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Original Article

Concomitant hip and distal radius fractures

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Abstract

Background: Concomitant ipsilateral hip and distal radius fractures are uncommon, and little research has been published about these injuries. Our aim was to evaluate the characteristics and results of treatment for these injuries.
Methods: Between 2006 and 2012, 35 concomitant hip and distal radius fractures were identified, comprising the study group. The characteristics and results of treatment for these injuries were evaluated and analyzed. Another matched control group with isolated hip fractures was collected for comparison of patient characteristics, fall mechanism, fracture pattern, bone density, and functional recovery.
Results: For the patients with concomitant fractures, the average age was 77.6 years, and the female-to-male ratio was 6:1 (30:5). The majority (91.4%) of patients sustained ipsilateral injuries. Among the controlled pairs, 20 (57.1%) patients in the study group sustained a backward fall, and 25 (71.4%) patients in the control group had a sideways fall. With respect to the pattern of hip fracture, 22 (62.9%) patients in the study group had femoral neck fractures and 20 (57.1%) patients in the control group had pertrochanteric fractures. The average hospital stay was 15.3 days in the study group versus 10.2 days in the control group. Twenty-five (71.4%) patients in the study group and 27 (77.1%) patients in the control group had osteoporosis. The average Barthel index score was 75.1 in the study group and 75.7 in the control group.
Conclusion: Concomitant hip and distal radius fractures were generally ipsilateral and involved the femoral neck after a backward fall. These patients were younger than and not more osteoporotic than the population with isolated hip fractures; however, the hospital stay was significantly increased. The functional outcome was not influenced by concomitant wrist fracture.

Keywords: concomitant fractures; fall mechanism; functional recovery; hip and wrist fractures

1. Introduction

Fall risk is a serious public health issue, and the frequency of falls increases with age and frailty level. Among community-dwelling individuals older than 64 years, 28–35% experience a fall each year. Among individuals older than 70 years, approximately 32–42% fall each year.[1–3] Consequences from falls include fractures, immobilization, dependence, restrictions in daily activities, and death.[4,5] Fall-related isolated hip, wrist, shoulder, elbow, and spine fractures are common in the orthopedic surgeon's practice, but concomitant fractures are more rare. Among these fractures, hip and distal radius fractures represent the two most common in elderly patients. Little research, however, has been published about these two combined injuries.

Many risk factors for hip fractures have been investigated, including age, race, education, medications, endocrine or

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metabolic diseases, injury mechanisms, and bone mineral density.[6–8] The strongest single risk factor associated with hip fracture is fall. Approximately 90% of hip fractures result from falls.[9] Studies also indicated that a sideways fall was associated with a six-fold greater risk for hip fracture than a forward or backward fall.[10,11] Few studies of concomitant hip and wrist fractures have assessed the type of falls sustained by patients.

Whether differences exist regarding patient characteristics, fall mechanism, fracture pattern, bone density, and functional recovery between isolated hip fractures and concomitant hip and distal radius fractures has not been well described. Therefore, this retrospective study analyzed the patients admitted with concomitant fractures of the hip and distal radius and compared these patients to a matched control group with isolated hip fractures.

2. Methods

Patients admitted to our institution for isolated hip fracture due to a simple fall between 2006 and 2012 were initially included for comparison to the study group for age and sex. This general population consisted of 2800 patients with an average age of 81.3 years (range, 55–102 years), and a female-to-male ratio of 2.5:1 (2000 female, 800 male).

Inclusion in the study group required concomitant hip and distal radius fractures as a result of a simple fall. Hip fracture was defined as intracapsular neck fracture (AO/OTA type 31-B1 to B3) or extracapsular pertrochanteric fracture (AO/OTA type 31-A1 to A3). Distal radius fracture was defined as an intra-articular or extra-articular fracture (AO/OTA type 23 A2-C3). A simple fall was defined as a sudden, unintentional change in position causing an individual to land at a lower level on an object or the ground, and was not the result of the sudden onset of paralysis, epileptic seizure, or overwhelming external force.[12] Atypical fractures, pathologic fractures, fractures caused by high-energy trauma, or fractures associated with dislocation were excluded from the study. A total of 35 patients were eligible for inclusion in the study group. These patients had an average age of 77.6 years (range, 69–82 years) and a female-to-male ratio of 6:1 (30 female, 5 male). Thirty-two patients (91.4%) sustained ipsilateral fractures.

For each patient in the study group, a control patient from the general population was matched for age, sex, race, and comorbidity. The dates of the falls sustained by patients in the control group occurred within 1 week of falls experienced by patients in the study group. Each participant in the study and control groups provided signed informed consent prior to entering the study. Comorbidity was assessed using the American Society of Anesthesiologists (ASA) classification,[13] which rates healthy patients as Class 1, patients with mild systemic disease as Class 2, patients with severe systemic disease as Class 3, patients with severe life-threatening systemic disease as Class 4, moribund patients as Class 5, and brain-dead patients as Class 6. The ASA classification data were collected from the records of the Anesthesia Preoperative Evaluation Clinic.

