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Use of Compression Hip Screws in Trochanteric Fracture in the Elderly: Effect of Screw-plate Angle on Ambulatory Ability and Change in Ambulatory Ability

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The objective of this research was to compare ambulatory ability after low-angle compression hip screw fixation (135° CHS) and high-angle CHS fixation (150° CHS) used to treat trochanteric fractures. An additional objective was to observe changes in ambulatory ability before and after treatment by CHS fixation and investigate factors that influence change. Subjects were 130 patients aged 60 years and older who underwent CHS fixation (135° CHS: 83 patients, 150° CHS: 47 patients). Outcome measures used were radiological findings related to ambulatory ability and ambulatory ability (including ability to function in society) seen preinjury and at discharge. To compare 135° CHS fixation and 150° CHS fixation in terms of the above-mentioned outcome measures, multivariate statistical analysis was carried out in order to avoid bias such as confounding of multiple variables. A significant difference was seen between 135° CHS fixation and 150° CHS fixation in terms of rate of maintenance of preinjury independent gait ability, but the difference in angle had no effect on ambulatory ability including rate of maintenance of independent gait ability. Ambulatory ability had decreased overall at discharge compared with before the injury was sustained. Common factors that influenced change were age, complications on admission and deuteropathy. No significant difference was noted in extent of sliding of the lag screw, in which a significant difference between groups would be expected, both theoretically and based on experimental studies by various researchers, due to the difference in angle. Moreover, except for rate of maintenance of independent gait ability, extent of sliding did not affect ambulatory ability.

Key words: compression hip screw, screw-plate angle, trochanteric fracture, gait ability, ambulatory ability

Introduction

The objective of treatment of trochanteric fractures is to regain preinjury ambulatory ability. However, it is a disease that cannot be overlooked in a society that is aging since trochanteric fractures in elderly people markedly impair ambulatory ability. Therefore, it is preferable for elderly people who sustain a trochanteric fracture to receive surgical treatment to reset and immobilize the fracture at an early stage, achieve early ambulation, and receive postoperative orthopedic surgical treatment. A surgical procedure used widely around the world for this fracture is compression hip screw (CHS) fixation. CHS fixation is characterized by a design that allows a lag screw inserted into the femoral neck and head to slide within a tube plate fixed in the femoral shaft, producing continuous compressive force at the fracture site. This allows solid stabilization and early bone union, which in turn is said to allow early rehabilitation of ambulatory ability. Various factors that affect the ambulatory ability of patients who have undergone CHS fixation have been reported. It is important, not only in the case of trochanteric fractures, to identify factors that af-

fect the outcome in elderly patients and to discuss with the patient and the patient's family ambulatory ability, which is a potential treatment goal, before treatment is given. Factors include age, gender, preinjury complications, preinjury ambulatory ability, status of the fracture site, deuteropathy during treatment, and postoperative therapy. The question to answer here is do differences in the screw-plate angle of the CHS device used to immobilize the fracture site become a factor. Conventional thought has been that a physiologically high angle (150°) slides more easily and more readily produces continuous compressive force than a low angle (135°) due to their dynamics. Does this consequently result in a difference in ambulatory ability? To ascertain this, we compared ambulatory ability after 135° CHS fixation and 150° CHS fixation. In addition, we investigated change in ambulatory ability and factors that influence change.

Subjects and Methods

1. Subjects

No adaptation criteria was set for the patients with 135° CHS and 150° CHS. Of the patients with trochanteric fracture who underwent CHS fixation in our department between June 1995 and April 2000, 130 were selected for this study. The 130 patients were at least 60 years old; they had not received other, additional stabilization materials; their planned angles fit; and they had not undergone open reduction surgery. Patients with pathological fractures or other trauma affecting ambulatory ability, patients with fractures in which the fracture line extended to the lateral cortical bone distal to the trochanter major (type II in the Evans classification), and patients with ambilateral fractures were excluded. The subjects included 92 women and 38 men with ages ranging from 60 to 97 years and a mean age of 80.8 years. A screw-plate angle of 135° was used for 83 patients and 150° for 47 patients.

