

Presentation of a Humeral Shaft Fracture Treated by Locked Intramedullary Nailing With Unlocked Technique

Sermet Inal^{1,*}; Canan Inal²; Betül Taspınar³

¹Department of Orthopedic Surgery, Dumlupınar University, Kutahya, Turkey

²Department of Anesthesiology, Dumlupınar University, Kutahya Evliya Celebi Education and Research Hospital, Kutahya, Turkey

³Department of Physiotherapy and Rehabilitation, Dumlupınar University, Kutahya, Turkey

*Corresponding author: Sermet Inal, Department of Orthopedic Surgery, Dumlupınar University, Kutahya, Turkey. Tel: +90-2742652031, Fax: +90-2742652277, E-mail: sermetinal@yahoo.com.tr

Received: April 13, 2014; Revised: May 13, 2014; Accepted: June 29, 2014

Introduction: Although intramedullary nailing (IMN) is used in a reamed or unreamed fashion for treatment of long bone fractures, the locked nails may also be used in the unlocked form if so decided by the orthopedic surgeon.

Case Presentation: We describe a 50-year-old man who had a shaft fracture of his right humerus. The fracture was treated with a reamed, locked IMN using unlocked technique.

Conclusions: The functional outcome 22 months post injury showed that although primary treatment method uses locked IMN in humeral shaft fractures, unlocked IMN can be used in appropriate cases. Less injury risk to the axillary and radial nerve, short period of surgery, and less radiation can be considered as advantages of this technique.

Keywords: Intramedullary Nailing; Bone Screw; Humerus

1. Introduction

Humeral shaft fractures are common in orthopedics and these fractures comprise 1.31% to 3% of all fractures (1). The goals of treatment are mechanical stabilization, biological stimulation, and early joint mobilization to optimize function (2, 3). Surgical treatment of humeral shaft fractures commonly includes intramedullary nailing (IMN), which offers good clinical outcomes. Intramedullary nails can be broadly categorized into two types: locked or unlocked nails. Kuntscher nail is an unlocked type, and is the only one of its kind now available (4, 5). The locked nails may be used in the unlocked form if so decided by the orthopedic surgeon. These techniques have certain mechanical and biological advantages and disadvantages (6). During the application of the locked technique, the radial and axillary nerves can be injured while there is no risk in this regard using the unlocked technique. On the other hand, the stability of the fracture is stronger in the locked IMN technique. We describe a 50-year-old man with a shaft fracture of his right humerus treated with a reamed, locked IMN but via an unlocked technique.

2. Case Presentation

A 50-year-old male patient referred one hour after falling on his right arm. The arm was deformed but

there was no neurovascular deficit.

Radiographs revealed a transvers-oblique humeral shaft fracture (Figure 1). After being anesthetized, the patient was placed in beach-chair position on the table and the entire limb is prepared and draped. Closed reduction was then performed and checked by imaging. Surgical treatment was performed via anterolateral approach. An antegrade locked IMN was performed with a reamed, unlocked technique. The patient was discharged with a Velpeau bandage.

After 3 weeks, rehabilitation program with Want exercises was started. Isometric exercises were also used during this period. Strength training was started after the callus formed. The patient was followed for 22 months and the outcome was evaluated by the disability of the arm, shoulder, and hand turkey (DASH-T), upper extremity functional index (UEFI) and sort-form 36 questionnaire (SF-36) at the 2, 4, 6, 9, 16, and 22 month of the injury (Figure 2 and Table 1). Total score of DASH-T was determined as 5.83%, UEFI as 96%, and SF-36 as 87.7% at the end of 22 months (Figure 3). The patient performed his daily living activities. He sometimes complained of the mild pain at the entry point of the nail during the whole follow-up period. The patient expressed that the severity of the pain did not change during this period.

