

Medium Term Outcome of Lancaster Cortical Window Technique For Extraction of Femoral Stem in Revision Hip Arthroplasty

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Abstract

Background The extraction of a femoral stem during the revision hip arthroplasty can be a daunting task and can lead to catastrophic complications for the patient. A sound technique employed intraoperatively helps in speedy recovery of the patient and reduces the risk of future surgical interventions. In this study, we present a medium-term outcome of our novel Lancaster Cortical Window technique which can be used for removal of cemented or uncemented femoral stems.

Methodology The study was conducted at a specialist centre in the North-West of the UK from January 2014 to May 2019. This is a retrospective case series where patients were treated surgically using Lancaster Cortical Window technique for removal of femoral implant during a revision hip arthroplasty. Patient's electronic notes and the radiographs were used to evaluate the functional and radiological outcome.

Results In this study, 18 patients were managed surgically using Novel Lancaster Window technique. The mean age of the all the patients was 81.5 years and the male to female ratio was 10:8. Fifteen patients underwent revision surgery for aseptic loosening of the femoral and acetabular component. Rest of the three patients had revision surgery for a broken femoral stem, intraoperative femoral canal perforation while implanting a total hip replacement femoral stem and infection. Twelve femurs were replanted with uncemented long femoral stems and six with long cemented stems. The cortical window osteotomy united in all the patients in 4.2 months (mean). The mean follow up of these patients is 20.9 months, and none of them had any implant subsidence or loosening at the time of their last follow up.

Conclusion We believe Lancaster cortical window technique can be safely used for removal of cemented stems during revision hip arthroplasty without the need for expensive equipment's.

1. Introduction

Revision hip arthroplasty is a complicated procedure and is associated with significant risks for the patients (Dy et al., 2014). A poor technique for extraction of components of a hip replacement can lead to complications such as fractures, massive blood loss, prolong surgical time and increased risk of post-operative infection (Akrawi et al., 2014). Operating surgeon must be aware of surgical techniques which can mitigate these risks.

A cemented femoral stem is implanted using a bone cement which acts as a grout instead of a glue. The bone cement forms a close interlock with the femoral stem and the bone (Vaishya, Chauhan and Vaish, 2013). Hence, extraction of this stem would require removal of metalwork as well as the bone cement within the intramedullary canal (Hofmann and Anderson, 1987). The indications for removal of components include aseptic loosening, broken stem, infection and periprosthetic fractures (Laffosse, 2016)

The commonly used method for extraction of cemented femoral stem is extended trochanteric osteotomy (Kraay, 2015). But the technique is associated with a high risk of non-union and bone resorption (Hellman, Capello and Feinberg, 1998). We previously have described a novel cortical window technique at the lateral aspect of the femoral shaft for removal of the cemented femoral stem (Singhai et al., 2019). We now present detail information on Lancaster cortical window technique along with the medium-term functional and

radiological outcome of our patients who underwent revision hip arthroplasty using this technique at our institute.

2. Material And Methods

This is a retrospective case series in which experienced revision arthroplasty surgeons operated on all the patients using Lancaster cortical window technique as part of revision hip arthroplasty for removal of the cemented femoral stem. The study was conducted at our institute in the North-West of the UK between January 2014 to May 2019. We included all the patients in this study who were managed surgically using Lancaster cortical window technique. Data collection was performed using patient electronic notes and radiographs. The purpose of the study was to find out if our technique can be safely used for removal of cemented femoral stem without increasing the risk of non-union, periprosthetic fracture and implant loosening. We also analysed the data to see if the patient's immediate post-operative mobility was affected directly due to cortical window. The mobility status and pain levels were assessed at regular follow up, which was at six weeks, three months, one year and then yearly. Below is the detail description of the surgical technique along with the intraoperative images, which we hope will provide in-depth insight to the reader about this novel technique.

2.1 Surgical Technique

The site for the cortical window should be marked preoperatively using the radiographs. First, the starting point of the cortical window is measured from the tip of the greater trochanter. Following that approximate length of the osteotomy is marked to cover the end of the femoral stem, cement column beyond the tip of the stem and the cement restrictor (**Image – 1 and 2**).