2. Treatment methods

1) Surgical procedure

The CHS device used was the Compression Hip Screw 2400 Series ECT Type (Zimmer, Switzerland). The tube plate angles used were 135° (low angle) and 150° (high angle). Two or three-hole plates were used.

With the patient immobilized in a supine position on a fracture table, the operation was performed with a C-arm fluoroscopic apparatus. The fracture dislocation was reset as accurately as possible. The skin incision was made as a standard lateral surgical exposure using standard CHS surgery techniques. All surgeries were performed in the presence of at least two orthopedists. The author was present at all surgeries as either the surgeon or the first assistant surgeon. The number of surgeons present at the surgery was five and the author performed 63 cases for 135° CHS (75.9%) and 37 cases for 150° (78.9%).

2) Postoperative therapy

Postoperative therapy and rehabilitation were provided to all subjects in a similar manner. Starting with a sitting position or a wheelchair, general active exercise designed not to affect the hip joint on the affected side was initiated on the day after surgery. Since non-weight-bearing ambulation of the affected leg is difficult for patients in the targeted age group, weight-bearing was permitted when moving between bed, wheelchair and toilet only from the beginning of wheelchair use. Active and constant weight-bearing was initiated after bone union was confirmed. Rehabilitation, the goal of which was recovery of ambulatory ability to preinjury level, was initiated in consideration of patients' habitation circumstances after discharge. As time of discharge drew nearer, potential problems were assessed by trial stays, and patients were instructed to exercise on their own after discharge.

3. Outcome measures (preoperative)

1) Gender

2) Age

3) Cause of injury

4) Number of days from injury to operation and number of days from hospitalization to operation

5) Complications on admission (existing before hospitalization)

6) American Society of Anesthesiologists (ASA) score[1] (Table 1)

ASA score was used to assess any health abnormalities present on admission. Subjects were classi-

Table 1 ASA score: anesthesia risk

Class	
1	A normally healthy patient
2	A patient with mild systemic disease
3	A patient with severe systemic disease that is not incapacitating
4	A patient with an incapacitating systemic disease that is a constant threat to life
5	A moribund patient who is not expected to survive for 24 hr with or without operation

ASA: American Society of Anesthesiologist.

Table 2 Social function (Jensen)

Group	Point		
1	1	Independent	Manages everything, Possibly working
2	2	Slightly dependent	Manages household, Meals-on-wheels, Home-help ≦ 4 hr/week, Manages personal needs
3	3	Moderately dependent	Home-help ≧ 5 hr/week, Possibly district nurse
4	4	Totally dependent	Living in nursing home or long-term nursing at home

fied and scored as shown in Table 1.

7) Preinjury ambulatory ability

In order to assess ambulatory ability before injury, the following items were evaluated. (1) Gait ability: Subjects able to walk were categorized as "independent gait (able to walk independently without walking aids)", "cane gait (able to walk with cane)", "walker gait (able to walk with walker)" and subjects unable to walk were categorized as "wheelchair-bound (unable to walk, transfer on wheelchair)" or "bedridden (life on bed, transfer on bed)". (2) Social function (Jensen Index)[2] (Table 2) : Classification of ambulatory ability in terms of social activity. The lower the score was, the better the patient's ambulatory ability was.

8) Fracture type

The Evans classification[3] was used to classify subjects' trochanteric fractures.

9) Bone density (Singh index)[4]

The degree of bone atrophy was assessed using radiographs of the hip on the healthy side. The state of the trabecular bone from the femoral head to the trochanter was assessed using the Singh index. Singh grades 1, 2, and 3 were considered to be an indication of the presence of osteoporosis, grade 4 was considered borderline, and grades 5 and 6 were considered to be normal.

4. Outcome measures (postoperative)

1) Duration of stay in orthopedic ward, duration of hospital stay, and postoperative follow-up period

The term "duration of stay in orthopedic ward" is used if a patient was admitted and stayed only in the orthopedic ward until discharge, while the term "duration of hospital stay" is used if a patient was admitted to the orthopedic department and received treatments at other departments after the surgery. During the postoperative follow-up period, deaths and subjects who changed hospitals in less than 3 months were excluded from the data.

