


CLINICAL ARTICLE

Effect of Orthogeriatric Co-Management on Geriatric Hip Fractures in China

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Objectives: Although geriatric hip fracture is a serious public health problem in China, the result of orthogeriatric co-management (OGC) is rarely reported. This study aimed to evaluate the effect of OGC in Chinese patients aged ≥ 65 years.

Methods: In this single-centre, pre-post intervention, retrospective study, traditional orthopaedic care (TOC) was used until OGC was implemented in May 2015, a multidisciplinary team was organized, and clinical protocol was designed. Consecutive hip fracture patients who were ≥ 65 years and injured within 3 weeks were included in this study. Demographic characteristics, comorbidities, fracture patterns, surgical procedure, time to surgery, length of hospital stay, inpatient complications, and in-hospital mortality were extracted and examined. At 1-year after surgery, data on patients' mobility and mortality were collected. The time to surgery, incidence of inpatient complications, mortality and functional outcomes were compared between the groups.

Results: There were no significant differences in sex, fracture type, and surgical pattern between OGC ($n = 434$) and TOC ($n = 452$) groups. Patients in OGC group were significantly older ($P < 0.001$) and had a higher age-adjusted Charlson comorbidity index ($P < 0.001$). However, waiting time between admission and operation was significantly lower in OGC group ($P < 0.001$). There was no significant difference in the mortality rate at the time of the patient being in-hospital and at 1, 3, and 6 months after surgery. Although 1-year mortality was higher in OGC group ($P = 0.036$), Cox regression analysis showed no significant correlation of OGC with 1-year mortality. There was no significant difference in pre-injury mobility and 1-year follow-up mobility assessed by Parker score. Only approximately half of the patients in both groups completely returned to their pre-injury mobility level.

Conclusion: OGC significantly shortens time to surgery for geriatric hip fractures compared with TOC. However, there is no significant effect on mortality rate within 1 year and functional status at 1 year of follow-up.

Key words: China; Hip fractures; Mortality; Orthogeriatric co-management; osteoporosis

Introduction

With an increase in the average lifetime, the world has entered a period of rapid aging. China is the most populous country, and the population aged >60 years accounted for 17.9% of the total population in 2018, and it is estimated to reach 25% by 2050^{1,2}. The direct consequence of this longevity will be an outbreak of diseases that afflict

older people, among which osteoporosis and fragility hip fractures will be prevalent. The number of new patients with hip fractures in China will rise to 1.079 million by 2050³. Hip fractures have become a public health problem globally because of their high mortality, high morbidity, and high cost. Despite advances in surgical and medical care, the excess mortality of hip fracture patient remains high, 1-year

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mortality after geriatric hip fractures could be as high as 20%–27%, 3–4 times higher than expected in the general population^{4,5}. In addition, other important clinical outcomes other than mortality, especially functional ability, are getting increasing attention from researchers and policymakers, as it was reported that 40% of hip fracture patients were unable to walk independently, 60% required assistance, and 33% were totally dependent 1 year after hip fracture⁶. The associated mortality and functional disability after geriatric hip fracture are huge burdens on society. Concurrent medical problems are common in geriatric patients with hip fracture, which is different to younger patients with musculoskeletal injury, as hip fractures are more likely to occur in frail older people with comorbidities such as cardiovascular disease, respiratory disease, renal disease, Parkinson's disease, and stroke. Previous evidence showed that these comorbidities are closely related to postoperative complications, prolonged hospital stays, and high mortality^{7,8}. These geriatric hip fracture patients should be assessed for frailty and comorbidities to better develop a care plan, this calls for an integrated clinical approach to the prevention and treatment of hip fractures.

