

# Experience of Medial Column Bone Graft Combined with PHILOS Plate in the Treatment of Proximal Humeral Adductive Fracture in the Elderly

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**Abstract:** To investigate the efficacy of medial column bone graft combined with PHILOS plate internal fixation for the treatment of proximal humeral adductal fractures in the elderly. The clinical data of 26 patients with proximal humeral adductal fractures were retrospectively analyzed. These patients were divided into bone graft group (14 cases, they were treated with medial column bone graft combined with PHILOS plate internal fixation) and no bone graft group (12 cases, they were treated with PHILOS plate internal fixation alone) according to whether or not the bone graft was performed. The indicators of operation time, fracture healing time, functional activity of shoulder joint and the angle loss of neck shaft angle were compared between the two groups. All patients were followed up for 12 to 23 months. There was a statistically significant difference between the two groups in the time of fracture healing, the degree of shoulder joint mobility (forward and uplift the arms) and the angle loss of neck shaft angle ( $P < 0.05$ ), however, there was no significant difference between the two groups in the operation time ( $P > 0.05$ ). Compared with no bone graft group, medial column bone graft combined with PHILOS plate has more satisfactory clinical results for the treatment of proximal humeral adduct fracture in elderly.

**Keywords:** Humerus Fracture, PHILOS Plate, The Elderly

## 1. Introduction

PHILOS plate has been widely used in the surgical treatment of proximal humeral fractures. After internal fixation, the medial structure is unstable, which may lead to complications such as adduction of the humeral head [1] and aseptic necrosis of the humeral head. The author retrospectively analyzed the 26 cases data of elderly patients with proximal humeral adductal fractures from August 2013 to December 2016 in Zhoushan Guhechuan Hospital, and compared the therapeutic effects of the medial column bone graft combined with PHILOS plate treatment and PHILOS plate treatment without bone graft. The related reports were as follows.

## 2. Materials and Methods

### 2.1. Patient Data

A total of 26 cases were included, 11 males and 15 females, aged 61-89 years old. Neer classification of fractures: 8 cases in part 2, 13 cases in part 3, and 5 cases in part 4. All of these fractures are closed injuries. The patients had 8 cases of diabetes, 13 cases of hypertension, and 5 cases of hypertension with diabetes. The surgeries were operated 3-5 days after wounded. Patients were divided into two groups according to whether they were treated with bone graft or not: 1 bone graft group: 14 cases, 6 males and 8 females, aged 61-85 years old, with internal column bone graft combined

with PHILOS plate internal fixation. 2 no bone group: 12 cases, 5 males and 7 females, aged 65-89 years old, treated with PHILOS plate fixation alone. There was no significant difference in the preoperative general data between the two groups ( $P>0.05$ ).

## 2.2. Operation Methods

Take a 4-part fractured medial column bone graft as an example: general anesthesia or brachial plexus anesthesia. The patient should have beach chair position and the injured shoulder should be raised. The proximal humerus was exposed by the classic pectoralis major deltoid approach. The joint capsule was preserved as much as possible. The tendon and bone junction of the scapular fracture of the rotator cuff was threaded with the 5th Ethibond suture. According to the location of the sulcus intertubercularis, the tuberculum majus was first adjusted. The Kirschner wire was used for temporary fixation to protect the soft tissue hinge at the proximal end of the humerus. Two skittler needles were used to reposition the adducted humeral head and correct rotation using the "rocker" technique, and the distal to proximal principle was used to reposition through the broken end of the lateral wall. At this time, the medial column has a bone defect, and the medial column is reconstructed with allograft allogeneic bone graft. The PHILOS plate was placed 5 mm below the tuberculum majus tip and 5mm behind the sulcus intertubercularis. The central axis of the steel plate can be adjusted by approaching the anteroposterior diameter of humeral head with thumb and index fingers. One lag screw sliding hole fixed the plate and squeezed the tuberculum majus for further reset, two locking nails fixed in the humeral head, two humeral talus screws were accurately locked into the subchondral bone in the inferior region of the humeral head. The fracture reduction and plate position were good with fluoroscopy observation by upper limb flexion elbow external 30° rotation. The remaining screws were locked. The rotator cuff was fixed to the rotator cuff reconstruction hole of the PHILOS plate. After satisfactory, the suture was rinsed.

