Brainlab Novalis Circle
9th International Conference 2023

DF STAR
REDE D'OR

Geometrical Validation of Image Fusion Angio – a phantom prototype

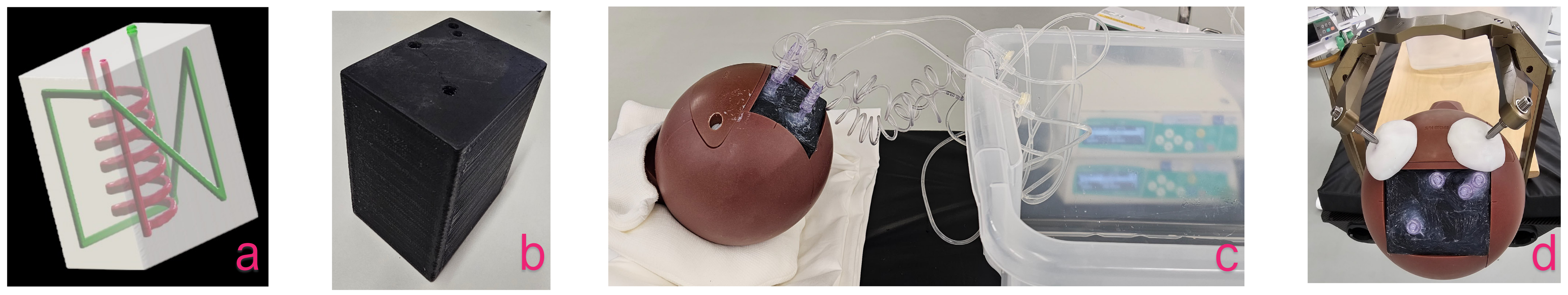
Querelli, Guilherme E.[1,2] I Silva, André B.[1,2] I Furquim, Luiz F. E. S.[1,2] I Castilho, Thaylane G.[2] I Ramos, Renan S.[2]
1 – DF STAR Hospital I 2 – Rede D´or São Luiz

Purpose

Our purpose is to create a phantom with which is possible to acquire all images sets needed by Brainlab Elements Image Fusion Angio (IFA). To perform an analysis of structure definition capability and compare the results with the same evaluation performed in Leksell Gamma Plan, Elekta AB (GP) with stereotactic localized images method. Our final goal is to remove the need of use Leksell Frame-G, Elekta AB in angiography acquisition.

Materials and Methods

The phantom was designed in Brainlab Elements Object Manipulation (OM), exported and printed in a filament 3D printer (Images 1 a-b). It has two ducts that simulates vessels, spiral (Vs) and linear (Vl), where fluids (water and contrast agent) are constantly injected by a hospitalar infusion pump. The piece was placed inside the Leksell Gamma Knife Icon (GKI), Elekta AB dosimetry phantom and then, the setup fixated in a Frame-G, (Images 1 c-d). To acquire the images CT, MRI and Angiography the specific Frame-G localizer was attached.

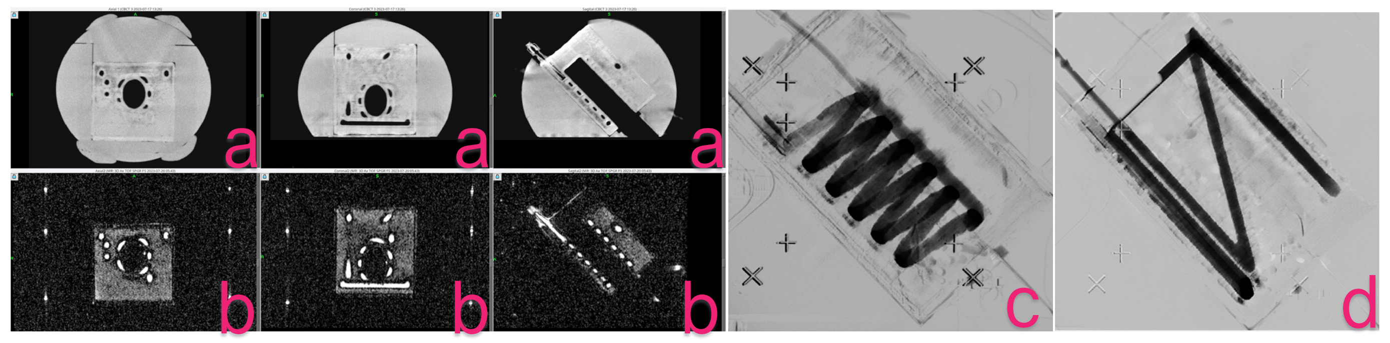


Images 1 a-d, proposed phantom: a – Designed form; b – Printed piece; c – Inside GKI phantom with pumps connected; d – fixed in Leksell Frame – G

In Elements we performed IFA, and in GP, images were corregisted through “box” localizers. Vessels were contoured manually in all images (CT, MRI and Angio) in both softwares. GP ´s structures were exported to OM in order to create intersections with the designed structure sent to be printed, allowing us to calculate “coverage” (CO) (Vstructure∩Vprinted/Vprinted) and “selectivity” (SE) (Vstructure∩Vprinted/Vstructure). Structure ´s center of mass (CM), provided by softwares were compared using vectorial displacement of coordinates.

Results

The phantom allows us to acquire all needed images to perform IFA and stereotactic localization with good quality (Images 2 a-d). Despite some leakage of liquid happened, causing air bubbles inside the vessels, in both softwares they could be identified and contoured. Results in Table 1 are shown in mean and standard deviation (SD), taking in account three structures created, one in each image modality per vessel per software. Mean CM deviation in Vs is less than 1 mm, meanwhile Vl has more than 2 mm, most likely to be by presense of air bubbles. CO were comparable for both vessels and softwares, being over 0,80 in every possible scenario. SE shows poorer results and high SD, than CO, due to finite information of angio images, acquired at ortonormal orientation as it is mandatory in GP.



Images 2 a – d: a – CT; b – MRI TOF; c – Lateral angiography of Vs; d – Lateral angiography of Vl.
Table 1: Results of CO, SE and ΔCM sorted by vessel and software

		SPIRAL			LINEAR		
		CO	SE	ΔCM	CO	SE	ΔCM
		Vstructure∩Vprint/Vprint	Vstructure∩Vprint/Vstructure	(mm)	Vstructure∩Vprint/Vprint	Vstructure∩Vprint/Vstructure	(mm)
Elements	Mean	0,89	0,57	0,9	0,80	0,50	2,0
	SD	0,03	0,45	0,4	0,06	0,11	1,1
GammaPlan	Mean	0,87	0,50	0,9	0,82	0,50	2,3
	SD	0,09	0,33	0,2	0,05	0,05	0,8

Conclusion

The analyzed parameters show good coherence between softwares. Although there is a lack of references in this subject, our results encourage us to eliminate the Frame-G from angiography image acquisition for GKI treatments, as Elements IFA secure the same accuracy and look after patient comfort without the need of Frame-G to be fixated. Future evaluations with more orientations than orthonormal should prove a better SE results for angio images. The proposed phantom could evolve to a more anatomical vessel shape and printed in a UV activated resin 3D printer, to avoid leakage and air bubbles.