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The Rotational Alignment of the Lower Limbs in Recurrent Dislocation of the Patella

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Abstract

The rotational alignment of the lower limbs of 24 patients who developed recurrent dislocation of the patella were measured by means of computed axial tomography. The femoral anteversion and the external rotation of the knee joint of these patients respectively showed 31.9±15.2° and 9.2±6.8° on the average. These figures were significantly larger than those of the control. The average external tibial torsion was 23.1±8.8°, showing no significant difference from that of the control. The external rotation of the knee joint of the patients with generalized joint laxity were significantly greater than that of the patients without generalized joint laxity. Such rotational malalignment as observed in these patients can be regarded as a cause of recurrent dislocation of the patella.

Introduction

Among what have been reported as possible causes of recurrent dislocation of the patella are trochlea dysplasia, patella dysplasia, vastus medialis obliques dysplasia, increased Q-angle, high riding patella, joint laxity and rotational malalignment such as femoral anteversion or external tibial torsion[3,4,5,8,9]. However, the objective analysis of rotational alignment has not been reported in recurrent dilocation of the patella. We report here the measurements of the rotational alignment of the lower limbs of the patients with recurrent dislocation of the patella by computed axial tomography (CAT).

Patients and Methods

Twenty-five patients, 20 women and 4 men with recurrent dislocation of the patella, participated in the study. Their median age was 21 years, range 13 to 34 years. The median age at the first dislocation was 14.3 years, range 7 to 20 years. The joint involved consisted of 15 right patellae and 13 left. The rotational alignment of the 48 lower limbs of the 24 patients was examined by CAT scan of the proximal femur, knee joint and ankle joint. When the CAT scan

Key words: Recurrent dislocation of patella, Computed axial tomography, Excessive femoral anteversion, External rotation of knee joint, Joint laxity.
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(Toshiba TCT-60A) were being taken, the patients were required to lie in the supine position with extended hip and knee joint and slightly extended ankle joint.

The angle formed by the center line of the femoral neck with the line connecting the posterior sides of the medial and lateral femoral condyles was defined as the angle of femoral anteversion; the angle formed by the posterior side of the proximal tibia with the line connecting the posterior

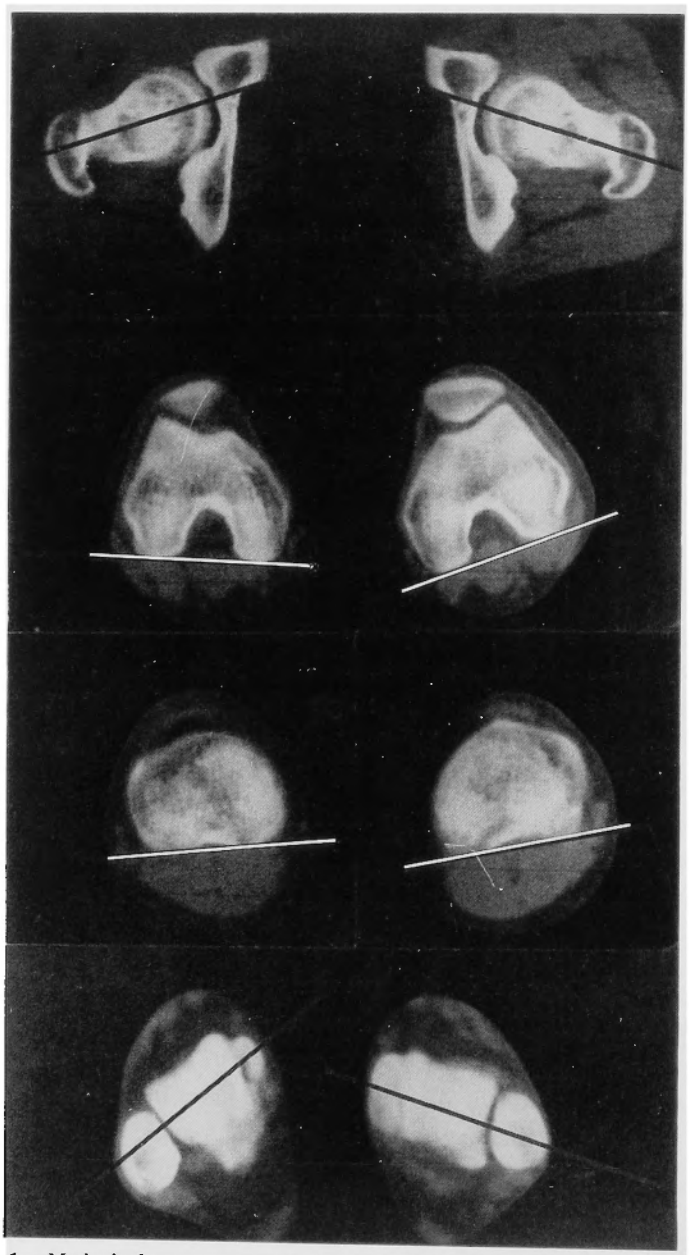


Fig. 1. Method of measurement of the rotational alignment by using computed axial tomography.

