Original Article

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Biological dynamic condylar screw fixation for management of Peritrochanteric hip fractures

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Abstract

Introduction: Inspite of routine encounters, hip fractures have the capacity to perplex even experienced orthopaedic surgeons at times. Management of these fractures has evolved with time and soft tissue preserving techniques have gained importance. Through this study we have attempted to analyse the results of traditional dynamic condylar screw plate construct used in a biological manner for treatment of peritrochanteric hip fractures.

Material & Methods: 18 patients in the age group of 22 to 78 years with post traumatic unstable intertrochanteric or subtrochanteric fractures in a pre-operative normal limb were included. All cases were operated within 5 days of trauma and were advised non weight bearing mobilisation for 6 weeks.

Results: Union was achieved in all cases with average duration of 14.6 weeks. 14 patients regained pre-fracture activities. 0.5 cm lengthening was seen in 2 cases.

Conclusion: Biological plating with dynamic condylar screw plate construct is a good modality for treatment of peritrochanteric hip fractures. There is a learning curve like any other surgical technique and results can be improved over time with proper patient selection and planning.

Key words: Biological, Dynamic condylar screw, unstable, Peritrochanteric fractures

Introduction

In spite of technological advances, the management of peritrochanteric hip fractures remains challenging. The unique anatomical and biomechanical characteristics of this area are a major factor why it continues to be so. High energy trauma, bone comminution and strong muscle forces subject the implants to substantial stresses until fracture union. Satisfactory reduction and implant selection are therefore critical for a better functional outcome. The importance of preserving the biological environment for successful fracture union has been stressed by many studies[1,2,3]. Consequently there has been a progressive shift from anatomical to biological fixation in recent years. Intramedullary nails have addressed this concept effectively and their biomechanical superiority makes them the first choice of implant. However, its use in certain fracture patterns was found to be technically demanding[4, 5]. Similarly, the sliding hip screw plate construct is not suitable for unstable cases and for those with lateral wall defect[6]. The traditional use of 95 degree dynamic condylar screw-plate construct for treatment of these fractures involved big incision, large amount of muscle dissection and significant soft tissue trauma. Through the present study, we have attempted to analyse the results obtained when these plates are used biologically for treatment of Peritrochanteric hip fractures.

Materials and methods:

18 patients (16 males and 2 females) in the age group of 22 to 78 years (mean age 42.3 years) were operated on using 95 degree DCS biologically by a single surgeon over a period of three years from 2011 to 2014. The inclusion criteria was either an unstable intertrochanteric fracture, an intertrochanteric fracture with sub trochanteric extension, a reverse oblique fracture or a sub trochanteric fracture in a pre-injury mobile patient. Pathological and open fractures were excluded. Fourteen (78%) of the fractures were caused by high energy trauma and 4 (22%) by fall. All cases were operated within 5 days of injury and were prospectively studied. Antero-posterior and lateral radiographs of the affected extremity along with antero-posterior radiograph of pelvis were obtained. Patients were screened for presence of other injuries. As per the AO classification there were eight A2.3 (45%), six A3.2 (32%) and four A3.3 (22%) fractures.

Surgical Technique:

Intra-operatively patients were positioned on a fracture table in a supine position with the affected limb in traction and slight

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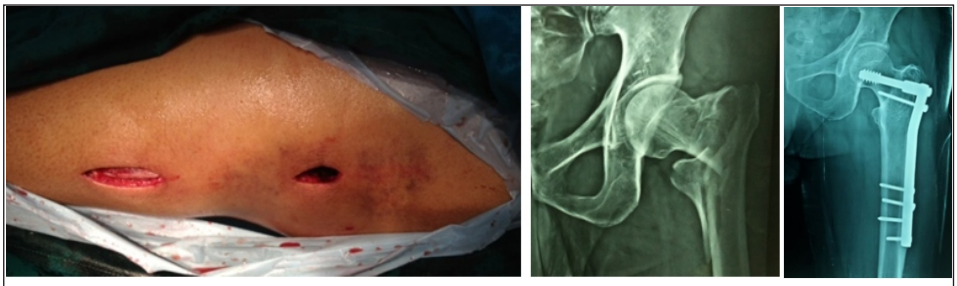

