

Case Report

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Expandable Retrograde Nail for Femoral Fracture above a Total Knee Replacement

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Periprosthetic fractures after total knee arthroplasty occur as a result of low energy trauma usually compounding some surgical pitfalls and patient related factors [1,2]. Patient and technique related predisposing factors are osteopenia, osteolysis, malalignment, anterior femoral notching, poor flexion (stiff knee), corticosteroid use, rheumatoid arthritis, myasthenia gravis and cerebral palsy [1,3]. The reported periprosthetic fracture incidence ranges from 0.3 to 2.5 percent [1,4]. But unfortunately an increase of periprosthetic fracture incidence would be inevitable due to increased life expectancy and osteoporotic patient numbers [3,5-7].

Treatment of periprosthetic fractures is a challenge for the surgeon because of decreased bone quality and complicating systemic diseases [2,5,8]. The most prevalent type of periprosthetic fracture is the Rorabeck type 2 [1,9-12]. Recommended treatment options are plating, external fixation and retrograde intramedullary nailing (RIMN) [1,4,13,14]. There is still continuing debate which treatment option is optimal for these patients [1,4,7,13]. There is no consensus on the technique to be used but logically it must be minimally invasive to decrease mortality and morbidity [6,7,14].

Stable osteosynthesis obtained by minimal invasive techniques assures more rapid fracture union [6,14]. In treatment of femoral periprosthetic fractures classic locked RIMN is currently the most successful technique with lowest complication rates [1,7,14]. But the applicability of this technique is confined to a limited number of periprosthetic femoral fractures. The main cause of this limitation is the small box size and design of some currently available prosthesis on the market, rendering insertion of classic RIMN [1,14]. In the coronal plane the entry point of femoral nail shifts far posterior limiting the insertion of a larger diameter femoral nail. We suggest that in treatment of periprosthetic fractures with a narrow intercondylar box sized femoral component, expandable intramedullary nails (EIMN) may be a valuable option. But also, it must be beared in mind that expandable nails have some technical pitfalls and because of this it should not be regarded as the first choice. To our knowledge use of EIMN for a periprosthetic femoral fracture has not been reported before in english-language literature. Our patient signed a written consent that data concerning the case would be submitted for publication.

Case Report

A 67 year old woman was admitted to our clinic for an elective total knee joint replacement. She had type II diabetes mellitus, hyperlipidemia, coronary artery disease and hypertension. Both coronary arteries were stented during his previous cardiac angiographies. She had a cerebrovascular stroke one year before her admittance for joint replacement. She had mild hemiparesia of left lower extremity. She had 3cm leg length discrepancy due to ipsilateral Crowe type 3 congenital hip dislocations. Her right knee was replaced with a posterior cruciate substituting total knee arthroplasty (TKA). The prosthesis used was Advance (Wright Medical Group Company-Arlington-USA). Both components were the smallest of their series (size 1). The day after the operation she was allowed to walk with two

crutches with full weight-bearing. On sixth postoperative day she sustained a fell during walking with crutches. On X-rays a metaphyseal periprosthetic displaced femoral fracture was evident (Figure 1A and 1B). Because of compounding systemic diseases and reduced bone quality we decided to make osteosynthesis with a RIMN which can be applied with a minimally invasive technique. This technique also assures stable enough osteosynthesis to allow early postoperative range of motion exercises. Wright Advance type femoral components may narrow box size limiting insertion of many classic intramedullary nails. So we decided to use an EIMN designed for humerus [Fixion IL humerus nail (Disc O Tech- Medical Technologies Ltd. Israel)]. These nails have a reduced diameter of 7.4 mm which reaches 11 mm after maximal inflation. An entry point at the intercondylar notch was drilled with an 8 mm reamer through the femoral component box. Medullary canal was not further reamed. Some of the staples were removed from proximal of the previous incision to reduce the fracture and fix with a cerclage wire. Under fluoroscopic control, femur was aligned and a Fixion IL humeral EIMN with 7.4 mm diameter and 280 mm length was implanted. Then the nail was maximally inflated with saline solution by its custom pump. Reduction and stabilization of fracture fragments were clearly visualized by fluoroscopy during nail inflation. During proximal locking of the nail, regular locking screws did not reach the opposite cortex as they were designed for humeral application. So we used 3.5

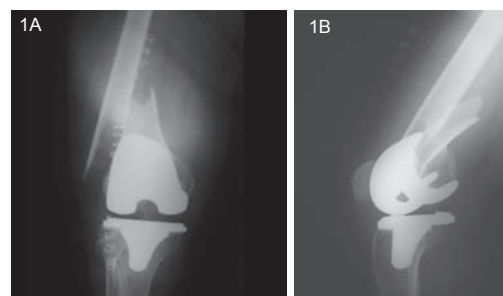


Figure 1: X-rays of a 67 years old woman with Rorabeck Type 2 periprosthetic fracture.
A. Anteroposterior.
B. Lateral.

