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Three-Dimensional Reconstruction In Medical Education: Report Case Of Aortic Aneurysm.

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Abstract:
Background*: CT angiography, was performed preoperatively in a 68-year-old patient with an aortic aneurysm. After processing the scanned images obtained, only thin sections with a thickness less than or equal to 1 mm were selected for three-dimensional reconstruction.*
Three-dimensional reconstruction of the processed scans produced a series of 3D images. These images, are used for theoretical teaching, close to reality as they are based on a real case. The aortic aneurysm observed on the sections studied gives learners a small glimpse of the clinical cycle of vascular pathologies and perfectly illustrates the interest of the question studied.
Materials and Methods*: A computed tomography angiography, was performed preoperatively on a 68-year-old patient with an aortic aneurysm. After processing the scanned images obtained in DICOM (Digital Imaging and Communications in Medicine) format, which is compatible with most brands of imaging equipment, only thin sections with a thickness of 1mm or less, were selected for three-dimensional reconstruction.*
Study Location: This study was carried out at the department of general anatomy and Morpho Functional Explorations, EHU, university hospital in Oran, Algeria.
Inclusion criteria : The cuts were serialized and thin, less than 1mm thick
Results*: Three-dimensional reconstruction of the processed scans has produced a series of 3D images. These images are used for theoretical teaching, close to reality because they are based on a real case.*
The aortic aneurysm observed in the sections studied gives learners a small insight into the clinical cycle of vascular pathologies and perfectly illustrates the interest of the question studied.
In vascular surgery, preoperative simulation, with upstream identification of the arteries to be obliterated and precise localization of aortic dilatation, enables surgical residents in training to be better prepared for surgery. The three-dimensional image of the aortic aneurysm is better understood by novice vascular surgeons at the start of their training, as it enables them to take a 3D approach to aortic dilatation.
Conclusion: *Three-dimensional simulation is the tool of the future in anatomy teaching. It offers students the opportunity to study models repeatedly at low cost and without the need for cadavers. Different models, can be used to present different perspectives of human anatomy. In our case, we have created a model of the aorta that could be a different learning opportunity.*
Nevertheless, 3D models are likely to enhance rather than replace lectures, with this study suggesting that expert teaching is likely to remain an essential part of medical education.
In addition, studies have shown that greater effectiveness, in terms of learning skills and knowledge acquired, was perceived when 3D systems were used by medical students.
Key Word*: Education; Medical; Three-Dimensional; Modeling; Simulation.*

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I. Introduction

Three-dimensional 3D simulation is currently gaining ground in the fields of healthcare and medical education. In practice, highly realistic 3D anatomical models are a teaching method capable of conveying understanding of complex physical structures and producing models that are difficult to obtain. Indeed, current teaching modalities are limited either to traditional two-dimensional forms of learning, such as textbooks, research papers and lectures, or to more costly modes such as cadaveric dissection. Among the areas of interest in three-dimensional reconstruction are its application in anatomy using virtual reality functions.[1, 2].

As regards the effectiveness of 3D models, in terms of learning skills and knowledge acquired by medical students, randomized controlled trials reported high scores. Most students in all trials expressed satisfaction, happiness and interest in using the 3D systems, and recognized that their abilities had been improved.[3].

In addition, virtual simulation-based learning is increasingly used in healthcare education to prepare students for clinical practice. For example, students training in radiation protection have simulated interventional radiology. [4].

One tool used in 3D is Osirix software. It is a tool for diagnostic imaging, teaching and research, with many possible applications in the field of maxillofacial surgery and stomatology. [5,6,7,8].

The aim of this study is to highlight the benefits of three-dimensional simulation in medical education. To this end, CT angiography was performed preoperatively on a 68-year-old patient with an aortic aneurysm. After processing the scanned images obtained, only thin sections with a thickness of 1 mm or less were selected for three-dimensional reconstruction.

Three-dimensional reconstruction of the processed scans produced a series of 3D images. These images, used for theoretical teaching, are close to reality as they are based on a real case. The aortic aneurysm observed on the slices studied gives learners a small insight into the clinical cycle of vascular pathologies, and perfectly illustrates the interest of the question studied.