Intraoperatively, Vastus lateralis is split to expose the lateral aspect of the femoral shaft, and the starting point is marked at a prefixed distance from the tip of the greater trochanter using a sterile ruler (**Image – 2**). Occasionally, femoral stem is loose and easily extracted after clearing bone cement from the shoulder of the implant. However, osteotomy may still be required to clear the cement column beyond the tip of femoral stem as shown in **image 1 a and 1 b**. In this situation, the femoral stem removed can itself be used as a template to mark the osteotomy site by placing the stem along the lateral aspect of femoral shaft. The average width of the osteotomy is 2.5 cm, but it also depends upon the width of the lateral cortical surface.

Now the four corners of osteotomy are drilled with a 2 mm drill bit. A narrow oscillating saw is used to connect these four corners and the osteotomy is completed with an osteotome. The saw and the osteotome should be angled to about 45 degrees to create a sloping edge which increases the surface area and improves healing as shown in image 3 a (**Image – 3**). The window is a rectangular shape, and any sharp corners should be avoided to reduce the risk of a stress riser. The cortical window can now be used to assess femoral stem, cement and the cement restrictor (**Image – 3B**). A cerclage wire can also be placed in the beginning below the site of cortical window to prevent any fractures. It is particularly important in patients with significant bone loss due to osteolysis.

After removing femoral stem and bone cement from intramedullary canal, the square piece of bone is replaced, and the window is stabilised with one or two cerclage wires (**Image – 4A**). If there are concerns about bone

healing, one can also consider using a bone grafting. The surgeon can now proceed with the preparation of femoral canal for reimplantation of cemented or uncemented femoral stem.

3. Results

During January 2014 to May 2019, 18 patients were surgically managed using Lancaster cortical window technique at our specialist centre. The mean age of these patients was 81.5 years (range 76–94 years), and the male to female ratio was almost equal (M: F = 10:8). Two patients in this study had a background of inflammatory arthritis, but this did not adversely affect the outcome.

The indications for revision hip arthroplasty for all the patients have been described in table – 1. One patient had a perforation of the femoral canal while undergoing revision arthroplasty for aseptic loosening of a total hip replacement. This intra-operative complication was recognised after the implantation of the cemented femoral stem. Hence, the patient underwent removal of the cemented femoral stem by our team using a cortical window technique (**Table – 1**).

All the revision surgeries were performed using the posterior approach. In all the patients, both acetabular cup and femoral stem were revised except in the patient with the broken femoral stem of the primary hip replacement (**Table – 2**). Twelve patients received long uncemented femoral stem where primary stability is achieved by diaphyseal fixation, and the rest of the six patients underwent reimplantation with a cemented femoral stem. The cortical window in all the patients was stabilised using one or two cerclage wire. No bone graft was used in any of the patients (**Image 5**).

The cortical window radiologically healed by 4.2 months (mean) in all the patients except two who did not have regular follow up after the initial visit to the clinic at six weeks. These two patients were medically unwell from the causes unrelated to the surgery. However, these two patients did have a yearly follow up and at their latest visit to the hospital the radiographs conformed that osteotomies have healed. In the immediate postoperative period, 16 out of 18 patients were able to mobilise bearing full weight over the operative limb. Two patients were advised to maintain protected weight-bearing for six weeks as there was significant bone loss around the femoral stem due to osteolysis. Both the patients received long uncemented femoral stem.

The mean follows up in this study is of 20.9 months. At the most recent follow up of 18 patients, all of them were mobilising pain-free, bearing full weight over the operated limb. Eight out of eighteen patients needed a single stick for support due to factors such as advancing age or worsening arthritis in the ipsilateral knee (**Table – 3**). No change was noticed in femoral stem position in the form of subsidence or implant loosening.

We had three patients who had hip dislocation within three months of the surgery. Out of three, two patients needed further surgical intervention in the form of an application of constrained acetabular liner and posterior lip augmentation device. One patient had closed reduction of the hip, and as the hip was stable, no further surgical intervention was required. This patient did not have any additional episodes of hip dislocation during the follow-up. None of the patients had any intraoperative fractures. But two patients had distal femur fracture after three months of revision surgery and needed internal fixation with locking plate and screws. The fractures were distant from the cortical window site, and osteotomy has healed at the time of these injuries.

