The Bone & Joint Journal

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Convenor: Mr J Lenihan
Attendees: Dr C Brewster, Mr R Kallala, Mr J Lenihan, Dr T Stubbs
Papers: Selected by Mr J Lenihan
Kingston Hospital NHS Foundation Trust Orthopaedic Journal Club

Theme: Hip Fractures

M Parker, S Cawley and V Palial. Internal fixation of intracapsular fractures of the hip using a dynamic locking plate. Two Year Follow Up*. Bone Joint J* 2013; 95-B:1402–5.

Reviewer: Dr C Brewster

Background
There are differing methods of treatment for Intracapsular hip fractures. These fractures can be treated with either Total Hip Replacement or Hemiarthroplasty, or some form of Internal fixation. Complication rates when displaced Intracapsular fractures are treated with Internal fixation are higher than when the same treatment is used for non-displaced fractures. To avoid these complication rates elderly patients with a displaced Intracapsular fracture tend to be treated with a form of hip replacement. The best method of treatment continues to be debated.

Aim
This paper presents the clinical results of the author's use of a new fixed angle locking plate, the Targon Femoral Neck (TFN), to treat both forms of Intracapsular hip fractures.

Method
This is paper is a consecutive series and as such is level 4 evidence. 330 patients with an Intracapsular hip fracture were recruited between August 2006 and November 2010. 10 patients were excluded (6 basi-cervical fractures and 4 pathological fractures).

The authors describe the construction of the Targon Femoral Neck, as a plate with six locking holes. Up to four 6.5 mm telescopic screws can be passed through the proximal plate and cross the fracture site to sit in the subchondral bone of the femoral head. They allow controlled collapse of the fracture. Two cortical locking screws distally hold the plate against the lateral femoral cortex.

The authors used standard reduction and a lateral sub-vastus approach to the proximal femur. A 130-degree jig was used to pass an initial guidewire in to the centre of the neck on AP and Lateral views. Further guidewires were then placed using the jig. Rotational control of the fracture was maintained as guidewires were measured, drilled and removed sequentially. The screws could be advanced a further 10 mm in to the subchondral bone of the head. Patients were allowed to fully

weight-bear after the operation, unless they were young and had a displaced Intracapsular fracture, in which case they undertook a 6-week period of partial weight-bearing.

Patients were followed up in a hip fracture clinic for one year where possible. Radiographs were taken to assess healing and complications e.g. avascular necrosis. There was a clear definition of avascular necrosis that was set as Steinberg stage 2 and upwards. Pain and mobility were also assessed using scales: 1(none)-6(severe and constant) and 0 (bedbound)-9(fully mobile without aids inside and outside) respectively.

Results

There were 112 undisplaced hip fractures and 208 displaced. The mean age was 76.0 years and 40.6% were male. 109 patients (34.1%) died during follow-up and 4 were non-contactable.

The lead author performed 269 of the procedures, a Consultant Orthopaedic Surgeon undertook 9 procedures, whilst an Orthopaedic trainee Surgeon undertook 42 procedures. Two telescrews were used in two patients (0.6%), three in 143 patients (44.7%) and four in 175 patients (54.7%).

Of the 112 patients with an undisplaced fracture 104 experienced uneventful fracture healing. 3 had non-union and 5 suffered avascular necrosis. 6 patients had their prosthesis removed and 5 were converted to either a hemiarthroplasty or THR. 93 patients were followed to one year. There were slight improvements in both pain scores and mobility function from one year to two years post-operatively.

In the displaced fracture group, 148 experienced uneventful fracture healing (71.1%). 33 developed non-union (15.4%) and 23 (11.1%) suffered avascular necrosis. 20.5% were revised to hip replacement. 115 patients were followed up at one year. There were slight improvements in both pain scores and mobility function at the final follow up.

Discussions

The authors claim their results are similar to previously published data for non-union rates but that they experienced a higher rate of avascular necrosis: 4.8 to 8.8%, when the data is considered as a whole.

They compared their results to those of 4468 patients in the Norwegian Hip Fracture Register with undisplaced Intracapsular fractures treated with internal fixation. The Norwegians reported 8.3% had to be revised to hip replacement within 12 months of the initial surgery compared to 4.5% in this study. Other published data reports a revision rate of 9%, but at a longer follow up time, mean 32 months.

