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# Role of double-plane high tibial osteotomy in the repair of posterolateral complex damage with bad lower limb force line.

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## Abstract

**Objective: To investigate the role of double-plane high tibial osteotomy in the repair of Posterolateral Complex (PLC) damage with bad lower limb force line.**
**Methods: A total of 56 cases of patients with PLC injuries who were admitted to our hospital from February 2015 to November 2016 were divided into the study group (n=28) and the control group (n=28) using the random distribution method. The patients in the study group underwent double-plane high tibial osteotomy, whereas the patients in the control group underwent the conventional conservative treatment method. The relative position of the mechanical axis of the lower limb passing through the tibia, the tibial caster angle, the tibial retroposition distance, and the lateral interval opening degree of the patients were compared 1 year postoperative. The postoperative joint function was evaluated using the Lysholm scoring system.**
**Results: The relative position of the mechanical axis of the lower limb passing through the tibia and the tibial caster angle recovery of the patients in the study group were higher than those of the patients in the control group. By contrast, the tibial retroposition distance and the lateral interval opening degree of the patients in the study group were lower than those of the patients in the control group, and the difference was statistically significant (P<0.05). The Lysholm score of the patients in the study group was significantly higher than that of the patients in the control group, and the difference was statistically significant ($\chi^2$=4.9088, P=0.0267).**
**Conclusion: PLC damage of the knee joint with bad lower limb force line was treated with double-plane high tibial osteotomy. The postoperative effect was satisfactory, and knee function recovery was better compared with that of conventional treatment. Such results are worth popularizing.**

**Keywords:** PLC, Double-plane high tibial osteotomy, Bad lower limb force line.

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## Introduction

Posterolateral Complex (PLC) injury of the knee joint is a severe sports injury that is commonly combined with posterior or anterior cruciate ligament injury, thereby resulting in a severe knee joint disorder [1]. If knee joint PLC injury is associated with genua vara or genu recurvatum, then it will cause knee joint instability. The main manifestation of such instability is varus or recurvatum, which are aggravated by the PLC injury [2,3]. Double-plane high tibial osteotomy is frequently adopted in clinical practice to correct lower limb force line and to perform ligament reconstruction. A total of 56 patients with PLC damage who were admitted to our hospital from February 2013 to November 2015 were selected to participate in the current study. The study is reported as follows.

## Materials and Methods

### *General information*

The 56 cases of patients with PLC damage admitted to our hospital from February 2013 to November 2015 were divided into the study group (n=28) and the control group (n=28) according to the random distribution method. The study group comprised 18 male and 10 female patients, aged 24-55 y old (average: 33.1 ± 1.4 y). Among the patients in this group, 15 had left knee injury, 10 had right knee injury, and 3 had combined injury. Hospitalization time was 25-58 d. Meanwhile, the control group consisted of 20 male and 8 female patients, aged 25-57 y old (average: 35.2 ± 1.6 y). In this group, 14 patients had left knee injury, 11 had right knee injury, and 3 had combined injury. Hospitalization time was

24-55 d. The sex, age, condition, length of hospital stay, and other general information of the patients presented no statistical significance (P>0.05).

The inclusion and exclusion criteria were in accordance with the PLC identification criteria. Patients with heart, liver, kidney, and psychiatric disorders were excluded. All the patients volunteered to participate and signed an informed consent form.

