RESEARCH ARTICLE

To derotate or not? The impact of a permanent derotation screw on the revision rate of dynamic hip screw fixation for intracapsular neck of femur fractures. [version 1; peer review: 1 approved with reservations, 2 not approved]

Simon Woods ¹, Richard Pilling¹, Ivan Vidakovic², Alloush Al-Mothenna³, Reza Mayahi⁴

¹Leeds Teaching Hospitals NHS trust, Leeds General Infirmary, Leeds, UK

²Warrington and Halton Hospitals NHS Trust, Warrington, UK

³Hairmyres Hospital, East Kilbride, Glasgow, UK

⁴Hull Royal Infirmary, Hull, UK

V1 First published: 15 May 2017, 6:678
<https://doi.org/10.12688/f1000research.11433.1>

Latest published: 15 May 2017, 6:678
<https://doi.org/10.12688/f1000research.11433.1>

Abstract

Background: In this retrospective study, we examine the impact that employing a permanent derotation screw (DRS) has on the rate of revision for 2-hole dynamic hip screws (DHS, a.k.a. sliding hip screws), used for internal fixation of intracapsular neck of femur (NOF) fractures. To the best of our knowledge, we are the first to examine the impact of using a derotation screw on DHS revision rate.

Methods: We obtained a list of 64 patients suffering intracapsular NOF fracture treated with 2-hole DHS over a 5-year period, 28 of these were also treated with a DRS, forming our DRS group, 36 were not (non-DRS group). Fracture severity and patient demographics between the groups were compared to ensure homogeneity. The rate of revision to arthroplasty (total or hemi) of the two groups were compared.

Results: The mean age in the DRS group was 70.79 years, 1.77 years lower than the non-DRS group ($p=0.570$). The DRS group had a rate of revision of 14%, in comparison with 39% in the non-DRS group ($p=0.0299$), corresponding with a number needed to treat of 4.06 derotation screws to prevent a single failure.

Conclusions: In this study, employing a permanent derotation screw alongside a 2-hole DHS was associated with a significantly lower rate of revision to arthroplasty than using a 2-hole DHS alone. We would recommend this be further investigated with prospective randomized trials, to provide robust evidence and make clinical recommendations.

Open Peer Review

Approval Status

	1	2	3
version 1 15 May 2017	 view	 view	 view

1. **Martyn J Parker**, Peterborough City Hospital, Bretton Gate, Peterborough, Cambridgeshire, UK

2. **Raju Karuppall** , Government Medical College, Kozhikode, Kozhikode, India

3. **Gianluca Testa** , University of Catania, Catania, Italy

Any reports and responses or comments on the article can be found at the end of the article.

Keywords

dynamic hip screw, hip fracture, intracapsular, neck of femur, sliding hip screw, derotation screw

Corresponding author: Simon Woods (simon.woods@doctors.org.uk)

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

Copyright: © 2017 Woods S *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Data associated with the article are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

How to cite this article: Woods S, Pilling R, Vidakovic I *et al.* **To derotate or not? The impact of a permanent derotation screw on the revision rate of dynamic hip screw fixation for intracapsular neck of femur fractures.** [version 1; peer review: 1 approved with reservations, 2 not approved] F1000Research 2017, 6:678 <https://doi.org/10.12688/f1000research.11433.1>

First published: 15 May 2017, 6:678 <https://doi.org/10.12688/f1000research.11433.1>

Introduction

Intracapsular neck of femur (NOF) fractures comprise one of the most common orthopaedic injuries¹. The majority are treated with arthroplasty, as the femoral neck biomechanics and vulnerability of the blood supply lead to a high incidence of non-union and avascular necrosis following internal fixation. Some may be treated with fixation rather than replacement depending on patient factors and fracture configuration, however, the optimal fixation method is controversial².

The choice of fixation method for intracapsular fractures is either cannulated hip screws (CHS), or dynamic hip screw (DHS) with or without a derotation screw (DRS). These devices provide stability in the plane of the femoral neck, whilst enabling compression at the fracture site to facilitate direct healing.

The biomechanics of basicervical fractures are influenced by fracture character and fixation method. Stankewich *et al.* (1996) investigated the biomechanical impact afforded to fracture configuration under cyclical and failure loading. They determined that force at the fracture site correlates with fracture angle. The more vertical the fracture angle, the greater the force resisted by the implant alone, and ultimate failure force correlated with the moment arm³.