Information on the direction of each fall (i.e., forward, sideways, or backward) was collected from the records at the emergency room and the charts on admission. Among the 35 matched pairs, the direction of the fall was recorded in only 10 patients. Data for the remaining patients were obtained by questionnaires sent in the mail and phone interviews.

The degree of osteoporosis was measured by evaluation of the radiographs of the uninjured hip at the time of injury and represented by the Singh index.[14] The Singh index is commonly used to assess osteoporosis based on the radiological appearance of the trabecular bone structure of the proximal femur on a plain anteroposterior view. The index has a six-point scale from Grade I, in which only the primary compressive trabeculae can be seen and which indicates severe osteoporosis, to Grade VI, in which all the major trabecular systems are visible and which reflects a normal bone. All of the digital radiographs were read by one author who was blinded to which the group the patient belonged. This observer took advantage of all tools for image adjustment, e.g., image magnification, adjustment of brightness level, and window range or image inversion, in order to reach optimal settings for evaluation. Singh I, II and III were defined as definite osteoporosis. All patients were followed for a minimum of 12 months (average, 42 months; range, 12–60 months). Functional status was evaluated by the Barthel index score.[15,16] Among the 35 control pairs (70 patients), 62 patients were assessed at the last outpatient department visit, six patients by phone interview and two patients by mail.

Predictive Analysis SoftWare version 18.0 (SPSS, Inc., Chicago, IL, USA) was used for the data analysis. Categorical variables such as age, sex, fall direction, fracture pattern, and definite osteoporosis were analyzed by Pearson's Chi-square test. Differences in length of hospital stay between the two groups of patients were determined by t test. The Barthel index scores for patients with concomitant hip and radius fractures and patients with single hip fractures were compared using the Mann–Whitney U test. The level of statistical significance was $p < 0.05$.

3. Results

Age and female-to-male ratio showed statistically significant differences between the general population of patients with isolated hip fracture and the study group patients with concomitant hip and distal radius fractures ($p = 0.038$ and $p = 0.041$, respectively; Table 1). The average age was 77.6 years (range, 69–82 years) in the study group and 78.1 years (range, 69–84 years) in the control group. There were 30

Table 1
Comparison of study group with the general population.

	Concomitant hip and wrist ($n = 35$)	Isolated hip ($n = 2800$)	p
Age (y), mean	77.6	81.3	0.038
Sex (F:M)	6:1 (F = 85.7%)	2.5:1 (F = 71.4%)	0.041

Data were analyzed using Pearson's Chi-square test.

women and five men in each group. The mean preoperative comorbidity ASA scores were 2.9 for each group (Table 2).

In the study group, three patients fell forward, 12 fell sideways, and 20 fell backward. In the control group, two patients fell forward, 25 fell sideways, and eight fell backward. Most patients with concomitant hip and wrist fractures fell backward rather than sideways (sideways:backward ratio: 0.6). In contrast, most patients who had isolated hip fractures fell sideways instead of backward (sideways:backward ratio: 3.1).

Our study group consisted of 22 femoral neck fractures and 13 pertrochanteric fractures (neck:trochanter ratio: 1.69). The control group comprised 15 femoral neck fractures and 20 pertrochanteric fractures (neck:trochanter ratio: 0.75). The average duration of stay in the hospital was 15.3 days in our study population versus 10.2 days in the control group ($p = 0.028$).

Definite osteoporosis by the Singh index consisted of 25 patients in the study group and 27 patients in the control group ($p = 0.661$). Functional recovery was evaluated $\geq$6 months after the injury with the Barthel index (averages: 75.1 for the study group vs. 75.7 in the control group, $p = 0.831$; Table 3).

Table 3
Comparison of study group with control group.

	Study group ($n = 35$)	Control group ($n = 35$)	p
Direction of fall			
Forward	3 (8.6%)	2 (5.7%)	
Sideways	12 (34.3%)	25 (71.4%)	
Backward	20 (57.1%)	8 (22.9%)	0.031[a]
Sideways:backward ratio	0.6	3.1	
Fracture pattern			
Femoral neck	22 (61.9%)	15 (42.9%)	
Pertrochanteric	13 (38.1%)	20 (57.1%)	0.052[a]
Neck:trochanter ratio	1.69	0.75	
Hospital stay (d)	15.3	10.2	0.028[b]
Definite osteoporosis	25 (71.4%)	27 (77.1%)	0.661[a]
Barthel index score	75.1	75.7	0.831[c]

Data were analyzed using: [a] Pearson's Chi-square test; [b] t test; [c] Mann–Whitney U test.

