#### Supplementary file 5: Distances and angles

3D-distances (D1–D6, Figure 3 in the article) between two predefined test points (coordinates) were calculated using Excel (Microsoft Corporation).

#### Measurement of 3D movements in a craniocaudal plane

To measure craniodorsal or craniocaudal movements of the tibia, we calculated D2 (distance between patella and tibial tuberosity).

The formula used for the calculation of 3D distance is as follows:

Furthermore, an angle was calculated to confirm our measurement of cranial or craniodorsal movements of the tibia. We designed vectors between the patella and tibial tuberosity and between the patella and the cranial origin of the coordinate system. In this angle we only used the x and z coordinates of the test points (Figure 4 in the article). The formula for calculations is as follows:

)

0 = auxiliary point = 0 left and right side

P1 = coordinates of patella

P4 = coordinates of tibial tuberosity

#### Measurement of 3D movements in mediolateral plane

Furthermore, we calculated the distances (D1 and D3) that can provide information about 3D mediolateral movements of the tibia.   
The formula used for distance calculation is as follows:

Additionally, in the measurement of mediolateral movements we calculated an angle. For this, we designed vectors between the patella and tibial tuberosity and between the patella and an auxiliary point (−1000, for the left limbs; +1000 for the right limbs). In this angle, only y and z coordinates of the test points were used (Figure 5 in the article).

)

A = auxiliary point = −1000 (left side); +1000 (right side)

P1 = coordinates of the patella

P4 = coordinates of the tibial tuberosity

#### Other distances

We also measured distances D4–D6 (Figure 3 in the article). However, the results did not provide any specific information about craniocaudal or mediolateral movements of the tibia (Tables 1–3).

**Table 1: Comparison of means of D4**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group | | Distance | BW load (%) | n | Mean (mm) | SD (mm) | Minimum (mm) | Maximum (mm) |
| 1 | D4 | | 10 | 20 | 27.18 | 3.16 | 22.23 | 32.39 |
|  | D4 | | 30 | 20 | 26.94 | 2.71 | 21.65 | 31.04 |
| 2 | D4 | | 10 | 20 | 26.23 | 3.20 | 22.14 | 31.84 |
|  | D4 | | 30 | 20 | 24.90 | 2.60 | 20.21 | 28.90 |
| 3a | D4 | | 10 | 10 | 26.56 | 2.22 | 23.50 | 30.06 |
|  | D4 | | 30 | 10 | 26.31 | 2.19 | 23.65 | 29.33 |
| 3b | D4 | | 10 | 10 | 26.75 | 3.16 | 22.12 | 30.92 |
|  | D4 | | 30 | 10 | 26.08 | 2.98 | 21.90 | 30.56 |

Comparison of means of D4, D4: distance between tibial tuberosity and medial collateral ligament with the loads of 10% and 30% body weight; group 1: intact CCL; group 2: transected CCL; group 3a, Mini TightRope; group 3b: fabellotibial suture

**Table 2: Comparison of means of D5**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Group | Distance | BW load (%) | n | Mean (mm) | SD (mm) | Minimum (mm) | Maximum (mm) |
| 1 | D5 | 10 | 20 | 31.77 | 3.07 | 26.75 | 37.83 |
|  | D5 | 30 | 20 | 31.21 | 3.12 | 27.32 | 37.21 |
| 2 | D5 | 10 | 20 | 30.20 | 3.88 | 23.93 | 38.85 |
|  | D5 | 30 | 20 | 26.76 | 2.46 | 23.61 | 31.32 |
| 3a | D5 | 10 | 10 | 32.05 | 3.04 | 25.78 | 37.12 |
|  | D5 | 30 | 10 | 30.88 | 3.08 | 25.34 | 34.72 |
| 3b | D5 | 10 | 10 | 31.69 | 3.81 | 27.59 | 39.89 |
|  | D5 | 30 | 10 | 29.72 | 3.48 | 26.04 | 36.47 |

Comparison of means of D5, D5: distance between tibial tuberosity and medial collateral ligament with the loads of 10% and 30% body weight; group 1: intact CCL; group 2, transected CCL; group 3a, Mini TightRope; group 3b, fabellotibial suture

**Table 3: Comparison of means of D6**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Group | Distance | BW load (%) | n | Mean (mm) | SD (mm) | Minimum (mm) | Maximum (mm) |
| 1 | D6 | 10 | 20 | 18.70 | 2.53 | 14.86 | 22.66 |
|  | D6 | 30 | 20 | 18.53 | 1.84 | 15.29 | 21.10 |
| 2 | D6 | 10 | 20 | 19.61 | 2.92 | 15.10 | 26.59 |
|  | D6 | 30 | 20 | 17.58 | 2.44 | 12.71 | 21.82 |
| 3a | D6 | 10 | 10 | 19.00 | 3.54 | 10.66 | 24.85 |
|  | D6 | 30 | 10 | 19.75 | 1.58 | 17.41 | 22.28 |
| 3b | D6 | 10 | 10 | 19.86 | 3.03 | 15.27 | 24.91 |
|  | D6 | 30 | 10 | 18.69 | 3.31 | 13.99 | 23.51 |

Comparison of means of D6, D6: distance between tibial tuberosity and medial collateral ligament with the loads of 10% and 30% body weight; group 1: intact CCL; group 2, transected CCL; group 3a, Mini TightRope; group 3b, fabellotibial suture