## 2.3. Postoperative Rehabilitation Exercise

On the day of surgery, the flexion and extension of clenched fist, wrist joint and elbow joint and pendulum

movement should be exercised gradually. Meanwhile, the sling of forearm was fixed for 2 weeks. After 2 weeks, shoulder joints should be functionally exercised in all directions by an active or passive manner. After 8~12 weeks, the strength training will be gradually strengthened, and the normal life will be gradually improved.

## 2.4. Statistical Analysis

SPSS 19.0 software was used for statistical analysis. Statistical analysis was performed using SPSS 19.0 software. The measurement data is expressed as  $\bar{x}\pm s$ , and the T-test was used after the measurement data between groups met the normal distribution; the  $\chi^2$  test was used for the measurement data.

## 3. Results

All patients were followed up for 12 to 23 months. No incision infections, neurogenic iatrogenic injuries or any other complications occurred during the primary healing stage of the patients' wounds. Also, the surgical results were pretty satisfying. The postoperative X-ray in the reexamination showed that all fractures in the bone grafting group got bone healing, among which, 13 cases had good fracture healing, 1 case had delayed fracture healing, and none had a fractured steel plate, loosening screw or any other complications. At the last follow-up, according to Neer scoring criteria, the shoulder joint replacement was evaluated in 9 excellent cases, 4 good cases and 1 middle case. Moreover, in the ungrafting group, 8 cases had good fracture healing, 3 cases had delayed fracture healing, 1 case had humerus with sterile necrosis, secondary shoulder joint replacement, no steel plate fracture, loosening screw or any other complication. At the last follow-up, according to the Neer scoring criteria, shoulder joint replacement was evaluated in 7 excellent cases, 3 good cases and 2 middle cases. There was a statistically significant difference between the two groups in the time of fracture healing, the degree of shoulder mobility (forward upward bend) and the angle of neck-shaft angle loss ( $P<0.05$ ). There was no significant difference in the operation time between the two groups ( $P>0.05$ ). One patient in the no bone graft group developed aseptic necrosis of the humeral head and performed shoulder joint replacement at the second stage.

**Table 1.** Comparison of surgical indicators between the two groups [min~max ( $\bar{x}\pm s$ )].

Groups	n/	Operation time (min)	Fracture Healing Time (week)	shoulder joint mobility degree at 12 months after operation (°)	angle loss of neck-shaft angle at 12 months after operation (°)
bone graft	14	69~137 (103±34)	7~13 (10±3)	168~180 (174±6)	1~9 (5±5)
No bone graft	12	87~129 (108±21)	10~16 (13±3)	145~179 (162±17)	5~19 (12±7)
$t/\chi^2$ value		0.521	3.104	4.127	7.881
$P$ value		0.621	0.003	0.004	0.005

## 4. Discussion

Due to the different degrees of osteoporosis in the proximal humeral adductive fracture in the elderly, the

medial column bone is usually compressed after being repositioned, resulting in the defect of the medial column. To achieve stability, the bone defect needs to be treated. Biomechanical studies have shown that without medial column plate internal fixation, the proximal humerus may be