II. Material And Methods

A computed tomography angiography was performed preoperatively on a 68-year-old patient with an aortic aneurysm. After processing the scanned images obtained in DICOM (Digital Imaging and Communications in Medicine) format, which is compatible with most brands of imaging equipment, only thin sections with a thickness of 1mm or less were selected for three-dimensional reconstruction. The reconstruction was carried out in four steps:

The first step was to introduce the 256 selected sections into the OSIRIX software database[5,6,7,8,9]. This is a reconstruction software package, the open access version of which is free, and available on machintoch. It allows the generation of three-dimensional 3D images by the formation of a digital mesh through the computer stacking of fine serialized sections.

The second step consisted in the surface and volume reconstruction of the scanned sections, using the "3D surface rendering" and "3 3D volume rendering" options available in the OSIRIX software toolbox.

The third stage consisted in segmenting the 3D model generated, using a range of tools to separate the aorta from surrounding structures.

The fourth step was to choose the right cross-sectional planes ,to highlight the aortic dilatation and its relationship with surrounding structures.

Study Location: This study was carried out at the department of general anatomy and Morpho Functional Explorations, EHU, university hospital in Oran, Algeria.

Inclusion criteria : The cuts were serialized and thin, less than 1mm thick.

III. Result

Three-dimensional reconstruction of the processed scans has produced a series of 3D images. These images are used for theoretical teaching, close to reality because they are based on a real case.

The advantages of 3D reconstruction are:

1- Theoretical teaching is more realistic, as it uses images taken from a real case.

2- The student can manipulate the image, turning it in all directions, offering a better appreciation of the model under study, far removed from conventional two-dimensional anatomy diagrams.

3-Virtual dissection of a digital thoracic model in VIVO as opposed to cadaveric dissection, which is more costly, more restrictive, and whose anatomical structures are sometimes slightly different from those in life [10,11, 12].

4- Possibility of isolating the 3D model; in our study, it is the aorta, which makes it easier to teach descriptive anatomy of the aorta: from its origin, path and thrust, to a description of its dimensions and general characteristics (figures 1 and 2).

5- A good visualization of the orientation of the various aortic segments in space, which is not evident on 2D diagrams (figure 1).

6- The use of bone and vascular fenestration provides an aorta projected onto the bony skeleton, enabling studies of its skeletal projection (figure 2).

7- The possibility of cross sectioning in 3 planes of space, enabling study of the anatomical relationships of the aorta with neighboring organs. (figures 3, 4 and 5).

8- The aortic aneurysm observed in the sections studied gives learners a small insight into the clinical cycle of vascular pathologies and perfectly illustrates the interest of the question studied.

9- In vascular surgery, preoperative simulation, with upstream identification of the arteries to be obliterated and precise localization of aortic dilatation, enables surgical residents in training to be better prepared for surgery [13, 14, 15].

10- The three-dimensional image of the aortic aneurysm is better understood by novice vascular surgeons at the start of their training, as it enables them to take a 3D approach to aortic dilatation.

Figure no 1: Isolated aorta with thoracic aortic aneurysm. With: 1-crosspiece of the aorta, 2-Thoracic aorta, 3-brachiocephalic arterial trunk, 4- left common carotid artery, 5-artere subclaviere gauche.

