The Necessity of Hip Lateral Radiograph for Operative Decision in Two Common Hip Fractures

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Background: *Recent studies showed that single hip anterio-posterior (AP) radiograph was adequate for diagnosis of most hip fractures (HF). However, lateral hip radiograph might be necessary to understand the fracture characteristics and to make better decision on surgical management.*
Material and Method: *100 HF radiographs (50 femoral neck fractures [FNF] and 50 intertrochanteric fractures [ITF]) were consecutively reviewed by five observers. The initial review used only single both hips AP radiograph. One month later, both hips AP and lateral films were reviewed. The diagnosis and operative decision were recorded, and then calculated.*
Results: *The average rate of changing treatment by the assessment of lateral radiographs was 5.0% for all HF, 2.8% for FNF, and 7.2% for ITF. There was no significant difference among those rates between five observers ($p<0.05$ all). The Intraclass Correlation Coefficients (ICCs) for interobserver agreement regarding the operative decision using only single AP film were 0.787 (95% confidence interval [CI], 0.698 to 0.852) for all HF, 0.818 (95% CI, 0.699 to 0.893) for FNF, and 0.394 (95% CI, 0.130 to 0.606) for ITF. After using both AP and lateral film, the ICCs were changed into 0.792 (95% CI, 0.705 to 0.856) for all HF, 0.795 (95% CI, 0.663 to 0.879) for FNF, and 0.552 (95% CI, 0.323 to 0.720) for ITF.*
Conclusion: *Using single both hips AP radiograph for operative decision is adequate and safe for most hip fractures. However, some of intertrochanteric fractures may require lateral radiograph for better operative decision.*

Keywords: *Lateral hip radiograph, Hip fracture, Operative decision, Single both hips AP radiograph*

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Hip fracture (HF) is a worldwide health problem and results in significant mortality and morbidity[1,2]. Generally, diagnosis of osteoporotic hip fracture is simple and need only the patient's history, physical examination, and plain radiograph. To treat these fractures, the characteristics of fracture, such as fracture geometry, bone quality and its intrinsic stability, and the orthogonal radiographs of the injured hip (antero-posterior [AP] and lateral cross-table view) are routinely required before selecting the surgical option. Therefore, they are considered as the gold standard radiographic investigation for HF. However, recent studies demonstrated the lateral radiographs might be unnecessary for the diagnosis and treatment of HF because the single both hips AP radiograph have been shown to be adequate and safe for diagnosing most hip fracture[3]. Additionally, the treatment was not significantly changed from using the lateral hip radiograph[4]. Finally, the lateral cross-table radiographs were mostly of poor quality[4] and required multiple times of contralateral leg movement for repeated x-ray resulting in pain aggravation, patient's discomfort, or even further fracture displacement of the injured hip[3]. Previous studies concerned mostly on femoral neck fracture diagnosis using two or three observers. Moreover, there were only two choices of surgical option in those studies, hemiarthroplasty and internal fixation, which might be considered inappropriate for the operative decision on different type of fractures, especially for intertrochanteric fracture. Therefore, the present study aimed to identify the effects of lateral hip radiograph on the surgical treatment selection of the two most common types of HF, femoral neck fracture (FNF) and intertrochanteric fracture (ITF), and then evaluate those effects on different fracture subtypes.