Figure1: A2.3 fracture in a 51 years old diabetic male with pre-operative haemoglobin 7.2 gm/dl

internal rotation. The proximal incision site was marked under an image intensifier by placing a DCS plate over the thigh. Approximately 3 cm incision was taken extending over the greater trochanter. Deep dissection was done with cautery till underlying cortex was reached. A guide wire was inserted in the proximal fragment under image control. The guide wire was inserted parallel to a line from the tip of greater trochanter to the centre of the femoral head. On AP view it was placed in the central part of the neck and inferior quadrant of head. On lateral view, either a central or posterior placement of the wire was accepted. A condylar lag screw of appropriate length was inserted over the wire after triple reaming. A barrel plate that allows insertion of at least 3 to 4 cortical screws distal to the fracture site was selected. A distal incision was made with the help of the plate under image control. A blunt instrument was passed in through both incisions to create a track for the passing plate. The plate was slid through the proximal incision keeping the barrel towards the surgeon. Once completely in, the plate was rotated 180 degrees and negotiated over the condylar screw. Distal fixation was done after confirming a satisfactory position of the plate, fracture reduction and alignment as per methods described by Krettek et al[7]. The compression screw was tightened over the lag screw. Closure was done in layers without using drain. Post-operative intravenous antibiotics were administered for 3 days, bedside mobilisation started on day 2 and non-weight bearing mobilisation with the help of walker started on day 5. Patients were followed up on every month till the fracture union and allowed unassisted full weight bearing once union was evaluated clinically and confirmed radiologically. Further follow up was carried out every 3 months for 1 year and every 6 months thereafter. Functional outcomes were assessed using the Harris hip score[8].

Results:

The mean operating time (i.e. time from skin incision to last suture) was 76.6 (range 62-96) minutes. The average blood loss was 150 ml. The mean number of radiation exposures was 21 (17-29). The mean time to union and full weight bearing was 14.6 (9.2-20) weeks. The mean follow-up period was 25 (range 18-30) months. Lengthening of 0.5 cm was seen in two patient and shortening of up to 0.5 cm was seen in two patient. Acceptable alignment (<100 varus or valgus and rotation) was observed in all cases[9]. According to the Harris hip score, functional outcome was excellent in 14 (78%) patients and good in 4 (22%) patients. The mean Harris hip score was 91.1. We had one case of intra-operative breakage of distal two screws while struggling with a small distal incision. The plate was finally held by proximal two and distal two screws only. However, the fracture united without any further intervention. Neither superficial nor deep infection was seen in any case. There was no incidence of avascular necrosis of femoral head.

Discussion:

The prerequisite for a successful fracture union is both mechanical and biological stability. An exclusive focus on anatomic reduction at the expense of large soft tissue dissection is dangerous; as is, an inadequate fixation which violates the principles of fracture fixation in a struggle with a small incision. Achieving a fine balance between them depends largely on the surgeon's judgement and experience. The prevalence of high energy and low energy hip fractures is steadily rising[10,11]. It is a reflection of the corresponding increase in speed at which people are functioning and an increase in the fragile population with greater life expectancy. A subset of these hip fractures are the unstable or problem fractures which demand more attention. Three or four part fractures with a large displaced postero-medial fragment, reverse oblique fractures, trochanteric fractures with sub trochanteric extension and comminuted trochanteric or sub trochanteric fractures are included in this category[12]. This diversity along with the wide range of implants available to manage them creates a perplexing situation and remains a source of endless debates. The developing notion of biologic fixation is intended to retain the fracture haematoma, maintain the fracture vascularity and provide a reasonably stable fixation that will protect this environment till fracture union[13]. Not only the fracture site, but the local soft tissue and periosteum are bypassed through proximal and distal fixation by an indirect reduction technique providing relative stability. The local soft tissues provide cellular and molecular elements that are critical to fracture repair and the periosteum contributes blood supply, undifferentiated mesenchymal cells as well as the osteoprogenitor cells that eventually become bone[14]. Lateral dissection may injure vital perforators and nutrient arteries and studies have shown that conventional plating can disrupt up to 80% of blood supply of the femur[7,15]. Similarly reamed intramedullary nailing can interfere with medullary blood supply and there is evidence that though reaming increases contact area, it reduces cortical blood flow and also decreases the cortical strength[16]. In this poorly vascularised and hypoxic area, the callus cannot mature.