2) Extent of sliding (Figure)

The extent of sliding of the lag screw was determined by measuring the length of the lag screw protruding from the tube plate within the femoral head on sequential radiograph images taken beginning immediately after the operation until the completion of bone union according to the methods of Doppelt[5] and Nakata[6], taking into account the magnification. The difference between the values measured immediately after the operation and at the completion of bone union was defined as the extent of sliding. For subjects in whom the screw continued to slide and reached the structural limit of the CHS device, the limit was recorded as the measured value. There were no subjects in whom fur-

ther sliding occurred after the completion of bone union.

3) Deuteropathy (those that occurred after admission)

4) Ambulatory ability at discharge

Gait ability and social function were evaluated in order to assess ambulatory ability at discharge.

5) Prognostic criteria (Handa)[7] (Table 3)

Changes between preoperative and postoperative pain, ambulatory ability, and ADL are evaluated.

6) Change in ambulatory ability

Changes in gait ability from before the injury to the time of discharge were evaluated as follows : (1) from the perspective of overall (subjects able to walk and unable to walk) gait ability before the injury ; (2) from the perspective of subjects who could walk (subjects able to walk independently, and with cane or walker) before the injury; and (3) from the perspective of subjects who could walk independently (subjects able to wallk independently) before the injury (rate of maintenance of independent gait ability: rate (%) of subjects who could walk independently before injury, and could walk independently at hospital discharge).

7) Relation between extent of sliding and ambulatory ability

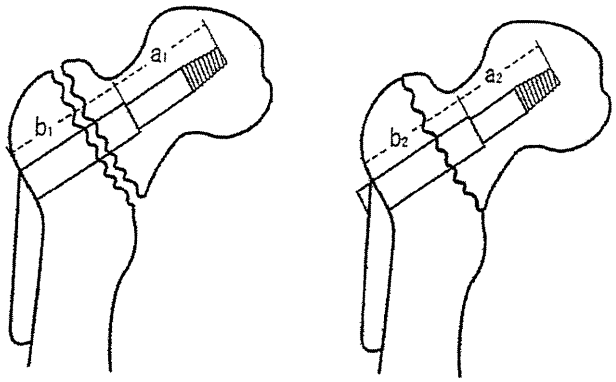

Figure Method to measure the extent of sliding
(I): immediate postoperative radiograph, (II): developmental radiograph.
a: length of lag screw on radiograph (a_1: immediate postoperative, a_2: developmental),
b: length of tube-plate on radiograph (b_1: immediate postoperative, b_2: developmental),
k: constant length of tube-plate as standardized article.
corrected length of lag screw = (a/b) k
extent of sliding = (a_1/b_1) k − (a_2/b_2) k

5. Statistical analysis

Subjects were divided into 135° and 150° CHS groups, and statistical evaluation was carried out by comparing preoperative and postoperative variables between the two groups. Using the chi-square test, Wilcoxon rank sum test (U test), and Student's t test (t test), a significance level less than 5% was considered a significant difference. Multivariate analysis (MA) was performed in order to verify the results while avoiding bias such as confounding of multiple variables. In other words, MA was performed using gait ability at discharge, change in gait ability, social function, and prognostic criteria (Handa) as criterion variables and other variables as explanatory variables to determine what variables, if any, other than the difference between the screw-plate angles 135° and 150°, affect ambulatory ability.

Required sample size: Achieving early bone union during postoperative therapy that aims to regain the preinjury levels of ambulatory ability is preferable in terms of both shortening the duration of treatment and cutting medical expenses. Postoperative X-ray examinations were implemented approximately every week, and clinical significance was judged to be present if there was roughly a

Table 3 Prognostic criteria (Handa)

Criteria	Point	Pain	
Excellent	1	−	gait ability・ADL comparable to preinjury level
Good	2	− or ±	gait ability・ADL decreased slightly from preinjury level
Fair	3	+	gait ability・ADL decreased moderately ormore from preinjury level
Poor	4	+	wheelchair, bedridden

ADL: activites of daily living.

week to 10 days difference in the healing time. The estimated SD was 2.6, and the least detectable difference (the minimum significant difference that should be detected) was 10 days. Since the ratio of the numbers of patients in the two groups was about 1 : 2, the number of the two groups used was 1 : 2 instead of 1 : 1. Assuming that $\alpha = 0.05$ and $\beta = 0.2$ (power = 0.80), the sample size required was calculated to be 38 patients for the 150° group and 76 patients for the 135° group. Hence, the sample size for this study is within the required size.

