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Clinical Outcome of Peritrochanteric Fractures Treatment with an Antegrade Trochanteric Static Lag Screw Nail (Inter TAN)

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Authors' contributions

This work was carried out in collaboration between all authors. Authors JAV and PKK designed the study, wrote the protocol and author PKK wrote the first draft of the manuscript. Author EP managed the literature searches, analyses of the study. Author SP revised the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: The preferred implant (intramedullary or extramedullary) of peritrochanteric fractures treatment is still on debate. The new cephalomedullary nail InterTAN permits intraoperative linear compression and prevents the excessive neck sliding, control shortening and varus collapse of the neck, minimizing the risk of malunion or nonunion of the fracture. The aim of this study is to determine the clinical and functional outcomes of unstable peritrochanteric fractures treatment with the use of the InterTAN.
Methods and Results: 126 consecutive unstable peritrochanteric fractures treated with an antegrade trochanteric nail InterTAN introduced to the study. The patients studied clinically and radiologically with the Harris Hip Score, Visual Analog Scale score and standard two view x-rays. Have been calculated intraoperatively and postoperatively at every follow up meeting the Tip Apex

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Index and the fracture Gap. The mean follow up was 19 months, mean age of the patient's was 80.3 years and mean hospitalization time was 7.8 days. The mean Tip Apex Distance (TAD) immediately post-operatively was 22.34 mm. The mean fracture gap immediately post-operatively was 3 mm. The TAD and the fracture gap remain invariable until the last follow up. The modified-HHS was 85.7/91 at the last follow up (67-91) and the VAS 0.6 (0-10).

Conclusion: The results of the new intertrochanteric antegrade nail InterTAN were satisfactory in most elderly patients. As a result of the negligible complication rate and improved clinical outcomes this implant is now the standard treatment for all unstable intertrochanteric fractures at our department.

Keywords: Peritrochanteric; fracture; antegrade nail; InterTan.

1. INTRODUCTION

In our years two types of implants are available, the intramedullary nails and the extramedullary implants (Sliding Hip Screw-SHS). The SHS appears superior for stable peritrochanteric fractures (AO classification- $A1^{1-3}$, $A2^{1}$) [1]. The intramedullary nails present advantages over SHS for subtrochanteric ($A3^{1-3}$) and unstable trochanteric fractures ($A2^{2-3}$) [2-5]. The new generation of orthopaedic surgeons change their fixation device preferences for the treatment of peritrochanteric fractures in favor of cephalomedullary nails [1]. The goal is to achieve fracture reduction, stable fixation and linear compression of the fracture favoring the easy, safe and fast consolidation. Improvement of patients functional recovery should be obtained by applying the same principles that are applied to all type of fractures, avoiding complications (neck shortening and varus collapse) [6,7]. The InterTAN^{R} nail (Smith–Nephew, Memphis), an antegrade trochanteric nail, was introduced to overcome the complications observed with the earlier generation cephalomedullary devices. The device allows immediate intraoperative 1,5-2 cm linear compression of the fracture in addition to rotational stability and higher fixation of the lag screw [8].

The purpose of this study was to determinate the clinical and functional outcomes of a series of unstable geriatric peritrochanteric fractures treated with InterTAN and to observe its advantages and limitations.

2. MATERIALS AND METHODS

From May of 2010 until March of 2013, 154 consecutive unstable peritrochanteric fractures ($A2^{2-3}$, $A3^{1-3}$) were included to our study and all the fractures after closed reduction were treated with antegrade trochanteric nail and intraoperative compression achieved (Figs. 1, 2). The fractures were classified according to the AO classification system. Pathological fractures, stable peritrochanteric fractures ($A1^{1-3}$, $A2^{1}$), other internal fixation, revision nailing and patients treated for hip fracture of the opposite side were excluded. All the patients should be followed at 6th week and 8th, 12th and 24th month, with an anteroposterior and lateral plain x-ray. Clinically the patients were estimated with the Modified Harris Hip Score and the Visual Analog Pain Score. The mean follow up was 19 months (12-24 months). Data regarding hospitalization time, operation time, intraoperative and postoperative complications were also elaborated. The achieved intraoperative compression, fracture gap and Tip Apex Distance (TAD) were calculated immediately postoperatively and at the following visits. The rehabilitation protocol was identical for all patients and full weight bearing on the affected extremity was allowed on 2nd postoperative day. For the statistical analysis we performed a paired t-test which is used to compare means on the same subject over time or in different circumstances. Analysis was performed by the Stata 11 (College Station, Texas, USA). The study has been approved by IRB of our hospital as required and there is no conflict of interest.