The load through the hip when walking at 4km/h is approximately 238% body weight (BW), increasing to 250% when ascending stairs and 260% when descending⁴. Therefore a 70kg person loads the hip with approximately 1400–1500N when walking. The torsional force through the femur is also 23–83% larger when climbing stairs than when walking⁴. Using synthetic femurs Freitas *et al.* (2014) compared the load to failure for a Pauwels III fracture fixed with a DHS plus DRS against a control group without fracture and found the mean load to failure in the DHS group was 1742N, compared to 1329N in the control group⁵.

Blair (1994) states that a DRS provides rotational control during insertion of the lag screw, but no additional fixation thereafter⁶. This opinion is echoed by both clinical experience of others^{7,8} and biomechanical testing by Swiontkowski *et al.* (1987)⁹. However,

biomechanical studies of cadaveric fractures have shown that DHS with DRS gives superior stabilisation, theoretically reducing AVN and non-union^{10,11}.

In this study we examine the impact employing a permanent derotation screw concomitantly with a 2-hole DHS has on rate of revision to arthroplasty in the treatment of intracapsular NOF fractures.

Methods

Patient selection

A list of 161 patients were identified as sustaining an intracapsular NOF fracture treated with internal fixation between April 2009 and April 2014. The patient follow-up notes and imaging were reviewed, excluding those treated with CHS, and ensuring follow up for at least one year. This left 64 patients treated with DHS, 28 of those treated with a derotation screw (the DRS group), and 36 without (the non-DRS group).

X-rays, operation notes, discharge summaries and clinic letters were reviewed to assess the outcomes associated with the treatments. Each fracture was assessed and scored using Pauwels and Gardens classifications¹ to ensure homogeneity between the DRS group and the non-DRS group with regards to fracture severity. The follow-up was reviewed and a negative outcome was defined as the need for revision surgery to hip arthroplasty.

The following inclusion criteria were applied:

1. Patient sustained intracapsular NOF fracture between the 1st April 2009 and 31st March 2014.
2. The fracture was treated with 2-hole dynamic hip screw.
3. Patient has been followed up for a minimum of 1-year following surgery.

Results

Patient demographics and fracture severity

Patient demographics between the groups are summarised in Table 1. The Pauwels and Gardens scores are shown in Table 2 and Table 3. Pauwels score cut-offs are 0–30° for 1, 30–50° for 2 and

Table 1. Summary of patient demographic in both groups. DRS: permanent derotation screw.

	DRS group	Non-DRS group	p-value (95% CI) statistical method
Number of patients	28	36	
Mean age (years)	70.89	72.67	P= 0.570 (-7.99 to 4.44 years) 2-tailed student t-test
Age range (years)	51–92	46–91	
Female (%)	21 (75%)	26 (72%)	P= 0.5951 Chi-Squared test
Male (%)	7 (25%)	10 (28%)	
Mean fracture angle (degrees)	39.78	35.18	P=0.0924 (-0.78 to 9.98 degrees) 2-tailed student t-test

>50° for 3¹². The mean fracture angle in the DRS group was 39.78 degrees (SD 11.11) compared to 35.18 degrees (SD 9.69) in the non-DRS group, and the proportion of each fracture character in the 2 groups shows a similar distribution. We therefore determined that the groups were sufficiently homogeneous to allow comparison.

Rate of Revision

The patients in the DRS group had a significantly lower rate of revision to arthroplasty than those in the non-DRS group ($p=0.0203$), as shown in Table 4. Without a derotation screw the revision rate was 39%, in comparison to 14% when a DRS was used.

Dataset 1. Source data used as a basis for the findings in this study

<http://dx.doi.org/10.5256/f1000research.11433.d161270>

Data collected for this study was collected through Hull Royal Infirmary's hip fracture database, which is gathered for the national hip fracture database (NHFD).

Table 2. Distribution of Pauwels classification in the DRS and non-DRS group.

Pauwels score	DRS	Non-DRS
1	10 (36%)	9 (25%)
2	17 (61%)	22 (61%)
3	1 (4%)	5 (14%)

Table 3. Distribution of Gardens classification in the DRS and non-DRS group.

Gardens Classification	DRS	Non-DRS
1	15 (54%)	20 (56%)
2	3 (11%)	6 (17%)
3	10 (36%)	10 (28%)
4	0 (0%)	0 (0%)

Table 4. Revision rate in patients treated with DHS and DRS compared to those treated with DHS alone.

N=64	Derotation screw	No derotation screw	
No Revision	24 (76%)	22 (61%)	
Revision	4 (14%)	14 (39%)	P=0.0299

Discussion

Employing a permanent derotation screw alongside a dynamic hip screw seems to offer protection against requirement for revision to arthroplasty, carrying a relative risk reduction of 66% and NNT of 4.06. This NNT suggests the clinical impact of routinely employing a DRS could be quite significant, and needs to be further investigated with robust, prospective clinical studies. To the best of the our knowledge, there are no previous studies analysing the impact a derotation screw has on the failure rate of 2-hole sliding hip screws when used for treating intracapsular hip fractures.