The authors acknowledge suggestions that undisplaced fractures should be treated by primary replacement as they have lower rates of requiring further surgery (3 to 6%). However they counter by arguing that internal fixation is a less extensive surgical approach, and that it also retains the femoral head. No comparison was made other than this one in terms of complication rates between TFN and primary hip replacement (hemiarthroplasty of THR).

The authors also compare their results on treating displaced Intracapsular hip fractures with previously published results. Their results of 15.4% for non-union and 20.7% of revision to hip replacement were favourable in comparison to previously published data which reported non-union rates of 33% and a revision rate of between 20 and 36%.

14 TFN (4.4%) had to be removed electively due to discomfort, but there was no comparison to any other published data.

Limitations
The main limitations are that this is a consecutive series performed at a single centre, with no other centre to compare results to. The lead author, who has had a role in developing this technology, performed the majority of the procedures that may have also skewed results. Despite this, rates of avascular necrosis were still higher than those reported after the initial case series of 83 patients treated with TFN back in 2008.

The authors fail to mention in their method who scrutinised the radiographs for evidence of complications and whether they were blinded. This would introduce another form of bias.

Conclusion
The authors conclude that TFN may be an option to treat Intracapsular fractures in the future. However, no future intentions are described.

Our thoughts
The topic is both relevant to clinical practice and the aim clearly defined. There are obvious limitations with a level 4 study and, as pointed out by the authors, an ideal study would be to compare the TFN to another form of internal fixation in a prospective randomised trial. Powering this study appropriately would however be difficult.

Another limitation was that the lead author, who helped to develop this technology, performed most of the procedures. He would have wanted the best possible outcomes to advertise the TFN positively. Data was collected over 4 years, but there was no mention of a learning curve when using it. Clearly a long learning curve would have a negative impact on outcomes in the short term. Further details of how they aim to tackle this also need to be made clear.

No analysis was undertaken between the number of telescrews used and complication rates. If this technology is to be adopted in the future, further research needs to be undertaken to look at this point. Logic would suggest that varying the number of screws proximally would change the biomechanical integrity of the construct that may impact upon outcomes.

We believe the authors should be clearer on who scrutinised the radiographs for evidence of complications and whether they were blinded.

Whilst we appreciate the author's view that Internal fixation should be attempted for undisplaced Intracapsular fractures due to a lesser surgical exposure, they make barely any comparison between their complication rates with TFN and those published for hemiarthroplasty. In our clinical practice we would advocate aiming for one operation for one patient, as long as they were medically fit to undertake it.

Overall our belief is that further studies are required. They should include multi-centres and ideally should compare the TFN against other methods of Internal fixation.

Hsu C-E, Shih C-M, Wang C-C, Huang K-C. Lateral Femoral Wall thickness: A reliable predictor of post-operative lateral wall fracture in intertrochanteric fractures. *Bone Joint J* 2013;95-B:1134–8.

Reviewer: Dr T Stubbs

Background
The importance of lateral femoral wall integrity in the treatment of intertrochanteric fractures is increasingly being recognised. There is little data regarding the development of post-operative

fractures of the lateral wall. Patients who suffer a lateral wall fracture have high rates of reoperation and complication. There are no published predictors of post-operative lateral wall fracture.

Aim

To investigate the reliability of lateral wall thickness as a predictor of lateral wall fracture after DHS implantation.

Method

This study is a retrospective cohort study and therefore level 3 evidence. The medical records of patients with AO/OTA 31-A1 (A1) and AO/OTA 31-A2 (A2) Intertrochanteric fractures treated with DHS implantation in the author's department between January 2003 and May 2012 were reviewed. Patients were excluded if they sustained non-traumatic fractures; previous fracture in the peri-trochanteric region; fixation other than DHS; pathological fracture; Tip-Apex Distance [TAD] greater than 25 mm (as described by Baumgaertner); poor fracture reduction (defined as >20 degrees angulation on the lateral radiograph, and > 4 mm of displacement of any fragment); or followed up for less than 6 months. 208 patients met the inclusion criteria (103 Males and 105 Females), average age 78 years (33 to 94). The mean follow-up was 23 months (6 to 83).

Patients were treated with a conventional DHS and allowed to mobilise at between 24 and 72 hours. Clinical follow up was undertaken at 1, 2, 3 and 6 months.

Post-operative lateral wall fracture was defined as a new fracture line occurring at the site of insertion of the barrel-plate or lateral displacement of fracture fragment on radiographs. Lateral wall thickness was defined as the length of the channel created by the triple reamer on the lateral wall. Two blinded observers measured TAD and lateral wall thickness on PACS. The mean value of the measurements was used for statistical analysis.

