BIOMECHANICAL COMPARISON OF MEDIAL PATELLOFEMORAL LIGAMENT RECONSTRUCTION AND DISTAL REALIGNMENT FOR PATELLAR INSTABILITY

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INTRODUCTION

In recent years, the medial patellofemoral ligament (MPFL) has been considered as the primary restraint of the medial patellar stabilizers [1]. Clinical reports have revealed that MPFL injury occurs in almost all patients with traumatic patellar dislocation, and attention has been focused on the repair and reconstruction of the MPFL in recurrent patellar dislocation and patellar subluxation [2]. On the other hand, realignment of the attachment of patellar tendon (distal realignment) has been performed as another surgical treatment for patellar instability. However, application of these surgical procedures for patellar instability is still controversial.

The objective of the study was to compare the biomechanical effect of two major procedures (MPFL reconstruction and distal realignment) for patellar instability.

MATERIALS AND METHODS

Three fresh-frozen knee specimens (average age, 86 years; 2 female and 1 male) were mounted in an originally designed knee simulator in which isokinetic flexion-extension motions under physiologic loading were simulated (Fig 1). Each knee joint could be serially flexed in the range of 0° to 90°. Forces of 10N and 50N were applied to the quadriceps femoris muscle, and lateral forces ranging from 0 up to 100N were applied to the patella using a loadcell. Lateral shifts of the patella were recorded by three-dimensional digitizer under following 4 conditions: intact, resection of MPFL, MPFL reconstruction and distal realignment, at 0 to 90 degrees of knee flexion. MPFL reconstruction was performed by LK15® ligament by applying 5N force as pretension. In distal realignment, attachment of patellar tendon was moved 10mm medial to the original position and fixed by original external fixator. Difference in the total lateral displacement of the patellar was compared among the conditions using Student T-test, with level of significance at p=0.05.

Figure 1 The kinematic knee simulator used in the study (left) and the specimen preparation (right)

RESULTS

The effects of applying a maximum of 100N (10kgf) laterally directed force after each of the experimental procedure were evaluated. Due to the difference of the specimen condition, maximum lateral force was selected by specimen to specimen. The resection of the MPFL significantly lateralized the patella at 30° knee flexion as compared to intact knee conditions (p<0.05, Figure 2 and Figure3). Between 0° and 90° knee flexion, reconstruction of the MPFL significantly decreased patellar lateral translation (p<0.05). When compare with distal realignment, MPFL reconstruction, significantly decreased the lateral patellar shift (p<0.05). In addition, effects to reduce lateral patellar movement by the distal realignment increased as the strength of the quadriceps femoris muscle increased (Figure 3).

DISCUSSION

The experiments performed in this study enabled the dynamic measurement of patellar movement to test the medial patellofemoral ligament function under nearly physiologic conditions [3]. The choice of the applied lateral subluxation force was made based on data that suggest that patellar dislocation could occur [4]. The results of this study showed that the MPFL prevents lateral patellar shift at knee joint flexion angles ranging from 0° to 90°, and that the reconstruction of the MPFL restores patellar displacement within normal range. However, optimal pretension of the MPFL reconstruction needs to be studied in the future.

On the other hand, the restraint effect of distal realignment was smaller than that of the reconstruction and was affected by the strength of the quadriceps femoris muscle. Examination at even larger strengths of the quadriceps femoris muscle is proposed to clarify the indications for each of these surgical procedures in the future.

As conclusion, the reconstruction of MPFL significantly reduced the lateral movement of the patellar, and the reconstruction provides better biomechanical stability than the distal realignment for lateral patellar instability.

REFERENCES