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Original Article

# Role of percutaneous cerclage wire in the management of subtrochanteric fractures treated with intramedullary nails

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ABSTRACT

*Purpose:* Cerclage wire application has emerged as a potential therapeutic adjunct to intramedullary nailing for subtrochanteric fractures. But its popularity is plagued by the concern of possible negative effect on fracture zone biology. This study was intended to analyze the clinico-radiological outcome and complications associated with cerclage wire application.

*Methods:* Retrospective analysis was performed on all the subtrochanteric fractures operated with intramedullary nailing between January 2012 and January 2016. After exclusion, 48 patients were available with an average follow-up of 20.8 months. Long oblique, spiral, spiral wedge or comminuted fracture configurations with butterfly fragments were particularly considered for cerclage wire application, which was employed by percutaneous cerclage passer in 21 patients. Assessment was done in terms of operation time, blood loss, quality of reduction, neck-shaft angle, follow-up redisplacement, union time, complications, and final functional evaluation by Merle d'Aubigne'-Postel score.

*Results:* Average operation time and blood loss were significantly higher in cerclage group ($p < 0.05$). However, cerclage use substantially improved quality of reduction in terms of maximum cortical displacement ($p = 0.003$) and fracture angulation ($p = 0.045$); anatomical reduction was achieved in 95.23% of cases as compared to 74.07% without cerclage. Union time was shorter, although not statistically different ($p = 0.208$), in cerclage group. Four patients in non-cerclage group developed non-union, 2 of them had nail breakage. No infection or any other implant related complications were reported with cerclage use.

*Conclusion:* Minimally-invasive cerclage wire application has proved to be beneficial for anatomical reconstruction in difficult subtrochanteric fractures, whenever applicable, without any harmful effect on fracture biology.



## Introduction

Subtrochanteric fractures continue to pose a management dilemma in Orthopaedic Traumatology. Despite recent technological advances and improvement of implant, potential risks of delayed union, nonunion, malunion, and implant failure challenge attainment of good results in these difficult fractures.[1] The fundamental basis of these complexities is attributed to certain anatomic and mechano-biologic peculiarities of this region. Subtrochanteric area is subject to highest compressive and tensile stresses in human skeleton which threaten stability, and therefore, risk implant failure. Decreased contact area, less vascularity of cortical bone, and strong deforming muscular forces acting in this region further add to the woes.[1,2]

Intramedullary (IM) nailing has arguably emerged as the standard treatment methodology achieving union rate in upto 95% of cases.[1,3] Fundamental tenets of managing these fractures with nails are restoration of alignment, rotation and length, and stable fixation. Various reduction techniques have evolved to combat the deforming forces, such as; percutaneous joysticking with Schanz pin, bone hook, Hoffman retractors, ball spike pusher.[4] However, achieving and maintaining reduction by closed means is often difficult. Afsari et al[5] recommended judicious use of minimally invasive clamp-assisted reduction during nailing; even so, fracture may 'spring open' after clamp release causing decrease bone-to-bone contact, therefore, risking the

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development of complications. Cerclage wiring to restore and maintain reduction has emerged lately as a reasonable adjunct to salvage difficult fracture pattern. Although, the concept of cerclage wiring of fracture is not new, its potential application in periprosthetic and complex femoral fracture has been encouraging.[6,7] Debate is still on as to the risk of violating the principle of biologic internal fixation in case of cerclage use. However, favourable reports in literature of cerclage use in subtrochanteric fractures are a portent of its usefulness.[8–12]

Against this backdrop, we intended to study the critical role of minimally invasive cerclage wire application in difficult subtrochanteric fractures, with particular emphasis on clinico-radiological outcome, and complications as compared to fractures managed without cerclage wiring.

## Materials and methods

All subtrochanteric fractures operated in our level I trauma centre between January 2012 and January 2016 were retrospectively evaluated. Ethical clearance was obtained before initiating the study from Institutional Review Board. One hundred and ten patients were traced during the stipulated time frame. Fractures were classified according to the AO/OTA classification.[13] Patients aged <75 years, isolated subtrochanteric fractures of long oblique, spiral or spiral wedge, comminuted configuration were included in this study; whereas, patients with pathological fracture, segmental fracture (AO/OTA type 32 C2.1), fractures associated with biphosphonates use, type II/III open fracture, associated with other lower limb or hip fracture or previous operations around hip were excluded. We also excluded patients whose subtrochanteric fractures were operated with other implants other than IM nails. Also transverse or short oblique fractures (AO/OTA type 32 A3.1), which are not deemed amenable for cerclage wire assisted reduction, were excluded. After exclusion, we had 61 patients, among these, 13 patients were lost to follow up, and thus finally 48 patients were taken for analysis.

