POSTER 212

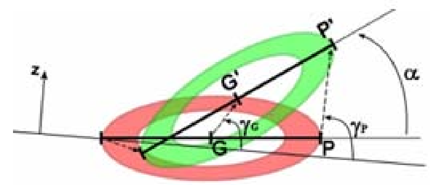
3D EVALUATION OF KIDNEY MOVEMENT DURING RESPIRATION USING 2.5D ULTRASOUND

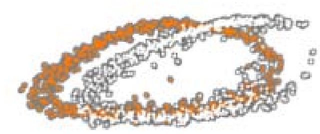
A. LEROY[1], P. MOZER[2,3], P. CONORT[3], E. CHARTIER-KASTLER[3], F. RICHARD[3], Y. PAYAN[2], J. TROCCAZ[2]

[1]KOELIS©, www.koelis.com
[2]TIMC Laboratory, IN3S, Faculté de Médecine, Domaine de la Merci, 38700 La Tronche, France
[3]Department of Urology, Pitié -Salpêtrière Hospital, Pierre et Marie Curie University Paris VI, France

Introduction: The evaluation of kidney movement during respiration has been addressed in 1994 by Schwartz, using fast-echo MRI on 14 volunteers. Under normal respiration, he reported an average motion of 16mm and an average mobility of 2.9mm, the mobility being the re-positioning error between two breathing cycles. However, the MR modality does not provide a sufficient resolution to clearly distinguish the kidney frontiers, especially at the poles, and furthermore it does not allow the screening of the movement in "true" 3D. In this study we aim at proving the feasibility of measuring the 3D movement (motion+mobility) of the kidney with the help of localized freehand ultrasound.

Methods: On 11 healthy volunteers, static and dynamic acquisitions of the right kidney were made through anterior access. The *static* acquisition consisted in sweeping the localized probe over the kidney after deep inhale, then after deep exhale. The *dynamic* acquisition consisted in placing the probe in the motion plane, and acquiring kidney median slices in real-time during several breathing cycles. With an image resolution of 0.3mm per pixel, this allowed to reconstruct clouds of kidney-shaped 3D points. Using a rigid least-squares registration, we could measure precisely distances GG', PP', and angles γ_G, γ_P, α, as described in the figures aside.





Results: Thanks to 3D registration we were able to measure distances and angles along the actual course of the organ. The range and average values for motion and mobility are shown hereunder. The values for the mobility basically depend on the corpulence of the volunteers. We may remember an average displacement of 30mm and 12°. Since no breathing assistance was used, the replacement of the kidney was dependent on the volunteers' ability to control their breathing. On average we obtained 4mm and 7°. The best replacement was 2.3mm and 2°, which gives hope to prove high repeatability under general anesthesia circumstances.

Motion	GG'	PP'	γ_G	γ_P	α
Range	10.1-60.0	7.8-55.5	9.1-129.7	11.2-134.9	6.5-17.5
Average	30.1	30.8	48.3	52.7	11.6

Mobility	GG'	PP'	α
Range	1.8-12.4	1.-9.2	2.0-18.9
Average	4.0	4.3	6.7

Conclusion: We showed the feasibility of measuring in 3D both motion and mobility of the kidney using 2.5D ultrasonography. The average values are coherent with the literature, although we believe that using a high-resolution freehand modality yields more reliable results. In the future we intend to re-iterate the tests using breathing assistance on volunteers, before going to the O.R. as a last stage. The influence of age, sex, size and weight, should be evaluated as well. A dedicated software is available.