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УДК 616.718.4-001.5-089.227.84

DOI 10.18019/1028-4427-2015-2-69-71

**Одновременная билोकальная компрессия зоны несращения бедренной кости и удлинение на интрамедуллярном гвозде.
Новая методика и случай из практики**

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Simultaneous femoral bifocal non-union compression and lengthening over an intramedullary nail. A novel technique and case report

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Представлено первое сообщение о проведении одновременного удлинения бедра и компрессии зоны несращения с применением ранее имплантированного интрамедуллярного гвоздя. У 38-летнего мужчины произошёл сегментарный перелом бедра, развилось стойкое атрофическое несращение со значительным укорочением сегмента. Для коррекции разницы в длине конечностей было выполнено удлинение в сочетании с компрессией зоны ригидного несращения при использовании интрамедуллярного гвоздя in situ и кольцевой наружной фиксации. В данном сообщении впервые описана успешная методика билोकальной компрессии зоны несращения и удлинения бедренной кости на гвозде для устранения последствий перелома.

Ключевые слова: бедренная кость, перелом, несращение, интрамедуллярный гвоздь, удлинение, кольцевая наружная фиксация, билोकальная компрессия.

A first report of simultaneous femoral lengthening with concomitant non-union compression over a previously implanted intramedullary nail is described. A 38 year old male sustained a femoral segmental fracture and developed a persisting atrophic femoral non-union with significant femoral shortening. Combined simultaneous lengthening to correct limb discrepancy with compression of the established non-union with an intramedullary nail in situ was performed using circular external fixation. Successful bifocal non-union compression and femoral lengthening over a nail to address sequelae of a fracture is here described for the first time.

Keywords: femur, fracture, non-union, intramedullary nail, lengthening, circular external fixation, bifocal compression.

INTRODUCTION

Ipsilateral concomitant femoral neck and shaft fractures are indicative of a high-energy injury; treatment options for the management of this acute combination of fractures include composite fixation of both fractures using a reconstruction nail type implant, fixation using a standard antegrade femoral nail with associated but separate cancellous screw fixation of the femoral neck, independent fixation of each fracture with screw and plate constructs, and external fixation. Femoral non-union following intramedullary nailing of closed fractures is a common and recognised complication, with rates 6 to 18% quoted in the literature, most frequently seen with reconstruction nail fixation [1-5]. Management of shaft non-unions is typically treated with exchange nailing and/or grafting, in this high-energy injury group complications are more prevalent and multiple procedures more likely [4].

Management of simultaneous complications is more troublesome, and may typically require sequential treatment of each issue. The Ilizarov Method is a powerful technique

for the management of deformity, limb lengthening, trauma and non-union [6]. Circular external fixation permits the simultaneous management of segmental pathology within one limb segment and can be applied to the treatment of complex post-traumatic pathology and failure of initial and conventional treatment. The subsequent development of the Hexapod computer-assisted circular external fixators (e.g. Ortho-SUV frame, Pitkar, Pune) has permitted multiplanar correction under precise control [7] and more rapid correction than the traditional Ilizarov frame, particularly with complex deformity [8]. In recent years, the technique of Lengthening-over-Nail (LON) has been developed, predominantly to reduce frame time and improve patient comfort [9-11].

This is the first report of a bifocal Non-union compression over an intramedullary nail and coincident LON which appears to be a powerful and minimally invasive technique to address two separate post-traumatic complications simultaneously.

CASE PRESENTATION AND TECHNICAL REPORT

A 38 year old man was involved in a motor vehicle collision during which he sustained a comminuted left femoral fracture with an associated ipsilateral femoral neck fracture (fig. 1).

He was treated in a major trauma centre with a Gamma Nail (Stryker, MI, USA), with significant inadvertent segmental comminution (fig. 2).

At 18 months following injury, his femoral neck fracture had united, however there was an established atrophic non-union with shortening of five centimetres of the femoral shaft fracture and fracture of the distal locking screws. The knee extensor mechanism was defunctioned due to the increased working length of the quadriceps in relation to the short femoral segment and clinical instability of the

knee was documented.

The patient was treated with a bifocal stacked hybrid circular fixator. A distal femoral metaphyseal Taylor Spatial Frame (Smith & Nephew, London, UK) was applied to the femur with the nail in situ, and a corticotomy made. Superior to this frame, an Ilizarov femoral arch fixator was applied across the atrophic non-union and connected to the Taylor Spatial Frame (fig. 3).

Weightbearing was commenced immediately, and the non-union portion of the frame sequentially compressed. Simultaneously, distraction was applied across the corticotomy site (fig. 4), with five centimetres of distraction

achieved after 16 weeks.

Femoral union was achieved at six months. Regenerate was considered sufficiently structural at nine months and the frame removed and nail locked at this point in time. The nail was subsequently removed at 18 months from commencement of frame treatment and whilst no overt sepsis had been noted in the femur, the Reamer Irrigator Aspirator (Synthes, PA, USA) was used to debride the intramedullary canal following removal.

At 12 months after frame removal, leg length remained equalised and the femur deemed fully consolidated (fig. 5 & 6).