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mm malleolar screw for distal locking. But proximal locking screw was jammed in the hole and screw head was broken. Removal of the screw head was attempted but, was not successful. After completion of overall procedure, dynamic stability of fracture fragments was again controlled under fluoroscopic visualization (Figure 2). There was less than 100ml blood loss and the operation time was only 40 minutes. Postoperative period was complication free. Patient was allowed to walk without weight bearing with a hinged knee brace the day after the operation. Passive range of motion exercises were ensued as tolerated. At sixth postoperative weeks active exercises were added to the rehabilitation programme. Partial weight bearing was allowed at eight weeks after confirmation of callus at control X-rays. She continued to wear the knee brace for three months. She progressed to full weight bearing at third postoperative month. X-rays taken second postoperative year (Figure 3A and 3B).

Discussion

Currently there is focus on three different methods in treatment of type 2 periprosthetic femoral fractures [1,4- 6,9,10,12,14,15]. These are osteosynthesis with a circular external fixation, blades and RIMN's. In recent years, a new system named less invasive stabilization system (LISS, Synthes) were introduced in to market which can be applied minimal invasively [6,10,17]. Although it was considered to be superior to other techniques as it can be minimally applied, drawbacks of this method can be listed as: 1) indirect reduction under fluoroscopic control increasing fluoroscopic exposure, 2) technically demanding as reduction and osteosynthesis is achieved simultaneously [18], 3) varus-valgus angulations [17] and 4) in osteoporotic pulling-out of proximal screws [5,6,8,10,17].

RIMN is one of the options for osteosynthesis of type 2 fractures. Biomechanically nails have higher bending capacity to shear forces than plates [13]. Besides this, operative time, perioperative blood loss and infection risk is lower with intramedullary nailing. In patients treated with intramedullary nailing fracture union rate is higher and knee range of motion is better [1,7,9,11,13,19].

Despite these advantages classic RIMN's are surpassed by locking plates in current practice. The main reason for this was the small size of femoral component box rendering insertion of classic RIMN's impossible [1,5,13]. In such a situation expansion of the intercondylar notch of femoral component with a diamond burr is recommended by some authors [20]. But this technique is not widely accepted because of the hazards of metal debris material generated during high speed burring [11]. The smallest diameter of the most commonly used classic RIMN's are usually 10 mm. Currall et al. investigated the box size of 19 different femoral components from 10 different manufacturers [21].



Figure 2: X-ray showing filling of the medullary canal after nail expansion.



Figure 3: X-rays at second postoperative years showing solid union without malalignment.
A. Anteroposterior.
B. Lateral.

They found that in five of the prosthesis (26.3%) femoral box was too narrow blocking the insertion of a 10 mm diameter supracondylar nails (Trigen, Smith and Nephew, Memphis, USA). Two of these 5 prosthesis (10.5%) was box closed [21]. In treatment of femoral supracondylar periprosthetic fractures lesser diameter classic tibial nails may also be used. The curve and diameter of these nails (smallest 8.5 mm) are suitable for retrograde supracondylar femoral fracture osteosynthesis. Their small diameters do not fill the femoral canal and necessitates distal locking at the level of lesser trochanter.

EIMN's designed for humerus can be a valuable alternative method in treatment of these periprosthetic femoral fractures. The smaller diameter and length of these nails broadens the applicability of RIMN for femoral periprosthetic fractures. EIMN's (Fixion IL humerus nail Disc o Tech-Medical Technologies Ltd. Israel) are available at three different diameters. Their reduced diameters are 6.7 mm, 7.4 mm and 8.5 mm. These nails are inflated with saline solution by their custom pump. Four flanks over the surface of nail expand and increase the diameter up to 60%. Thus expanded diameter increases to 10 mm, 11 mm and 13.5 mm, respectively. As these nails have smaller diameter at the reduced state, they can be inserted through a wide range of femoral components. Another advantage of these nails is the availability at smaller lengths (180-280 mm), making it suitable for all scenarios. They can be implanted even in the case of inherent ipsilateral femoral stem or short stature. These EIMN's have unexpanding proximal part nearly in 50 mm length. Two locking holes exist at this part. Fracture line must be more than 50 mm from intercondylar notch to achieve stable fixation. Expanding part of the nail homogeneously fills the medullary canal and achieves rotational stability even in patients with a large medullary canal [22]. In conclusion, advantageous of EIMN's can be summarized as follows: application with a minimal invasive technique without medullary reaming, no distal locking holes, optimal rotational stability, one of the techniques with minimal blood loss, minimizes fluoroscopic exposure and shortens operative time.

EIMN's should not be regarded as a first line option in treatment of all periprosthetic fractures above knee prosthesis. The technique has also some drawbacks. Non-inflatable proximal part of the nail decreases the stability of osteosynthesis in a relatively large metaphysis. Breakage and deflation of nail can be a potential problem [22]. In some patients medullary cavity can be large enough to be stabilized by inflation of the nail. And also in some others too much inflation can cause distension of the fracture line through the diaphysis.

