

## Treatment for Trochanteric Fracture of the Femur with Short Femoral Nail: A Comparison between the Asian Intramedullary Hip Screw (IMHS) and the Conventional IMHS

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**Introduction:** We usually use short femoral nails for the treatment of trochanteric fracture of the femur. In this retrospective study, we investigated and compared the clinical results of the conventional intramedullary hip screw (IMHS) and the Asian IMHS, which is a redesigned version of the former.

**Materials and Methods:** The subjects were 42 patients; 21 treated with the Asian IMHS and 21 were treated with the conventional IMHS. From the clinical records, we retrospectively investigated the patients' age, sex, in-hospital waiting period for operation, operating time, intraoperative blood loss, walking ability before fracture and at discharge, and complication pertaining to the operation.

**Results:** The 21 patients (4 men and 17 women) receiving the Asian IMHS and the 21 patients (5 men and 16 women) receiving the conventional IMHS did not differ significantly in mean age, sex ratio, preoperative waiting period, mean postoperative hospital stay, mean operation time, or mean intraoperative blood loss. Among patients receiving the Asian IMHS, the complications of intraoperative fractures of the femur developed in 3 patients and breakage of the implant occurred in 1 patient. No complications occurred in patients receiving the conventional IMHS.

**Discussion and Conclusion:** Compared with the conventional IMHS, the Asian IMHS is smaller, has increased variations in the shaft/neck angle of the lag screw, and has a titanium-alloy construction, allowing magnetic resonance imaging. The intraoperative fracture may have occurred because of the configuration of the distal interlocking screw in the Asian IMHS. Breakage of the implant likely occurred because the nail was too small in diameter, and too short in length for the unstable AO 31-A3 fracture. If careful attention is paid to the configuration of its distal interlocking screw intraoperatively and a nail of appropriate size is selected, the Asian IMHS is better suited than the conventional IMHS for treating Japanese patients, who generally have a small physique, because of its many variations in size and angle. (J Nippon Med Sch 2016; 83: 113–117)

**Key words:** short femoral nail, trochanteric fracture of the femur, Asian IMHS

### Introduction

Sliding hip screws and short femoral nails are generally used for the treatment of trochanteric fractures of the femur. Despite the fact that more intraoperative and postoperative fractures are reported with short femoral nails<sup>1,2</sup>, clinical results of both these implants are similar in previous reports<sup>3,4</sup>. In addition, short femoral nails are reported to be favorable for unstable fractures<sup>5,6</sup>. At our hospital, we treat trochanteric fractures using short femo-

ral nails in almost all cases. Although we formerly used the conventional intramedullary hip screw (IMHS) (Smith & Nephew, Memphis TN, USA), we changed to the Asian IMHS, which is a redesigned version of the former and has been available since 2006. In this study, we retrospectively investigated and compared the clinical outcomes of these two implants.

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Table 1 Demographic Data of the Patients

|                                    | Group A                  | Group I                 |
|------------------------------------|--------------------------|-------------------------|
| Age (years)                        | 78.4 (37–93)             | 82.3 (62–95)            |
| Gender (male : female)             | 4 : 17                   | 5 : 16                  |
| Waiting Period (days)              | 11.1 (5–22)              | 10.1 (2–19)             |
| Postoperative Hospital Stay (days) | 44.4 (3–93)              | 55.6 (12–110)           |
| Operating Time (minutes)           | 53.5 (35–85)             | 50.2 (32–100)           |
| Blood Loss (grams)                 | 69.6 (20–150) / 12 cases | 77.5 (20–200) / 8 cases |
|                                    | Mean (range)             |                         |

There were no significant differences between two groups.

Table 2 Walking Ability Before Suffering Fracture and at the Time of Discharge

|                   | Group A         |              | Group I         |              |
|-------------------|-----------------|--------------|-----------------|--------------|
|                   | before fracture | at discharge | before fracture | at discharge |
| Walk unassisted   | 16              | 1            | 9               |              |
| Walk assisted     | 5               | 11           | 10              | 6            |
| Wheelchair        |                 | 8            | 2               | 13           |
| In-hospital death |                 | 1            |                 | 2            |

### Materials and Methods

There were 42 patients in the study, 21 of whom were treated with the Asian IMHS since 2006 (Group A) and the remaining 21 were treated with conventional IMHS before we started using the Asian IMHS (Group I). From the clinical records, we retrospectively investigated the patients' age, sex, in-hospital waiting period from admission to operation, postoperative hospital stay, operation time, intraoperative blood loss, walking ability before fracture and at discharge from the hospital, and complications pertaining to the operation.