Published guidelines have already stressed the importance of inclusion of a geriatrician from the time of admission, optimal pain control, comprehensive geriatric assessment, prompt surgery within 48 h, and early rehabilitation^{9–12}; these factors are associated with better functional outcome, a lower risk of complications and decreased mortality in geriatric hip fracture patients. Multidisciplinary approaches and orthogeriatric co-management (OGC) are therefore recommended by these guidelines to decrease perioperative complications and improve efficiency. Management on geriatric hip fracture patients mainly depends on each country's healthcare system. Literature is abundant on national observational cohort¹³; however, data are rarely comparable from one country to another depending on its healthcare system; for instance, normally surgery is performed and managed by care in a ward under the supervision of orthopaedic surgeons in China, but a recent survey showed significant gaps in perioperative management of geriatric hip fractures between current practice in China and worldwide guidelines and consensus. Multidisciplinary collaboration was not established in most hospitals and the interval between admission to surgery was longer than 48 h in 80% of the hospitals¹⁴. Therefore, interventions need to be implemented to contemplate the flow for patient care according to current practice guidelines. One previous study showed that introduction of the co-management model could significantly reduce the time from admission to surgery and improve other practice outcomes during hospitalization¹⁵, and the study also provided preliminary evidence about the feasibility of a multidisciplinary care approach for geriatric hip fracture patients in a Chinese tertiary hospital. However, few studies have examined functional recovery and mortality after a multidisciplinary care approach in China, for the primary target of the co-management model was to reduce the time to surgery, while the goal was to improve patients' outcomes.

The purpose of this study was to determine if there was any continuous improvement in patient care as we

progressed through the orthogeriatric co-management model of care. For this reason, the main purposes of this retrospective study are: (i) to evaluate the effect of multidisciplinary orthogeriatric co-management on time to surgery and incidence of inpatient complications; (ii) to analyze the difference in short-term and long-term mortality between pre- and post-intervention of multidisciplinary orthogeriatric co-management; and (iii) to describe the functional outcomes on long-term survival in geriatric patients undergoing hip fracture surgery.

Materials and Methods

Inclusion and Exclusion Criteria

The inclusion criteria were: (i) aged 65 years or older; (ii) injured within 3 weeks; (iii) underwent surgery for hip fracture; (iv) the study population has to be stratified according to the care model used in each study period: (a) patients who received surgery from January 2014 to December 2014 were in TOC group; (b) patients who received surgery from May 2015 to April 2016 were in OGC group.

The exclusion criteria were: (i) patients with pathological fracture; (ii) patients with periprosthetic fractures.

Patients

All data were collected from the electronic medical records of all eligible patients who were admitted from January 2014 to April 2016, all eligible patients met the inclusion criteria were enrolled in this study, with those who received operations from January 2014 to December 2014 allocated to the TOC group, while those who received operations from May 2015 to April 2016 were allocated to the OGC group. This study was approved by the local ethical committee (No. 201807-11).

Intervention

Traditional Orthopaedic Care

Before May 2015, geriatric hip fractures were managed with TOC in Beijing Jishuitan Hospital (BJH). The patients were admitted to one of the three orthopaedic trauma wards at random, under the care of different orthopaedic trauma teams. Routine preoperative tests for surgery include resting ECG, chest X-ray, full blood count, comprehensive metabolic panel, hemostasis tests, arterial blood gas analysis, infectious disease screening. Considering the presence of multiple comorbid conditions of elderly patients, echocardiography, spirometry examination, 24 h Holter monitoring, ambulatory blood pressure monitoring, duplex ultrasound for deep vein thrombosis were also routinely offered before surgery. The abnormal results of these preoperative tests and medical comorbidities were consulted by a specialist if required.

Orthogeriatric Co-Management

From May 2015, OGC was implemented for geriatric hip fractures. A multidisciplinary team, including orthopaedic surgeons, anesthesiologists, geriatricians, nurses, physical