### *Method*

Preoperative anteroposterior X-radiography was performed on the patients in the two groups. The correction angle was measured. The patients in the study group underwent double-plane high tibial osteotomy. A patient was laid in a supine position, and intraspinal anesthesia was administered. The operation was performed using a tourniquet. A straight incision, approximately 10 cm long, was made on the anteromedial tibia. The subcutaneous tissue of the patient was isolated, and the flap was dissociated to expose the ending point of the medial patellar tendon and tibial tuberosity. The superficial layer of the medial collateral ligament was loosened. The posterior tibial periosteum was stripped using a periosteal detacher to expose it. A protective drag hook was inserted into the interval of the posterior tibial periosteum. The lines for the double-plane osteotomy were marked. The first line was located at the upper edge of the pes anserinus, approximately 48-50 mm away from the inner diameter of the tibia. The second line began at the tuberosity patella of the tibia and ended at its posterior edge. The included angle was 110° with the first osteotomy line. A Kirschner wire was inserted into the intersection point of the two osteotomy lines. Another Kirschner wire was inserted near the posterior edge of the tibia and parallel to the first wire. The distance between the two wires was approximately 2 cm. Osteotomy was performed using the oscillating saw along the direction of the Kirschner wires. The drag hook was used to protect the blood vessels and nerves. During osteotomy, the direction and depth of the osteotome were observed under fluoroscopy. Hence, the operation was completely in accordance with the guide pin and the depth only reached the lateral osteotomy hinge of the tibia. By contrast, the patients in the control group underwent conventional conservative treatment. The patients were followed up for 1 year.

### *Observation index*

The relative position of the mechanical axis of the lower limb passing through the tibia, the tibial caster angle, the tibial retroposition distance, and the lateral gap opening degree of the patients in the two groups were compared 1 year postoperative. The postoperative joint functions were evaluated using the Lysholm scoring system and were divided into three levels: excellent (≥ 85), good (<85 but ≥ 70), and poor (<70). The full mark was 100. Excellent and good rate=excellent rate+good rate.

### *Statistical analysis*

The data were analysed using the SPSS 18.0 statistical software. The data were expressed as mean ± standard deviation. The measurement data, as well as the enumeration data, were compared *via* t-test. P<0.05 indicated that the difference was statistically significant.

## Results

### *Comparative analyses of the lower limb force line and knee joint stability of the patients in the two groups 1 year postoperative*

The relative position of the mechanical axis of the lower limb passing through the tibia and the tibial caster angle recovery of the patients in the study group were higher than those of the patients in the control group. By contrast, their tibial retroposition distance and the lateral gap opening degree were lower than those of the patients in the control group. The difference was statistically significant (P<0.05), shown in Table 1.

***Table 1.*** *Comparison of the lower limb force line and knee joint stability of patients in the two groups 1 year postoperative ($\bar{x}$ ± s).*

| Item | n | Mechanical axis of the lower limb passing through the tibia | Tibial caster angle | Tibial retroposition distance | Lateral gap of the opening degree |
|---|---|---|---|---|---|
| Study group | 28 | 43.12 ± 8.12 | 16.46 ± 6.25 | 5.45 ± 4.91 | 13.35 ± 8.30 |
| Control group | 28 | 38.12 ± 8.60 | 12.13 ± 5.67 | 8.23 ± 4.57 | 18.01 ± 8.21 |
| t | | 2.2369 | 2.7151 | 2.1931 | 2.1122 |
| P | | 0.0294 | 0.0089 | 0.0326 | 0.0393 |

### *Comparative analysis of the Lysholm scores of the patients in the two groups*

The Lysholm score of the patients in the study group was significantly higher than that of the patients in the control group, and the difference was statistically significant ($\chi^2$=4.9088, P=0.0267), as shown in Table 2.

### *Comparison of the preoperative and postoperative knee joint functions of the patients in the two groups*

The preoperative and postoperative Hospital for Special Surgery (HSS) scores and knee joint flexion degrees of the patients presented no statistical significance in both groups (P>0.05). However, the postoperative knee joint flexion degree of the patients in the study group (110.52 ± 4.78°) was significantly higher than that of the patients in the control group (93.53 ± 5.59°), and the difference was statistically significant (P<0.05), as shown in Table 3.

