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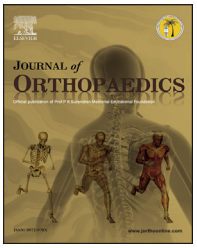

Original Article

Favorable radiographic outcomes using the expandable proximal femoral nail in the treatment of hip fractures – A randomized controlled trial

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ABSTRACT

Aim: To compare the functional and radiographic results of dynamic hip screw (DHS) and expandable proximal femoral nail (EPFN) in the treatment of extracapsular hip fractures.
Methods: A randomized controlled trial of sixty hip fracture patients. Outcomes included mortality, residency, independence, mobility, function and radiographic results at a minimum of 1 year.
Results: Twenty-nine EPFN patients demonstrated fewer cases of shaft medialization or femoral offset shortening compared to the 31 DHS patients. Mortality, complications and functional outcomes were similar.
Conclusion: EPFN provides stable fixation of pertrochanteric hip fractures and prevents neck shortening that is commonly observed after DHS fixation.

1. Introduction

Pertrochanteric fractures of the proximal femur are very common among the elderly. The incidence of these fractures is expected to rise even further with advancing age of the population. These fractures lead to high rates of mortality, morbidity and loss of independence.[1,2] The goal of treatment of these fractures is to achieve rigid fixation and to allow early mobilization and weight bearing in order to prevent morbidity and to facilitate rehabilitation.[3] Pertrochanteric hip fractures have been treated successfully with dynamic hip screw (DHS) implants that allow controlled compression at the fracture site.[3–6] Alternatively, these fractures can be treated using proximal femoral nails (PFN), usually inserted percutaneously and associated with decreased blood loss, less exposure to radiation and lower blood transfusion requirements.[4,7,8] PFNs also provide greater stability due to their short moment arm and their buttress effect prevents medialization of the femoral shaft.[6] However, complications associated with their use include mainly femur fractures, cut outs through the femoral head, and the need for reoperations.[6,7,9–14] PFNs have only been proven superior in the very unstable subtrochanteric and reverse oblique fractures (OTA/ASIF 31A3) and these implants are more expansive when compared to DHS.[9]

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The expandable PFN (EPFN) [Fig. 1] uses a hydraulic expansion mechanism and allows good purchase of both femoral shaft and head without need for reaming or distal locking.[8,15,16] It therefore provides the biomechanical advantages of a PFN with a potential for reduced cutouts and associated fractures.

This study was designed to assess whether surgical treatment with EPFN is superior to DHS in terms of malunion and functional outcome following pertrochanteric hip fractures. We chose to compare this implant to the most common treatment choice (DHS) in order to demonstrate its potential mechanical benefits.

2. Materials and methods

Between June 2008 and February 2010, we randomized patients who had a unilateral extracapsular (OTA/ASIF 31A1 and 31A2) hip fracture following low-energy trauma to surgical treatment with either a DHS (CHS; Smith & Nephew, Warwick, UK) or an EPFN (Fixion; HMB Medical Technologies, Herzliya, Israel). Exclusion criteria were age below 60 years, pathologic fractures, patients with a life-threatening disease (ASA score $\geq$4), subtrochanteric or reverse oblique fracture patterns (OTA/ASIF 31A3), inability to give informed consent due to dementia or confusional state, and previous fracture or previous surgery of the affected leg. The study was approved by the institutional review board and informed consent was obtained from all patients before surgery.