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Material and Method

This was a single-center, retrospective review

of radiographs of 100 HF patients (50 FNF and 50 ITF) treated in our hospital between 2010 and 2012. Prior approval was obtained from our Institutional Review Board. The inclusion criteria were, 1) the patients, either FNF or ITF, diagnosed as new isolated HF, 2) age more than 60-year-old, 3) sustained low-energy injury. The exclusion criteria were, 1) pathological fractures other than osteoporotic fracture, 2) bilateral or multiple injuries, 3) having previous surgery on the injured hip, and 4) having underlying hip disease such as osteonecrosis, and osteoarthritis. The radiographs were then recruited based on the fracture classification and incidence of fracture severity. Fifty FNF patients included 8 patients (16%) with Garden type 1 or 2, and 42 patients (84%) with Garden type 3 or 4. Fifty ITF patients included 27 patients (54%) with AO/OTA type A1, 17 patients (34%) with AO/OTA type A2, and 6 patients (12%) with AO/OTA type A3. All radiographs were extracted from the hospital PACS (Picture Archiving and Communication System) by one of the authors (SS) who did not involve in the radiographic reviewing process, and using only the standard both hips AP and hip lateral cross-table radiographs. Radiographs of both hips AP view and lateral cross-table were collected and saved into two compact discs. One disc contained only both hips AP view, and another contained both hips AP and lateral cross-table view. Five orthopedic surgeons, including three orthopedic trauma staffs and two orthopedic trauma fellows, reviewed the first disc and followed by the second disc one month later. For each radiographic review, surgeon was asked to give the most suitable operative decision from the available four options; 1) multiple screw fixation, 2) bipolar hemiarthroplasty, 3) dynamic hip screw, or 4) proximal femoral nail. Before the study started, all reviewers were asked to follow the same treatment strategy such as multiple screw fixation and dynamic hip screw, for minimally displaced and stable FNF, and stable ITF respectively. Bipolar hemiarthroplasty and proximal femoral nail were used for displaced FNF and unstable ITF. Then the operative decision from the first and second discs by each reviewer were collected and calculated for intraobserver agreement. The operative decisions, depending the assessment of only both hips AP radiographs or both hips AP and lateral radiographs, from all reviewers were calculated for interobserver agreement. Agreement was analyzed by using intraclass correlation coefficient (ICC) and then interpreted following the guideline of Landis et al[5]. The incidence of changing treatment after assessing the lateral radiographs, the difference of those fracture type, and the difference in the average incidence of changing treatment between staff group and fellow group were analyzed by Chi-square test. Statistical analysis was calculated by MedCalc Statistical Software version 15.8 (MedCalc Software bvbv, Ostend, Belgium).

Results

The results of operative decision, from five observers, after assessing the lateral hip radiograph were shown in Table 1. The average incidence of changing treatment was 5.0% for all HF (range, 3 to 7%), 2.8% for FNF (range 2 to 4%), and 7.2% for ITF (range 4 to 12%).

No significant difference of the changing treatment incidence had been found between all five observers in the present study ($p = 0.72$ for all HF, 0.93 for FNF, and 0.41 for ITF, respectively). Regard to the result of each observer, the changing treatment incidences were also non-significant difference between FNF and ITF ($p<0.05$ all). Subgroup analysis showed the average incidences of changing treatment for all HF and FNF in the staff group (OS-1, OS-2, and OS-3) were non-significant difference compared to the fellow group (OS-4 and OS-5) (4% vs. 6.5% for all HF, $p = 0.30$, and 3.3% vs. 2% for FNF, $p = 0.82$). However, there was a non-significant lower in the average incidence of changing treatment for ITF in staff group (4.7%) compared with those in fellow group (11%), ($p = 0.1$).

Table 2 showed the intraobserver agreement and interobserver agreement on operative decision between using only single AP and using both AP and lateral radiographs. The average ICCs of operative decision for intraobserver agreement between using only single AP and both hips and lateral films were 0.927 for all HF (range, 0.910 to 0.955), 0.926 for FNF (range, 0.895 to 0.944), and 0.847 (range, 0.714 to 0.913) for ITF. The ICCs of interobserver agreement for using only single AP radiograph were 0.787 (95% CI, 0.698 to 0.852) for all HF, 0.818 (95% CI, 0.699 to 0.893) for FNF, and 0.394 (95% CI, 0.130 to 0.606) for ITF. After the assessment of both AP and lateral radiographs, the ICCs of interobserver agreement were 0.792 (95% CI, 0.705 to 0.856) for all HF, 0.795 (95% CI, 0.663 to 0.879) for FNF, and 0.552 (95% CI, 0.323 to 0.720) for ITF.

The detail of changing treatment after assessing the lateral radiographs was shown in Table 3. There was not significant difference in the changing treatment incidence between five observers ($p = 0.72$ for FNF, and 0.33 for ITF). Comparing the effect of

fracture type on the changing treatment, the type of FNF, either non-displaced (Garden type 1-2) or displaced fracture (Garden type 3-4), there was not significant difference ($p = 0.24$). However, there was a significant difference in proportion of changing treatment in each type of ITF according to AO classification ($p = 0.005$), with the highest incidence on A2 type. The examples of case with changing treatment was shown in Fig. 1. Furthermore, on A3 type, no observers changed the operative decision after assessing the lateral hip radiograph (0%).