4. Discussion

Total hip replacement is considered one of the most successful orthopaedic procedure and has high patient satisfaction rate (Learmonth, Young and Rorabeck, 2007). As per the UK National joint registry, the 15-year revision rate for a cemented hip replacement is 5.46 % (Reports.njrcentre.org.uk, 2020). At the time of revision hip replacement surgery, removal of components of a cemented hip replacement requires specialised skills and instruments (Kraay, 2015). The most common surgical technique described in the literature is ETO (extended trochanteric osteotomy) (Masri, Mitchell and Duncan, 2005). The ETO can also be used to correct varus femoral deformity, which is secondary to bone remodelling around a loose femoral component (VALLE et al., 2003). But the current literature suggests that ETO is also associated with complication such as arterial injury, intra and post-operative fractures, proximal migration of osteotomy fragment and non-union (Wronka et al., 2020).

There have been several versions of cortical osteotomy described in the literature for extraction of the broken femoral stem (Akrawi et al., 2014) or removal of cemented/uncemented femoral stem (Harada and Fujita, 2016). But these are the technique described in a case report or in the form of a case series with smaller sample size and limited follow up. This affects the external validity of these studies. There is also a lack of insight into the long-term consequences of these techniques, such as implant subsidence or loosening.

Park et al., (2019) described their version of anterior cortical window technique for removal of the femoral stem during revision arthroplasty. In this study, the implant subsidence rate was 8.4% (within one year of surgery), and non-union rate for the cortical window was 2%. The reoperation rate was also significantly high, i.e. 21.4% due to factors such as loosening of the femoral stem and acetabular cup, bursitis related to cerclage wire, periprosthetic femur fracture, prosthetic joint infection and superficial wound infection. The technique is also different from ours as the length of the window is almost equal to an ETO, extending from the shoulder of the stem to the end of cement restrictor. This technique does warrant patients mobilise with protective weight-bearing over operated limb for six weeks. In our study, all cortical windows united mainly due to the smaller size of the window in addition to the meticulous surgical technique. The bevelled edge created by angulating the saw while making the window increases the surface area, and once the window is reduced, it heals with primary healing (Marsell and Einhorn, 2011). The osteotomy was considered healed when cortical bridging was noticed on anterior-posterior and lateral radiographs (Fisher et al., 2018). We did not see a change in implant position in any of our patients during the follow-up, and all the patients were allowed full weight-bearing over revised hips.

Melmer et al., (2004) in their study described long anterolateral cortical window which is made near the tip of the stem. Unfortunately, the author fails to explain the methodology of deciding the site of the window. A window made far from the implant tip will require alteration and further extension. This can potentially increase the length of the window and also the associated risks such as periprosthetic fracture and implant subsidence. In their study, 5.8% of the patients had implant subsidence post osteotomy. To avoid such complications, we believe that it is crucial to mark the osteotomy site by assessing preoperative radiographs or CT scan as described in our surgical technique.

We acknowledge that there are limitations to this study. This is a retrospective case series and provides level IV evidence (Murad et al., 2018). But the follow up of almost 2 years of majority of the patients in this study,

provide a strong evidence that this technique does not increase the risk of intraoperative fractures and implant failure.

5. Conclusion

We believe the surgical technique described in this study is reproducible and has fewer complications. The procedure does not warrant any unique instrument and hence avoid the need for surgeons to add a more complex and expensive kit to their standard revision instruments set. Due to the compact size of the osteotomy and inherent stability, patients can be allowed to full weight bear in the immediate post-operative period, and this expedites patient rehabilitation in turn shorter inpatient stay.

6. Abbreviations

Not applicable

7. Declarations

- Ethics approval and consent to participate

The study was conducted after obtaining approval from the institute research and audit department.

- Consent for publication

Not applicable

- Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

- Competing interests

The authors declare that they have no competing interests

- Funding

No funding was required for this study.

- Authors' contributions

The authors AS, SM, SG and NC contributed to data collection and analysis. All patients underwent surgery by KP and DH. AS, KP and DH have contributed majorly in writing manuscript. All authors read and approved the final manuscript.