AO/ASIF fracture classification was determined by three independent investigators based on pelvic anteroposterior (AP) and axial hip radiographs. Randomization was done by sealed envelopes that were prepared in advance using a computer-generated randomized list and concealment was strictly maintained. Each patient's background data were collected on admission, and included age, gender, laterality of the fracture, comorbidities (specifically, ischemic heart disease, congestive heart failure, hyperlipidemia, hypertension, diabetes mellitus, history of cerebrovascular accident, chronic renal failure, atrial fibrillation, Parkinson's disease and dementia), pharmacological treatment, smoking status, ASA score,[17] residency (living in own home, nursing home or institution), social function and independence status [using Jensen's classification][18] and mobility [using Parker and Palmer's scoring system].[19]

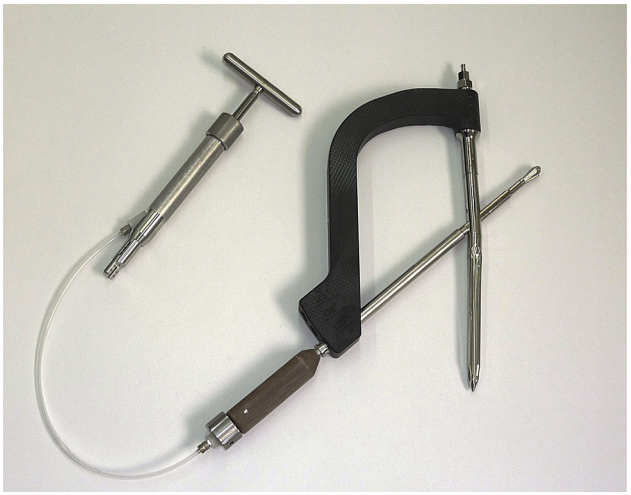

Fig. 1 – Expendable proximal femoral nail system.

Surgery was performed on the first available operative day following optimization of the patient's medical state. The patient was operated while lying in the supine position on a fracture table, and the procedure was carried out under fluoroscopic guidance. Closed reduction was attempted in all cases, and open reduction was performed when satisfactory fracture alignment could not be achieved in a closed fashion. All patients received intravenous antibiotics immediately before surgery and low-molecular-weight heparin for 6 weeks after it. The DHS was introduced through a vastus lateralis split approach. A 135° plate was used and 3 diaphyseal screws were inserted in all cases. The femoral head screw was inserted in a central–central or a central-inferior position, and a tip apex distance of less than 25 mm was achieved in all cases. The EPFN [Fig. 1] was introduced via a percutaneous trochanteric approach. It was inserted at the medial tip of the greater trochanter without reaming of the femoral canal. Either a 10 mm or a 12 mm nail with a 130° nail-peg angle was used, and the EPFN was inflated to a maximum of 70 mmHg and expanded to a maximum of 16 mm or 19 mm, respectively. The nail height was then determined under fluoroscopy and an eight mm hole was drilled into the femoral head at a 130° angle to the nail using the lateral handle sleeve. Femoral head peg was inserted via percutaneous approach and inflated to 100–140 mmHg, followed by locking of the nail-peg interface. The recorded intraoperative parameters included the time from trauma to surgery, length of operation time, amount of exposure to radiation, type of implant used and any complication or technical difficulty.

Following surgery, all patients were allowed weight bearing as tolerated and all were encouraged to begin walking with a frame on the first postoperative day. Rehabilitation protocol was the same for all patients, regardless of the type of implant used. The drop in blood hemoglobin concentration, amount of blood transfused, length of hospital stay and any postoperative complications were recorded. Patients were discharged either to their own home or to a rehabilitation facility.

Follow up was performed at 6 weeks, 12 weeks, 3 months, 6 months and 1 year at the outpatient clinic. The physical examination at each visit included measurement of leg length discrepancy (LLD), wound healing, range of motion of both hips, mobility assessment using the Parker and Palmer score, and radiographic evaluation with standard pelvic and hip AP and axial views. The Harris Hip Score (HHS),[20] independence (Jensen's) and mobility (Parker & Palmer's) scores, and residency status were used to evaluate functional status at the last follow up visit. Patients who did not attend the clinic for their follow up visit were visited by one of the investigators at their home.

Radiographs were assessed and analyzed by three independent investigators. The immediate postoperative reduction was classified as anatomic (cortical continuity, symmetrical neck shaft angle, no shortening), good or poor (>10 degrees of varus or valgus compared to the contralateral side and/or >10 mm of shortening). Last follow up radiographs