***Table 2.*** *Comparison of the Lysholm scores of the patients in the two groups.*

| Group | n | Excellent | Good | Poor | Excellent and good rate |
|---|---|---|---|---|---|
| Study group | 28 | 12 | 13 | 3 | 25 (89.29) |
| Control group | 28 | 6 | 12 | 10 | 18 (64.29) |
| $\chi^2$ | / | / | / | / | 4.9088 |
| P | / | / | / | / | 0.0267 |

***Table 3.*** *Comparison of the preoperative and postoperative knee joint functions of the patients in the two groups.*

| Group | Knee joint flexion degree | | HSS score | |
|---|---|---|---|---|
| | Preoperative | 1 year postoperative | Preoperative | 1 year postoperative |
| Study group (28) | 87.63 ± 5.37 | 110.52 ± 4.78 | 61.98 ± 7.06 | 85.27 ± 6.88 |
| Control group (28) | 88.36 ± 4.43 | 93.53 ± 5.59 | 62.41 ± 6.39 | 84.37 ± 7.03 |
| t | 0.580 | 12.363 | 0.248 | 0.551 |
| P | 0.564 | 0.000 | 0.805 | 0.584 |

## Discussion

PLC injuries of the knee joint account for 2% of all acute knee ligament injuries. After knee joint PLC injury, genua vara instability and posterolateral rotation displacement of the upper end of the tibia are significantly increased [4]. The main symptoms include pain in the posterolateral knee, genu recurvatum, and genu varum. When PLC injury is ignored, chronic posterolateral knee instability can result. A severe case can lead to failure of cruciate ligament reconstruction, and finally, traumatic osteoarthritis. Therefore, familiarity with anatomical characteristics is essential and helpful for correctly diagnosing PLC damage, evaluating knee injuries comprehensively and accurately, and to formulating a reasonable therapeutic schedule [5]. Clinical findings show that the incidence of PLC injuries is increasing annually. Simultaneously, patient expectation for knee function recovery is increasing annually. PLC injury is typically accompanied by combined injury and categorized under severe injury type [6]. Serious cases can lead to knee joint dysfunction. In addition, the majority of the patients exhibit combined adverse symptoms of lower limb force line, which further negatively affects their mind and life.

Double-plane high tibial osteotomy enables postoperative knee joint to become stable and significantly improve varus symptoms. This procedure can even satisfy the postoperative demand for daily exercise and activities of the patients [7]. In addition, ligament reconstruction is not required at the second phase, which can reduce treatment cost and risk to a certain extent. The stability factors of knee joints must be considered when cases for osteotomy are selected. For patients with severe preoperative functional instability (including collateral ligaments, posterior cruciate ligaments, and other factors), joint functions are not improved after high tibial osteotomy [8]. Researcher emphasized the roles of the posterior joint capsule and the posterior cruciate ligament, and proposed that severe genua vara could significantly relax the anterior lateral cruciate ligament. The latter osteotomy was performed at the femoral condyle. Some others also suggested the preoperative radiography of single lower limb weight-bearing joints under the action of varus or valgus stress tests. The lateral stability of the knee joint was indirectly determined through the internal and external clearance X-ray sign [9]. Severe functional instability may also cause patellar dislocation or subluxation. Therefore, correction should be performed beforehand and high tibial osteotomy should be conducted. The follow-up visit of researcher showed that the postoperative curative effect was unrelated to the preoperative stability of the knee joint. The maximum lateral activity of some patients was 12.5°. However, the postoperative effect was satisfactory [10]. The increase in postoperative joint instability was significantly associated with surgery. If joint instability was increased to >5°, then the effect would be poor. The current study found that for patients who underwent double-plane high tibial osteotomy, the relative position of the mechanical axis of the lower limb passing through the tibia and the tibial caster angle recovery were higher than those of patients who underwent conventional conservative treatment method 1 year postoperative. By contrast, their tibial retroposition distance and the lateral gap opening degree were lower than those of the patients who underwent conventional conservative treatment, thereby suggesting that double-plane high tibial osteotomy could improve postoperative knee joint stability and varus symptoms. In addition, the postoperative knee joint function score of the patients in the study group was higher than that of the patients in the control group. This result suggests that double-plane high tibial osteotomy can fulfil the requirements of postoperative exercises and improve patient satisfaction.

## Conclusion

To conclude, knee joint PLC damage with bad lower limb force line was treated with double-plane high tibial osteotomy. The postoperative effect was satisfactory, and knee function recovery was better compared with that of conventional treatment. Such results are worth popularizing.

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