sides of the medial and lateral femoral condyles was defined as the angle of external rotation of the knee joint. In the same way the angle formed by the posterior side of the proximal tibia and the line connecting the medial and lateral malleoli was defined as the angle of external tibial torsion (Fig. 1).

The ten lower limbs of five persons who had no lesions in their limbs were chosen as the control group. The average age was nineteen.

Generalized joint laxity was diagnosed when more than three of the following tests were positive: (1) passive apposition of the thumb to the flexor aspect of the forearm; (2) hyperextension of the elbow; (3) hyper-extension of the knee; (4) foot dorsiflexed to 30 degrees or more; (5) palms touching the floor on flexing the lumbar spine[2].

Results

The femoral anteversion angle, the external rotation of the knee joint and the external tibial torsion in the control group showed $8.6\pm5.5°$, $4.1\pm2.3°$ and $21.0\pm6.3°$ respectively.

The femoral anteversion angles of 48 limbs of the patients ranged from 6° to 70° and were $31.9\pm15.2°$ when averaged. The external rotation angles of the knee joints varied from 0° to 22° showing $9.2\pm6.8°$ on the average. The external tibial torsion angles ranged from 2° to 38°, averaging $23.1\pm8.8°$ (Table 1). No significant difference was observed between the involved and uninvolved limbs in femoral anteversion, external rotation of the knee joint and external tibial torsion.

Generalized joint laxity was observed in 13 patients, one male and 12 females. The external rotation angle of the knee joint of the patients with generalized joint laxity were significantly greater than that of the patients without generalized joint laxity (Table 1).

Significant differences were recognized in femoral anteversion and external rotation of the knee between the lower limbs of the control group and those with recurrent dislocation of the patella ($p<0.005$).

A significant correlation was observed between femoral anteversion and external rotation of the knee (Fig. 2), but little correlativity was recognized between femoral anteversion and external tibial torsion. The limbs which showed 21° or more in femoral anteversion numbered

Table 1. Measurements of rotational alignment of the lower limbs (degrees, M±SD).

	Femoral anteversion	External rotation of knee joint	External tibial torsion
Control (n=10)	8.6± 5.5	4.1±2.3	21.0±6.3
Recurrent dislocation of the patella (n=48)	31.9±15.2**	9.2±6.8**	23.1±8.8
With generalized joint laxity (n=26)	34.7±15.1	10.1±6.9*	23.5±9.9
Without generalized joint laxity (n=22)	28.8±14.5	6.4±8.5	22.6±7.5

** $p<0.005$ compared to control.

* $p<0.05$ compared to the patients not combined with generalized joint laxity.

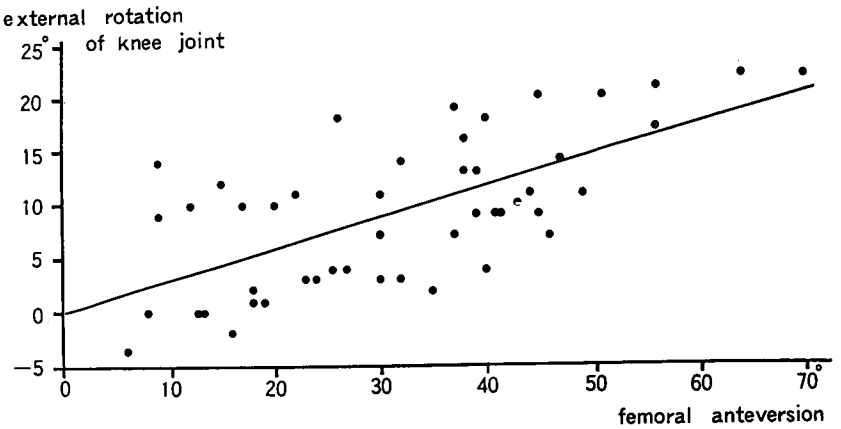


Fig. 2. Correlation between femoral anteversion and external rotation of knee joint is statistically significant ($r=0.66$, $y=0.30x-0.22$, $p<0.01$).