Figure2: A 3.2 fracture in a 55 years old farmer.

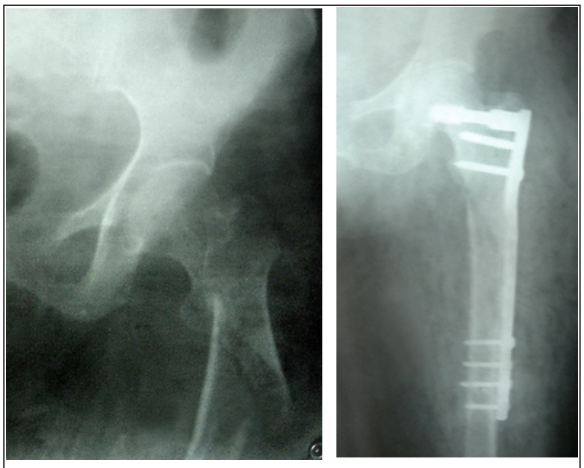

Figure3: A3.3 fracture in a 78 years old female.

In contrast, early callus bridging the fracture site can be seen in viable and vascular area with biological plating[17]. The rapid maturating callus lessens implant load thus preventing its fatigue and loosening[18]. The 100% union seen in our study, which is comparable to other studies[1, 2, 19], can be attributed to this natural physiological occurrence. (Table 1)