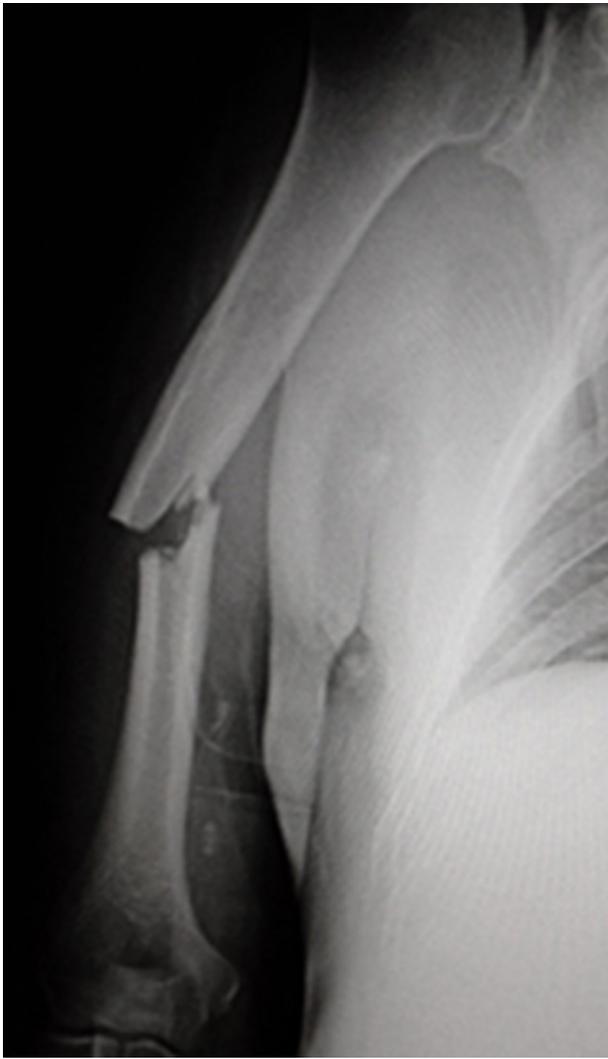


Figure 1. X-Ray Demonstrating the Transvers- Oblique Fracture Pattern of the Humeral Shaft



Figure 2. X-Ray Demonstrating the Union of Fracture at the 22 Month of the Injury

Table 1. The Table of Fracture Healing and Assessment Parameters During the Follow Up

Month	Status of Fracture Healing on X-Ray	DASH-T	UEFI	SF-36
2	Beginning of callus at the medial cortex of the fracture line. No callus formation at the lateral cortex of the fracture line.	85.3	17	24.7
4	Increase of callus formation at the medial cortex of the fracture line. No callus formation at the lateral cortex of the fracture line.	64	26	38.6
6	Increase of callus formation at the medial cortex of the fracture line. No callus formation at the lateral cortex of the fracture line.	55.6	43	46
9	Increase of callus formation at the medial cortex of the fracture line. Beginning of callus at the lateral cortex of the fracture line.	30.2	69	59.5
16	Complete of callus bridging at the medial cortex of the fracture line. Increase of callus formation at the lateral cortex of the fracture line	13	85	81
22	Complete of callus bridging at the medial cortex of the fracture line. Complete of callus bridging at the lateral cortex of the fracture line.	5.83	96	87.7

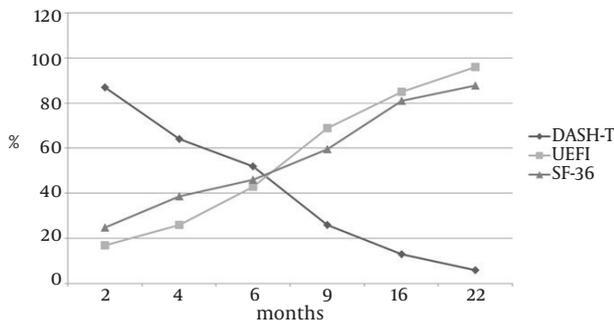


Figure 3. The Graph of Patient's Improvement During the Follow Up

3. Discussion

In recent years, closed techniques are more widely used for the fixation of fractures. IMN is one of them and has traditionally been applied to the femur, but now it is also used in the tibia and humerus. The nails are widely used with reamed and locked technique in routine applications. There are many reports of significant morbidity after surgical treatment of fractures of the humeral shaft, and complication rates of as high as 67% in intramedullary fixation have been reported (7). The reported complications were related to nonunion, delayed union and axillary or radial nerve injury when used with the locked technique.

Historically, the first intramedullary unlocked rigid nails were Lottes and Kuntscher (4, 5, 8, 9). Later, the nails were improved and locked IMN technique became more applicable.

In our case, we used the locked intramedullary nail with unlocked technique. In the current literature, there is neither any report of humeral fracture treated with unlocked technique nor any. There are some studies about the application of nails in the lower extremity using the unlocked technique. Santos de la Fuente et al. (9), Gadegone and Salphale (10) reported that unlocked IMN technique is simple, easily applicable, and also shorten the operation time. On the other hand, Saruhan et al. (11) reported that there was no significant functional difference between the locked and unlocked IMN technique in tibial fractures.

