‘Rail Road’ Proximal Femoral Osteotomy: A New Technique to Remove Well-Fixed Femoral Stem or Cement Mantle in Revision Total Hip Arthroplasty

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Objective: *To present the institutional experiences of using a new and simple surgical technique to remove well-fixed femoral stem or cement mantle in revision total hip arthroplasty (THA).*
Material and Method: *A retrospective chart review of patients who had revised total hip arthroplasty by the “railroad technique” between January 2007 and January 2009 at Orthopedics department, Khon Kaen hospital was done. The Railroad (long parallel) osteotomy was performed at proximal femur in patients who had complicated revision femoral stem or had removed cement mantle. Long revision stem was used together with the osteotomised bone fragment, which was fixed with cerclage wires. Outcomes of this technique were assessed based on the postoperatively revision stem stability, bone ingrowth, osteotomised bone fragment union, and complications.*
Results: *Twenty railroad proximal femoral osteotomies in 19 patients were performed to remove femoral stem or cement mantle. Postoperative assessment showed good stability, evidence of bone ingrowth, and bone fragment union. No complications including infection, fracture, dislocation, or subsidence were reported.*
Conclusion: *Railroad technique used in the complicated femoral revisions provided great clinical outcomes with no complication. This evidence supports the practical use of railroad technique, which requires basic instruments to perform.*

Keywords: *Railroad, Proximal femoral osteotomy, Revision total hip arthroplasty, Remove femoral stem, Well fixed femoral stem, Technique remove stem*

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The number of patients requiring revision total hip arthroplasty (THA) continues increasing. One major problem of revision THA is the removal of well-fixed implant or cement mantle, which is made possible by many techniques including standard and modified trochanteric osteotomy. The choice of osteotomy depends on the need for exposure in a particular situation during operation. Knowledge of the biomechanics of these osteotomies may prove to be useful for lowering risk of complications. We study pitfalls of the old surgical technique and present simple technique that can solve many problems. The goal of this study is to present a new proximal femoral osteotomy technique that has adequate exposure, ease of stem removal, and low complications including stem stability, fracture, reduced weakness of abductor mechanism, and bone loss, requiring only conventional instrument.

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Material and Method

We reviewed all patients who had revisions total hip arthroplasty by using Railroad osteotomy technique between January 2007 and January 2009 at Orthopedics department, Khon Kaen Hospital. These osteotomies were performed by one surgeon (KP). Railroad osteotomy is defined as long parallel osteotomy that looks similarly to a railroad.

The eligible criteria for this surgery technique were (i) those patients who had the complex revision stem based on the pre-operative radiographic assessment, type of femoral stem, and clinical symptoms,

(ii) patients who the surgeon expected having difficulty to remove cement and femoral implant without osteotomy proximal femur.

Surgical technique

Extended posterolateral approach was used. Greater trochanteric-neck junction was identified; railroad (long parallel) osteotomy line was marked with electrocautery at posterolateral aspect of proximal femur. The end of osteotomised length was 1 cm above stem's tip or proximal to the distal extent of the cement mantle measured from radiography. The width of osteotomised was one-third to one- half of the femoral width diameter. Oscillating saw and osteotome are required to complete the cut. The osteotomised bone fragment was elevated.

A curve osteotome was used to separate femoral stem from inner cortex of the femur. Each femur was reamed in step-wise fashion, typically under reamed 0.5 mm compared to diameter of revision femoral component. The femoral component, 20 cm fully porous coated curve stem with collar (Solution® stem, DePuy Orthopedics, Inc, Warsaw, IN, USA) was press-fit into place until there was contact between the collar and cut surface of the femoral neck or the stem was complete tightness. At the end of the operation, osteotomised bone fragment was positioned at the desired level then was fixed with double horizontal cerclage wires in 2.5 cm interval. The fixation was provided by the revision femoral stem. Finally, strut bone graft was added at this point to augment proximal bone stock if required (Fig. 1).

Outcomes assessment

Clinical outcomes of THA using the railroad osteotomy were postoperatively assessed in three aspects. Firstly, evidence of bone ingrowth is defined as increased density of bone adjacent to the porous coating and absent of diverging radiolucent line, stem subsidence, and pedestal sign. Secondly, the evidence of bone fragment union is defined as radiolographic study of bone fragment show homogenization, callus formation and then follow by development of the trabecular structure. Thirdly, the complications *e.g.* fracture, dislocation, subsidence, and infection from the surgeries were examined.