Results

Patients who undergo this surgery often stop follow-up visits within a short time after discharge. Therefore, ambulatory ability was assessed at discharge. There is likely little difference between a patient's ambulatory ability at discharge and his/her ultimate ambulatory ability. No subjects exhibited any major changes in ambulatory ability during periodic follow-up visits after discharge.

The results are shown in Table 4-5. There were no statistically significant differences found other than those shown below. No statistically significant differences were seen between the two groups except for rate of maintenance of preinjury independent gait ability (rate (%) of subjects who could walk independently before injury, and could walk independently also at hospital discharge) used as a measure of change in gait ability. Ambulatory ability had decreased overall at discharge compared with before the injury was sustained. Common factors that influenced change in ambulatory ability were age, complications on admission and deuteropathy.

1. Variables for which there were significant differences between 135° and 150° CHS fixation in terms of posttreatment ambulatory ability

1) Maintenance of preinjury independent gait ability

The percentage of subjects who had maintained their preinjury independent gait ability at discharge was 37.0% in the 135° CHS group, but it was higher in the 150° CHS group at 60.0%. MA showed that it was affected by gender ($p = 0.0261$), deuteropathy ($p = 0.015$), and extent of sliding ($p = 0.0454$).

2. Change in ambulatory ability

1) Gait ability

About half of subjects in both groups were able to maintain their preinjury ability level, while the rest experienced a decline.

2) Social function

Social function scores, used as an indicator of social ambulatory ability, fell at least 0.4 points in both groups. The percentage of those who had maintained their preinjury level of social function was about 65% in both groups. Regarding subjects who had a preinjury score of 1 to 3, which indicates a relatively good ambulatory ability, the rate of decline was higher in those with a score of 3 than in those with a score of 1.

3. Factors that have an effect on change in ambulatory ability

1) Change in gait ability

(1) From the perspective of overall gait ability before the injury

We divided subjects as follows for comparison: those who had moved up 1 class or were able to maintain the same class, those who had moved down 1 class, and those who had moved down 2 classes or more at discharge relative to the preinjury level. No significant difference was seen between the two groups. MA showed that it was affected by age, preinjury gait ability, deuteropathy (psychiatric), deuteropathy (general), and complications on admission (psychiatric).

(2) From the perspective of subjects who could walk before the injury

MA showed it was affected by age, preinjury social function, and number of days to surgery after admission.

(3) From the perspective of subjects who could walk independently before the injury

As in 1. above, significant difference was seen between the two groups in terms of the proportion of subjects who could walk independently before the injury and also at discharge.

2) Change in social function

No significant difference was seen between the two groups in terms of change in scores from the preinjury level to that at discharge or the rate of