Upon arrival in emergency department, all patients were evaluated and managed according to the Advanced Trauma Life Support (ATLS) protocol, and were kept on upper tibial skeletal traction till the time of operation.

### *Ethical approval*

Ethical approval was granted by institute review board (IEC/NP-Q3 95/2016, dated January 2nd, 2016). All procedures performed in this study involving human participants were in accordance with the ethical standard of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standard.

### *Surgical procedure*

All operative procedures were performed in supine position on fracture table by different surgeons of the same unit, and statically locked cephalomedullary nails or reconstruction nails were used in all the cases. Before prepping and draping, and surgeon scrubbing, closed reduction was attempted by manual pressure under fluoroscopy. In cases where satisfactory reduction was achieved by manual pressure, operation was proceeded with standard antegrade IM nailing. In cases with difficult reduction, various percutaneous manoeuvres were employed. Of the 48 patients, cerclage wire was used in 21 (43.75%) patients, and in the rest 27 (56.25%) patients no cerclage wire was used. Percutaneous mini-open clamp-assisted reduction with/without cerclage wire application was performed according to surgeons' discretion in long oblique, spiral or spiral wedge, comminuted subtrochanteric fractures with butterfly fragments, whenever deemed necessary. For this, 3–4 cm incision was placed on lateral aspect of thigh around the fracture site. Without direct visualization of fracture site, and stripping of soft tissue, clamp was placed to manipulate and reduce the fracture. One or two cerclage wire was employed based on the fracture geometry. Percutaneous cerclage passer device (DepuySynthes®) was use to execute the procedure without additional trauma to soft tissue envelope. This device consists of two dividable forceps with cannulation inside it for safe passage of wire. After attaining satisfactory reduction, cerclage wire was tightened around it to maintain the reduction after ensuring correct rotation, length by direct palpation of fracture site, and/or by fluoroscopic visualization. Achieving anatomic or near anatomic reduction with cerclage was found to effect satisfactory and facile execution of nailing procedure (Fig. 1). After completion of procedure, wound was washed and closed in layers without putting any drain.

### *Post-operative protocol*

The day following operation, patients were made to mobilize in bed, and range-of-motion (ROM) was initiated. Depending upon the stability of reconstruction, immediate toe-touch or partial weight bearing protocol, according to operating surgeons' discretion and within the realm of medical safety, was commenced with assistance of walker or cane for the initial 8–12 weeks; which progressed to full weight bearing after clinical and radiological confirmations of signs of progressive union.

### *Follow-up and outcome evaluation*

Post-operative radiographs were evaluated for grading quality of reduction in both frontal and sagittal plane by an independent observer in radiology department. Reduction was judged based on maximum cortical displacement and angulation at fracture site on antero-posterior (AP) and lateral radiographs, which was grades as either good (both angulation $\leq 10^{\circ}$ and maximum cortical displacement <4 mm), acceptable (either angulation $\leq 10^{\circ}$ or maximum cortical displacement <4 mm), and poor (both angulation $>10^{\circ}$ and maximum cortical displacement $\geq$4 mm).[12] Limb length discrepancy (LLD) was evaluated by comparing with the opposite normal limb, and/or by standing full length scanogram (>1 cm LLD was considered significant). Union was defined as visible callus formation and obliteration of fracture line on ¾ cortices on both AP and lateral radiographs, and absence of pain with weight bearing. Neck-shaft angle was measured on post-operative radiograph and compared with the uninjured hip. Reduction was judged to be a varus malreduction when the angle of uninjured hip was $\geq 5^{\circ}$ compared to the operated hip.[14] All patients were called telephonically or by letter for final follow-up evaluation in the outpatient department. At last follow-up, variables evaluated were patients' mobility status, gait, activity of daily living, resumption of pre-injury activity level, need for any assistive device, nonunion, malunion, subsequent displacement of fracture reduction from immediate post-operative position (>5 mm was considered significant), implant failure and other implant related complications (screw cut-out, breakage, or pull-out), infection, and reoperation. Functional outcome assessment was done by modified Merle d'Aubigne'-Postel scoring system.[15,16]

### *Statistical analysis*

Statistical assessment was performed using SPSS v16 software. Continuous data were summarized as mean and standard deviation (SD), or median and range; whereas categorical data were summarized as frequencies and percentage. Comparison among