

## ORIGINAL ARTICLE

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## Intertrochanteric fractures in adults younger than 40 years of age

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**Abstract** This study reviewed 66 intertrochanteric fractures in patients younger than 40 years old (average 33.0 years old; range 17–40 years old). In contrast to the usual population with intertrochanteric fractures, the factors male predominance (46/66), less pre-injury comorbidity (9/66), more outdoor high energy trauma (47/66), and more associated injuries (32/66) were evident. The distribution of associated injuries was wide. Some of them were life threatening. According to Boyd's classification, 20 were type I, 24 were type II, 13 were type III, and 9 were type IV. Twenty-nine were stable, and 37 were unstable. Stratified by the mechanism of injury, the difference in distribution between the subgroups was significant ( $p = 0.027$ , two-tail Fisher's exact test). Simple falls only caused Boyd type I and II fractures. Boyd type III or IV fractures were found more often after vehicular trauma or falls from a height. All the intertrochanteric fractures healed on average 70.5 days (range 31–213 days) after operation. The fractures resulting from vehicular trauma or fall from a height healed significantly more slowly ( $p = 0.02$ , univariant log-rank test). There were 6 intertrochanteric fracture-related complications. The mechanism of injury determines the character of intertrochanteric fractures in young adults. Given tougher bone stock, better healing ability, and less co-morbidity, proper management can lead to healing of all intertrochanteric fractures. The extent of functional recovery was also determined by the associated injuries.

### Introduction

Intertrochanteric fractures happen in the elderly. They are osteoporosis-related. Most of them result from simple falls from standing height [5, 6]. Though the energy is low, comminution of the fractures is usual due to osteoporosis. Co-morbidity in the aged patient always complicates the management of these fractures.

Although it is relatively uncommon, intertrochanteric fractures also occur in the young, most commonly in men after high-energy injuries [16]. The energy required to break this tough bone is high in a cadaver study [6]. To our knowledge, only limited information is available regarding the clinical picture of intertrochanteric fractures in young adults. We did not know that the distribution of fracture patterns resulted from a severer impact upon tougher bones. Associated injuries are more frequent with high-energy trauma, and the blood supply is disrupted more extensively. Healing of the fractures will be slowed after these high-energy injuries. However, the ability to heal is generally better in the young. The features of healing of intertrochanteric fractures influenced by these opposing factors are still unknown. The purpose of this study was to identify the characteristics of intertrochanteric fractures in a series of patients younger than 40 years old.

### Patients and methods

Between January 1985 and December 1994, 75 patients younger than 40 years old with intertrochanteric fractures were treated in our institution. Patients with an immature skeleton or pathological fracture were excluded. Postoperatively, 9 patients could not be followed up regularly because of co-morbid psychological disorders or because they moved away. The mean age of the other 66 patients at the time of operation was 33.0 years (range 17–40 years). There were 20 women and 46 men. Twenty-four fractures happened on the right hip and 42 on the left.

Surgical stabilization of the intertrochanteric fracture was performed under general or spinal anesthesia as soon as the patient's condition permitted. We reduced these fractures on fracture-tables under image intensifier television fluoroscopy. Closed reduction

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was routinely tried first. The choice of fixation device was based on the stability of the fracture. We fixed stable intertrochanteric fractures with dynamic hip screws. Unstable fractures were also fixed with dynamic hip screws before 1990. After 1990, they were fixed with gamma nails of Asian-Pacific type. Long dynamic hip screws and long gamma nails were required in intertrochanteric fractures with a long subtrochanteric extension. A suction drain was routinely inserted. All patients received standard antibiotic prophylaxis perioperatively. The associated fractures were treated in standard fashion. Early mobilization was encouraged if the associated conditions permitted.

Patients were followed up at regular intervals. For patients with stable fractures, we suggested discarding the crutches when the soft callus bridging had crossed the fracture site. For patients with unstable fractures, weight-bearing was permitted only after the density on the radiographs approximated that of the non-fractured area. For those with associated injuries in the lower extremities, both the intertrochanteric fractures and the associated injuries decided when weight-bearing was introduced.