Table 4 Preoperative data

Variables	135° n = 83 (%)	150° n = 47 (%)	p value	
Sex			0.1905	χ^2 test
women	62 (74.7)	30 (63.8)		
men	21	17		
Age (y) mean ± SD	81.2 ± 6.87	78.2 ± 8.38	0.0678	U test
Cause of injury			0.1489	χ^2 test
at home	48 (57.8)	21 (44.7)		
away from home (in hospital)	35 (8)	26 (3)		
Days from				
fracture to ope (mean)	7.8 ± 16.16	6.8 ± 8.38	0.5767	U test*
hospital admission to ope (mean)	5.0 ± 2.74	6.1 ± 3.74	0.1498	U test*
General complications on admiddion			0.8879	χ^2 test
No. of patients	54 (65.1)	30 (63.8)		
No. of complications	74	38		
psychological	7	5		
visual disorder	5	1		
trauma	3	7		
knee osteoarthritis	8	3		
neurologic	12	5		
endocrine	4	4		
malignant tumor	2	1		
cardiovascular	23	8		
respiratory	5	0		
urinary	1	3		
gastrointestinal	3	1		
decubitus ulcers	1	0		
ASA (American Society of Anesthesiologist) score			0.8644	U test
Class 1	14 (16.9)	6 (12.8)		
2	40 (48.2)	27 (57.4)		
3	29 (34.9)	14 (29.8)		
4	0 (0)	0 (0)		
5	0 (0)	0 (0)		
Preinjury gait level			0.4678	χ^2 test
able to walk independent	54 (65.1)	35 (74.5)		
cane	11 (13.3)	7 (14.9)		
walker	14 (16.9)	3 (6.4)		
unable to walk wheelchair	3 (3.6)	2 (4.3)		
bedridden	1 (1.2)	0 (0.0)		
able to walk : unable to walk	79 : 4	45 : 2	0.8828	χ^2 test
Social function			0.9671	χ^2 test
Group 1	9 (10.8)	5 (10.6)		
2	48 (57.8)	29 (61.7)		
3	15 (18.1)	7 (14.9)		
4	11 (13.3)	6 (12.8)		
mean score	2.34	2.30	0.7655	U test
Fracture type (Evans)			0.3628	χ^2 test
Stable Group 1	10 (12.1)	7 (14.9)		
2	39 (47.0)	24 (51.1)		
Unstable 3	25 (30.1)	8 (17.0)		
4	9 (10.8)	8 (17.0)		
Stable : Unstable	49 : 34	31 : 16	0.4358	χ^2 test
Bone density (Singh)			0.5704	U test
Grade 1	2	0		
2	3	4		
3	34	16		
4	36	20		
5	8	7		
6	0	0		

* outlier

Table 5 Postoperative data

Variables	135° n = 83 (%)	150° n = 47 (%)	p value	
Hospital stay (mean)				
Duration of stay in				
orthopedic ward	93.4 ± 42.09	88.3 ± 28.42	0.4395	U test*
hospital	104.2 ± 41.92	92.7 ± 30.26	0.0988	U test*
Duration of postoperative follow-up (mo)	4.9 ± 3.29	5.0 ± 2.65	0.3558	U test*
Extent of sliding mean (mm)	5.5 ± 5.16	4.2 ± 4.28	0.1566	U test*
Deuteropathy (occurring after hospital admission)				
No. of patients	33 (39.8)	15 (31.9)	0.3733	χ^2 test
No. of complications	42	16		
psychological (dementia)	17	5		
cardiovascular	2	2		
respiratory	5	2		
urinary	5	1		
gastrointestinal	1	1		
decubitus ulcers	5	0		
peroneal palsy	4	3		
others	3	2		
Gait level at hospital discharge			0.1310	χ^2 test
able to walk independent	20 (24.1)	21 (44.7)		
cane	25 (30.1)	7 (14.9)		
walker	13 (15.7)	6 (12.8)		
unable to walk wheelchair	23 (27.7)	12 (27.7)		
bedridden	2 (2.4)	1 (2.1)		
able to walk : unable to walk	58 : 25	34 : 13	0.7669	χ^2 test
Change in gait ability				
overall gait level			0.3017	χ^2 test
same. equel class	39 (47.0)	27 (57.5)		
1 class lower	24 (28.9)	8 (17.0)		
above 2 class lower	20 (24.1)	12 (25.5)		
for patients who could walk preinjury, rate of regaining gait ability (%)				
	73.4	75.6	0.7936	χ^2 test
for patients who could walk independently preinjury, rate of regaining independent gait ability (%)				
	37.0	60.0	0.0338	χ^2 test
Social function			0.9417	χ^2 test
Group 1	8 (9.6)	5 (10.6)		
2	29 (34.9)	18 (38.3)		
3	15 (18.1)	9 (19.1)		
4	31 (37.3)	15 (31.9)		
mean score	2.83	2.72	0.5658	U test
change in score	0.49	0.42	0.6576	U test
rate of change in score	0.2	0.2	0.6611	U test*
Prognostic criteria			0.0882	U test
Excellent	41 (49.4)	27 (57.4)		
Good	22 (26.5)	7 (14.9)		
Fair	4 (4.8)	7 (14.9)		
Poor	16 (19.3)	6 (12.8)		

* outlier

change. MA showed that it was affected by preinjury social function, deuteropathy (general), complications on admission (psychiatric), deuteropathy (psychiatric), and ASA score.

