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Use of the Tip-Apex Distance in predicting Dynamic Hip Screw Cut Out in Intertrochanteric Fracture of the Femur in Asian Population

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ABSTRACT

The objective of this study was to assess the rate of screw cut out in elderly patients treated with the dynamic hip screw and the relationship to the Tip Apex Distance (TAD). This is a retrospective radiological evaluation of 100 cases of elderly patients with intertrochanteric fracture treated with dynamic hip screw fixation surgically treated between 1998 and 2002. The incidence of screw cut out was assessed and correlation of risk of cut out with the TAD was assessed. The rate of screw cut out was 9.0% and the average length of time to screw cut out was 3.8 months (range, 1 to 6 months) post-operatively. The incidence of screw cut out increased significantly when the TAD was 20 mm or more. The screw cut out rates were 2.9%, 20.0%, 30.8%, 50% and 100% for TAD of 20-24 mm, 25-29 mm, 30-34 mm, 35-44 mm and > 45 mm respectively. Overall, a TAD of 20mm or more was associated with a statistically significant screw cut out risk in this Malaysian population.

Key Words:
Screw Cut Out, Tip Apex Distance (TAD), Intertrochanteric Fracture, Dynamic Hip Screw

INTRODUCTION

Proximal femoral fracture is a common problem among elderly patients, especially those in the seventh or eighth decades of life [1-4]. The main underlying cause for this fracture is osteoporosis. In Malaysia, the incidence of proximal fracture femur is in increasing trend due to changes in population demography toward an aging population [5]. Dynamic Hip Screw (DHS) fixation is one of several options for treating intertrochanteric fracture of the femur [6-9]. The design of this device that allows dynamic sliding of the screw in the barrel provides direct compression of the fracture perpendicular to the usual intertrochanteric plane when the patient ambulates. However, this device is not without its complication and one of the well-known complications of this device is screw cut out [6, 8, 9].

Although risk factors for screw cut out are well documented in the English literature, excepting Tip Apex Distance, there are inconsistences in these reports. This study aims to assess the use of TAD in predicting screw cut following DHS fixation in an Asian population.

MATERIALS AND METHODS

Study Sample

This is a retrospective study of 100 patients who presented with intertrochanteric fracture and were treated with DHS fixation in our centre between 1st July 1998 and 30th June 2002. Patients 60 years old and above were included in this study. Patients were excluded if: i) the fracture was secondary to malignancy; ii) there were pre-existing femoral or acetabular deformity such as coxa vara, acetabulum dysplasia or previous malunion.

Methods

Dynamic hip screw was the standard procedure for all intertrochanteric fractures in our institution during the study period. All patients were hospitalised and their comorbidities or medical problems were optimised. Either spinal or general anaesthesia was utilised. The patient was positioned on a traction table and the fracture was reduced using an image intensifier. Surgery was performed by orthopaedic surgeons or senior registrars through a standard lateral approach. Postoperatively patients were encouraged to mobilise with walking frame, using partial weight bearing for a duration of four to eight weeks depending on the patients' physical condition.

A total of 100 cases of intertrochanteric fractures with complete preoperative, immediate postoperative and follow up radiographs at 1, 3, 6 and 12 months (± 4 weeks) post-operative were included into this study. The pre-operative radiographs of anteroposterior and the lateral views of the fracture hip were traced and to confirm the fracture and to rule out any other secondary pathological causes (i.e., malignancy or previous fracture resulting coxa vara). Immediate post-operative radiographs of the operated hip were obtained to assess the TAD of the DHS fixation using the definition as described by Baumgaertner *et al* [10]. The TAD is defined as the sum of the distance, in millimetres, from the

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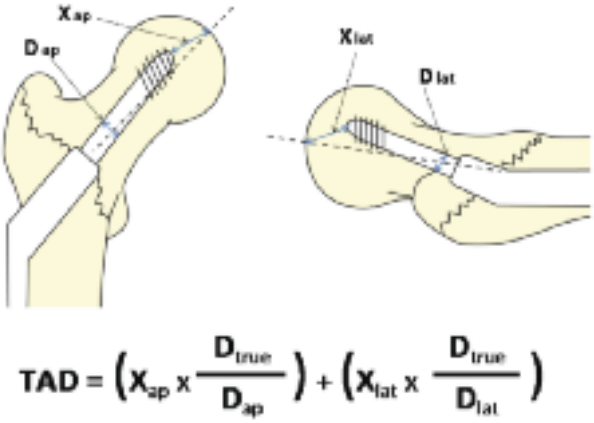