For statistical analysis, the paired *t*-test was applied.

### Results

The 21 patients (4 men and 17 women) receiving the Asian IMHS and the 21 patients (5 men and 16 women) receiving the conventional IMHS did not differ significantly in mean age, sex ratio, preoperative waiting period, mean postoperative hospital stay, mean operation time, or mean intraoperative blood loss (Table 1).

The number of patients who could walk unassisted before fracture but were discharged in wheelchairs was five in Group A, which included 3 patients over 90 years of age and 2 patients with dementia: three such cases were there in Group I, which included 2 patients over 90 years of age and 1 patient with dementia. Any other patients who could walk unassisted before fracture were able to

walk unassisted or with a T-cane when discharged. In hospital death occurred in 1 case in Group A and 2 cases in Group I among which 2 patients died from cardiovascular complications arising before fracture and 1 died from complications of terminal cancer. We regarded these deaths as unrelated to the implants (Table 2).

With regard to complications pertaining to the operation, Group A had 3 intraoperative fissure fracture of the femur and 1 breakage of implant. In Group I, there were no surgical complications. All of the intraoperative fractures occurred at the sites of distal screws (Fig. 1). Although the fissure fracture seemed to arise from the distal screws on postoperative radiographs, the fracture lines all stayed within the bony cortex. Postoperative rehabilitation for these patients was performed similar to that for all other patients of Group A and I. Among the 3 intraoperative fracture cases, one died as an inpatient, and the other 2 were discharged walking with a T-cane.

The breakage of implant occurred 6 months postoperatively in a case of unstable AO 31-A3 fracture (reversed oblique type) (Fig. 2). Although the alignment was poor in postoperative radiographs, there appeared to be union of the fracture prior to the breakage of the implant. However, after the breakage of the implant, varus deformity of the fracture was noted. Subsequently, this patient suffered from a cerebral infarction. Therefore, re-operation was not performed, and the patient remains confined to



Fig. 1 Intraoperative fracture of the femur

**A:** Postoperative X-ray

Postoperative X-ray revealed a fissure fracture of the femur extending from the distal screw.

**B:** Fissure fracture of the femur recognized in enlarged X-ray

The fracture is clearly recognized in an enlarged X-ray. The fissure fracture seemed to be confined to a portion of the cortex.

a wheelchair.

### Discussion

A comparison between the Asian IMHS and the conventional IMHS is shown in **Table 3**. Characteristics of the Asian IMHS are as follows: The implant is smaller (compared to the conventional IMHS), there is increased variations in the shaft/neck angle of the lag screw, and it has a titanium-alloy construction, allowing magnetic resonance imaging. Only the diameter of the distal interlocking screw becomes larger than that of the conventional IMHS.

In Asian populations, a strong anterior bowing of the femur is often observed. As a result, mismatch of the implant shape and morphology of the femur may occur<sup>7</sup>. We have actually experienced cases in which the conventional IMHS was difficult to insert because of its large size, or in which crepitation occurred because the implant was too long and protruded from the superior aspect of the greater trochanter. Accordingly, the characteristics mentioned above for the Asian IMHS are thought to be better suited for the generally smaller physique of the Japanese people.

With regard to the complications with the Asian IMHS recognized in this study, the larger diameter of the distal interlocking screw of the Asian IMHS may be a cause of intraoperative fractures. In the conventional IMHS, the diameter of the distal interlocking screw is 4.5 mm, whereas it is 5.0 mm in the Asian IMHS. In addition, as shown in **Figure 3**, the distal interlocking screw of the

Asian IMHS is larger in diameter at the base of the screw than that at its tip. Thus, overtightening of the screw may result in a fissure fracture in a fragile femur of a patient with osteoporosis. Moreover, using two screws in close proximity may result in an increased number of fractures. In consideration of these points, we usually use a single screw in a dynamic hole in cases of fractures types AO 31-A1 and A2, in order to prevent intraoperative fractures. Thus, we determine the length of the screw to be 5 mm longer than the actual length indicated by a depth gauge, and the screw is then tightened so as to leave the wider base of the screw protruding outside of the bone without entering the cortex of the femur. Accordingly, in the situation that there have been no screws in place, we consider that the maker should improve the design of the screw to avoid potential fracture.