Results

Twenty railroad proximal femoral osteotomies were performed in 19 patients (Table 1). There were ten male and nine female patients. One male patient had bilateral osteotomies of proximal femur. The mean age was 46.84 years (range 23-65 years). The average length of follow-up was 12.05 months (range 2-24 months). The follow-up was every 1-2 months in the consecutive sequences and there was no lost of follow-up. The indications for revision THA were acetabulum bone erosion of the hemiarthroplasty (12 hips, 60%) and aseptic loosening THA (8 hips, 40%). Previous stem components were cemented in 14 hips (70%) and cementless in six hips (30%). In the last follow-up date, all patients had evidently improved in bone ingrowth, and osteotomised bone fragment union. There is no patient with significant complication (Table 2).

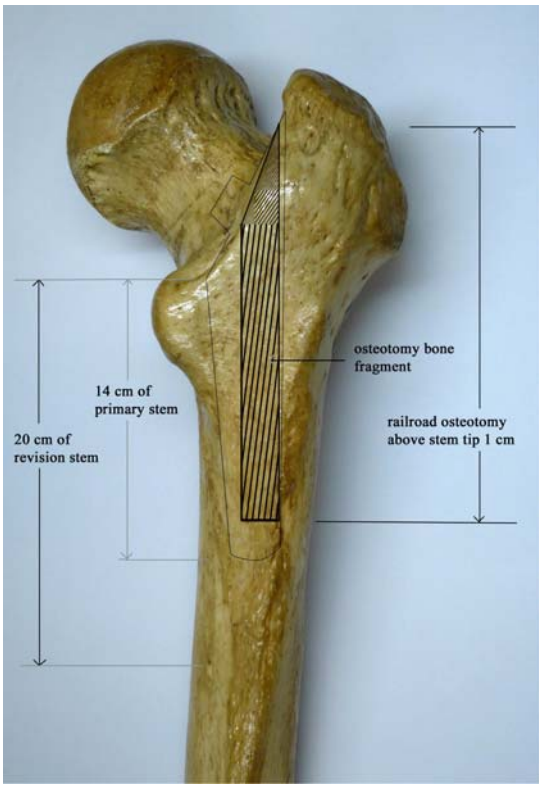

Fig. 1 Demonstration of railroad proximal femoral osteotomy

Discussion

Removal of the stem is doable by many techniques including standard trochanteric osteotomy, extended trochanteric sliding osteotomy[1,16], trochanteric slide osteotomy[2], femoral bone slot osteotomy[3,4], posterior longitudinal split osteotomy[5], extended trochanteric osteotomy[6-11] and modified trochanteric osteotomy[12]. Despite the efficacy of

Table 1. Patient demographic data

Mean age, years (range)	46.84 (23-65)
Operative side, hips	Right 13
	Left 7
Sex	Male 10
	Female 9
Causes of revision THA, hips	Acetabulum erosion 12
	Loosening THA 8
Length of osteotomy, average (range)	11.7 cm (10.5-12.5)
Number of cerclage wires, range	4-6 loops
Causes of osteotomy, hips	Remove distal stem fracture 1
	Remove cement mantle 13
	Remove well-fixed Stem 6
Type of revised stem, hips	Cementless stem 6
	Cemented stem 14

Table 2. Outcomes assessment

Average follow-up, months (range)	12.05 (2-24)
Evidence of bone ingrowth, hips	20
Evidence of osteotomised bone fragment union, hips	20
Complications, hips	
Stem subsidence	0
Dislocation	0
Infection	0
Fracture	0

these techniques, the considerable complication rates were reported. These included non-union (1-3%), proximal migration of greater trochanteric fragment (0-1.2%), infection (1-3%), fracture (4-20%), subsidence of stem, weakness of abductor mechanism[13]. Overall complication rate is approximately 24%. Acknowledgement of these complications associated with osteotomy and fragment reattachment, the railroad technique presented here might be an alternative approach with satisfactory efficacious and no significant complications. Advantages of railroad proximal femoral osteotomy included the ease of surgical technique, which can perform by using only basically available instruments, and no compromise to the greater trochanteric blood supply[14]. In addition, this technique provides an optimal access to the proximal femoral diaphysis and allows the expansion of the diameter of the femur resulting in the less complicated extraction with minimal bone loss. Osteotomised bone fragment is also easily repairable comparing to trochanteric osteotomy, with a low incidence of complications.