therapists, and pharmacists, was organized. The implementation of the co-management care model started from the time of admission to the Emergency Department (ED) to discharge from the hospital (Figure 1). In the ED, patient care was jointly provided by the orthopaedic surgeons and ED physicians, with the participation of anesthesiologists. The ED physicians provided assessments including electrocardiogram and blood tests. Immediately after the patients were admitted to the orthogeriatric ward, orthopaedic surgeons and geriatricians jointly led the care of the patients. Geriatricians saw patients every day including weekdays and weekends, and provided preoperative assessment, comorbidity treatment, postoperative prevention of complications, and secondary prevention of fracture (i.e. bone protection and falls assessment). In the orthogeriatric ward, nutritionists, physiotherapists, and nurses were also involved in the pre-, peri- and postoperative assessment and treatment. Except for the routine preoperative tests for surgery, only echocardiography and duplex ultrasound for deep vein thrombosis were routinely offered. The multidisciplinary team determined the need for additional examinations based on the patients' medical comorbidities, and rapid access to all these additional examinations were well-established. Orthopaedic surgeons and geriatricians shared surgical and clinical information at the daily briefing with anesthesiologists, and decisions regarding surgical fitness and optimal timing of surgery were generally discussed, especially for patients with American Society of Anesthesiologists grade 3 or 4. Post-operatively, orthopaedic surgeons decided on the weight-bearing regimen with physical therapists. The target was leaving bed on the day after surgery and starting walking exercise within 3 days after surgery. The management indicators of OGC adapted the recommendations of the UK guideline in hip fracture management, including quick admission to an orthogeriatric ward, expedited surgery, geriatrician assessment, secondary

prevention of fracture, pressure ulcer prevention, provision of physiotherapy, and early discharge¹⁰.

Data Collection

The population study included 886 eligible patients who were stratified according to the care model used in each period (452 TOC patients and 434 OGC patients.)

For the present study, the following variables were collected:

The Baseline Data

Patients' demographic data were recorded, including age, gender, fracture patterns, surgical procedure. Age-adjusted Charlson comorbidity index (CCI)¹⁶ was calculated based on the preoperative comorbidities. Parker score was used for functional evaluation.

Outcome Variables

Time to Surgery, Length of Stay (LOS)

The time to surgery, defined as the number of hours stayed in hospital previous to surgical procedure, and the patients who could receive surgery within first 48 h from admission. Current guidelines recommend surgery within 48 h, early hip surgery within 48 h was associated with lower mortality risk and fewer perioperative complications. The LOS was defined as the length of an inpatient episode of care, calculated from the day of admission to the day of discharge, and based on the number of nights spent in hospital. The LOS is an important indicator of the efficiency of hospital management. Reduction in the number of inpatient days results in decreased risk of infection and medication side effects, improvement in the quality of treatment with more efficient bed management.

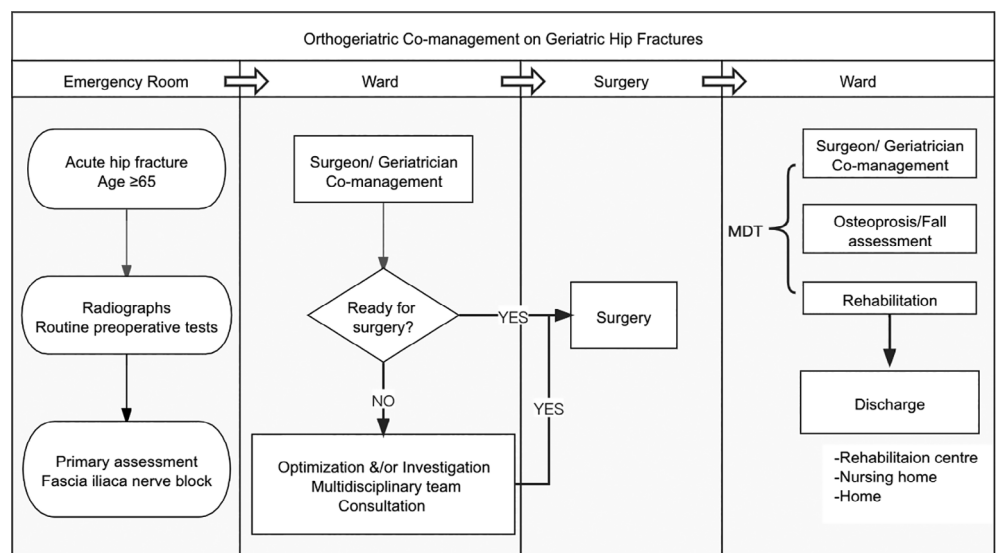


FIGURE 1 Flow chart of orthogeriatric co-management

Inpatient Complications

Reduced perioperative mobility with extended bed rest predisposes geriatric hip fracture patients to a variety of complications, including pressure ulcer, deep vein thrombosis (DVT), pneumonia, and urinary tract infection (UTI). The patients' details of these complications during their hospitalization were obtained from the case report form. In this study, we use this outcome to explore the relationship between inpatient complications of prolonged bed rest and time to surgery.