4. Discussion

Concomitant hip and distal radius fractures are more rare compared to isolated hip fractures. Distal radius fractures have an incidence of 1.7–3.9% among patients with hip fractures.[17,18] Our cohort revealed 35 distal radius fractures in 2800 isolated hip fracture patients (1.25%). The vast majority (91.4%) of the distal wrist fractures occurred ipsilateral to the hip fractures in this study. High proportion of ipsilateral concomitant fractures was also presented by previous studies, with a percentage ranging from 94% to 100%.[18,19]

Several studies show that hip fracture patients with concomitant distal radius fractures tend to be older[17,20] or similar[18] in age to the population of patients sustaining isolated hip fractures. Our cohort, however, revealed a relatively younger age in the study group compared with the general population. Younger patients may be more active and mobile and have better protective responses with attempt to break their fall with hands than older patients, which caused a higher risk of concomitant wrist fractures.

The female-to-male ratio was much higher in the study group compared to that in the general population (6:1 vs.2.5:1). Female predominance was reported by several studies, with a female bias of 5.6:1 to 8:1 in concomitant wrist fracture patients.[17,18,20] In addition to osteoporosis, which is a well-known problem among postmenopausal women, the greater incidence of falls in females has been documented in several studies.[21–23]

The literature indicates that sideways falls create a six-fold greater risk for hip fractures than forward or backward falls.[10,11] A domestic statistic in our country showed sideways falls were associated with a 15.2-fold increased risk for hip fractures compared with forward falls for men and a 12.8-fold higher risk for women.[24] A predominance of sideways falls was also noted in our control group (71.4%). In our study group, however, patients tended to sustain backward falls (57.1%). Nevitt and Cummings reported the risk of sustaining a wrist fracture is higher during backward falls in a clinical study of 294 cases.[25] A biomechanical study also concluded that smaller impact velocities to the wrists in forward falls could impart a lower fracture risk compared with backward falls.[26]

In our cohort, femoral neck fractures, rather than pertrochanteric fractures, were more numerous in the patients sustaining concomitant wrist and hip fractures. Tow et al reported a significantly higher cervical-to-trochanteric ratio for simultaneous hip and wrist fractures, which is similar to our value.[20] A reasonable interpretation could be that cervical fractures occur more frequently in more active and younger patients.[27,28] Similar cervical-to-trochanteric fracture ratios were reported by Mulhall et al[17] and Robinson et al.[18] Di Monaco et al suggested trochanteric predominance in concomitant upper limb fractures.[29]

Although some studies reported a similar length of hospitalization in patients with and without concomitant fractures,[30] longer hospital stays in patients with concomitant injuries were reported by most of the previous studies.[17,18,20] The present study also noted patients sustaining combined injuries had a significantly longer hospitalization.

Although Singh's index is a simple and inexpensive method for the determination of bone quality, the predictive value has been criticized due to subjective characteristics and poor interobserver agreement. Singh's index was used to determine the presence and degree of osteoporosis in this retrospective

Table 2
Control group data.

	Study group ($n = 35$)	Control group ($n = 35$)
Age (y), mean	77.6	78.1
Sex (F:M)	6:1 (female = 30)	6:1 (female = 30)
ASA, mean	2.9	2.9

ASA = American Society of Anesthesiologists classification.

study because we did not perform a DEXA scan for patients routinely at the time when the injuries occurred, although it was more objective than Singh's index and was accepted as the gold standard for the diagnosis of osteoporosis. A high proportion of patients with definite osteoporosis was observed in both groups, but the difference between the two groups was small. Not only was the presence of osteoporosis important for fracture risk, other factors, such as fall mechanism and patient activity, also played important roles in the development of concomitant fractures.

Functional status was assessed in the mid-to long-term follow-up in our cohort study, and no significant differences were noted between the two groups. Although Tow et al[20] indicated that patients with concomitant wrist fractures had impaired ambulatory status at discharge, other studies suggest there was no influence on functional recovery at the end of rehabilitation.[29,30] Shabat et al observed that double trauma represented a better premorbid condition relative to patients in the same age group with single injury, and thus double trauma might be a prognostic indicator for success in rehabilitation.[19,31]

Our study has some limitations. First, the number of patients with concomitant wrist and hip fractures was rather small. A larger sample population would be needed to raise the statistical power. The retrospective nature of the study also implied the possibility of recall bias and confounding factors.

In conclusion, we found that patients sustaining concomitant distal radius and hip fractures were not necessarily older and more osteoporotic than the patients with isolated hip fractures. We also verified previously reported data that indicated combined injuries were more likely in women, occurred ipsilateral to each other, were associated with longer hospital stays, and demonstrated similar functional recoveries compared with isolated hip fractures. Our cohort study also presented trends of backward falls and femoral neck fractures in patients with concomitant fractures. In contrast, the majority of patients with isolated hip fractures experienced sideways falls and pertrochanteric fractures.

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