3. RESULTS

Out of 154 patients treated, 28 patients (15%) died or have been lost during the regular follow up after the first year. There were 126 unstable peritrochanteric fractures with mean age of the patient's 80.3 years (65-92 years). 86 were females and 40 males. The 61% of the patients were classified as ASA 3 and the 39% as ASA 2 (ASA: American Society of Anesthesiologists physical status classification system). The mean operation time (skin incision to final confirmation of the implant position) was 37 min (25-53 min) and mean hospitalization time was 7.8 days (6-13 days). There were no intraoperative

Table 1. Mean values of fracture gap, TAD, Harris Hip Score and Visual Analog Score during the follow up periods for 126 patients. The acquired intraoperative result regarding fracture gap, compression and TAD were preserved at the last follow up

	6 weeks	8 months	12 months	24 months	P value
Gap (mm)	3.5	3.3	3	3	0.0591
TAD	22.8	22.7	22.3	22.3	0.0742
HHS	44	74.4	85	85.7	0.0032
VAS-pain	3	2	1	0.6	0.0257

TAD: Tip Apex Distance, HHS: Harris Hip Score, VAS: Visual Analog Score

complications. Out of 126 nails were used 98 short (18 mm) for unstable intertrochanteric fractures and 28 long (34 mm) for subtrochanteric and oblique reverse fractures. The system is provided with two possibilities of implant insertion to the medullary canal. First can be used a rigid guide positioned to the metaphyseal proximal part of the femur, with necessary reaming of the entire canal and the secondly with a flexible intramedullary canal guide with appropriate reamers. Has been reported from the surgical team a difficulty of positioning the implant with the rigid guide system especially at A2[3] fractures and at A3[1-3] fractures. Also has been reported a difficulty of entire promotion of the nail into the intramedullary canal because of straight diameter of the canal. In those two cases we had to use the flexible guide and ream the canal (Fig. 3). It is important to note that actual center of the composite is designed slightly above the compression screw and the TAD is calculated in appropriate way [8] (Fig. 4).

The mean Tip Apex Distance (TAD) was post-operatively 22.34 mm (range 16-27 mm) and remained invariable at the last follow up. There were no cut outs of the lag-screw post-operatively and no other complications. The mean gap post-operatively was 3 mm (range 0-5mm) and also remained invariable at the last follow up. The mean HHS-modified was 85.7/91 at the last follow up (range 67-91) and the VAS 0.6 (range 0-10) (above Table 1). For all the radiological parameters studied until the last follow up we didn't observe any statistical difference.

4. DISCUSSION

Sliding hip screws, as well as blade-plates, dynamic condylar screws and the formerly used intramedullary devices presents serious mechanical complications, reported in the literature with rates between 4-18% [7,9]. These complications include non-union, cut out, varus collapse, limb length discrepancy, femoral head penetration, Z effect, reverse Z effect, hardware breakage [2,5,9-12]. The medial proximal femur in unstable fractures is a very special and important area. During weight bearing of an unstable and mal reduced fracture, a load sharing mechanical loss result [13]. Unstable peritrochanteric fractures treated with Sliding Hip Screw (SHS) and dynamic intamedullary nail (IMN) may lead to deformity of the femoral head and cut out of the lag screw, observed as mechanical failure of osteosynthesis [14-16]. Over compression femoral neck shortening can lead to limb length discrepancy and is a well-known clinical finding after fixation with SHS and IMN, particularly in geriatric patients [10,12,17]. The peritrochanteric fracture should be reduced as accurately as possible and the implant should be placed centrally within the femoral head, according to maintain Tip Apex Index (TAD) between 20-25 mm [15,18-20].

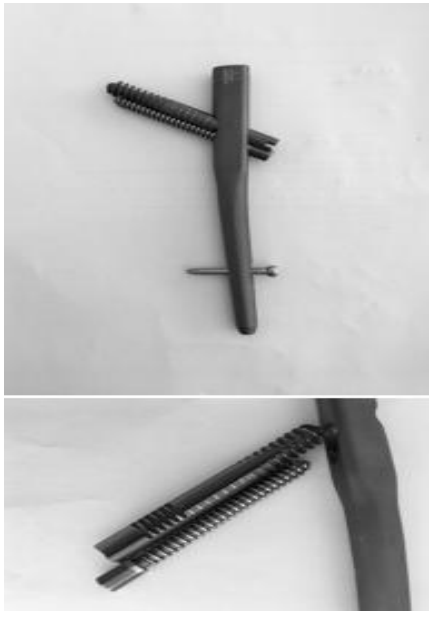

Fig. 1. Antegrade trochanteric static lag screw nail (Inter TAN, Smith–Nephew, Memphis)