Parker Score

At follow-up of 1-year after surgery, patients or their caregivers were asked by phone for information regarding their functional status. Parker score was used to evaluate the patients' mobility¹⁷, including their ability to walk inside, walk outside of the house, and go shopping or visit family. For each question, there were four ordinal responses with the individual fixed count, which were then summed up. The final sum ranged from 0 to 9 where the maximum score states independent mobility.

Mortality

The mortality rates were calculated by the number of death cases divided by the number of patients in each group after surgery. The mortality rates can be influenced by the medical care, disease status, and comorbidities of patients, or by medical or surgical therapies.

Statistical Analysis

SPSS 25.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Metric scaled data were reported as the mean \pm standard deviation and categorical data as absolute frequency and percentage distribution. Depending on the distribution of variables, the *t* test for independent variables or the nonparametric Mann-Whitney *U* test was used. The Kolmogorov-Smirnov test was used to assess the distribution. The chi-square test or Fisher's exact test was used to analyze categorical data. The multiple linear regression was used to evaluate the association between pre-post intervention and 1-year mortality as well as physical functions between both groups. The mixed models were used to account for repeated 1-, 3-, and 6-month mortalities. Potential confounders were adjusted in modeling, including pre-post intervention group, age, sex, timelines, age-adjusted CCI, etc.

Results

The Baseline Data

Of all the 886 patients included, the overall average age was 78.3 ± 7.0 years (mean \pm standard deviation, SD; range, 65 to 99), 69.1% were women. The baseline data of the two groups are shown in Table 1. Patients in the OGC group (79.3 ± 7.2 ; range, 65–99) were significantly older than those in the TOC group (77.3 ± 6.6 ; range, 65–95), ($P < 0.001$).

TABLE 1 Baseline data of the patients in the TOC and OGC groups

Characteristics	TOC group (n = 452)	OGC group (n = 434)	t value	P value
Age, mean (SD)	77.3 (6.6)	79.3 (7.2)	-4.170	0.000
Gender, n (%)			0.392	0.531
Female	311 (68.8%)	307 (70.7%)		
Male	141 (31.2%)	127 (29.3%)		
Fracture type, n (%)			1.181	0.277
Femoral neck fracture	257 (56.9%)	231 (53.2%)		
Trochanteric region fracture	195 (43.1%)	203 (46.8%)		
Surgical procedure, n (%)			1.184	0.276
Internal fixation	245 (54.2%)	251 (57.8%)		
Hip arthroplasty	207 (45.8%)	183 (42.2%)		
Age-adjusted CCI, mean (SD)	4.05 (1.26)	4.70 (1.43)	-7.865	0.000
Fully independent ^a , n (%)	263 (58.2%)	268 (61.8%)	1.172	0.279

^aParker score = 9.

There was no significant difference in the sex ratio, fracture type, or surgical pattern between the two groups. The preoperative age-adjusted CCI in the OGC group (4.70 ± 1.43 ; range, 3–11) was significantly higher than that in the TOC group (4.05 ± 1.26 ; range, 3–10), ($P < 0.000$). The percentage of fully independent patients according to the pre-fracture Parker score was 58.2% (263/452) in the TOC group and 61.8% (268/434) in the OGC group ($P = 0.279$).

Time to Surgery, Length of Stay (LOS)

After implementation of orthogeriatric co-management, the mean waiting time between admission and the operation significantly decreased from 5.9 days to 2.8 days ($P < 0.001$). The proportion of surgery within 48 h of admission was increased from 10.2% to 48.2% ($P < 0.001$). The mean length of hospital stay was decreased from 10.6 days to 7.6 days ($P < 0.001$).

Inpatient Complications

The percentage of inpatient complications related with extended bed rest was higher in the TOC group (12.8%) compared with in the OGC group (10.1%), without statistical difference ($P = 0.209$) (Table 2).