Non-union rates as high as 17- 23% have been reported with open reduction of subbtrochanteric fractures and 29% of patients needing bone grafting[20, 21,22]. Though autologous bone graft promotes healing, Arrington et al., have identified upto 10 % minor and 5.8% major complications like herniation of abdominal content, deep infection, neurovascular injuries and iliac wing fractures in a review of 414 consecutive cases of iliac crest bone graft procedures[23]. Indirect reduction, on the other hand reduces the need for bone grafting even in cases with large defects. On its own, the periosteum is capable of bridging gaps up to one half of the diameter of the bone. These findings again reinforce the importance of soft tissue preservation for better functional outcomes. In the present study, bone grafting was not required in any case. Load bearing at the proximal femur is predominantly through the calcar femorale. Therefore with comminution or void in this area, the supporting implant will be subjected to excessive loads. In such a scenario, an extramedullary implant will be subjected to even higher loads because of its location and distance from the femoral head which increases the moment arm. Naturally for unstable fractures, the failure rate for DHS has been as high as 22% [6]. In case of intramedullary implants the moment arm is less and so is the load. Their strategic position close to femoral head gives them a distinct advantage over other implants. However, this advantage is lost with suboptimal reduction and improper placement of nail and screws[24,25]. Associated complications like Z effect, reverse Z effect, implant breakage, shaft fracture at tip of nail, abductor lurch and trochanteric bursitis are not infrequent, and as per recent literature, the risk of implant failure in high energy fractures is equivalent for both extramedullary and intramedullary implants[19]. With ongoing intense and in depth research, the lateral trochanteric wall has assumed vital importance just like its posteromedial counterpart. It acts as a buttress to the proximal fragment and has been described as a key element of stability[26]. A compromised lateral wall allows excessive collapse of the proximal fragment over the sliding screw and it has been found that an inadequately managed fracture of the lateral wall is an important predictor of reoperation after trochanteric fractures[6]. Here the DCS plate has a slight advantage over the intramedullary nails as it is able to correct the abduction of proximal fragment and simultaneously provide a buttressing effect laterally. With its biologic insertion, the lateral wall below the trochanteric flare is not violated as screw purchase is restricted above it and in the distal shaft. Another advantage of the DCS construct is that it is comparatively stronger than the sliding screw in its ability to neutralise the forces that tend to displace fracture and also counteract the medial compressing forces. The strength is not only due to a secure fixation in the cancellous bone of the neck and head, but also because of the length of fixation. Additional proximal screws improve the rotational stability[3]. There were no implant failures in our series, probably because of the above explanation along with a strict weight bearing protocol. With regards to fracture union and implant failure, similar observations were found in other such studies. A modest surgical technique is an essential component of a successful surgical procedure, the foundation being a good reduction. We feel that the present technique is straighforward and can be practised by the majority of orthopaedic surgeons. Since the fracture is reduced by a close and indirect method, the fluoroscopy exposure is increased. In our series the mean number of exposure was 21 which is slightly more than other studies[1, 3]. Rather than an anatomical reduction, the target was to achieve a moderate reduction within the acceptable alignment in three planes. We were able to do so in all cases. Even the two cases which post-operatively appeared in varus of upto 10 degrees, one each in reverse oblique and sub trochanteric fracture, did functionally well. With small incisions and less muscle trauma, we had minimal intraoperative blood loss. This is desirable, especially in the elderly population, as steady haemoglobin level speeds up functional recovery and with major muscle continuity rehabilitation can be started earlier[27]. None of the patients required blood transfusion. It was also observed that the analgesic requirement diminished in the first week of surgery. These findings justify an early discharge from the hospital which was possible in all cases. One of the drawbacks with this assembly is that it does not allow much collapse at the fracture site. Excessive traction may be harmful and cause limb length discrepancy. Clinically, lengthening less than 0.5 cm was seen in

Table 1: Comparison of union rates with other studies

Investigator	Number of patients	Included fractures	Implant	Union	Mean Time to union	Complications
Rohilla *et al*[1] 2008	43 (29 male)	Comminuted subtrochanteric	DCS (Biological)	1	16 weeks	NU: 0, IF: 0
Vaidya *et al*[3,] 2003	31 (28 male)	Comminuted subtrochanteric	DCS (Biological)	1	4.9 months	NU: 0, IF:0
Our series	18 (16 male)	Unstable IT Reverse oblique Subtrochanteric	DCS (Biological)	100%	14.6 weeks	NU: 0, IF:0
Nungu *et al*[22] 1993	15	Subtrochanteric	DCS (Open)	80%	4-7 months	NU:2, IF:3
Kulkarni *et al*[21] 2003	53	Subtrochanteric	DCS (Open)	0.774		NU:12, IF:12

two cases, however both patients adapted well by the end of one year. This possibility should be taken into consideration and proper attention should be given to the fracture site. As suggested by Rohilla et al. the correct angle of guide wire insertion on antero-posterior and lateral planes is crucial to avoid a varus or valgus fixation [1]. Just like in intra-medullary nailing, it is advisable to proceed with this preliminary step after obtaining a good reduction. The limitations of our study are a small sample size and the absence of a control group; it therefore cannot provide strong evidence necessary to confirm our findings. However, our observations are in line with many studies that endorse the biological philosophy of fracture treatment. We admit, that addressing fully a problem of this enormity in a statistically convincing manner would need further continuation of this study.

Conclusion:

We conclude that biological DCS plating is a reliable alternative for management of peritrochanteric hip fractures. Good functional outcome in terms of resuming pre-fracture activities with less complications can be obtained with proper case selection, precise planning and careful surgical execution.

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