Fig. 1: Tip Apex Distance (TAD) as described by Baumgaertner et al. [10]

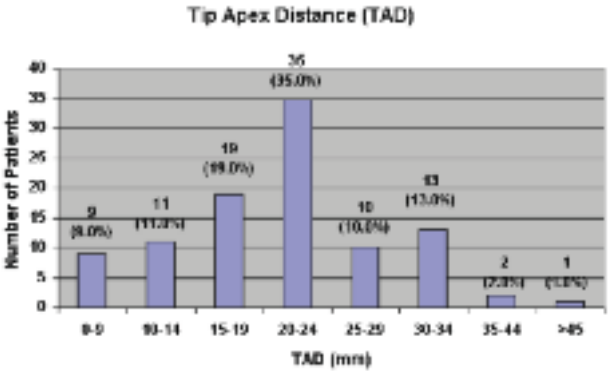

Fig. 2: The distribution of TAD as described by Baumgaertner et al. [10]

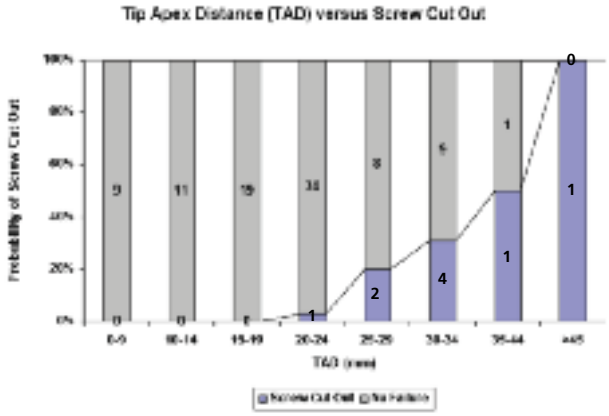

Fig. 3: The screw cut out rate in relation to TAD ($p < 0.001$).

tip of the lag screw to the apex of the femoral head in the anteroposterior and lateral view of the radiographs (Figure 1), after correction has been made for magnification [10]. In this instance, the known diameter of the lag screw was used to nullify the magnification effect of the radiographic images. Measurements were made at 3 occasions and the mean values were used for analyses.

All the follow up radiographs of the patients were traced and reviewed for any occurrence of screw cut out. Screw cut out is detected when the tip of the screw is located beyond the articular margin of the femoral head in either the anteroposterior or lateral radiographs. Special attention was paid to cases in which the tip of the screw was located over the antero-superior or postero-superior zones of the screw tip as described by Cleveland *et al.* [1] Screw tips located over this area can cut out and yet not be visualized in standard anteroposterior or lateral radiographs. The use of oblique radiographs helps to identify screw cut out in these cases.

Data was tabulated and analysed using, SPSS Version 16 statistical software for Windows.

RESULTS

There were 66 (66%) female and 34 (34%) male patients. Sixty-one per cent of the study sample was Chinese, whereas Indian and Malay constituted of 22% and 13% of the sample respectively. We found that there were 9 (9.0%) cases of screw cut out in the study sample and the average postoperative length of time for the screw cut out to occur was at 3.8 months (range: 1- 6 m). Overall, the average TAD was 22.55 mm (range: 6.22-58.66mm). Thirty-nine per cent of cases had a TAD of less than 20 mm (Figure 2), and there was no screw cut out noted in the group with TAD<20mm. Twenty-six per cent of cases had a TAD of more than 25 mm, and in this group, the incidence of screw cut out was noted to be significantly higher at 31.0% ($p < 0.001$).