Discussion

Hip fracture (HF) is one of the leading causes of death and devastating complications in elderly population, requiring a prompt and appropriate diagnosis and treatment to achieve the best possible outcome. Traditionally, the plain radiographs are usually sufficient for diagnosing the fracture and recognizing the fracture characteristics, and only 4% of hip fractures patient, who had negative initial radiographs, required advanced investigations to identify occult fractures[6]. Recent studies showed that the single both hips AP radiograph was suitable enough to diagnose most HFs[3,4]; however, the role of the lateral radiograph on the operative decision was still unclear, especially for the intertrochanteric fracture (ITF). Our study aimed to clarify the effects of the lateral hip

Table 1. Comparison of treatment selection after using only single AP film versus both AP and lateral films in each observer.

	OS-1	OS-2	OS-3	OS-4	OS-5	*p*-value[1]
All hip fractures (n = 100)*						
Same treatment	95 (95)	96 (96)	97 (97)	94 (94)	93 (93)	0.72
Change treatment	5 (5)	4 (4)	3 (3)	6 (6)	7 (7)	
Femoral neck fractures (n = 50)*						
Same treatment	48 (96)	48 (96)	49 (98)	49 (98)	49 (98)	0.93
Change treatment	2 (4)	2 (4)	1 (2)	1 (2)	1 (2)	
Intertrochanteric fractures (n = 50)*						
Same treatment	47 (94)	48 (96)	48 (96)	45 (90)	44 (88)	0.41
Change treatment	3 (6)	2 (4)	2 (4)	5 (10)	6 (12)	
p-value[2]	1.00	1.00	1.00	0.20	0.11	

OS = observer

[1] = The *p*-value compared between each observer.

[2] = The *p*-value compared between the changing treatment in femoral neck fractures and those in intertrochanteric fractures.

* = value presented as no. of case received the same or changed operative decision after the assessment of lateral radiographs (percentage).

Table 2. Intra-observer and inter-observer agreement of treatment selection in each type of hip fracture

	All hip fractures (n = 100)	Femoral neck fractures (n = 50)	Intertrochanteric fractures (n = 50)
Intra-observer agreement*			
OS-1	0.910 (0.869 to 0.939)	0.895 (0.822 to 0.940)	0.893 (0.818 to 0.938)
OS-2	0.930 (0.898 to 0.953)	0.915 (0.855 to 0.951)	0.913 (0.851 to 0.950)
OS-3	0.955 (0.934 to 0.970)	0.941 (0.897 to 0.966)	0.913 (0.851 to 0.950)
OS-4	0.934 (0.903 to 0.955)	0.944 (0.904 to 0.968)	0.800 (0.671 to 0.882)
OS-5	0.916 (0.877 to 0.943)	0.936 (0.889 to 0.963)	0.714 (0.544 to 0.828)
Inter-observer agreement*			
Single both hips AP	0.787 (0.698 to 0.852)	0.818 (0.699 to 0.893)	0.394 (0.130 to 0.606)
Both hips AP and lateral	0.792 (0.705 to 0.856)	0.795 (0.663 to 0.879)	0.552 (0.323 to 0.720)

OS = observer

* = value presented as Intraclass Correlation Coefficient (95% confidence interval)

Table 3. Details of change treatment group in each observer

	OS-1 (n = 5)	OS-2 (n = 4)	OS-3 (n = 3)	OS-4 (n = 6)	OS-5 (n = 7)	*p*-value[1]	*p*-value[2]
Femoral neck fractures**							
Garden 1-2 (n = 8)	1 (13)	1 (13)	1 (13)	1 (13)	1 (13)	0.72	0.240
Garden 3-4 (n = 42)	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)		
Intertrochanteric fractures**							
A1 (n = 27)	1 (4)	0 (0)	0 (0)	3 (11)	2 (7)	0.33	0.005*
A2 (n = 17)	2 (12)	2 (12)	2 (12)	2 (12)	4 (24)		
A3 (n = 6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		