4. Prognostic criteria (Handa)

No significant difference in prognostic criteria was seen between the two groups. MA showed that it was affected by age, deuteropathy (general), gender, and preinjury social function.

5. Relation between extent of sliding and ambulatory ability

A measurable difference in leg length that would

affect gait ability and that resulted from excess sliding was not seen in any cases in this study. No relation other than independent gait ability was noted.

Discussion

The objective of treatment for trochanteric fractures is maintenance of preinjury ambulatory ability, but the proportion of patients who do not regain their preinjury level of ambulatory ability by the time they leave the hospital is not low. While there are numerous reports available regarding the outcome of CHS fixation for the treatment of trochanteric fractures (gait ability, in particular)[8)~10)], there are few clinical reports of studies that investigate whether or not different screw-plate angles yield differences in outcomes related to function such as ambulatory ability. Koval[11)] stated that there have been no reports of a significant difference between the two groups in clinical research.

Den[12)], Meislin[13)], and Kyle[14)] have reported the results of experiments that looked at the effect of different screw-plate angles using the bones of cadavers. However, functional outcomes cannot be compared in experiments using cadavers.

In this study, a significant difference was found between the two groups in the rate of maintenance of preinjury independent gait ability at discharge. In addition, we investigated factors that affect gait ability at discharge, change in gait ability, change in social function, and outcome criteria (Handa) using MA. We also investigated the relation with the extent of sliding distance, which has been reported to have an effect on change in ambulatory ability[15)]. We will include a brief discussion of these variables.

1. Factors that affect gait ability at discharge

1) Age

The older the subject was, the greater the subject's gait ability at discharge had decreased. The proportion of wheelchair users increased with age in both groups. It exceeded 50% in subjects over 90 years old.

2) Preinjury gait ability

The lower the subject's preinjury gait ability was, the greater the subject's gait ability at discharge had decreased, but even in the case of subjects who could walk by some means before sustaining their injury, the lower the subject's gait ability was, the more likely it was they would stay in the same class.

3) Deuteropathy (general)

Subjects without these deuteropathy had a higher gait ability at discharge. The lower the gait ability was, the lower the percentage of subjects without deuteropathy was.

4) Complications on admission (psychiatric)

Subjects without these complications had a higher gait ability at discharge. The proportion of subjects with these complications was higher in subjects without some gait ability than in those with some.

2. Factors that have an effect on change in gait ability

Many reports in the literature indicate that gait ability is maintained in about 70% of patients[15)16)]. In addition, it was reported[17)] that many persons who were able to walk but not independently prior to injury were not able to maintain the same level of gait ability as they had before the injury. Some reports have mentioned cardiovascular and respiratory complications as complications that have an effect on change in gait ability[16)17)], but there is a report that shows the opposite[15)]. These had no effect on gait ability in this study.

Many reports have mentioned psychiatric complications and deuteropathy as factors that have an effect on recovery of gait ability[15)~18)].

There may be reasons for this other than the problem of a lack of understanding of disease or a lack of cooperation with treatment. Some hold the view that it is because the risk of trochanteric fracture is 5-6 times higher in mentally disabled patients than patients not suffering from any psychiatric disorders[18)].

As in other reports that found no significant difference in recovery of gait ability between subjects with different types of fracture[15)17)], type of fracture had no effect on change in gait ability in this study.

1) From the perspective of overall gait ability before the injury

(1) Age

The older the subject was, the greater the sub-

ject's gait ability decreased. Gait ability decreased relative to the preinjury level in over 60% of subjects over 85 years old in both groups.