Of the 18 patients requiring revision, 16 underwent total hip arthroplasty, 1 underwent hemiarthroplasty and one (in the non-DRS group) was managed conservatively despite requiring revision. We included this patient as it was documented that they required revision to arthroplasty, but were not fit for surgery, and therefore met our definition of a negative outcome.

Limitations

When reviewing images it was not possible to ascertain whether an intraoperative derotation wire had been used as these images were rarely saved, and operative notes were unreliable in reporting this. Our non-DRS group therefore likely contained some patients that were covered with an intraoperative derotation wire and some that were not.

Conclusions

This study shows a reduced rate of revision to arthroplasty when a permanent DRS was used alongside a 2-hole DHS for fixation of intracapsular neck of femur fractures when compared to DHS alone. Given effect size suggested in this study and potential improvements in patient care that could be achieved we recommend this is an area that should be investigated with a randomised controlled trial.

Data availability

Dataset 1: Source data used as a basis for the findings in this study. Data collected for this study was collected through Hull Royal Infirmary's hip fracture database, which is gathered for the national hip fracture database (NHFD). DOI, [10.5256/f1000research.11433.d161270](https://doi.org/10.5256/f1000research.11433.d161270)¹³.

Consent

All data collected for this study was collected through Hull Royal Infirmary's hip fracture database, which is gathered for the national hip fracture database (NHFD). From the [NHFD website](#): "the NHFD is approved by the NHS England HRA Confidentiality Advisory Group (CAG) to collect patient data without consent under Section 251 exemption. (This approval was formerly administered under the NIGB-ECC/PIAG)." and "patients do not need to give formal consent" for data to be collected, but "may opt out if they wish".

Author contributions

SW, lead researcher and author, designed the study, collected data, analysed data and performed the write up. RP performed background research and contributed to the write up. IV assisted with data collection and analysis. AA-M obtained patient lists and internal permissions. RM oversaw the project.

Competing interests

No competing interests were disclosed.

Grant information

The author(s) declared that no grants were involved in supporting this work.

Supplementary material

Supplementary File 1: Statistical analysis of the source data summarising the main findings. Statistics were calculated using SPSS.

[Click here to access the data.](#)

References

1. Parker MJ: **The management of intracapsular fractures of the proximal femur.** *J Bone Joint Surg Br.* 2000; **82**(7): 937–941.
[PubMed Abstract](#)
2. Deneka DA, Simonian PT, Stankewich CJ, *et al.*: **Biomechanical comparison of internal fixation techniques for the treatment of unstable basicervical femoral neck fractures.** *J Orthop Trauma.* 1997; **11**(5): 337–43.
[PubMed Abstract](#) | [Publisher Full Text](#)
3. Stankewich CJ, Chapman J, Muthusamy R, *et al.*: **Relationship of mechanical factors to the strength of proximal femur fractures fixed with cancellous screws.** *J Orthop Trauma.* 1996; **10**(4): 248–57.
[PubMed Abstract](#) | [Publisher Full Text](#)
4. Bergmann G, Deuretzbacher G, Heller M, *et al.*: **Hip contact forces and gait patterns from routine activities.** *J Biomech.* 2001; **34**(7): 859–71.
[PubMed Abstract](#) | [Publisher Full Text](#)
5. Freitas A, Torres GM, Souza AC, *et al.*: **Analysis on the mechanical resistance of fixation of femoral neck fractures in synthetic bone, using the dynamic hip system and an anti-rotation screw.** *Rev Bras Ortop.* 2014; **49**(6): 586–592.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
6. Blair B, Koval KJ, Kummer F, *et al.*: **Basicervical fractures of the proximal femur. A biomechanical study of 3 internal fixation techniques.** *Clin Orthop Relat Res.* 1994; (306): 256–63.
[PubMed Abstract](#)
7. Sim E, Schmiedmayer HB, Lugner P: **Mechanical factors responsible for the obstruction of the gliding mechanism of a dynamic hip screw for stabilizing pertrochanteric femoral fractures.** *J Trauma.* 2000; **49**(6): 995–1001.
[PubMed Abstract](#) | [Publisher Full Text](#)
8. Stiasny J, Dragan S, Kulej M, *et al.*: **Comparison analysis of the operative treatment results of the femoral neck fractures using side-plate and compression screw and cannulated AO screws.** *Ortop Traumatol Rehabil.* 2008; **10**(4): 350–61.
[PubMed Abstract](#)
9. Swiontkowski MF, Harrington RM, Keller TS, *et al.*: **Torsion and bending analysis of internal fixation techniques for femoral neck fractures: the role of implant design and bone density.** *J Orthop Res.* 1987; **5**(3): 433–444.
[PubMed Abstract](#) | [Publisher Full Text](#)
10. Bonnaire FA, Weber AT: **Analysis of fracture gap changes, dynamic and static stability of different osteosynthetic procedures in the femoral neck.** *Injury.* 2002; **33**(Suppl 3): C24–32.
[PubMed Abstract](#) | [Publisher Full Text](#)
11. Baitner AC, Maurer SG, Hickey DG, *et al.*: **Vertical shear fractures of the femoral neck. A biomechanical study.** *Clin Orthop Relat Res.* 1999; (367): 300–5.
[PubMed Abstract](#)
12. Bartonicek J: **Pauwels' classification of femoral neck fractures: correct interpretation of the original.** *J Orthop Trauma.* 2001; **15**(5): 358–60.
[PubMed Abstract](#) | [Publisher Full Text](#)
13. Woods S, Pilling R, Vidakovic I, *et al.*: **Dataset 1 in: To derotate or not to derotate: A retrospective study on the impact of derotation screws on the revision rate of 2-hole dynamic hip screw fixation of intracapsular neck of femur fractures.** *F1000Research.* 2017.
[Data Source](#)