Early rehabilitation is possible and union time is comparable to other minimal invasive techniques. EIMN's broaden the treatment

spectrum of RIMN's for periprosthetic femoral fractures. When box size of the femoral component is not known EIMN's will be more useful than classic RIMN's. It must be also beared in mind that the femoral component may have a closed box necessitating application of a locking plate.

References

1. Bezwada HP, Neubauer P, Baker J, Israelite CL, Johanson NA (2004) Periprosthetic supracondylar femur fractures following total knee arthroplasty. J Arthroplasty 19: 453-458.
2. Parvizi J, Jain N, Schmidt AH (2008) Periprosthetic knee fractures. J Orthop Trauma 22: 663-671.
3. Tharani R, Nakasone C, Vince KG (2005) Periprosthetic fractures after total knee arthroplasty. J Arthroplasty 20: 27-32.
4. Pafilas D, Kourtzis N (2006) Hybrid external fixation as a new treatment method for periprosthetic femoral fracture. A case report. J Bone Joint Surg Am 88:188-192.
5. Ricci WM, Borrelli J Jr (2007) Operative management of periprosthetic femur fractures in the elderly using biological fracture reduction and fixation techniques. Injury: 53-58.
6. Fulkerson E, Tejwani N, Stuchin S, Egol K (2007) Management of periprosthetic femur fractures with a first generation locking plate. Injury 38: 965-972.
7. Herrera DA, Kregor PJ, Cole PA, Levy BA, Jönsson A, et al. (2008) Treatment of acute distal femur fractures above a total knee arthroplasty: systematic review of 415 cases (1981-2006). Acta Orthop 79: 22-27.
8. Kaab MJ, Stöckle U, Schütz, Stefansky J, Perka C, Haas NP (2006) Stabilization of periprosthetic fractures with angular stable internal fixaton: a report of 13 cases. Arch Orthop Trauma Surg 126: 105-110.
9. Gliatis J, Megas P, Panagiotopoulos E, Lambiris E (2005) Midterm result of treatment with a retrograde nail for supracondylar periprosthetic fractures of the femur following total knee arthroplasty. J Orthop Trauma 19: 164-170.
10. Anakwe RE, Aitken SA, Khan LA (2008) Osteoporotic periprosthetic fractures of the femur in elderly patients: outcome after fixation with the LISS plate. Injury 39: 1191-1197.
11. Althausen PL, Lee MA, Finkemeier CG, Meehan JP, Rodrigo JJ (2003) Operative stabilization of supracondylar femur fractures above total knee arthroplasty: a comparison of four treatment methods. J Arthroplasty 18: 834-839.
12. Rorabeck CH, Taylor JW (1999) Classification of periprosthetic fractures complicating total knee arthroplasty. Orthop Clin North Am 30: 209-214.
13. Pleva L, Sir M, Madeja R (2004) Our experiences with the treatment of periprosthetic fractures of femur. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub 148: 75-79.
14. Chettiar K, Jackson MP, Brewin J, Dass D, Butler-Manuel PA (2009) Supracondylar periprosthetic femoral fractures following total knee arthroplasty: treatment with a retrograde intramedullary nail. Int Orthop 33: 981- 985.
15. Hurson C Synnott K, McCormack D (2005) Above knee Ilizarov external fixation for early periprosthetic supracondylar femoral fracture-a case report. Knee 12: 145-147.
16. Simon RG, Brinker MR (1999) Use of Ilizarov external fixation for a periprosthetic supracondylar femur fracture. J Arthroplasty 14: 118-121.
17. Ricci WM, Loftus T, Cox C, Borrelli J (2006) Locked plates combined with minimally invasive insertion technique for the treatment of periprosthetic supracondylar femur fractures above a total knee arthroplasty. J Orthop Trauma 20: 190-196.
18. Haidukewych G, Sems SA, Huebner D, Horwitz D, Levy B (2008) Results of poliaxial locked-plate fixation of periarticular fractures of the knee. J Bone Joint Surg Am 90:117-134.
19. Tanaka Y, Kobayashi T, Ohashi M, Kaneko D, Nemoto K (2007) A new operative procedure using a Kuntcher nail for a periprosthetic supracondylar femoral fracture after revision total knee arthroplasty. Knee 14: 59-62.
20. Maniar RN, Umlas ME, Rodriguez JA, Ranawat CS (1996) Supracondylar femoral fracture above a PFC posterior cruciate substituting total knee arthroplasty treated with supracondylar nailing. A unique tecnical problem. J Arthroplasty 11: 637-639.
21. Currall VA, Kulkarni M, Harries WJ (2007) Retrograde nailing for supracondylar fracture around total knee replacement: a compatibility study using Trigen supracondylar nail. Knee 14: 208-211.
22. Oliveira MLR, Lemon MA, Mears SC, Dinah AF, Waites MD, et al. (2008) Biomechanical comparison of expandable and locked intramedullary femoral nail. J Orthop Trauma 22: 446-450.