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Not applicable

References

1. AKRAWI, H., MAGRA, M., SHETTY, A. and NG, A., 2014. A modified technique to extract fractured femoral stem in revision total hip arthroplasty: A report of two cases. *International Journal of Surgery Case Reports*. 5 (7), pp. 361-364.
2. Buehler, K.O. and Walker, R.H., 1998. Polymethylmethacrylate removal from the femur using a crescentic window technique. *Orthopedics*, 21(6), pp.697-700.
3. DY, C., BOZIC, K., PAN, T., WRIGHT, T., PADGETT, D. and LYMAN, S., 2014. Risk Factors for Early Revision After Total Hip Arthroplasty. *Arthritis Care & Research*. 66 (6), pp. 907-915.
4. FISHER, J., KAZAM, J., FUFA, D. and BARTOLOTTA, R., 2018. Radiologic evaluation of fracture healing. *Skeletal Radiology*. 48 (3), pp. 349-361.
5. HOFMANN, A. and ANDERSON, M., 1987. Removal of cemented total hip components. *Techniques in Orthopaedics*. 2 (1), pp. 34-40.
6. HELLMAN, E., CAPELLO, W. and FEINBERG, J., 1998. Nonunion of extended trochanteric osteotomies in impaction grafting femoral revisions. *The Journal of Arthroplasty*. 13 (8), pp. 945-949.
7. HARADA, H. and FUJITA, H., 2016. A Novel Antero-Medial Cortical Window Technique for Removal of Well-Fixed Fully Porous Stem in Revision Total Hip Arthroplasty. *Orthopedic & Muscular System*. 05 (02).
8. Kraay, M.J., 2015, February. CEMENTED COMPONENT REMOVAL: TRICKS OF THE TRADE. In *Orthopaedic Proceedings*(Vol. 97, No. SUPP_1, pp. 52-52). The British Editorial Society of Bone & Joint Surgery.
9. LAFFOSSE, J., 2016. Removal of well-fixed fixed femoral stems. *Orthopaedics & Traumatology: Surgery & Research*. 102 (1), pp. S177-S187.
10. LEARMONTH, I., YOUNG, C. and RORABECK, C., 2007. The operation of the century: total hip replacement. *The Lancet*. 370 (9597), pp. 1508-1519.
11. MASRI, B., MITCHELL, P. and DUNCAN, C., 2005. Removal of Solidly Fixed Implants During Revision Hip and Knee Arthroplasty. *Journal of the American Academy of Orthopaedic Surgeons*. 13 (1), pp. 18-27.
12. MARSELL, R. and EINHORN, T., 2011. The biology of fracture healing. *Injury*. 42 (6), pp. 551-555.
13. MELMER, T., STEINDL, M., SCHIESSEL, A. and A ZWEYMÜLLER, K., 2004. Fenestration of the Femoral Shaft: A Standard Procedure in Revision Hip Surgery Without Bypassing the Cortical Defect. *Orthopedics*. 27 (9), pp. 965-966.
14. MURAD, M., SULTAN, S., HAFFAR, S. and BAZERBACHI, F., 2018. Methodological quality and synthesis of case series and case reports. *BMJ Evidence-Based Medicine*. 23 (2), pp. 60-63.
15. PARK, C., YEOM, J., PARK, J., WON, S., LEE, Y. and KOO, K., 2019. Anterior Cortical Window Technique Instead of Extended Trochanteric Osteotomy in Revision Total Hip Arthroplasty: A Minimum 10-Year Follow-up. *Clinics in Orthopedic Surgery*. 11 (4), p. 396.
16. Reports.njrcentre.org.uk[online]. Available from: <https://reports.njrcentre.org.uk/Portals/0/PDFdownloads/NJR%2016th%20Annual%20Report%202019.pdf> [Accessed 13 May 2020].
17. Singhai, S., Gandavaram, S., Herlekar, D. and Patel, K., 2019. Effectiveness of Cortical Window Technique for Revision Hip Arthroplasty. *Orthopaedic Journal of MP Chapter*, 25(1).