The average TAD was 36.9 mm (range: 23.1-58.7mm), compared to 21.7 mm (range: 6.2-41.8mm) in those without screw cut out. The risk of screw cut out is associated directly with the increasing TAD (Figure 3). When TAD was 20-24 mm, the risk of screw cut out was 2.9%. There was an increase risk of screw cut out of 20.0%, 30.8%, 50% and 100% when the TAD range increased from 25-29 mm, 30-34 mm, 35-44 mm and > 45 mm respectively.

DISCUSSION

Intertrochanteric fracture of the femur is common in Malaysia due to the increasing number of elderly individuals in this country. Management of this fracture is usually accomplished by immediate optimisation of the patient's medical comorbidities, followed by surgical stabilisation. The options for fixation include the conventional dynamic hip screw or newer forms of intramedullary sliding devices (i.e.. gamma nail or proximal femoral nailing devices). DHS fixation has been proven to be successful in many studies and has become the standard treatment for this fracture. Despite the superior results of DHS fixation published in

many studies, it has also shown a significant rate of implant failure ranging from 5-23%[6, 10-13]. In a local series, Nordin *et al.* showed that the overall complication was high: 6.7% screw penetration and 6.7% screw cut out[3]. The most common mode of implant failure, which results in screw cut out, was the collapse of the neck-shaft angle into varus alignment, leading to extrusion, or so called 'cut out' of the screw from the femoral head articular surface superiorly. The screw will later cut into the hip joint and start to destroy the superior weight-bearing portion of the articular surface of the acetabulum. If the condition is not addressed immediately, the screw will further cut into the superior acetabulum, into the ilium, or out of the superior acetabular margin. Destruction of the weight-bearing portion of the acetabulum results in hip pain and causes difficulty in revision surgery.

The incidence of screw cut out ranges from 2.0% as reported by Leif Ahrengart et al and Mainds et al to as high as 12.6% in the report by Davis *et al.*[6, 14, 15]. In the present study, we found similar results in that the incidence of screw cut out was 9.0% and the mean time to screw cut out was 3.8 months (ranges: 1-6m) post-operatively, which is similar to findings of other studies as well[14, 16, 17]. The first six postoperative months is a crucial period for development of bony union. During this time, the race is on between development of bony union and incidence of cut out. If the union fails to develop in a timely manner, screw cut out inevitably will result.

The incidence of screw cut out is frequently related to the position of the lag screw in the femoral head. Many reports regarding TAD and postoperative results were inconsistent. For example, Jensen et al has advised a placement of the screw tip over 10 mm from the articular surface whereas Kyle *et al.* has advised a placement within 10 mm[8,12]. Schumpelick and Jantzen reported that the tip of the screw should be 3-5 mm from the articular surface[18], but Davis et al. found that this distance was not critical[6].

Baumgaertner *et al.* first published information regarding the concept of TAD[10]. In his series, the average TAD was 24 mm for the successfully treated fractures compared with 38 mm for those screw cut out group. There was a very strong statistical relationship between an increased TAD and the rate of cut out, regardless of other variables related to the fracture. They concluded that TAD of more than 25mm is associated with increased risk of screw cut out. However, most traumatologists aim for a TAD of less than 20 mm to further decrease the risk of screw cut out[19].

In this study, we show similar findings in that there was a direct relationship between increased TAD and an increased risk of screw cut out. There were no cases of screw cut out in patients with a TAD of less than 20 mm as compared to Baumgaertner's series, which advocated a TAD of less than 24 mm. The reason for our smaller observed TAD value compared to the Baumgaertner's series is likely due to the smaller femoral head morphometry in the Asian population. The incidence of screw cut out in this study increased significantly when the TAD was 20 mm or more (Figure 3). Factors such as the age of the patient, quality of bone, pattern of the fracture, stability of the reduction, angle of the implant, and the zone of the lag screw within the femoral head which can possibly be related to the mechanism of failure was not analysed[7, 8.]

CONCLUSIONS

Dynamic Hip Screw is the standard surgical treatment for elderly patients with intertrochanteric fracture. There is a significant rate of screw cut out (9.0%) in the management of intertrochanteric fracture with DHS fixation in the Malaysian population. TAD of 20mm or more is associated with a statistically significant screw cut out risk. Therefore, we should try to ensure TAD of 20mm or less when this fixation method is used.

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