Fig. 1. Initial radiograph showing simple midshaft femoral fracture



Fig. 2. Radiograph after initial stabilisation with comminution of fracture site



Fig. 3. Initial bifocal frame

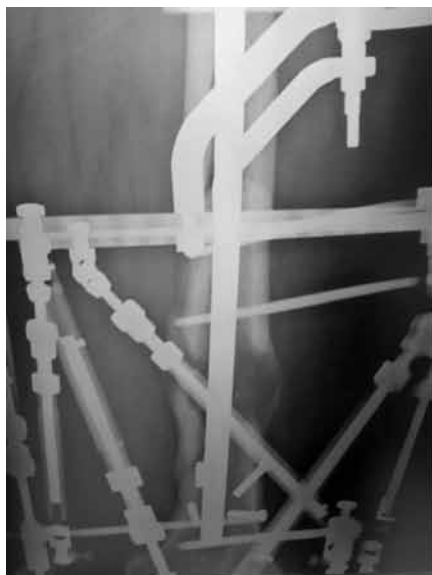


Fig. 4. Appearance during combined distraction and compression



Fig. 5. Fully united and consolidated non-union and regenerate



Fig. 6. Fully united and consolidated non-union and regenerate

CONCLUSION

LON is a powerful tool in limb lengthening, providing a clear trajectory for osteogenesis and permitting early locking of the nail and weightbearing with reduction of the External Fixation Time Index. However, no reports of this occur with a significant interval between nail insertion and delayed lengthening. No published studies describe

external fixator compression of femoral non-unions with a nail in situ although plate fixation of a non-union with a nail in situ has been reported in a single case [12] and there is some experience of the use of compression over a nail with a monolateral fixator in the humerus [13].

Lengthening over nail can significantly reduce frame

time [9-11], and here has been shown to be achievable with frame application temporally remote from nail insertion. Non-union compression utilising circular fixation is well known [14], however in the presence of a femoral intramedullary nail this has not previously been described. Technical difficulty can occur with half pin insertion with the nail in situ however with careful technique the half pins can be inserted into the femoral cortex tangential to the nail.

Hexapod fixators such as the Taylor Spatial Frame and the Ortho-SUV frame have been shown to be at least as effective as the original Ilizarov frame in lengthening and deformity correction, with reduced frame size with subsequent improved patient acceptance and more precise control of multiplanar deformity during a single frame

application [7,8].

This report confirms the breadth of utility of the application of circular fixation as a method to simultaneously address significant pathology within long bones, and introduces a further mode of application for the management of complications of internal fixation.

Consent

The patient has provided informed consent for the case report to be published.

Competing interests

None

Authors' contributions

MDAF is the sole contributor of the submission and has approved the final manuscript.

REFERENCES

1. Ipsilateral fractures of the proximal femur and the femoral shaft / P. Douša, J. Bartoniček, T. Pavelka, L. Luňáček // Acta Chir. Orthop. Traumatol. Cech. 2010. Vol. 77, No 5. P. 378-388.
2. Cephalomedullary interlocked nail for ipsilateral hip and femoral shaft fractures / P. Jain, L. Maini, P. Mishra, A. Upadhyay, A. Agarwal // Injury. 2004. Vol. 35, No 10. P. 1031-1038.
3. Reconstruction nailing for ipsilateral femoral neck and shaft fractures / A. Tsarouhas, M.E. Hantes, T. Karachalios, K. Bargiotas, K.N. Malizos // Strategies Trauma Limb Reconstr. 2011. Vol. 6, No 2. P. 69-75.
4. Watson J.T., Moed B.R. Ipsilateral femoral neck and shaft fractures: complications and their treatment // Clin. Orthop. Relat. Res. 2002. No 399. P. 78-86.
5. Wiss D.A., Sima W., Brien W.W. Ipsilateral fractures of the femoral neck and shaft // J. Orthop. Trauma. 1992. Vol. 6, No 2. P. 159-166.
6. Ilizarov G.A. Clinical application of the tension-stress effect for limb lengthening // Clin. Orthop. Relat. Res. 1990. No 250. P. 8-26.
7. Solomin L.N. The basic principles of external skeletal fixation using the Ilizarov and other devices. 2nd ed. Stürtz GmbH, Würzburg: Springer-Verlag, 2012.
8. A comparative study of the correction of femoral deformity between the Ilizarov apparatus and Ortho-SUV Frame / L.N. Solomin, D. Paley, E.A. Shchepkina, V.A. Vilensky, P.V. Skomoroshko // Int. Orthop. 2014. Vol. 38, No 4. P. 865-872.
9. Simpson A.H., Cole A.S., Kenwright J. Leg lengthening over an intramedullary nail // J. Bone Joint Surg. Br. 1999. Vol. 81, No 6. P. 1041-1045.
10. Lengthening of the femur over an existing intramedullary nail / H.J. Kim, A.T. Fragomen, K. Reinhardt, J.J. Hutson Jr, S.R. Rozbruch // J. Orthop. Trauma. 2011. Vol. 25, No 11. P. 681-684.
11. Femoral lengthening over an intramedullary nail. A matched-case comparison with Ilizarov femoral lengthening / D. Paley, J.E. Herzenberg, G. Paremain, A. Bhave // J. Bone Joint Surg. Am. 1997. Vol. 79, No 10. P. 1464-1480.
12. Said G.Z., Said H.G., el-Sharkawi M.M. Failed intramedullary nailing of femur: open reduction and plate augmentation with the nail in situ // Int. Orthop. 2011. Vol. 35, No 7. P. 1089-1092.
13. El-Rosasy M.A. Nonunited humerus shaft fractures treated by external fixator augmented by intramedullary rod // Indian J. Orthop. 2012. Vol. 46, No 1. P. 58-64.
14. Ali F., Saleh M. Treatment of distal femoral nonunions by external fixation with simultaneous length and alignment correction // Injury. 2002. Vol. 33, No 2. P. 127-134.

Рукопись поступила 02.03.2015.

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