OS = observer

[1] = *p*-value compared between each observer, [2] = *p*-value compared the difference of incidence of changing treatment in each type of fracture

* = significant difference between group with $p<0.05$, ** = value presented as no. of case having changing operative decision after the assessment of lateral radiographs (percentage for each fracture classification)

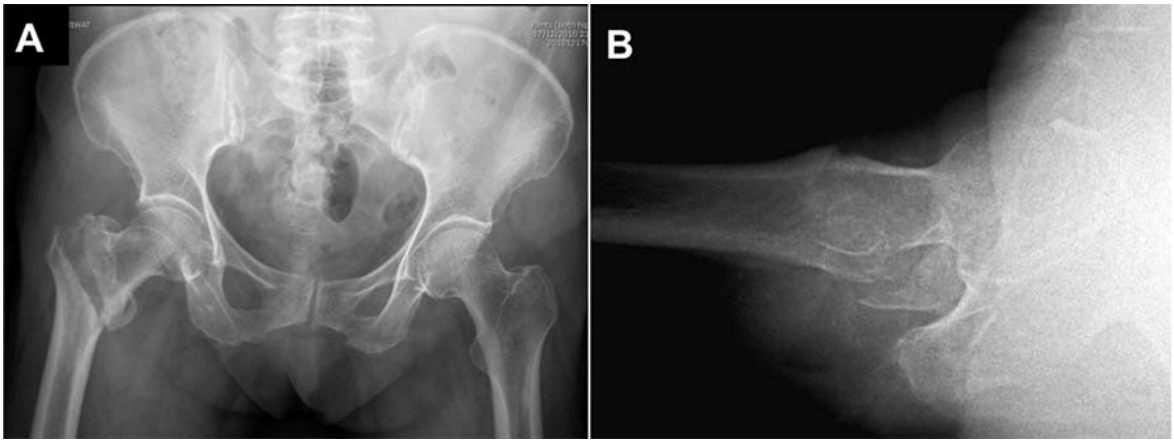

Fig. 1 Case examples of a 70-year-old female with right intertrochanter fracture (ITF) that having treatment change after using hip lateral radiograph. The both hips AP radiograph (A) showed displaced ITF with minimal fracture comminution, and therefore all observers selected treatment as dynamic hip screw fixation. However, the hip lateral radiograph (B) showed additional information as fracture greater trochanter in which resulting in changing of treatment to proximal femoral nail in two observers.

radiograph assessment for selecting the treatment in HF.

The results of the present study showed that the operative decision for overall HF was not significantly changed after using the lateral radiograph, with the average incidence of changing treatment at only 5.0% (Table 1). The intraobserver agreements for overall HF was rated as almost perfect with the ICC more than 0.9 in all five observers (range, 0.910 to 0.955). Moreover, the ICC for interobserver agreement, before and after using the lateral hip radiograph, was comparable (0.787 and 0.792) (Table 2). Therefore, our findings were consistent with the findings of previous studies that single both hips AP radiograph was adequate and safe for most HF[3,4].

In regards the effects of lateral radiographs on the operative decision for each fracture type, FNF group showed that the changing treatment incidence was only 2.8%, and the intraobserver and interobserver agreements of this group were nearly all considered almost perfect (range, 0.895 to 0.944 for intraobserver agreement, and 0.795 to 0.818 for interobserver agreement). This could be explained that the operative decision on FNF usually depended on the amount of

fracture displacement in which was easily seen in both hips AP radiograph. Therefore, the single both hips radiograph should be adequate and safe for the treatment of FNF. However, those effects on ITF were different from FNF. Although the intraobserver agreement from all five observers was rated as substantial and almost perfect (ICC >0.7 all), there was a higher incidence of changing treatment in ITF (7.2%). Moreover, the interobserver agreement was changed from 0.394 (single both hips AP radiograph) to 0.552 after assessing the lateral radiograph. This might be explained by the poor reproducibility of ITF classification, the unclear definition of fracture stability, and the controversial management on ITF[7,8]. Consequently, the lateral hip radiographs of ITF, especially on A1 or A2 type, might have additional information that would change the operative decision. Furthermore, previous study also showed that the increase of surgeon's experience was significantly improved the reliability of ITF classification and the ability to determine the fracture stability[9]. Therefore, although the intraobserver agreement for ITF was excellent among all observers, the operative decision of some ITF would be more accurate with the assessment of lateral hip radiograph as shown in the improvement of the interobserver agreement in the present study.