Their charts were thoroughly reviewed. The radiographs were re-examined for Singh index of bone quality [17], Boyd's classification of fracture patterns [3], stability of the fractures [8], and callus formation. We assumed healing of the fracture when the soft callus bridging had been positively identified as crossing the fracture gap. Data were entered and analyzed using SAS (SAS Institute, Cary, N.C.).

## Results

Of these 66 patients, 9 had co-morbid conditions. Three were schizophrenic, and a failed suicide attempt led to their fracture. The others included 2 rheumatoid arthritis, 1 bronchial asthma, 1 diabetes mellitus, 1 hypertension, and 1 pulmonary tuberculosis.

The mechanism of injury was a simple fall in 11, vehicular trauma in 36, and fall from a height in 19 patients. Four of those injured after a simple fall had co-morbid diseases.

Thirty-two patients (48.5%) had associated injuries, and 16 (24.2%) of them had more than two associated injuries. The most common one was head injury, and the most common associated fracture occurred in the pelvis (Table 1). None of the 11 patients injured after a simple fall had an associated injury, but 21 of the 36 vehicular trauma, and 12 of the 19 fall from a height did.

In this study, all Singh indexes were above 3. There was only one open intertrochanteric fracture. According to Boyd's classification, 20 of these 66 fractures were type I; 24 were type II; 13 were type III, and 9 were type IV. Twenty-nine fractures were stable, and 37 were unstable. Stratified by the mechanism of injury, the difference in distribution between subgroups was significant ( $p = 0.027$ , two-tail Fisher's exact test). The correlations between mechanism of injury and fracture pattern and fracture stability are listed in Table 2 and Table 3.

All the intertrochanteric fractures healed on average 70.5 days (range 31–213 days). The mean and standard deviation of time to heal for fractures resulting from a simple fall, vehicular trauma and fall from a height were  $48.6 \pm 14.1$ ,  $75.4 \pm 37.9$ , and  $74.0 \pm 39.5$  days, respectively. The fractures caused by vehicular trauma or fall from a height healed significantly more slowly ( $p = 0.02$ , univariate log-rank test). Not all of the associated fractures healed.

**Table 1** Associated injuries in 66 young adults with intertrochanteric fractures

Associated injuries	No. of cases
Head injury	13
Pelvis fracture	6
Femur shaft fracture	5
Lacerations	3
Mandible fracture	3
Radius fracture	3
Tibia-fibula fracture	3
Acetabular fracture	2
Ankle fracture	2
Open fracture	2*
Sciatic nerve injury	2
Temporal bone fracture	1
Zygomatic fracture	1
Scapular fracture	1
Rib fracture	1
Olecranon fracture	1
Ulna fracture	1
Lumbar spine fracture	1
Tibia plateau fracture	1
Calcaneus fracture	1
Metatarsal fracture	1
Burn injury	1
Spleen rupture with internal bleeding	1
Pneumothorax	1

\* Open fracture: femur supracondylar fracture, tibia plateau fracture

**Table 2** Distribution of fracture types stratified by the mechanism of injury ( $p = 0.027$ , two-tail Fisher's exact test)

Mechanism	Boyd type	No. of cases	Total
Simple fall	I	4 (36.4%)	11
	II	7 (63.6%)	
	III	0 (0%)	
	IV	0 (0%)	
Vehicular trauma	I	12 (33.3%)	36
	II	14 (38.9%)	
	III	6 (16.7%)	
	IV	4 (11.1%)	
Fall from a height	I	4 (21.1%)	19
	II	3 (15.8%)	
	III	7 (36.8%)	
	IV	5 (26.3%)	

There were 6 complications related to the intertrochanteric fractures. Infection and loosening of the screws on the sideplate of dynamic hip screws happened in 2 patients with ipsilateral intertrochanteric and shaft fractures. The others were pressure sore, aspiration pneumonia, superficial infection, cortex reamed through in gamma nailing. There was no mortality during the period of follow-up.