(2) Preinjury gait ability

The lower the preinjury gait ability was, the smaller the difference between preinjury gait ability and that at discharge was. As a matter of course, the status of persons able to walk independently prior to injury could change to independent gait, cane gait, walker gait, wheelchair-bound, or bedridden at discharge. The status of persons who are wheelchair-bound before injury, however, can only be wheelchair-bound or bedridden at discharge.

(3) Deuteropathy (psychiatric)

Subjects without these deuteropathy had a higher gait ability at discharge. Subjects without these deuteropathy made up 94.9, 87.9, 80.0, and 64.7% of subjects with gait ability status of independent gait, cane gait, walker gait, and wheelchair-bound, respectively.

(4) Deuteropathy (general)

Subjects without these deuteropathy exhibited less change in gait ability. Forty-eight (68.6%) of 70 subjects without these deuteropathy exhibited no change in gait ability. Twenty-five (43.9%) of 57 subjects with these deuteropathy exhibited no change in gait ability.

(5) Complications on admission (psychiatric)

Subjects without these complications had a higher gait ability at discharge. About 76% of subjects in both groups were without these complicatons and could walk at discharge.

2) From the perspective of subjects who could walk before the injury

(1) Age

Subjects who could walk became unable to walk as they got older. The proportion of subjects who were able to walk by some means before the injury but became unable to walk at discharge was high in the age range 80 to 85 years old.

(2) Preinjury social function

When this score was high, subjects who were able to walk before the injury became unable to walk. The average score of subjects who were able to walk before the injury and could also walk at discharge was 2.1. The average score of those who became unable to walk was 2.7.

(3) Number of days to surgery after admission

When the number of days was great, subjects who were able to walk before the injury became unable to walk. The average number of days for subjects who were able to walk before the injury and could also walk at discharge was 5.3 days. It was 6.5 days for subjects who became unable to walk. According to one report, the average number of days from injury to surgery was 3.5, and the older the patient was, the greater the number of days[19].

3) From the perspective of subjects who could walk independently before the injury

(1) Deuteropathy (general)

Subjects without these deuteropathy had a higher rate of maintenance of independent gait ability. The rate of maintenance of independent gait ability was 23.1 and 78.6% in subjects with these deuteropathy and those without these deuteropathy, respectively.

(2) Gender

Men had a higher rate of maintenance of independent gait ability than women. In the present study, ability was maintained in 32.3% of women and 64.7% of men. There has been a report[17] that the rate of maintenance of independent gait ability is 72%, but the majority of reports contend it is 50-60%[16].

(3) Extent of sliding

Less sliding resulted in a higher maintenance rate. The average extent of sliding in subjects who were able to maintain the ability to walk independently was 4.7 mm, while that in those who were not able to maintain the ability was 5.7 mm.

3. Factors that have an effect on change in social function

1) Preinjury social function

Subjects with a high preinjury score also had a high score at discharge. Subjects with a preinjury score of 1, 2, 3, and 4 had a score at discharge of 1.1, 2.6, 3.5, and 4.0 at discharge, respectively.

2) Deuteropathy (general)

Subjects without these deuteropathy had a lower social function score at discharge. The average so-

cial function score at discharge was 3.3 for subjects with these deuteropathy and 2.6 for those without them.

3) Complications on admission (psychiatric)

Subjects without these complications had a lower social function score at discharge. The social function score at discharge was 3.6 for subjects with these complications and 2.7 for those without them.

4) Deuteropathy (psychiatric)

Subjects without these deuteropathy had a lower social function score at discharge. The social function score at discharge was 3.6 for subjects with these deuteropathy and 2.9 for those without them.

5) Complications on admission (general)

Subjects without these complications had a lower social function score at discharge. The social function score at discharge was 2.9 for subjects with these complications and 2.6 for those without them.

6) ASA score

Subjects with a high ASA score also had a high social function score at discharge. Looking at the social function score at discharge for each ASA score (Scores of 1, 2, and 3 were seen in this study, but not 4 and 5), it was 2.4 for an ASA score of 1, 2.4 for a score of 2, and 3.5 for a score of 3. The literature includes a report of a study in which the mean ASA score in a group with reduced gait ability was 3.3, while that in a group that retained its gait ability was 1.9[20].