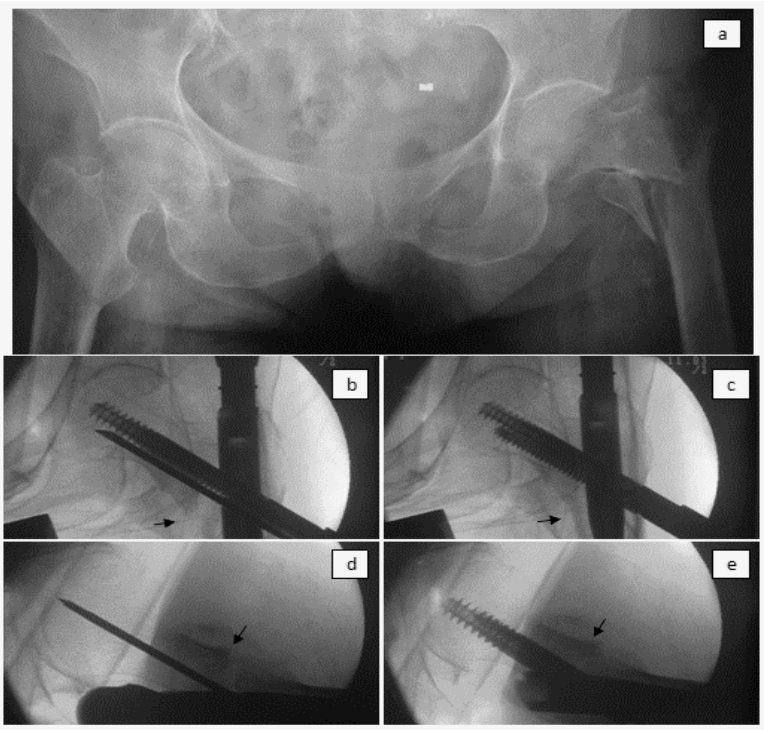

Fig. 2. Unstable peritrochanteric fracture (a) and the final intraoperative result. The arrows showing the fractures gap before the intraoperative linear compression (b, d) and the final reduction of the gap with optimal medial and posterior cortex contact, achieving stable final reduction and stabilization of the fracture (c, e)

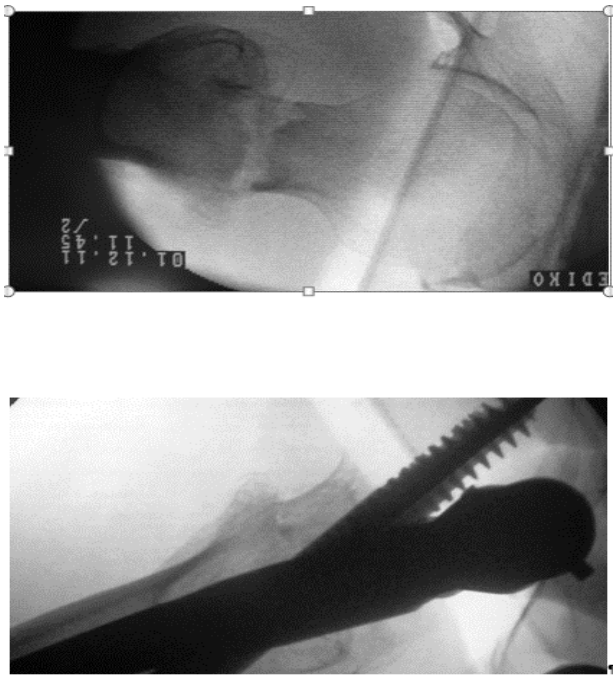

Fig. 3. Intraoperative compression of lag screw and closure of the fracture's gap

Fig. 4. Unstable peitrochanteric fracture treated with InterTan and accomplished intraoperative fracture compression. Preoperative and 8th week postoperative x-ray

The single lag screw when is rotationally unstable within the bone, results in loosening of the bone– screw interface, with the screw cutting out [21]. An advantage of the InterTAN is the possibility of the system to maintain the reduction during the maneuvers of the screw insertion thru the anti-rotation blade [8]. The lag screw design can significantly affect the fixation strength and cutout resistance [21,22]. The oval lag screw of InterTAN offers increased resistance to cut-out compared to a device that uses a single lag screw [23-25]. The choice of use a static or a dynamic lag screw is still controversial. There is a 12.4% reduction in axial stiffness in dynamic lag screw. When the static lag screw used for treatment of unstable peritrochanteric fractures, axial and lateral stiffness should be study [9]. InterTAN's' intraoperative linear compression of the fracture and the static lag screw offers maximum stability and prevents subsequent excessive neck sliding, shortening and varus collapse, minimizing the rates of malunion and non-union. The primary intraoperative stability provide improvement in postoperative pain, mobility and consolidation time [26,27].

5. CONCLUSION

The results of the new intertrochanteric antegrade nail InterTAN were satisfactory in most elderly patients. The linear intraoperative compression and the locking lag screw offers high union rate and good functional outcomes during unstable peritrochanteric fractures treatment, with a very low rate of complication.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this paper and accompanying image.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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