With the locked technique fracture line stability increases by fixing screws within bone and intramedullary nailing. Furthermore, surgery and radiation exposure increases with the locked technique. During locking with screws at the distal and proximal part of the nail, axillary, and radial nerves can be injured. We believe the nails can also be used with unlocked technique if they fits and can be tightened in the medullary canal. In these cases, bone and intramedullary nail behave like a composite mate-

rial. While intramedullary nail behaves as a fiber, the bone behaves as a matrix. Intramedullary nail counters the compressive forces. Torsional forces are countered by bone and intramedullary nail. For this reason, the locked nails are preferable. On the other hand, no risk of axillary or radial nerve injury as well as shorter operation time and less radiation can be advantages of the unlocked technique.

According to the text, intramedullary nails acts as stress-shielding instruments when locked statically; and acts as a stress-sharing instrument when it is not locked. Unlocked nails also act as an internal splint while the fracture heals (12). When the nail is stress shielding, fracture healing is primary (with no callus), unless the nail is not well fixed, in which case fracture healing is secondary. When the nail is stress shearing, fracture healing is secondary (with callus) (12).

Although primarily treatment is locked IMN in humeral shaft fractures, unlocked IMN can be used in practice of orthopedic surgery in appropriate cases.

Authors' Contributions

1- study concept and design: Sermet Inal. 2- acquisition of data: Sermet Inal. 3- analysis and interpretation of data: Sermet Inal. 4- drafting of the manuscript: Canan Inal. 5- critical revision of the manuscript for important intellectual content: Canan Inal. 6- administrative, technical, and material support: Betul Taspinar. 7- study supervision: Canan Inal.

Funding/Support

This report was self funded by the authors.

References

1. Tsai CH, Fong YC, Chen YH, Hsu CJ, Chang CH, Hsu HC. The epidemiology of traumatic humeral shaft fractures in Taiwan. *Int Orthop*. 2009;**33**(2):463-7.
2. Pugh DM, McKee MD. Advances in the management of humeral nonunion. *J Am Acad Orthop Surg*. 2003;**11**(1):48-59.
3. Ebrahimzadeh MH, Birjandinejad A, Sahebjam A, Taraz Jamshidi MH. Concomitant olecranon fracture, ipsilateral segmental humerus fracture and intercondylar humerus fracture in a 4-year-old girl: an extremely rare case report and literature review. *Arch Trauma Res*. 2013;**2**(1):50-3.
4. Gakuu LN. Historical note on Gerhard Kuntscher 1900-1972: East Afr. *Orthoped J*. 2009:41-2.
5. Kuntscher G. [The nailing of the spine in spondylolisthesis]. *Z Orthop Ihre Grenzgeb*. 1967;**103**(3):375-7.
6. Admani AL. Commonly Asked Questions On The Practice of Intramedullary Nailing. *East Afr Orthopaed J*. 2012;**6**:48-50.
7. Stern PJ, Mattingly DA, Pomeroy DL, Zenni EJ, Kreig JK. Intramedullary fixation of humeral shaft fractures. *J Bone Joint Surg Am*. 1984;**66**(5):639-46.
8. Howard MW, Zinar DM, Stryker WS. The Use of the Lottes Nail in the Treatment of Closed and Open Tibial Shaft Fractures. *Clin Orthop Relat Res*. 1992;**279**:246-53.
9. Santos de la Fuente FJ, Lopez Arevalo R, Tena Carrillo C, Ramos Salguero JC, Fernandez Medina JM. Intramedullary nailing and functional bracing of tibial shaft fractures: 167 cases followed for minimum 2 years. *Acta Orthop Scand*. 1998;**69**(5):493-7.

10. Gadegone WM, Salphale YS. Dynamic osteosynthesis by modified Kuntscher nail for the treatment of tibial diaphyseal fractures. *Indian J Orthop.* 2009;**43**(2):182-8.
11. Saruhan CS, Algun R, Baris B, Budak K. [Unlocked using of inter-locked intramedullary nails in tibial shaft fractures]. *Eklemlik Cerrahisi.* 2013;**24**(1):23-9.
12. Hoppendorf SV. *Treatment & Rehabilitation of Fractures.* New York: Lippincott Williams & Wilkins; 2000.