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Management of unstable pertrochanteric fractures with proximal femoral locking compression plates and affect of neck-shaft angle on functional outcomes☆

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ABSTRACT

Background: Management of unstable pertrochanteric fractures remains a challenge with various implant choices. Intramedullary devices are usually preferred for the management of the unstable fractures. When nailing is unsuitable for the configuration of the fracture extra medullary procedures are preferred. PFLCP is a contact limited implant that allows multiple angularly stable fixations with preserving more bone stock after implantation as an extramedullary implant. There are only a few reports in the literature about the osteosynthesis of unstable trochanteric fractures with proximal femoral locking compression plates and their results are conflicting. In the present study we aimed to evaluate the functional and radiological outcomes of proksimal femoral locking compression plates in open reduction and internal fixation of AO/OTA 31A2-2 and 3 fractures.

Methods: Patients older than 18 years of age with a minimum follow-up time of 1 year matching the inclusion criteria retrospectively evaluated. Patients' demographics, Singh index, intra and post-operative data, mobilization and union time gathered from the patients' files. Baumgaertner modified criteria of fracture reduction was used to assess the post-operative reduction quality. Early and last follow-up radiographs were used to evaluate malunion and change in neck- shaft angle. Final clinical outcome was assessed using the Harris Hip scoring system.

Results: 18 male and 13 female patients with the mean age of 74 (46–88) met the inclusion criteria. Reduction quality according to Baumgaertner modified criteria was good in 25 patients and acceptable in 6. Mean union time was 21.53 ± 4.18 weeks. There was neither non-union nor malunion. The mean neck-shaft angle change was $-3.1° \pm 2.16°$. The mean HHS was 77.90 ± 4.84 and there was no significance in HHS according to reduction quality and change in neck-shaft angle ($p = 0.385$, $p = 0.0059$). HHS was negatively correlated with age, mobilization time and, longer union time ($p < 0.05$). There was no correlation between Singh index and reduction quality ($p = 0.865$). Singh index was only correlated with the patient's age ($p = 0.000$, $rho = -0.595$). There were 2 infections and, 2 backing of the proximal screws.

Conclusion: Even though PFLCP is not the first choice in management of unstable pertrochanteric fractures, it must be kept in mind as an alternative to the other conventional plates and intramedullary implants with the properties of an increased stability by multiaxial screw locking and the results are satisfactory when appropriate settlement achieved.

1. Introduction

Pertrochanteric fractures account for nearly 50% of all proximal femoral fractures with mortality rates ranging from 4.5% to 22%.[1,2] These fractures are associated with functional disability, loss of mobility and independence.[3] While stable intertrochanteric fractures are usually managed with sliding hip screws (SHS), the unstable fractures remain a challenge with various implant choices

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and less clearly defined indications with mechanical complication rates reaching 20%.[4–7] Although unfavorable results have been shown with the use of SHS and the side plates, the 95° angle blade plates have better results.[8] However, the 95° angle blade plates are technically difficult to implant and have higher failure and revision rates when compared to intramedullary nails. And also, 95° angle blade plates clinical outcome is similar to locking plates but they require a more extensile approach.[6,9] When unstable trochanteric fractures are managed by dynamic hip screws (DHS), shortening, medialisation of the distal fragment, implant cut–out, lateralization of proximal fragment and, varus collapse are common.[4] Proximal femoral locking compression plates (PFLCP) offer certain advantages to address these complications of DHS.[4] The intramedullary devices are usually preferred for the management of the unstable fractures because of biomechanical advantages.[5,6,9,12–15] But, when nailing is difficult or unsuitable for difficult fracture patterns with comminution or when the medullary canal is narrow for the intramedullary implantation, extra medullary procedures are preferred.[9,16,17] As an extra medullary implant PFLCP is a contact limited implant that allows multiple angularly stable fixations.[2,8] It preserves more bone stock after implantation and, it is also stronger and stiffer than the other angular stable implants especially in osteoporotic fractures.[2,8,10,11]

The intact lateral trochanteric wall is an another key point of the stabilization of unstable trochanteric fractures and breakage of this wall causes collapse of the fixation.[18] This complication has not been yet reported while fixing unstable trochanteric fractures via percutaneous plating.[18] Locking plates with lateral wall buttress are also useful for maintaining reduction of unstable fractures.[4,17,18]

There are only a few reports in the literature about the osteosynthesis of unstable trochanteric fractures with proximal femoral locking compression plates and their results are still conflicting.[1,2,6,8,10] Considering the issues mentioned above, we have aimed to report the clinical and radiological results of PFLCP in the management of unstable trochanteric fractures. We hypothesized that the functional results are independent in terms of the change in neck-shaft angles and reduction quality.