Mortality

The follow-up rate at 1 year was 80.3% (363/452) in the TOC group and 88.0% (382/434) in the OGC group. Patients in the OGC group (79.3 ± 7.1 ; range, 65–99) were an average of 1.9 years older compared with those in the TOC group (77.2 ± 6.5 ; range, 65–95), ($p < 0.001$). The age-adjusted CCI was significantly higher in the OGC group (4.73 ± 1.41 ; range, 3 to 11) compared with the TOC group (4.05 ± 1.27 ; range, 3 to 10), ($p < 0.001$). There was no significant difference in the sex ratio, fracture type, surgical

TABLE 2 Time to surgery, length of hospital stays, inpatient complications related with extended bed rest, and in-hospital mortality

	TOC group (n = 452)	OGC group (n = 434)	t value	P value
Time to surgery (h), mean (SD)	141.0 (78.1)	67.3 (40.3)	16.062	0.000
Time to surgery within 48 h, n (%)	46 (10.2)	209 (48.2)	155.81	0.000
Length of hospital stay (day), mean (SD)	10.6 (3.6)	7.6 (3.2)	13.408	0.000
Inpatient complications, n (%)	58 (12.8)	44 (10.1)	1.577	0.209
Pneumonia	9 (2.0)	5 (1.1)	1.002	0.317
UTI	4 (0.8)	9 (2.1)	2.164	0.141
Pressure ulcers	2 (0.4)	0 (0)	1.925	0.166
DVT	43 (9.5)	30 (6.9)	1.981	0.159
In-hospital mortality, n (%)	1 (0.2)	3 (0.7)	1.088	0.297

procedures, or pre-injury Parker scores between these two groups (Table 3).

There were no significant differences in the mortality rates of in-hospital and at 1, 3, and 6 months after surgery between the TOC and OGC groups (Tables 2 and 3). The 1-year mortality rate was significantly higher in the OGC group compared with the TOC group (6.3% vs 3.0%, $P = 0.036$) (Table 3). Cox regression analysis showed no significant correlations of implementation of the OGC program, sex, fracture type, surgical procedure, and preoperative age-adjusted CCI with 1-year mortality. However, age was significantly associated with 1-year mortality ($P = 0.006$). As the age of patients increased, the risk of death increased within 1 year postoperatively (hazard ratio = 1.080, 95% confidence interval: 1.022–1.140).

Functional Recovery at the 1-Year Follow-Up

There was no significant difference in pre-injury mobility as assessed by the Parker score (8.2 ± 1.9 in the TOC group vs

8.4 ± 1.4 in the OGC group, $P = 0.433$). For patients who were still alive at the 1-year follow up, functional status was similar as assessed by the Parker score (6.7 ± 2.7 in the TOC group vs 6.8 ± 2.4 in the OGC group, $P = 0.441$). Only approximately half of the patients completely returned to their pre-injury mobility level (56.3% in the TOC group vs 50.3% in the OGC group, $P = 0.119$). At 1 year postoperatively, the percentage of fully independent patients was 43.2% (152/352) in the TOC group and 37.2% (133/358) in the OGC group ($P = 0.101$) (Table 3).

Discussion

Effect of Multidisciplinary Orthogeriatric Co-Management

China has the largest population in the world and the number of older people is rapidly increasing. Although the incidence of hip fracture in older people is relatively low in China compared with other countries¹⁸, the number of hip fracture cases

TABLE 3 Baseline data, mortality, and functional recovery of patients who were followed for 1 year