**Table 3** Distribution of fracture stability stratified by the mechanism of injury ( $p = 0.046$ , two-tail Fisher's exact test)

Mechanism	Stability	No. of cases	Total
Simple fall	Stable	7 (63.6%)	11
	Unstable	4 (36.4%)	
Vehicular trauma	Stable	18 (50.0%)	36
	Unstable	18 (50.0%)	
Fall from a height	Stable	4 (21.1%)	19
	Unstable	15 (78.9%)	

## Discussion

Young men's bones are less osteoporotic. However, their more active lifestyle predisposes them to injuries. Most of the patients in this study were injured during work. The places and mechanisms of injuries reflect the influence of lifestyle.

Breaking of the proximal femur requires greater energy than that generated in a simple fall for most young adults [6]. Robinson and his colleagues had also found vehicular trauma and fall from a height to be the major causes [16]. However, simple falls also caused intertrochanteric fractures in 11 patients. Further investigation is required to explain this, because the incidence of osteoporosis in young individuals is only 4.1 per 100,000 person-years [11]. Since none of them had an associated fracture, early preferential deficit of bone mineral density in the femur may partially answer the question [1,2, 9], though their Singh indexes did not reflect osteoporosis. The directions of the fall, the site of the impact, the rate of impact, the state of muscle action, the body configuration, and the use of passive and active energy-absorbing mechanisms may also influence the occurrence of the fractures [6].

Simple falls lack sufficient energy, so none of the patients injured in a simple fall had an associated injury. This is similar to the elderly population. Since most of the intertrochanteric fractures in the young adults were caused by high-energy trauma, it is not surprising that nearly half of the patients had at least one associated injury, and nearly one-quarter had more than two. As the energy was high, the range of associated injuries was wide.

The range of fracture types resembled that seen in the elderly [12]. Associated injuries had shared part of the causative energy. The influence of the remainder was offset by the tougher bone. Stratified by the mechanism of injury, the distribution in each subgroup was distinct. Because of the tougher bone in the young, only Boyd type I and II fractures were seen in those injured in a simple fall. In those fractures caused by vehicular trauma or fall from a height, the influence of the high energy exceeded that of the bone stock. Therefore, the distribution was quite different. There were more Boyd type III or IV fractures.

The intertrochanteric area is composed of cancellous bone. Union of the fractures is common. The nonunion rate is 1% to 2% [4, 10, 14, 15, 18]. Due to a different definition of union and different methods of treatment, the

reported union times vary [5, 13]. Because the energy in each injury was diverse, the time to healing varied greatly. With a young adult's better ability to heal, callus formation was faster in those who suffered simple falls. It was slower in those who suffered vehicular trauma or fall from a height, because the blood supply and soft tissue were disrupted more. The healing was related to the mechanism of injury. In intertrochanteric fractures, fixation of the proximal fragment depends entirely on the quality of the cancellous bone present [7]. In the young, the bone stock is good enough for the fixation. The determination of fracture stability and the choice of fixation device become paramount. Allowing weight-bearing is also important in the management of the unstable fractures. The principles followed in our institution worked well. All of the intertrochanteric fractures healed. There was no implant failure or nail penetration. Varus deformity and retroversion did not happen in the unstable fractures treated with gamma nails or dynamic hip screws and bone grafting. Good bone stock and proper management were the keys to success.

There were fewer complications in the young adults with intertrochanteric fractures. This was related to their age and the presence of fewer co-morbid conditions. In ipsilateral intertrochanteric and shaft fractures, extended dissection was required to fix both fracture sites with one long sideplate of dynamic hip screw. Disturbing the healing of the soft tissue and fractures resulted in nonunion, screw loosening, and infection. Gamma nailing via closed reduction could be a better choice in this situation.

The characteristics of intertrochanteric fractures in young adults were mainly related to the mechanism of injury. Given tougher bone stock, good healing ability, and less co-morbidity, proper management of the patients can lead to healing of all intertrochanteric fractures. However, the functional recovery of these patients was also determined by the type of associated injuries. To prevent misdiagnosis of these scattered associated injuries, thorough systematic evaluation is indispensable.

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