4. Factors that affect prognosis criteria

1) Age

The older the subject was, the higher this score became. These criteria are assessed by pain, gait ability, and ADL before injury and at discharge. Therefore, the slower the recovery of an elderly patient in terms of gait ability and ADL, the higher this score will be. It has been reported that the rate of recovery to a level equal to the preinjury level falls below the nonrecovery rate at around the age of 75[17]. This may be because of a decline in physiological competency and an increase in the prevalence of complications that come with aging. Some reports put the age at around 80[15][16][20].

2) Deuteropathy (general)

Criteria scores were lower in the absence of these deuteropathy. Many of the subjects with these deuteropathy had high criteria scores.

3) Gender

Women had higher criteria scores. The average score was 2.0 for women and 1.7 for men. However, it has been reported that there is no significant difference between men and women[17].

4) Preinjury social function

Subjects with a high preinjury social function score had a high criteria score.

5. Relation between extent of sliding and ambulatory ability

In experiments using cadaver bones, Meislin[13] found that sliding was significantly greater in the case of 150° CHS than in 130° and 140° CHS. Kyle[14] reported that more power was necessary to initiate sliding in the case of 130° CHS than 150° CHS. Some clinical studies have found that there is no difference in the amount of sliding between 135° CHS and 145° CHS[21][22]. In the present study, there was no significant difference in the extent of sliding between the two groups, and no significant difference was seen when subjects were divided into the stable type and the unstable type. This may be because conditions differ greatly between cadaver experiments and clinical studies. In addition, it was reported that many subjects with sliding of 10mm or more (at time of bone union) could not recover their preinjury level of gait ability[15]. Hence, we investigated factors that influenced ambulatory abilities using MA. However, the extent of sliding only affected the rate of maintenance of independent gait ability.

Conclusions

1) When ambulatory ability was compared after treatment with 135° CHS or 150° CHS, the only variable for which a significant difference was found between the two groups was rate of maintenance of preinjury independent gait ability. The difference in angle did not affect this significant difference.

2) Ambulatory ability had decreased overall at discharge compared with before the injury was sustained. Approximately half of the subjects were able to maintain a level of ambulatory ability equal to the preinjury level.

3) Common factors that influenced change in gait abiliity were age, complications on admission, and deuteropathy during hospitalization. Of the complications and deuteropathy, those that were psychiatric had the greatest influence.

4) The extent of sliding affected the rate of maintenance of independent gait ability, which is consited one of ambulatory ability.

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高齢者大腿骨転子部骨折の Compression Hip Screw 方法
—固定角度の体動歩行能力への影響および体動歩行能力の変化—

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大腿骨転子部骨折に対する low angle compression hip screw（135°CHS）法と high angle compression hip screw（150°CHS）法による治療後の体動歩行能力の比較をすることと，更に，CHS 法による治療前後の体動歩行能力の変化を観察し変化に影響する因子を検討することを目的とした．CHS 法を用いた 60 歳以上の患者 130 例（135°CHS 83 例，150°CHS 47 例）を対象とした．評価項目は，体動能力関係の X 線所見での項目，受傷前と退院時の体動歩行能力（社会的行動能力をも含めて）を使用した．評価項目について 135°CHS 法と 150°CHS 法の両群を比較するために，多変量間の交絡などの bias を回避すべく多変量解析も援用して統計学的に解析した．その結果，受傷前の独歩能力維持率の項目で 135°CHS 法と 150°CHS 法間の有意差が見られたが，角度の差は独歩能力維持率を含めて体動歩行能力には影響していなかった．体動歩行能力は退院時には受傷前よりも全体的に低下していた．変化に影響する因子としては，年齢・入院時合併症・続発症が多かった．理論上からも，また諸家の実験的研究からも，角度の差が原因となって両群間に有意差の生じることが予想される lag screw の sliding 距離に有意差は認められなかった．また，sliding 距離は体動歩行能力には独歩能維持率以外には影響していなかった．