Results

A fracture of the lateral wall occurred in 42 patients (20%). The mean pre-operative lateral wall thickness of these patients was 18.4 mm (SD 5.54) compared with 27.0 mm (SD 7.35) in the 166 patients without lateral wall fracture ($p < 0.001$, Student's t-test).

The incidence of post-operative lateral wall fracture was significantly higher in A2 fractures than in A1 fractures ($p < 0.001$, Fisher's exact test). No relationship was found when age, gender, side of fracture, TAD, and duration of follow up were used as variables.

3 lateral wall fractures occurred in the A1 group (3.1%). None of these fractures failed, whilst 2 of the 95 patients without lateral wall fracture did fail. In the A2 group 39 patients (35.1%) developed a lateral wall fracture of which 19 (48.7%) failed, compared to 6 patients of 72 in the A2 group who failed despite not having a lateral wall fracture.

The mean lateral wall thickness of 97 A1 fractures was 29.8 mm (SD 6.63) compared to 21.2 mm (SD 6.43) found in 111 A2 fractures ($p < 0.001$, Student's t-test). The lateral wall thickness significantly contributed to lateral wall fracture in the A2 fractures ($p < 0.001$, Student's t-test), whilst no significance was found for lateral wall fractures in the A1 group ($p = 0.071$, Student's t-test).

In the A2 group, the mean lateral wall thickness in those without lateral wall fracture was 22.9 mm (SD 6.40) that was significantly greater than 18.1 mm (SD 5.25) in those with a lateral wall fracture. There was no significant difference in the A1 group.

Receiver Operating Characteristics Curve was used to estimate a threshold value that could predict lateral wall fracture. They set a limit of lateral wall thickness of 20.5 mm, which had sensitivity 82.7% and specificity of 77.8%.

Discussion
Lateral wall thickness was a reliable predictor of post-operative lateral wall fracture with a threshold value of 20.5 mm for predicting secondary lateral wall fracture. The lateral wall thickness had no statistically significant effect on lateral wall fracture in A1 fractures. They postulated this was due to the low numbers of patients who had lateral wall fractures.

The authors account for the high success rate (bone union) in A1 patients with a post-operative lateral wall fracture as the posteromedial section of the femur prevents excessive sliding of the screw and proximal fragment. However, when a lateral wall fracture occurs in A2 fractures, the screw and proximal fragment slide laterally and there is no structure to block this movement. Further stress on the femoral head causes failure.

Conclusion
The authors make three conclusions. Their first conclusion is that lateral wall thickness is a reliable predictor of post-operative lateral wall fracture. Additionally, a limit of > 20.5 mm for lateral wall thickness should be set if using a DHS to minimise the risk of post-operative lateral wall fracture. Finally, an intertrochanteric fracture with lateral wall thickness of < 20.5 mm should not be treated with DHS alone.

Critique
Strengths

- Well defined inclusion and exclusion criteria were used in the study design.
- Well defined measurement criteria: tip apex distance, treatment failure.
- The study used two blinded observers making measurements on PACS, who had good Intraclass Correlation Coefficient (0.724)
- Representative population: range of demographics, age and sex.
- The incidence of lateral wall fractures was in keeping with previous literature.

Weaknesses

- Retrospective cohort study and therefore subject to the inherent bias with this study design.
- No consideration of confounding factors like bone health, falls risk, BMI, (although the authors elude to this)
- No evident adjustment for confounding factors – stratification, logistic regression etc.
- More than one operating surgeon with different operative experience
- Different post-operative instructions in terms of mobilisation (24-72 hours)
- Fracture classification only used radiology
- Small sample size
- The discussion commented on a number of parameters (risk factors) that were investigated for predictive value of lateral wall fractures, however these links were not part of the papers aims. Furthermore, no data regarding these were supplied.

Overall
We believe this study to be relevant to clinical practice as DHS is commonly used to treat Intertrochanteric fractures. There are both strengths and weaknesses with this study that we have highlighted.

Lateral wall fracture is reported in the literature although is rarely seen in our practice. This may be because we do not follow up patients who undergo DHS implantation as a routine, unless they represent at a future date to A+E. We aim to mobilise all our patients on Day 1, or sooner if able.
This particular study is filling a gap in the literature: no previous studies have investigated predictive factors for lateral wall fractures after treatment with DHS.
This is an easily measurable quantity (on radiographs) and can therefore be used in clinical practice in aiding the Surgeon's choice on what form of fixation to undertake.