The case of the breakage of the implant we experienced may have occurred because the nail used for the procedure was too small in diameter and too short in length for the particular unstable AO 31-A3 type fracture. Because the patient was extremely short, we decided not to use a large-diameter nail; furthermore, because the patient's femur had a markedly bowed anteriorly, we decided not to use a long nail. Therefore, we chose a nail 9 mm in diameter and 16.5 cm in length. We speculate that the load concentrated on the distal screw hole of the small nail may have resulted in the breakage of the implant. In the previous reports<sup>8,9</sup>, the rate of the breakage of the implant in trochanteric fracture is relatively low (0.2%–5.7%), and the timing of the breakage of the im-

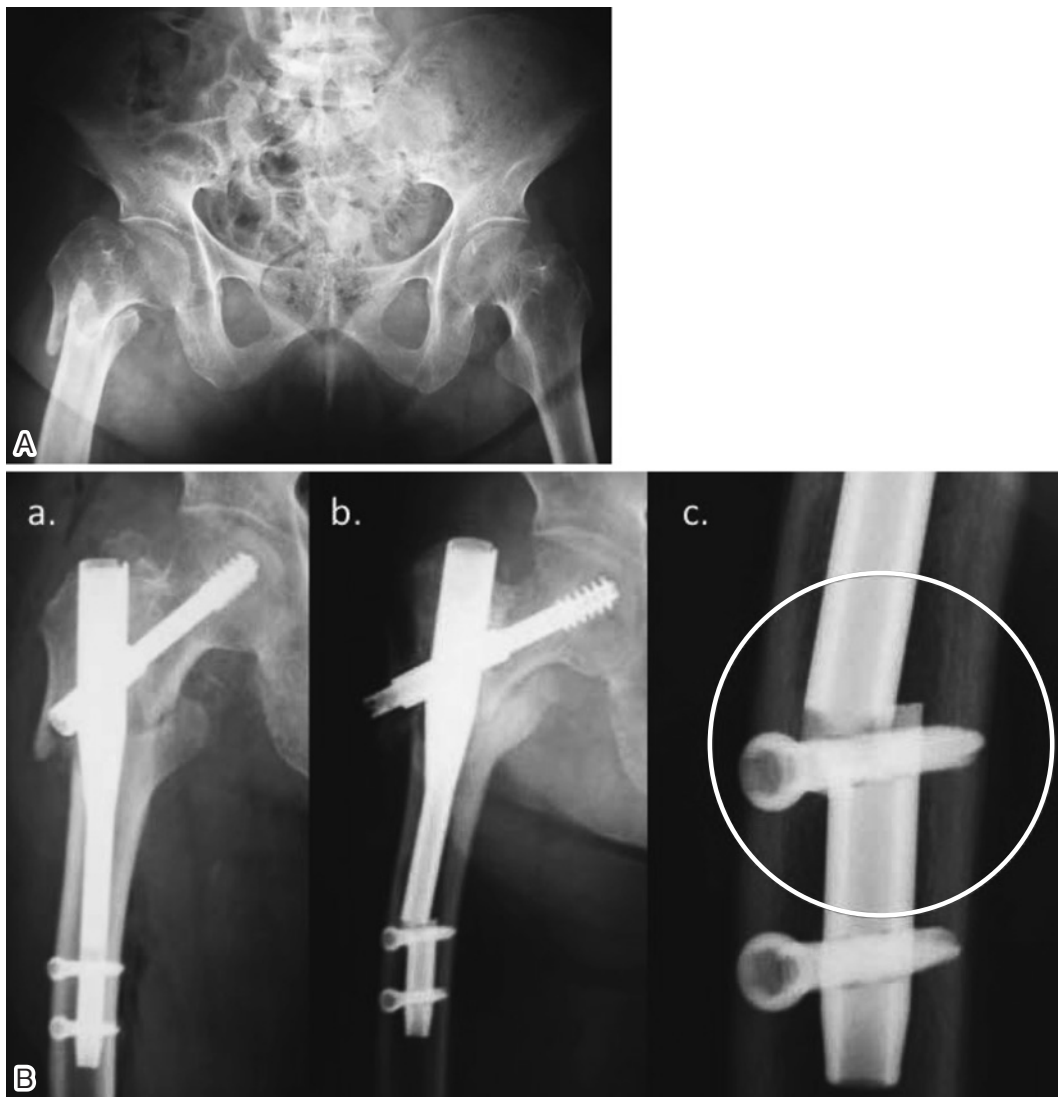


Fig. 2 Breakage of the implant

**A:** Preoperative X-ray

An X-ray image taken at admission showed the fracture to be of type AO 31-A3 (reversed oblique type).

