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RELIABILITY OF KNEE ANATOMICAL REPERES DETERMINATION IN CINARTRO VIDEOFLUOROSCOPIC IMAGES

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CINARTRO is an instrument to determine the biomechanical behaviour of a moving knee under video-fluoroscopy (VFC) [1]. The software analyses series of X ray images to estimate the tibial plateau length in each frame, the extension/flexion angle and the extremities of the patellar ligament. The Tibio Femoral Contact Point (**TFCP**) is considered a proxy of the centre of rotation [2]. It allows to determines the distance to the line along which the quadriceps applies a force, i.e. the instantaneous Moment Arm (**MA**) of the knee.

RESEARCH GOAL

To estimate the measurement precision of CINARTRO used by trained and novel medical imaging operators on a cadaveric lower limb.

METHOD

Four expert imaging operators and three medical students read in five occasions the same video-fluoroscopic images at different times separated by at least one week. The cadaveric limb was secured in three different angles from extension to flexion. TFCP and MA were measured. Standard deviation of the mean is indicator of measurement dispersion.

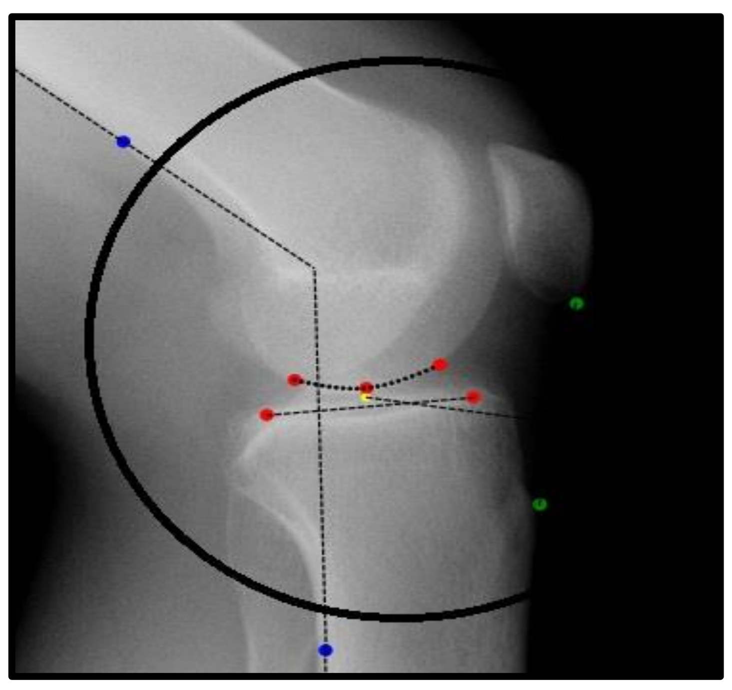

Figure 2. Details of points defined by the user and TFCP (yellow) calculated by the software. This allows to record the biomechanical knee behaviour in a reproducible way, with a known error.

RESULTS

At angles of 47º, 25º and 8º, the error was below 1º for expert and non-experts alike. The measurement dispersion estimated as Standard Error of the mean was around 2.5% for experts (TFCP migration & MA), 3% (MA) and 6% (TFCP) for novel readers.

