

Parameter	Value
Patients (all male)	n = 6
Affected site	Tibia 5 · Femur 1
Mean age, years (range)	48 (38–57)
Mean bone defect, mm (range)	60 (45–80)
Transport rate	0.6 mm/day
Transport method	PABST (plate-assisted bone segment transport), or bone transport nail
Definitive fixation	Standard trauma nail, or plate and screws

TABLE 2 · OUTCOMES

Parameter	Value
Union achieved	6/6 (100%)
Infection eradication	6/6 (100%)
Mean time to healing, months (range)	11 (6–21)
Mean secondary procedures/patient (range)	3 (1–6)
Secondary procedure types	Docking-site grafting; nail conversion; magnet recharging; debridement

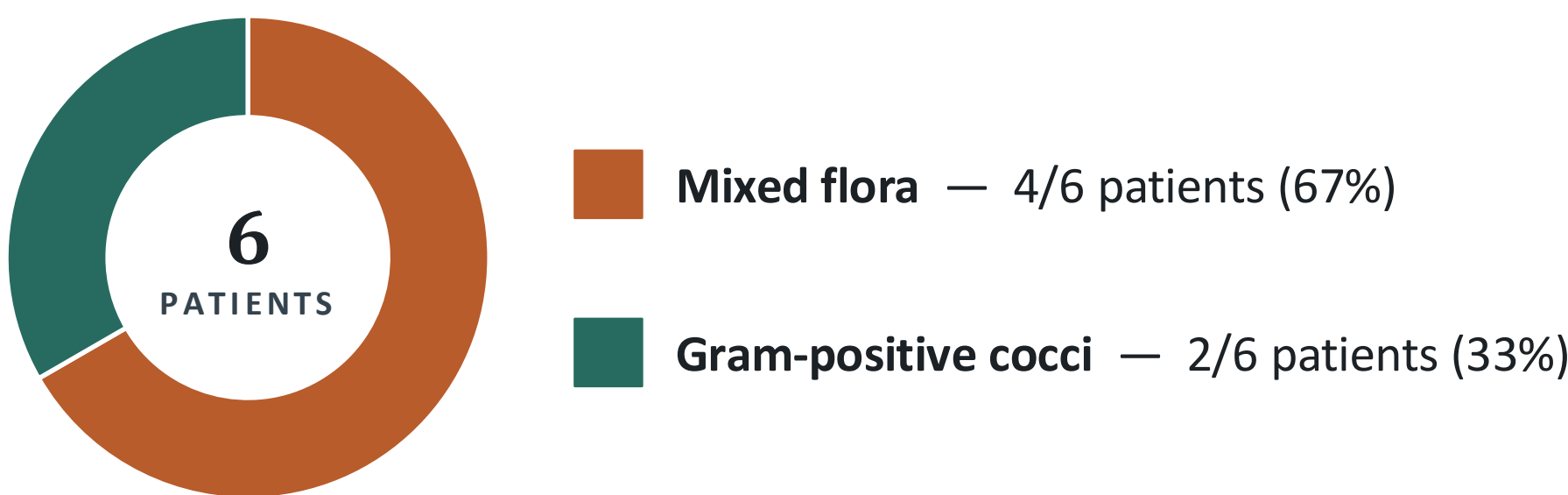


Figure 2. Distribution of infecting organisms across the cohort (n = 6).

KEY OUTCOMES AT A GLANCE

100 %

UNION & INFECTION ERADICATION

6 of 6 patients

60 mm

MEAN BONE DEFECT

range 45–80 mm

11 mo

MEAN TIME TO HEALING

range 6–21 months

3

MEAN SECONDARY PROCEDURES

range 1–6 procedures

Figure 3. Range plots (bar = min–max, dot = mean) for defect size, healing time, and secondary procedures.

Why It Matters

By keeping the transport mechanism fully implanted, this technique removes the pin-tract infections, discomfort, and frame-related morbidity that limit circular external fixation — the current gold standard — while achieving comparable rates of union and infection control.

STUDY LIMITATIONS

This is a preliminary experience in a small cohort (n = 6) without a comparator arm; larger, longer-term series are needed to confirm these findings against circular external fixation.

3 Illustrative Case

A representative patient with a post-traumatic tibial defect, from cement spacer through bone transport to complete bony union.



Pre-operative

Segmental tibial defect after radical debridement, temporary cement spacer in place



Bone Transport

All-internal motorized magnetic nail transporting the bone segment across the defect



Final Follow-Up

After conversion to a standard trauma nail, showing complete healing of the defect

4 Conclusions

All-internal bone transport using magnetic intramedullary nails is a **promising technique** for managing large bone defects associated with chronic osteomyelitis. Achieving **union and infection eradication in every patient**, without the pin-tract complications inherent to circular external fixation, supports this approach as a viable alternative for reconstructing large post-infective defects — particularly for patients who cannot tolerate a prolonged external frame. Nevertheless, the treatment course is prolonged and frequently requires additional procedures.

TAKE-HOME MESSAGE

“A fixator-free path to eradicating chronic osteomyelitis — at the cost of time and repeat surgery.”