**B:** Postoperative X-ray

An X-ray image taken just after the operation shows poor reduction of the fracture (a). Six months later, X-ray images showed the breakage of the implant (b and c).

Alignment of the fracture worsened after the breakage of the implant, which may suggest non-union of the fracture.

plant ranges from 3 months to 2 years. The site of the breakage of the implant was thought to be primarily at the proximal lag screw hole. The reason for the breakage of the implant was reported to be because of overload on the implant due to an inadequate reduction of the fracture and subsequent non-union. In our case, although fracture union appeared to have occurred on X-ray before the breakage of the implant, the change in the alignment of the bone after the breakage of the implant suggested a non-union.

In this study, there were no statistically significant dif-

ferences in operating time or intraoperative blood loss between the two groups. In addition, postoperative hospital stay and ability to walk showed no statistical differences between the two groups. Accordingly, shifting from the conventional IMHS to the Asian IMHS presents no disadvantage in clinical outcomes. By paying careful attention to the configuration of its distal interlocking screw, the compact design of the Asian IMHS should prove advantageous for the generally smaller physique of the Japanese people. In addition, even in cases of unstable AO 31-A3 fractures, by selecting an adequate

Table 3 Comparison of Asian IMHS and conventional IMHS

|   | Asian IMHS                   | Conventional IMHS         |
|---|------------------------------|---------------------------|
| Material                                  | Titanium Alloy (Ti-6Al-4V)   | Stainless Steel (ASTM138) |
| Proximal diameter of the nail             | 16.25 mm                     | 17.5 mm                   |
| Proximal length of the nail*              | 28 mm                        | 33 mm                     |
| Total length of the nail**                | 16.5, 19.0 cm                | 18.0, 21.0 cm             |
| Distal diameter of the nail               | 9, 11, 13 mm                 | 10, 12, 14 mm             |
| Neck/shaft angle                          | 125, 130, 135 degrees        | 130, 135 degrees          |
| Length of the lag screw                   | every 10 mm                  | every 5 mm                |
| Diameter of the distal interlocking screw | 5.0 mm                       | 4.5 mm                    |
| Distal screw hole                         | each dynamic and static hole | 2 static holes            |
| Length of the endcap                      | 0, 5, 10 mm                  | 5 mm                      |

\* The length between proximal end and lag screw hole

\*\* Long nails also available

Asian IMHS: 24–32 cm (every 2 cm) with neck/shaft angle of only 130 degrees

Conventional IMHS: 34 and 38 cm with neck/shaft angle of 130 and 135 degrees

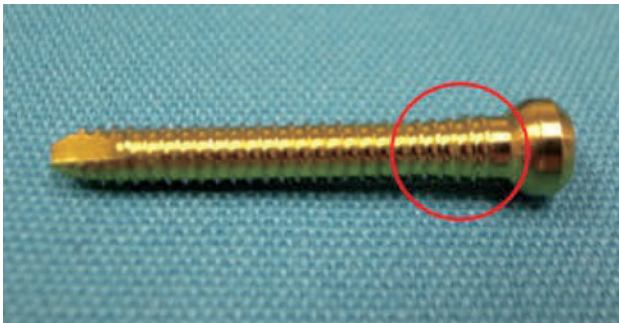


Fig. 3 Distal interlocking screw of the Asian IMHS

The diameter of the distal interlocking screw is 5.0 mm in the Asian IMHS and 4.5 mm in the conventional IMHS. Moreover, the screw base (shown with the circle) is larger in size than the screw tip.

length and size in diameter of the nail, the Asian IMHS should be a useful implant for trochanteric fractures in the Japanese population.

### Conclusion

Because the Asian IMHS is designed specifically for the Asian people with small physiques and has many variations of the size and angle, it is considered to be useful for treating trochanteric fractures in the Japanese population.

**Conflict of Interest:** The author declares no conflict of interest.

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