18. VAISHYA, R., CHAUHAN, M. and VAISH, A., 2013. Bone cement. Journal of Clinical Orthopaedics and Trauma. 4 (4), pp. 157-163.
19. VALLE, C., BERGER, R., ROSENBERG, A., JACOBS, J., SHEINKOP, M. and PAPROSKY, W., 2003. EXTENDED TROCHANTERIC OSTEOTOMY IN COMPLEX PRIMARY TOTAL HIP ARTHROPLASTY. The Journal of Bone and Joint Surgery-American Volume. 85 (12), pp. 2385-2390.
20. WRONKA, K., GERARD-WILSON, M., PEEL, E., ROLFSON, O. and CNUUDE, P., 2020. Extended trochanteric osteotomy: improving the access and reducing the risk in revision THA. EFORT Open Reviews. 5 (2), pp. 104-112.

Tables

Table 1

Indications for revision arthroplasty and patient distribution

Indication	Number of Patients
Aseptic loosening	15
Infection	1
Broken femoral stem	1
Intraoperative femoral canal perforation	1

Table 2

Distribution of patients as components revised, technique of revised femoral stem implantation and cortical window union rate

Surgical Intervention	No of Patients
Acetabular cup revised	17
Femoral stem revised	18
Revision with long uncemented stem	12
Revision with long cemented stem	6
Cortical window union	18

Table 3

Mobility and Pain status of patients at last follow up

Mobility Status	No of Patients	Pain
Full Weight bearing	10	No
Full Weight bearing with support	8	No

Figures



A



B

Figure 1

a & b – Radiograph showing broken femoral stem. Note the cement column beyond the tip of femoral stem in image a