	TOC group (n = 363)	OGC group (n = 382)	t value	P value
Age, mean (SD)	77.2 (6.5)	79.2 (7.1)	-3.965	0.000
Gender, n (%)			0.383	0.536
Female	249 (68.6%)	270 (70.7%)		
Male	114 (31.4%)	112 (29.3%)		
Fracture type, n (%)			3.62	0.057
Femoral neck fracture	218 (60.1%)	203 (53.1%)		
Trochanteric region fracture	145 (39.9%)	179 (46.9%)		
Surgical procedure, n (%)			2.547	0.110
Internal fixation	186 (51.2%)	218 (57.1%)		
Hip arthroplasty	177 (48.8%)	164 (42.3%)		
Age-adjusted CCI, mean (SD)	4.05 (1.27)	4.73 (1.41)	-8.231	0.000
Parker Score before injury, mean (SD)	8.2 (1.9)	8.4 (1.4)	-0.784	0.433
Mortality, n (%)				
30-day mortality	2 (0.6%)	6 (1.6%)	1.822	0.177
3-month mortality	4 (1.1%)	8 (2.1%)	1.156	0.282
6-month mortality	6 (1.7%)	9 (2.4%)	0.466	0.495
1-year mortality	11 (3.0%)	24 (6.3%)	4.398	0.036
Functional recovery				
Parker Score at 1 year, mean (SD)	6.7 (2.7)	6.8 (2.4)	-0.770	0.441
Complete recovery ^a , %	56.3% (198/352)	50.3% (180/358)	2.430	0.119
Fully independent ^b , %	43.2% (152/352)	37.2% (133/358)	2.687	0.101

^a The Parker score at 1 year was completely restored to that before injury.; ^b Parker score = 9.

per year is considerable because of the large population base. Geriatric patients with hip fracture need to have a safe, quick, and efficient recovery after injury to return to their pre-injury life. However, this situation in China is not optimistic. A retrospective audit¹⁹ was performed on 780 geriatric patients with hip fracture who were treated between 2009 and 2011 in BJH when TOC was used. This audit showed that only 8% of patients received surgery within 48 h of admission compared with 83% in the UK National Hip Fracture Database 2012, which was collected from 180 hospitals. These results highlight a considerable gap between surgical practice in China compared with the best practice in UK hospitals. Therefore, strategies need to be implemented to increase the uptake of best practice hip fracture care in China.

Many guidelines recommend using multidisciplinary collaboration to help cope with geriatric hip fractures efficiently^{10–12}. However, this collaboration has not yet been established in most hospitals in China. A survey had been performed on orthopaedic surgeons during the 12th International Congress of the Chinese Orthopedic Association in November 2017¹⁴. Valid questionnaires of 171 orthopaedic surgeons from 28 provinces of China showed that multidisciplinary collaboration was not established for geriatric hip fractures in 71.9% of hospitals. In many hospitals, a pulmonary function test (61.4%, 105/171), Holter monitoring (38.0%, 65/171), and ambulatory blood pressure monitoring (53.8%, 92/171) were routine preoperative investigations. In 56.3% (96/171) of the hospitals, traction was performed before the operation. In 80.1% (137/171) of the hospitals, the time between admission to surgery was longer than 48 h for most patients. There are many reasons for this large disparity between countries, including no implementation model in China. Before 2015, geriatric hip fracture patients were admitted to the orthopaedic trauma wards together with other trauma patients. The orthopaedic surgeons were responsible for hip fracture treatment including pain control, basic preoperative assessment, and optimization. At that time, many additional preoperative examinations were performed without rapid access. Consultation with internists and anesthetists was on request without standard protocol. Lack of space on theater lists was common. All led to high rate of surgery delay or cancellations. In contrast, a multidisciplinary team on geriatric hip fractures was organized on May 2015 in BJH. Patients aged ≥ 65 years with acute hip fracture were admitted to a specialized unit under co-management of an orthopaedic surgeon and geriatrician. Clinical protocol was designed specialized for geriatric hip patients from emergency to discharge. The role of each discipline in the team and assessment timeframe were assigned in the protocol. Unnecessary examinations were canceled and rapid access was granted if needed. Geriatricians were responsible for preoperative optimization and postoperative management. All patients could receive a senior medical review in a much earlier time. Available theater lists dedicated for geriatric hip fracture patients were increased, which allows the patients to undergo surgery as planned. This is the first orthogeriatric co-management unit to specialize in geriatric hip fractures in mainland China. In a previous study, 1192 patients received orthogeriatric co-management between May 2015 and April

2017. Half of the patients received surgery within 48 h of admission to the ward compared with 6.4% in 1839 patients before co-management¹⁵. Orthogeriatric co-management was found to improve efficiency by decreasing the time to surgery and the length of hospital stay. The current study focused on mortality and functional recovery by comparing the follow-up results between TOC and OGC.