Open Peer Review

Current Peer Review Status:

Version 1

Reviewer Report 20 November 2017

<https://doi.org/10.5256/f1000research.12344.r28128>

© 2017 Testa G. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Gianluca Testa

Department of General Surgery and Medical-Surgical Specialties, Section of Orthopaedics and Traumatologic Surgery, Azienda Ospedaliero - Universitaria Policlinico-Vittorio Emanuele, University of Catania, Catania, Italy

The article is written with a native English, but a poor number of patients was included in the study. The Methods and Results must be better reported (percentage and range must be added). Discussion is poor and does not justify the findings described - the number of patients is not sufficient to determine conclusions. Newer references should be considered.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

No

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

No

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 21 June 2017

<https://doi.org/10.5256/f1000research.12344.r23554>

© 2017 Karuppall R. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Raju Karuppall

Department of Orthopaedics, Government Medical College, Kozhikode, Kozhikode, Kerala, 673602, India

The objective of the article is interesting. The problems are mainly the small sample size, how do they randomise the sample and the discussion part is poorly written. How do the researchers assess the sole reason for revision in non-DRS group. The result/ statistical part needs to be improved by including more details of patient demographics.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 06 June 2017

<https://doi.org/10.5256/f1000research.12344.r23260>

© 2017 Parker M. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Martyn J Parker

Department of Orthopaedics, Peterborough and Stamford Hospitals NHS Foundation Trust,
Peterborough City Hospital, Bretton Gate, Peterborough, Cambridgeshire, UK

Essentially the article is concise and well written. The problem is the small number of patients studied, there really have not been a sufficient number to be able to justify the conclusions stated in this article. Other comments are -

There must have been many more patients treated by internal fixation over the 5 year study period. This is a selected group of patients. How were they selected?

Numbers not just percentages must be given in the abstract.

There are only very limited presentation of the patient demographics.

There is only need for one decimal place.

Were there more displaced fractures in the de-rotation screw group?

The treatment of the complications should be in the results not the discussion.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

No

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

No

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for

reasons outlined above.

Author Response 12 Jun 2017

simon woods, Leeds General Infirmary, Leeds, UK

Many thanks for taking the time to review our article, we hope this addresses some of your feedback.

How were they selected?

The patient's were not actively selected. A list of patients sustaining intracapsular neck of femur fracture NOT treated with arthorplasty (hemi/THR) was obtained (2642 patients). From this we reviewed patient imaging and eliminated those that had been miscoded (2481 patients: mostly patients that had actually been treated with arthoplasty, or extracapsular fractures). A further 39 were eliminated if they did not have clinical follow up for 1 year post op. This left 122 patients, 58 treated with cannulated screws and not included in this study, 64 teated with 2-hole DHS.

We don't doubt there were also patients with IC NOFs treated with fixation that were incorrectly coded and so lost to this study, but there was no intentional patient selection. This would have been included in the limitations section given more words to use.

There are only very limited presentation of the patient demographics.

There is a 1000 word limit and so we only reported age, sex, and fracture angle.

Were there more displaced fractures in the de-rotation screw group?

The distribution of Garden classification and Pauwel scores can be found in tables 2 and 3

The treatment of the complications should be in the results not the discussion

True. There is a lot more we would have liked to included in the discussion but were limited by the 1000 word limit

Competing Interests: No competing interests were disclosed.

The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com

F1000Research