2. Materials and methods

The patients with unstable multifragmentary pertrochanteric fractures who were treated between 2009 and 2015 via proximal femoral locking compression plate (PFLCP) (PERI-LOC® PFP, Smith & Nephew, Inc., Memphis, USA) were enrolled in this retrospective study.

The inclusion criteria were; age older than 18 years old with a fracture of AO/OTA 31A2-2 or 31A2-3 multifragmentary pertrochanteric fracture, an American Society of Anesthesiologist (ASA) score of 1–4 and minimum follow-up time of 12 months. Polytrauma patients and patients with pathologic fractures and concomitant severe medical conditions (ASA 5) were excluded.

The operations were performed with the patients supine on the fracture table under fluoroscopic guidance. After closed reduction under fluoroscopic control, standard lateral approach over the trochanteric region was used to perform PFLCP. Minimally invasive approach was used whenever possible.

After the admission of the patient, anti-coagulative therapy with low molecular weight heparin was begun and continued for 3 post-operative weeks. All patients received single dose 1 gr. 1st generation cephalosporin prophylaxis prior to surgery. Patients received 4 more doses of cephalosporin after surgery.

Active and passive exercises for the ankle joint and quadriceps strengthening were begun under the supervision of the physiotherapists on the first postoperative day. All patients were mobilized with toe-touch using a walking frame on day 1 or 2.

Patients' AO/OTA classification, preoperative Singh index, demographics, average time from injury to surgery, post-operative blood loss, the mean mobilization time, and length of hospital stay were noted from the file records. All patients were followed for over 12 months.

Routine follow-ups were done at 6th week, 3rd, 6th and 12th post-operative months. Partial weight bearing was allowed at the 6th post-operative week for all of the patients. Full weight bearing was encouraged if fracture healing was evident with callus seen on at least 3 cortices.

The quality of fracture reduction was assessed according to the modified criteria of Baumgaertner et al. [19] Time for union was assessed retrospectively from the patients' files. Plain radiographs that were obtained at the early postoperative period and at the last follow-up visit were used to measure femoral neck-shaft angles. Change in the femoral neck-shaft angles (CNSA) and malunion were noted. At least 10° of varus in femoral neck −shaft angle accepted as malunion. Final clinical outcomes were assessed using the Harris Hip Scoring system (HHS) at the last follow-up.[20]

Statistical analyses were performed using SPSS software (v11.5; SPSS Inc. Chicago, IL, USA). Categorical variables were reported as frequencies (percent). The baseline characteristics compared for equality by means of an independent samples T-test for continuous variables, Mann-Whitney *U* test for two unpaired groups. Pearson's rank correlation was used when looking for statistical dependence between two variables. A p value <0.05 is considered as statistically significant.

3. Results

31 patients with 31 fractures met inclusion criteria. Mean patient age was 74 (46–88) years old. 13 (41.9%) of the patients were female where as 18 (58.1%) were male. The mechanism of trauma was ground-level fall in 21, traffic accident in 6 and, high −level falls in 4 of the patients. Patients' co-morbidities are outlined on Table 1. Patients' demographics, fracture classification, preoperative Singh index, average time from injury to surgery, bleeding measured post-operatively in the hemovac drain, the mean mobilization time and, length of hospital stay are outlined on Table 2.

Postoperative reduction quality according to Baumgaertner criteria was good in 25 patients and was acceptable in 6 patients (Table 3). The mean HHS of the patients' who had reduction qualities assessed as good was 78.24 ± 5.04 and, 76.20 ± 3.63 whom had reduction qualities assessed as acceptable. There was no statistically significance in HHS according to the Baumgaertner's reduction quality ($p = 0.385$). Mean union time was 21.53 ± 4.18 weeks and there was neither non-union nor malunion. When the post-operative early mean neck-shaft angle compared with the mean neck-shaft angle assessed at the final follow-up there was change in neck- shaft angles with a mean angle of $-3.1° \pm 2.16°$ (Table 3). There was no correlation between HHS and CNSA Table 4. The mean early postoperative and last follow-up

Table 1
Medical co-morbidities of the patients.

Co-morbidities	PF-LCP (n:14)
Hypertension	3
Chronic obstructive pulmonary disease	2
Chronic renal disease	1
Diabetes mellitus	–
Alzheimer	–
DM and Hypertension	5
DM and Alzheimer	2
DM and Parkinson	1

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