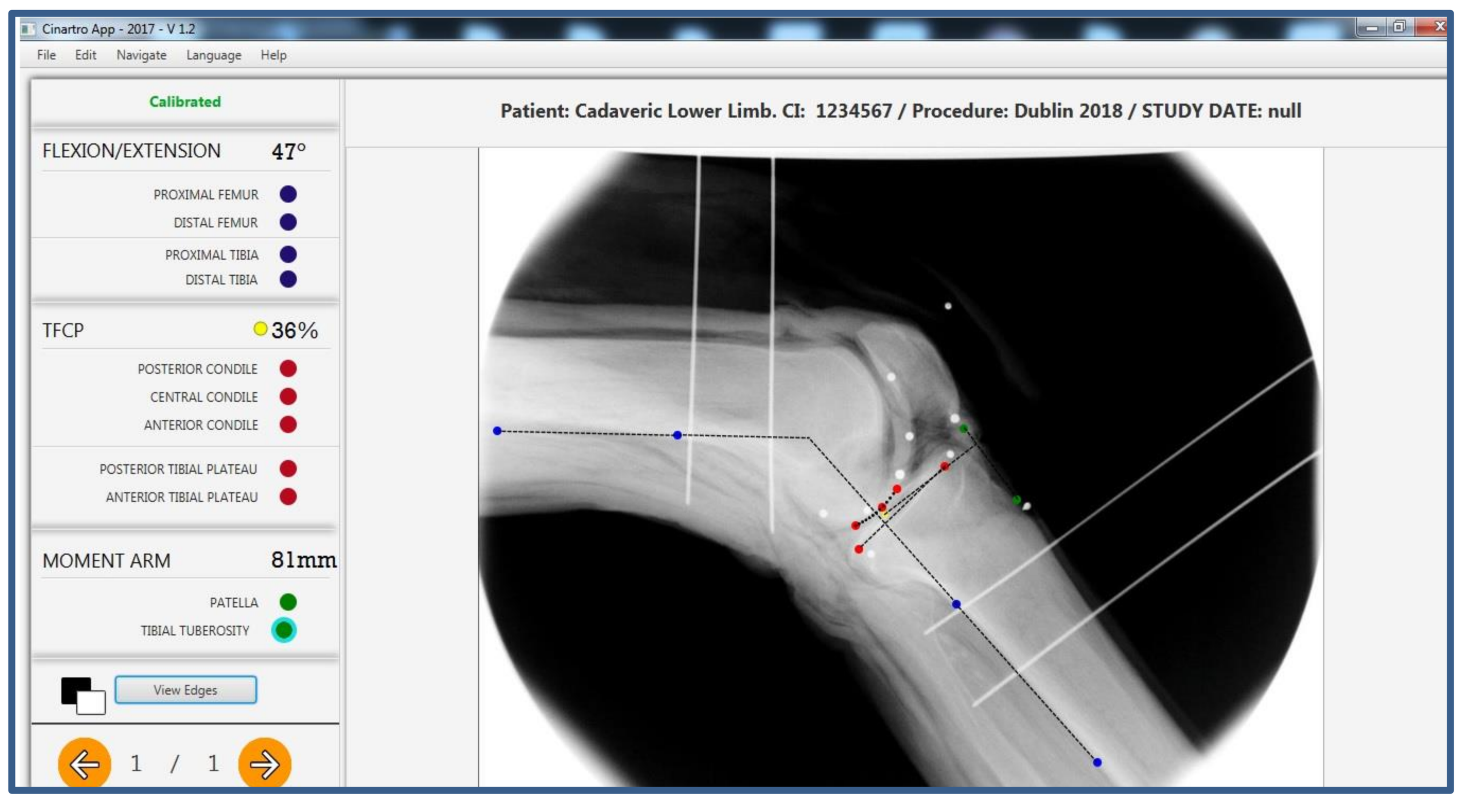

Figure 1. **CINARTRO** user interface processing a cadaveric limb. With angles 47º, 25º and 8º, anatomical *repères* are identified by the user and TFCP and MA are calculated by the software.

TABLE 1 - TFCP & MA AT ANGLES OF 47º, 25º & 8º

Knee Angle	Expert Image Readers ± SD	Novel Image Readers ± SD	SE mean Expert & Novel SE/√n	
Flexion @47º	46.7 ± 2.4	47.7 ± 1.8	0.5%	0.5%
MA (mm)	37.9 ± 0.6	40.9 ± 1.0	1.6%	2.4%
TFCP (%)	35.4 ± 1.7	32.0 ± 2.0	4.9%	6.2%
Mid Range @25º	24.5 ± 2.1	25.7 ± 1.3	0.5%	0.3%
MA (mm)	28.8 ± 0.7	33.5 ± 1.2	2.4%	3.6%
TFCP (%)	57.3 ± 1.5	46.5 ± 3.0	2.6%	6.5%
Extension @8º	8.6 ± 1.8	8.13 ± 1.3	0.4%	0.3%
MA (mm)	33.0 ± 0.7	35.0 ± 1.1	2.1%	3.1%
TFCP (%)	48.6 ± 1.3	49.8 ± 3.2	2.7%	6.4%

CONCLUSIONS

A reasonable precision gives reliability to the **CINARTRO** method, now ready to be used clinically [3] to evaluate the biomechanical parametres (MA and TFCP migration) of injured knees, both prior and after surgery as well as during rehabilitation of professional sportsmen. Prescription of **CINARTRO** can help in case of ACL reconstruction and Total Knee Replacement (TKR). The addition of 3D analysis of knee rotation can now be tackled to further refine clinical evaluations [4].

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