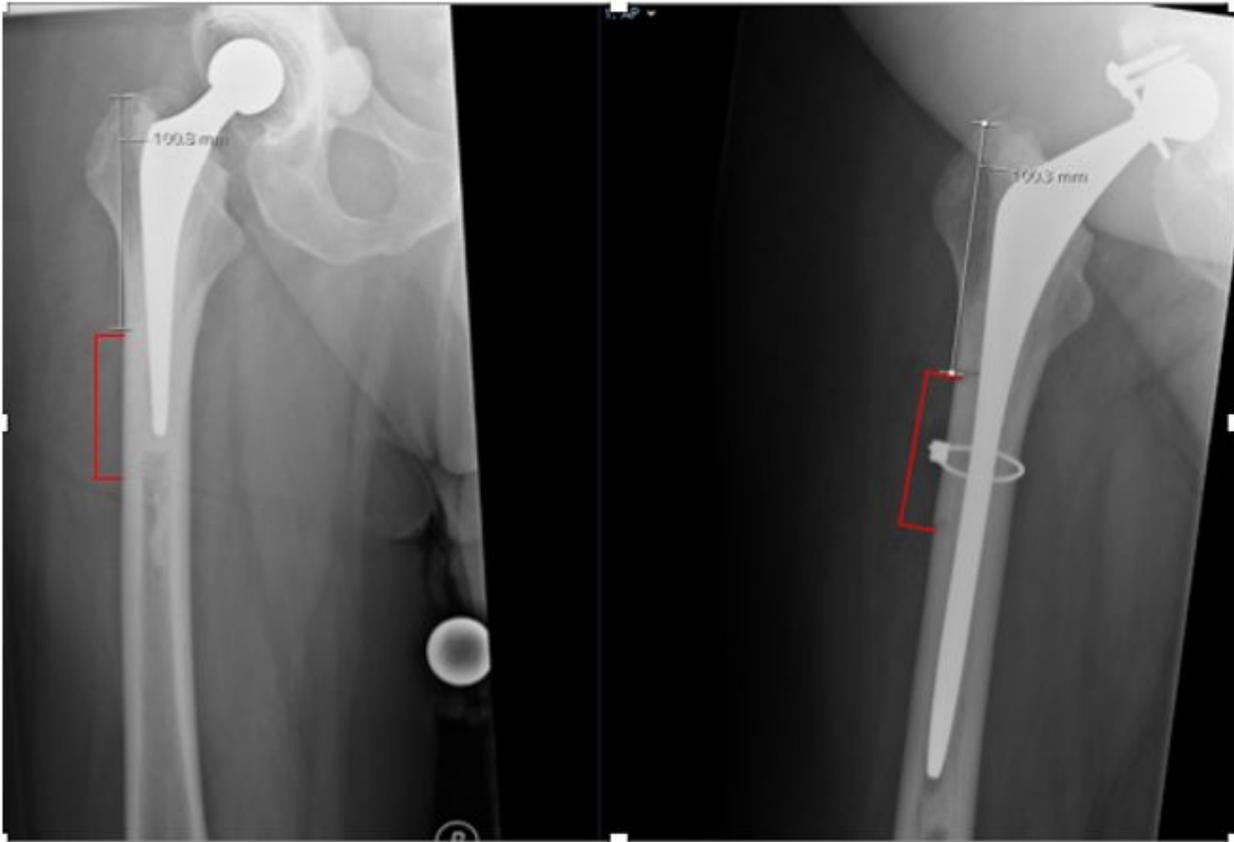


Figure 2

Radiographs of a patient with infected cemented THR, marked preoperatively for osteotomy site. Note the starting point of osteotomy site measured from the tip of greater trochanter

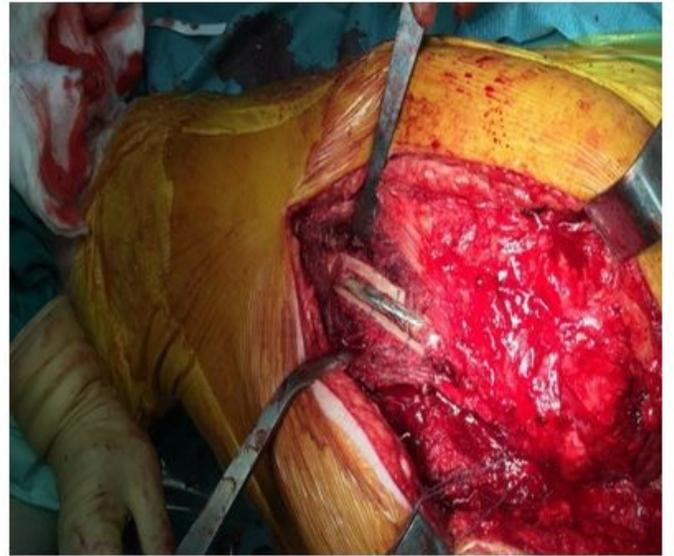


Figure 3

Intraoperative marking the starting and the end point of osteotomy



a



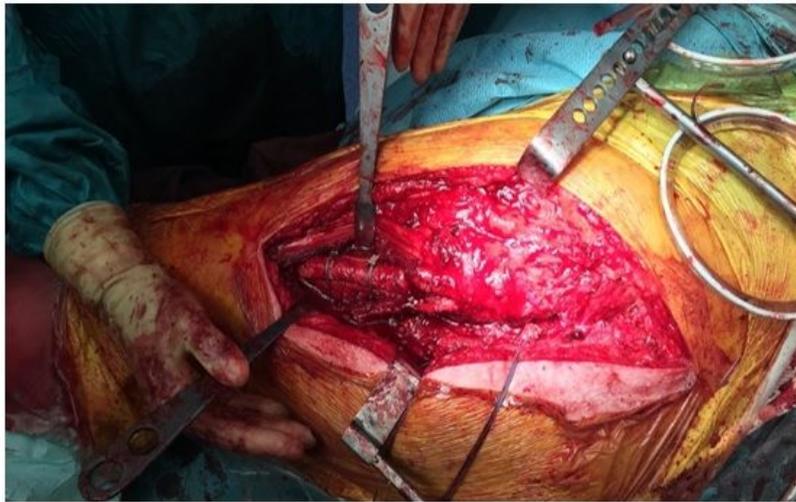
b



c

Figure 4

a- Creating window using narrow osteotome. b- Lancaster Cortical Window along lateral femoral cortex with exposed cement and femoral stem. c – Retrograde extraction of stem once bone cement is cleared around the femoral stem.



a



b



c

Figure 5

a – Intraoperative image showing stabilization of window with cerclage wires. b – Immediate Post-Operative radiographs. c – 2 years Follow Up radiograph with healed cortical window osteotomy