Mortality

Reducing short-term and long-term mortality are primary goals in the management of geriatric hip fractures. Theoretically, a multidisciplinary approach can reduce mortality, but previous literature has reported different results. Lau *et al.*²⁰ reported that in-patient mortality decreased from 2.86% to 0.95% and 30-day mortality decreased from 5.36% to 1.67% after implementing a multidisciplinary geriatric hip fracture clinical pathway. Collinge *et al.*²¹ reported that the in-hospital mortality rate increased during the implementation phase of a multidisciplinary geriatric hip fracture program. However, once established, the in-hospital mortality decreased to a more typical level. Friedman *et al.*²² reported a decrease in in-hospital mortality from 2.5% to 1.6% after introducing a hip fracture program that was co-managed by geriatricians and orthopaedic surgeons. However, their improvement did not reach a level of significance. This study showed no significant reduction in in-hospital, 30-day, 3-month, and 6-month mortality for patients who underwent surgeries with multidisciplinary orthogeriatric co-management. Although 1-year mortality was higher in the OGC group than in the TOC group, Cox regression analysis showed that age, rather than early surgery or the co-management program, affected 1-year mortality. The present study showed that the OGC program improved management efficiency of geriatric hip fractures without increasing mortality. Education and experience are important for a multidisciplinary team because balance between optimization of medical conditions and early surgical management is required.

In our study, 1-year mortality was 3.0% in the TOC group and 6.3% in the OGC group. Both rates are much lower than the recognized mortality rate at approximately 20%^{4,5}. Comparing this study with a similar study by Civinini *et al.*²³ that was performed in Italy, both studies investigated the effect of the multidisciplinary geriatric co-managed care unit on hip fracture in patients aged >65 years at the same period. In Civinini *et al.*'s study, 677 patients were included with a 1-year mortality rate of 18.7%. The average age of Civinini's study population was 84.5 years old, which is higher than 79.3 years in this study. The comorbidities were more common and severe in Civinini's study compared with this study. There is also a large difference in pre-fracture mobility status between studies. The percentage of fully independent patients according to the Parker score was 19.4% in Civinini *et al.*'s study, while it was 58.2% (263/452) in the TOC group and 61.8% (268/434) in the OGC group in the current study. The reason for low mortality at 1 year in this study is probably because patient group was younger and healthier compared with previous studies. One-year mortality of geriatric hip fractures in Japan was

reported as 9.8%–10.8%²⁴, which means there may be ethnic differences.

Functional Outcomes

Another important goal of geriatric hip fracture management is to restore pre-injury mobility and quality of life. In this study, approximately half of the patients were not able to return to the pre-injury functional state at 1 year of follow-up, with no significant difference between the TOC and OGC groups. The results are consistent with a review by Dyer *et al.*⁶, which showed that only 40%–60% of study participants recovered their pre-fracture level of mobility. Grigoryan *et al.*²⁵ performed a systematic review and meta-analysis on orthogeriatric care models and outcomes in patients with hip fracture. In their review, function was reported by five studies, three of which reported improved function with routine geriatric consultation. Early mobilization after surgery, including standing and ambulation, is important for functional recovery. Rehabilitation after hip fracture requires joint effort and takes a long time. The length of hospital stays in this study was approximately 1 week and rehabilitation after discharge did not receive enough attention. Further study is required to determine the best model of rehabilitation with adaptation to different health systems.

The present study has some limitations. Only patients who received surgery were included in this study. There were some patients who were not operated on or even not admitted

to hospital. The ratio of operative intervention is an important parameter in assessing management of geriatric hip fractures. The outcome of conservative treatment was not followed.

Conclusion

This study demonstrated that orthogeriatric co-management could significantly shorten time to surgery for geriatric hip fractures compared with traditional orthopaedic care, without influence on mortality rate within 1 year. The significance of this study is the feasibility of orthogeriatric co-management and the preliminary results of shared care in China. Further study is required to investigate the possibilities and barriers of applying this model to other hospitals.

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AUTHORSHIP DECLARATION

All authors acknowledge that they meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and that all authors are in agreement with the manuscript.

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