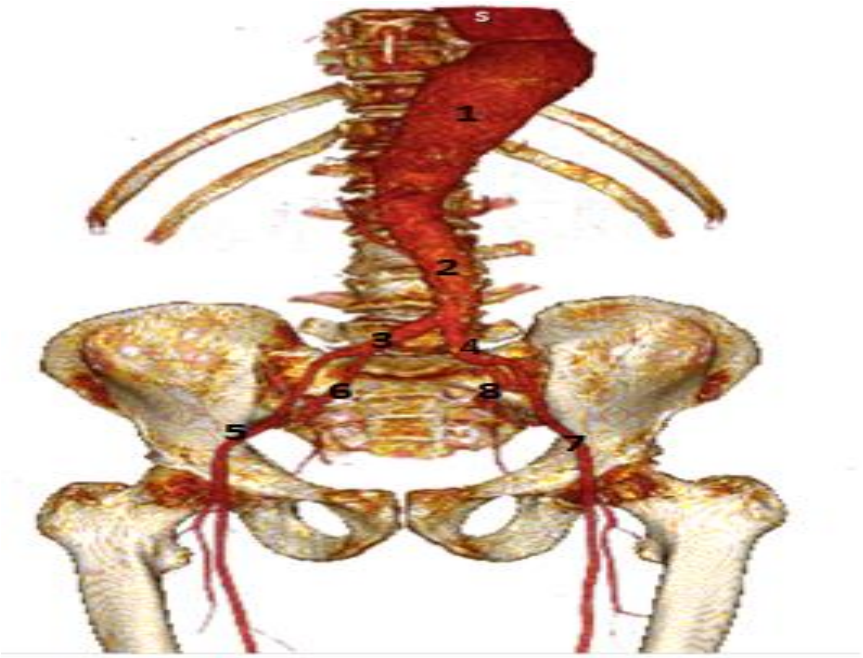

Figure no 2: Aortic aneurysm projected on the skeleton. With: 1- Aortic aneurysm, 2- Abdominal aorta, 3- Right common iliac artery, 4- Left common iliac artery, 5- Right external iliac artery, 6- Right internal iliac artery, 7- Left external iliac artery, 8- Left internal iliac artery.

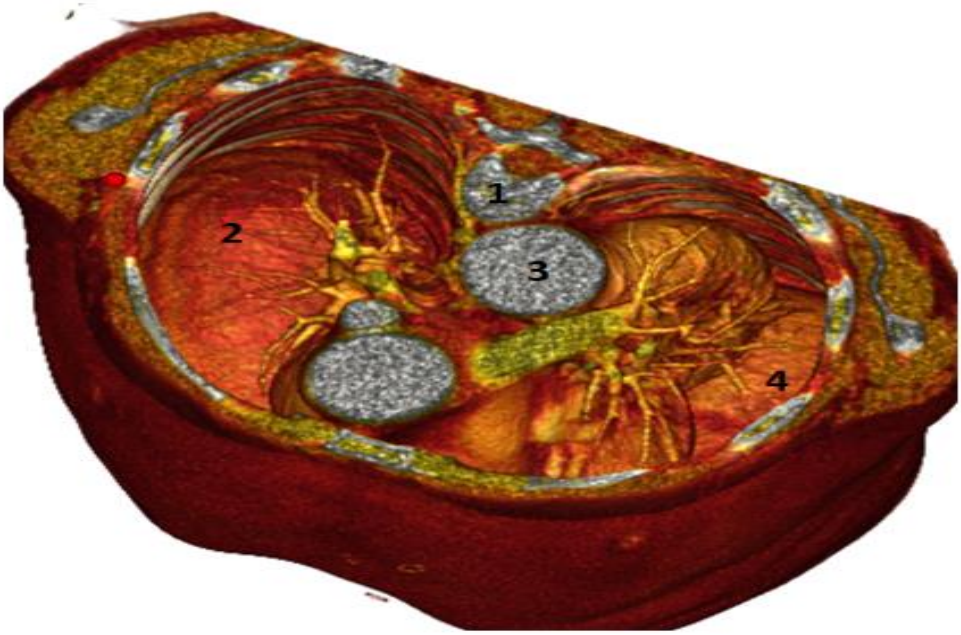

Figure no 3: Axial section at the level of T5 showing the resonance of the aneurysm in the posterior mediastinum. With: 1- 5th thoracic vertebra , 2- right lung , 3- thoracic aorta sectioned, 4- left lung.