Another major challenge in revision THA is the implant selection for femoral bone loss and femoral stem stability. Revision strategy is to bypass the bone deficiency and adequate distal diaphysis fixation, which brings about low mechanical failure rates (2.4-6%). For implant of choice, fully porous coated[15], diaphysis fitting femoral component, and 4-6 cm of cortical bone fixed with collar is required to prevent the subsidence and to obtain the clinically satisfactory rate of osseointegration. Since 2007, we have used this technique in patients who we expected to have difficulties to remove well fixed femoral stem, distal cement mantle, broken distal femoral stem, bone preparation, and reconstruction of the femur. This assessment during two years showed the high rate of stability (100%), great evidence of bone ingrowth (100%), bone fragment union (100%), and no complication (0%).

Conclusion

This railroad surgical technique yielded clinically satisfactory outcomes with no complication in difficult femoral revisions. This evidence supports the practical use of technique, which requires only basic instruments to perform.

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เทคนิคการตัดกระดูกแนวยาวคู่ขนานรูปแบบรางรถไฟเพื่อนำแกนกระดูกต้นขาเทียมหรือซีเมนต์เดิมที่ติดแน่นออกในการผ่าตัดเปลี่ยนข้อสะโพกเทียมใหม่ซ้ำ

เกรียงศักดิ์ ปิยกุลมาลา, ธนนิตย์ สังคมกำแหง, กีรติ เจริญชลวานิช

วัตถุประสงค์*: เพื่อนำเสนอประสบการณ์ในการนำเทคนิคการตัดกระดูกแบบใหม่ และง่ายต่อการผ่าตัดเปลี่ยนแกนกระดูกต้นขาเทียมใหม่ซ้ำ*

วัสดุและวิธีการ*: ศึกษาข้อมูลผู้ป่วยย้อนหลังที่เปลี่ยนข้อสะโพกเทียมใหม่ซ้ำในระหว่าง มกราคม พ.ศ. 2550 ถึง มกราคม พ.ศ. 2552 ที่กลุ่มงานออร์โธปิดิกส์โรงพยาบาลขอนแก่น ประเทศไทย โดยต้องผ่าตัดนำเอาแกนกระดูกต้นขาเทียมเดิม หรือ ซีเมนต์ที่ติดแน่นออก ซึ่งจำเป็นต้องตัดกระดูกต้นขาส่วนต้นเป็นแนวยาวคู่ขนานแบบรางรถไฟแล้วใส่แทนด้วย long revision femoral stem และหลังการผ่าตัดจะทำการติดตามผลการรักษา และภาวะแทรกซ้อนที่เกิดขึ้น*

ผลการศึกษา*: จากข้อมูลข้อสะโพก 20 ข้างในผู้ป่วยจำนวน 19 คน ที่ได้รับการผ่าตัดเปลี่ยนข้อสะโพกเทียมใหม่ซ้ำ โดยพบว่าผู้ป่วยทุกคนมีแกนต้นขาเทียมใหม่ที่มั่นคงดี, กระดูกมีการงอกยึดแกนต้นขาเทียม, กระดูกบริเวณที่ตัดมีการสมานตัว, ไม่มีภาวะแทรกซ้อนอื่น ๆ เช่น การทรุดตัวของแกนต้นขาเทียม, การติดเชื้อ, การหลุดของข้อสะโพกเทียม หรือ กระดูกหักเกิดขึ้น*

สรุป*: จากการศึกษานี้พบว่าเทคนิคการผ่าตัดกระดูกแนวยาวคู่ขนานของกระดูกต้นขาส่วนบนรูปแบบรางรถไฟเพื่อนำแกนต้นขาเทียมเดิมออกให้ผลการรักษาที่ดีและไม่พบภาวะแทรกซ้อนเกิดขึ้น ดังนั้นการผ่าตัดเทคนิคนี้จึงเป็นวิธีหนึ่งที่สามารถนำมาใช้ได้แม้ในภาวะที่มีเพียงเครื่องมือพื้นฐานเท่านั้น*