unstable in sagittal plane and coronal plane [2], with a certain tendency of rotation and adduction displacement. The medial column could increase the axial compressive stiffness, torsional stiffness and shear resistance, and provide effective supports for humeral head. Chen Xin et al. [3] believed that intraoperative reconstruction of the medial column can not only disperse the stress of the nail interface, but also effectively resist the adduction stress caused by the contraction of the rotator cuff; while the medial column has no effective support and the fracture end can not complete the reduction of cortex to the cortex, these were important factors in the failure of postoperative humeral head adduction or even internal fixation loosening, which is especially important in patients with osteoporosis. In recent years, the treatment of intramedullary transplantation of allograft fibula with fixed steel plate has been applied to these fractures. Xiong Jiawei [4] used this treatment in 40 cases of elderly patients suffered from Neer III, IV fracture of proximal end of humerus fracture with severe osteoporosis for 15 months in the postoperative period. He concluded that for elderly patients, proximal humeral fractures in allograft fibula segment combined with osteoporosis can be dealt with the treatment of intramedullary transplantation of allograft fibula with fixed steel plate, which can serve as the inside of the column reduction and be stable, strong support. It can also reduce the incidence rate of postoperative complications. Lescheid et al. [5] showed that the effective support of the medial column of the proximal humerus can make the fracture more stable, and the displacement of the neck shaft angle is minimal, and the shoulder function can be significantly improved [6]. Internal fixation of proximal humeral fractures requires full recovery of the cervical trunk Angle, which can effectively avoid the surgical failure rate [7]. Reconstruction or restoration of the medial column is a key factor influencing the efficacy of internal fixation of the proximal humeral fracture [8]. As for the compressing fracture, the allogeneic bone or autogenous bone should be transplanted to fully graft bone reconstruction when the bone mass loss is more. Guo [9] pointed out in his study that the use of screw to support for the medial column had the advantages of solid fixation. Also, there was fewer complications and other advantages in the treatment of proximal humeral fractures with fixed steel plate, and the postoperative functional recovery was more satisfactory.

At present, there are several common methods for the defect reconstruction of the proximal humeral medial column: 1, Use the humeral talus screws to support the medial column. 2, Reconstruction of the medial column with reconstruction of the autogenous iliac bone or fibula. 3, Filled with bone cement or artificial bone. 4, The medial column is fixed with a reconstruction plate or a 1/3 tube plate [10]. Although the "beam" structure of the medial column is reconstructed by humeral talus screw fixation alone, the defect of the medial column bone still exists, and the screw control weakness is easy to occur in patients with osteoporosis. Screw fixation for splintered fracture of proximal humerus is a contraindication to this operation [11].

The Gerard pique's pins have the advantage of smaller iatrogenic injuries, and it will not affect the blood supply of fractured end. Thus, it is suitable for the proximal humeral fractures with smaller fracture displacement, and the patients should have a higher compliance. Li Chuncai [12] used the needle with pique internal fixation treatment to treat the patients with fracture of proximal humeral fractures. These patients were healed well, although 1 case of the patients had the needle sliding out for 1 gram. Autogenous iliac bone grafts in elderly patients are often used as an alternative scheme because of the low bone mass due to osteoporosis; 10 cm long iliac bone graft through the medullary cavity to reconstruct the medial column can not only add enough bone mass, but also strengthen the medial column [13], and provide double cortical fixation for the screw. However, taking the autologous bone has some disadvantages such as increased trauma, prolonged operation time and complications in donor bone. Bone cement filling is more suitable for patients with low risk of blood supply to the humeral head, at the same time, it lacks bone morphogenetic protein and other active osteogenic substances, which is not conducive to the healing of fractures. Artificial bones are often not routinely used by scholars due to its shortcomings such as easy liquefaction and heavy rejection reaction [14]. The medial plate reconstruction can provide greater stability to the medial column, but the continuity of the medial periosteal hinge structure is often destroyed during use, thereby increasing the risk of ischemic necrosis of the humeral head. At present, some scholars have inserted the fractured end and reconstructed the medial column with a locking plate. On the one hand, unnecessary shortening of humerus will be caused by insertion [15]. On the other hand, after the insertion and shortening, the plate screw is not attached, which makes the position of the humeral talus screw off-site and could not support the medial column effectively. In this study, the bone graft group used the same kind of bone block to reconstruct the medial column, and restore the proximal humerus to the original shape, and combined with the use of PHILOS plate and humeral screw, repairing and reconstructing the rotator cuff. This method can not only increase the inner column support effect, but also strengthen the control force and stability of humeral talus screw, reduce the tension side stress of the steel plate. Moreover, it is convenient to use, less trauma, less complications, has the ability of bone induction and good biological compatibility, and does not increase the damage of humeral head blood supply.

In summary, the medial column bone graft combined with the PHILOS plate can effectively support the fracture end of the humerus in the treatment of the proximal humeral adductor fracture in the elderly, so that the control of the humerus talus screw has more powerful mechanical stability. It can reduce postoperative humeral head adduction deformity, humeral head necrosis and other complications, with satisfactory clinical efficacy and mature technology, which is worthy of promotion in primary hospitals.

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