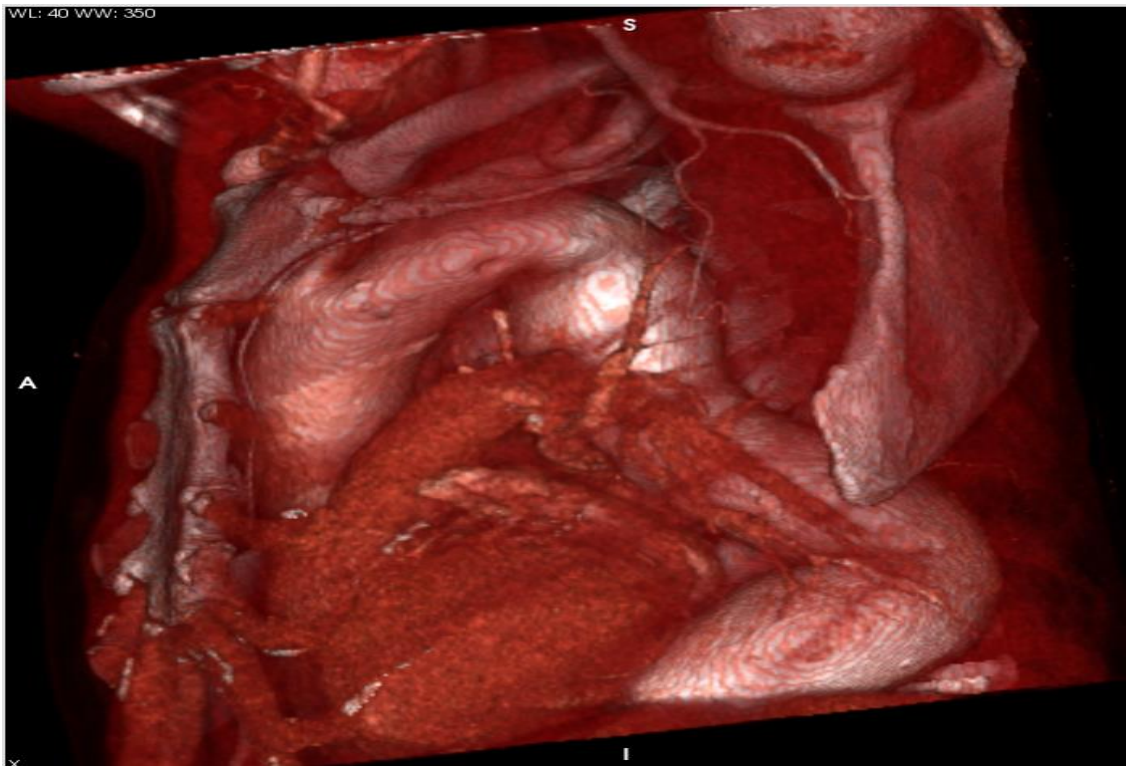

Figure no 4: lateral view of the mediastinum highlighting the relationships of the aorta to the mediastinum.

Figure no 5: Anatomical relations of aortic Aneurysm highlights the aneurysm after image processing.

Figure no 6: VRT (volume rendering).

IV. Conclusions

Three-dimensional simulation is the tool of the future in anatomy teaching. It offers students the opportunity to study models repeatedly at low cost and without the need for cadavers. Different models can be used to present different perspectives of human anatomy. In our case, we've created a model of the aorta that could be a different learning opportunity.

Nevertheless, 3D models are likely to enhance rather than replace lectures, with this study suggesting that expert teaching is likely to remain an essential part of medical education.

In addition, studies have shown that greater effectiveness, in terms of learning skills and knowledge acquired, was perceived when 3D systems were used by medical students.

References

[1]. Po Siang Bridget Chua, Chang Zheng Lee, Darren Ren Kiat Teng, Johan Susanto, Wenhui Dennis Ong, Kai Lee Tan, Peng Chung Cheow, Siang Hui Lai, Mark Bangwei Tan, Xiaojuan Khoo, Fernando Bello,Affordable And Accessible 3D Printed Models Of The Liver To Support Medical Education, Materials Today: Proceedings, 2022;70: 258-264. Https://Doi.Org/10.1016/J.Matpr.2022.09.234.

[2]. Steven Lo, Abdul Shakor Sandel Abaker, Fabio Quondamatteo, Jenny Clancy, Paul Rea, Michael Marriott, Paul Chapman, Use Of A Virtual 3D Anterolateral Thigh Model In Medical Education: Augmentation And Not Replacement Of Traditional Teaching?, Journal Of Plastic, Reconstructive & Aesthetic Surgery, 2020; 73(2): 269-275,ISSN 1748-6815, Https://Doi.Org/10.1016/J.Bjps.2019.09.034.

[3]. Carlos M. Ardila, Daniel González-Arroyave, Mateo Zuluaga-Gómez, Efficacy Of Three-Dimensional Models For Medical Education: A Systematic Scoping Review Of Randomized Clinical Trials, Heliyon, 2023; 9 (2) : E13395,, Https://Doi.Org/10.1016/J.Heliyon.2023.E13395.