Conclusion

The assessment of single both hips AP radiograph is sufficient for selecting the appropriate treatment for most hip fractures, especially for femoral neck fractures. However, the lateral radiograph still has a role for better operative decision for some type of intertrochanteric fractures.

What is already known in this topic?

Previous studies showed that the single both hips AP radiographs was safe and adequate for the hip fracture diagnosis. However, due to many surgical options for hip fracture treatment, the operative decision for each fracture type may require additional information from the lateral radiograph.

What this study adds?

This study introduced the data on the interobserver agreement after using lateral hip radiograph for diagnosis and selection of treatment. The result demonstrated that most of hip fractures needed only single both hips radiograph for adequate treatment. However, some of intertrochanteric fracture required lateral hip radiograph for better operative decision.

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Potential conflicts of interest

None.

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การพิจารณาการผ่าตัดกระดูกสะโพกหักโดยใช้หรือไม่ใช้ฟิล์มเอกซเรย์สะโพกด้านข้างร่วมด้วย

นรชาติ ศิริศรีตรีรักษ์, ปพน สง่าสูงส่ง, สุวัฒน์ ศรีอนุชาต, ภัทรวัณย์ วรธนารัตน์, สุกิจ เลาหเจริญสมบัติ, ชาญยุทธ ศุภชาติวงศ์

วัตถุประสงค์: เพื่อเปรียบเทียบความสอดคล้องในการวางแผนการรักษาของภาวะกระดูกสะโพกหักระหว่างการใช้ภาพรังสีด้านหน้าเพียงรูปเดียว และการใช้ภาพรังสีด้านหน้าและด้านข้างร่วมกัน

วัสดุและวิธีการ: ศึกษาจากภาพถ่ายรังสีของผู้ป่วยที่มีกระดูกสะโพกหักจำนวน 100 ราย (50 รายเป็น femoral neck fracture: FNF) และ 50 ราย เป็น intertrochanteric fracture: ITF) และให้แพทย์ออร์โธปิดิกส์จำนวน 5 ราย เป็นผู้แปลผลและวางแผนการรักษา แล้วนำมาคำนวณความสอดคล้อง

ผลการศึกษา: พบว่าภายหลังจากใช้ภาพถ่ายรังสีด้านข้างร่วมด้วย อัตราการเปลี่ยนแผนการรักษาเฉลี่ยของภาวะกระดูกสะโพกหักทั้งหมด, เฉพาะ FNF, และเฉพาะ ITF เท่ากับร้อยละ 5.0, 2.8 และ 7.2 ตามลำดับ ไม่พบว่ามีความแตกต่างอย่างมีนัยสำคัญในอัตราการเปลี่ยนแผนการรักษาระหว่างแพทย์ทั้ง 5 ราย ค่าความสอดคล้อง Interobserver agreement และ 95% confidence interval (CI) ของการใช้ภาพถ่ายรังสีด้านหน้าเพียงอย่างเดียวในการวางแผนการรักษาของกระดูกสะโพกทั้งหมด, เฉพาะ FNF, และเฉพาะ ITF เท่ากับ 0.787 (95% CI 0.698-0.852), 0.818 (95% CI, 0.699-0.893) และ 0.394 (95% CI, 0.130-0.606) ตามลำดับ หลังจากใช้ภาพถ่ายรังสีทั้งด้านหน้าและด้านข้างพบว่า ค่า Interobserver agreement และ 95% CI ในการวางแผนการรักษาของกระดูกสะโพกทั้งหมด, เฉพาะ FNF, และเฉพาะ ITF เท่ากับ 0.792 (95% CI, 0.705-0.856), 0.795 (95% CI, 0.663-0.879) และ 0.552 (95% CI, 0.323-0.720)

สรุป: การใช้ภาพรังสีด้านหน้าเพียงรูปเดียวนั้นเพียงพอต่อการวางแผนการรักษา แต่ในผู้ป่วยบางรายที่มี intertrochanteric fracture นั้นมีความจำเป็นต้องใช้ภาพรังสีด้านข้างด้วย