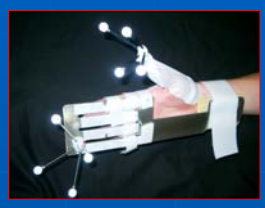
In vivo trapeziometacarpal joint kinematics: a study with Polaris® system

J-N. Goubier, L. Devun, D. Mitton, F. Lavaste (Laboratoire de biomécanique, ENSAM, Paris, France)

Trapeziometacarpal joint is important concerning thumb function. However, this deep joint is clinically difficult to assess. The purpose of our study is to evaluate the range-of-motion (ROM) of trapeziometacarpal joint with an in vivo kinematics protocol.

Material & Methods: 115 hands have been studied in 73 healthy subjects.

An optoelectronic device (Polaris®) was used to analyse thumb range-of-motion.

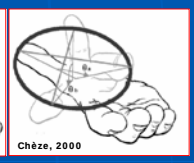


–Splints were used to evaluate the isolate trapeziometacarpal joint. Retroreflective markers were placed on the splints and thumb.

–Anatomical landmarks were pointed to localize bone segment. Guides were used to improve movement repeatability.

–Five movements were analysed: flexion-extension, abduction-adduction and circumduction.

Kapandji, 1986



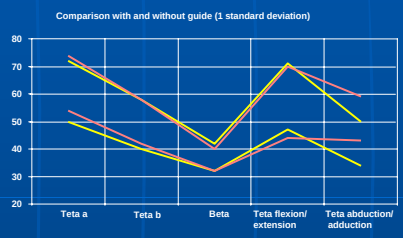
Chèze, 2000

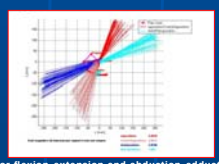
Results: The protocol has been feasible in all subjects. The mean time of measure was 15 minutes.

Mean flexion-extension and abduction-adduction was respectively 53 and 42 degrees without guides, 68 and 48 degrees with guides.

The mean axial rotation of the thumb was 27 degrees.

The mean distance between axes of each movement was 3 millimetres.





rotation axes for flexion-extension and abduction-adduction movements

Discussion: *Kuo* used electromagnetic tracking device to measure circumduction represented with a spherical area. However, no distance between rotation axes can be calculated with this method.
Cheze proposed an in vivo protocol with an optoelectronic device. Results of ROM were similar to our study. However, the protocol is not minutely described and only 24 hands were studied. Distance between axes was 1 mm in *Cheze* and 3 mm in ours. However, we used two movements with perpendicular axes described by *Kapandji*. *Cheze* used a global movement which includes abduction and flexion.
In *Coert* protocol (thumb circumduction with an electronic device) PI and MP joint were not stabilized. Therefore TMC joint ROM cannot be precisely calculated.

Conclusion: We validated an in vivo protocol of TMC joint kinematics analysis. The data basis of our study will permit to compare patients with arthritis thumb or healthy subject. Moreover, thumb ROM should be compared before and after operation for trapezectomy or TMC arthroplasty.

– Cheze, L.; Doriot, N.; Eckert, M.; Rumelhart, C.; and Comtet, J. J.: [In vivo cinematic study of the trapezometacarpal joint]. *Chir Main,* 20(1): 23-30., 2001.
– Coert, J.; Hoek van Dijke, G.; Hovius, S.; Snijders, C.; and Meek, M.: Quantifying thumb rotation during circumduction
– Kapandji, A.: Functional anatomy of the first web space. *Ann Chir Main,* 5(2): 158-65, 1986.
– Kuo, L. C.; Cooney, W. P.; Chen, Q. S.; Kaufman, K. R.; Su, F. C.; and An, K. N.: A kinematic method to calculate the workspace of the trapeziometacarpal joint. *Proc Inst Mech Eng [H],* 218(2): 143-9, 2004.

ENSAM LBM CNRS