[4]. R. Burgade, J.F. Uhl, G.D. Prat, C. Ruiz, B. Lorea, V. Delmas, P. Rosset, L.R. Le-Nail. 3D-Modeling Of Sternal Chondrosarcomas From Angio-CT-Scan: Clinical Application And Surgical Perspectives. Annals Of 3D Printed Medicine. 2021;1: 100003. Https://Doi.Org/10.1016/J.Stlm.2020.100003.

[5]. G. Melissano, L. Bertoglio, V. Civelli, A.C. Moraes Amato, G. Coppi, E. Civilini, G. Calori, F. De Cobelli, A. Del Maschio, R. Chiesa. Demonstration Of The Adamkiewicz Artery By Multidetector Computed Tomography Angiography Analysed With The Open-Source Software Osirix. European Journal Of Vascular And Endovascular Surgery. 2009; 37 (4): 395-400. Https://Doi.Org/10.1016/J.Ejvs.2008.12.022.

[6]. S. Albert, J.-P. Cristofari, A. Cox, J.-L. Bensimon, C. Guedon, B. Barry. Reconstruction Mandibulaire Par Lambeau Microanastomosé De Fibula. Modélisation Radiologique Préopératoire Par Le Logiciel Osirix. Annales De Chirurgie Plastique Esthétique. 2011 ; 56(6) : 494-503. Https://Doi.Org/10.1016/J.Anplas.2009.12.008.

[7]. R. Bhandari, K. Andi, R. Kukadia. P60 OSIRIX Dicom Viewer And Its Use As A Clinical Tool In Oral And Maxillofacial Surgery. British Journal Of Oral And Maxillofacial Surgery. 2010; 48 (1) : 40.Https://Doi.Org/10.1016/S0266-4356(10)60151-9.

[8]. Antoine Rosset, Luca Spadola, Osman Ratib.Osirix: A New Generation Of Multidimensional DICOM Viewer Based On New Imaging Standards. International Congress Series. 2004; 1268: 1247. Https://Doi.Org/10.1016/J.Ics.2004.03.048.

[9]. Antoine Rosset, Luca Spadola, Osman Ratib.Osirix: A New Generation Of Multidimensional DICOM Viewer Based On New Imaging Standards. International Congress Series. 2004; 1268: 1247. Https://Doi.Org/10.1016/J.Ics.2004.03.048.

[10]. P. Baqué, Enseignement De L'anatomie Aujourd'hui Et Demain, Bulletin De l'Académie Nationale De Médecine, 202 3 ; 207(1) : 45-47, Https://Doi.Org/10.1016/J.Banm.2022.10.013.

[11]. V. Delmas, A. Chays, D. Poitout, P. Vouhé, Rapport 22-10. Anatomie A L'heure Du Numérique, Bulletin De l'Académie Nationale De Médecine, 2022 ; 206 (8) : 942-951, Https://Doi.Org/10.1016/J.Banm.2022.07.004.

[12]. J.F. Uhl, O. Plaisant, O. Ami, V. Delmas, La Modelisation Tridimensionnelle En Morphologie: Méthodes, Intérêt Et Resultants, Morphologie, 2006 ; 90 (288) :5-20, Https://Doi.Org/10.1016/S1286-0115(06)74313-2.

[13]. F. Bonnel, G. Godlewski, F. Canovas, D. Prat, M. Prudhomme, J. Pujol, G. Captier, S. Chemouni, F. Banegas, C. Bonnel, Enseignement Dirigé D'anatomie A L'aide D'un Logiciel Spécifique D'analyse D'images (Projet Des Laboratoires d'Anatomie De Montpellier Et Nîmes), Morphologie, 2006, 90 (289) :69-70, Https://Doi.Org/10.1016/S1286-0115(06)74344-2.

[14]. J.F. Uhl, M. Chahim, V. Delmas, Les Nouveaux Outils Pour Etudier L'anatomie Vasculaire : La Modélisation 3D Interactive Et La Réalité Virtuelle Anatomique, Journal Des Maladies Vasculaires, 2014 ; 39 (2) :139, Https://Doi.Org/10.1016/J.Jmv.2013.12.055.

[15]. Sonia Pujol, Michael Baldwin, Joshua Nassiri, Ron Kikinis, Kitt Shaffer, Using 3D Modeling Techniques To Enhance Teaching Of Difficult Anatomical Concepts, Academic Radiology, 2016; 23 (4) :507-516, Https://Doi.Org/10.1016/J.Acra.2015.12.012.