35. The limbs showing 10° or more in the external rotation of the knee joint numbered 24. The limbs showing an external tibial torison of 30° or more were 12.

Discussion

HEYWOOD[4] mentioned that two of 76 patients he treated for recurrent dislocation of the patella showed lateral rotational deformities of the tibia and that together with the laxity of the medial joint capsule, lateral rotational deformities cause the lateralization of the insertion of the patella tendon and eventually serve as a cause of recurrent dislocation. However, HUGHSTON[5] reported that no significant external tibial torsion had been observed among patients he treated for recurrent dislocation. It is indicated that when excessive femoral anteversion is combined with considerable external tibial torsion, there is a possibility of dislocation of the patella or patella chondromalacia ensuing[11]. On the other hand, it is reported that the rotational malalignment of the lower limbs can cause pain in the patella but rarely causes dislocation[3,6].

We analyzed the rotational alignment of the lower limbs of patients with recurrent dislocation of the patella by means of CAT scan, which is demonstrated to be more accurate measurement method of rotational alignment than X-ray picture[7,10,12]. Our study revealed the existence of excessive femoral anteversion and significant external rotation of the knee joint in the lower limbs of patients but that no difference was observed in terms of external tibial torsion.

Although it was unable to demonstrated the site of femoral or tibial torsion in this study, the torsion has been considered to occurr at proximal or distal metaphysis of long bone. Excessive femoral anteversion makes the lower limb internally rotate in standing position and causes medial torsion of femoral condyle. Lateral vector of rectus femoris, one of biarticular muscles, acting on the patella become larger. Furthermore, the vector is made still larger when excessive femoral anteversion is combined with increased external rotation of the knee joint. All external rotators and internal rotators of knee joint are biarticular muscles except short head of biceps and popliteus

muscle[1]. In the presence of excessive medial torsion of femoral condyle, bi-articular external rotators could be tightened and bi-articular medial rotators could decrease its action. This muscle umbalance would cause the external rotation of the knee joint. If generalized joint laxity is combined, the knee joint would be rotated more externaly.

The lateral dislocation of the patella would be easily resulted from excessive femoral anteversion combined with large external rotation of the knee joint, but not external tibial torsion.

Conclusion

The femoral anteversion and the external rotation of the femoro-tibial joint were significantly greater in the patients with recurrent dislocation of the patella than in the control. There was no significant difference of the external tibial torsion. The femoral anteversion was correlated with the external rotation of the knee joint, but not the tibial torsion.

External rotation angle of the knee joint in the patients with generalized joint laxity had greater than that in the patients without generalized joint laxity. Such rotational malalignment could be a cause of recurrent dislocation of the patella.

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和文抄録

反復性膝蓋骨脱臼における下肢回旋アライメント

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反復性膝蓋骨脱臼を有する女20，男4例の下肢回旋アライメントをコンピュータ断層撮影像より計測した．年令は13～34歳，平均21歳であり，初回脱臼時の年令は7～20歳であった．脱臼側は右11，左9関節で，両側例が4例，8関節であった．大腿骨前捻角は6～70°，平均 31.9±15.2°，膝関節外旋は 0～22°，平均 9.2±6.8° と対照と比較して有意に大きかった．脛骨外捻は2～38°，平均23.1±8.8°であり対照と有意な差はなかった．また，罹患側（28肢）と非罹患側(20肢)との間には大腿骨前捻角，膝関節外旋，脛骨外捻ともに有意な差はなかった．全身性関節弛緩を有する26下肢の大腿骨前捻角は 34.7±15.1°，膝関節外旋は 10.1±6.9° と，全身性関節弛緩を有しない20下肢と比較して有意に大であったが，脛骨外捻には差は認められなかった．大腿骨過度前捻は2関節筋である大腿直筋の膝蓋骨に対する外側への作用ベクトルを大きくする．さらに，膝外旋筋，内旋筋群は大腿二頭筋短頭および膝窩筋を除いてすべて2関節筋であるため，大腿骨過前捻が存在すると膝外旋筋群は内旋筋群よりも優位となる．すなわち膝関節での下腿外旋力が優位となり，全身性関節弛緩の合併により膝関節での過度の外旋を生じる．大腿骨過度前捻と膝関節での過度外旋の合併は膝蓋骨への外側ベクトルをさらに大きくして，膝蓋骨外側脱臼の素因となるものと思われる．