

The use of 3D printing in improving patient-doctor relationship and malpractice prevention

Iulia Tevanov¹, Eduard Liciu¹, Marius Octavian Chirila¹, Andrei Dusca¹, Alexandru Ulici^{1,2,*}

Abstract: Doctor-patient relationship is mostly build on effective communication which plays an important role in delivering proper health care. Doctors have the duty to provide appropriate and sufficient information to the patient, concerning his medical condition and the available treatment options. The breakdown between doctor-patient relationship is the cause of majority of patients' complaints and aversions. Using customized 3D printed models for each patient and having the conversation and the explanations needed, based on the palpable particularities of the patient's medical condition, helps towards a more efficient communication and a better understanding of the ailment and the treatment's outcomes, thus reducing patients' insecurities to the medical act, preventing complaints, dissatisfaction and malpractice accusations.

Key Words: 3d print, doctor-patient relationship, complaint, malpractice.

INTRODUCTION

The therapeutic doctor-patient relationship is mostly build on effective communication, which plays an important role in delivering proper health care [1]. The main objective of doctor-patient communication is to improve the development of better therapeutic solutions, this way improving patient's health and the general medical care. A patient who fully understands his condition and the required surgical treatment and it's risks, becomes more compliant, thus leading to better outcomes.

Doctor-patient communication has the goals to create good interpersonal relationships, to enable the exchange of information and also to include the patient in discussions concerning the therapeutic stage [2, 3]. Studies have shown that a proper relationship between the two, improves patient satisfaction with medical experience, lowers patient's psychological stress and increases the trust in medical care providers [4].

The breakdown between doctor-patient

relationship is the cause of the majority of patient complaints and aversions [1]. Poor communication and improper attitude between the doctor and the patient are the most frequent causes of malpractice litigation, complaints against doctors and decrease in patients' compliance to treatment [5, 6]. Strategies to strengthen communication are to be taken into consideration, in order to prevent complaints, dissatisfaction and malpractice accusations [2].

Doctors have the duty to provide proper and sufficient information to the patient, concerning his medical condition and the available treatment options. This might help the patient make better informed choices. The doctor who performs the procedure has the responsibility to ensure that the proper informed consent was obtained, as it is him who could be held responsible in law [7]. Usually, patients sue doctors because of the feeling that they are not heard, that their needs are not properly cared about, this resulting in a poor outcome due to neglect or mistake. "The best way to handle

1) "Grigore Alexandrescu" Emergency Hospital for Children, Department of Pediatric Orthopedic Surgery, Bucharest, Romania

* Corresponding author: "Grigore Alexandrescu" Emergency Hospital for Children, Bucharest, 30-32, Iancu de Hunedoara Bvd., 011733, Bucharest, Romania, Tel: +40723188988, E-mail: alexandruulici@yahoo.com

2) "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

medico-legal issues is by preventing them” [6].

Medical 3D printing is rapidly expanding its applications, that include tissue and organ fabrication, customized prosthetics, implant, anatomical models and replicas of the area of interest [8, 9], that can help the physician to better understand the pathology, to develop an improved therapeutic plan and last but not least to provide the patient with a superior description of his condition and the treatment options.

Nowadays, with a 3D software and a 3D printer it is possible to convert medical image data (MRI, CT) in 3D models. Doctors can use 3D printed models to recreate patient's injured areas, and to easily explain to the patient their medical status.

METHODS

In order to improve the patient-doctor relationship, doctors have to provide sufficient information to the patient and/or his tutors, concerning the medical condition and the treatment options.

In our department, we produced 3D printed models of scoliotic spines for 5 patients who suffered from severe deformities. In the process of making a 3D printed model we start from analysing a 2D CT image of the spine. First we “extract” the bone geometry from the targeted DICOM files (Digital Imaging and Communication in Medicine) provided by CT, then a graphic pattern based on the geometry of the virtual target is obtained and processed in a specific 3D printing software, setting the model characteristics. In our current practice we used Layer Height 0.25 mm, Wall Thickness 0.80 mm, Fill Density 18%, Speed Print 50 mm/s, Speed Travel 150 mm/s, Speed Infill 85 mm/s. In the last stage of production the processed graphic 3D model is sent to the printer and the printing may begin. In the selected cases of complex deformities, we usually split the printing model into three or four sections, which are assembled secondarily, in order to decrease the production time.

We proceed by showing the printed replica to the patient and the parents, describing the diagnosis, analysing the complexity of the deformity, explaining the alternated anatomy and the aims of the surgical treatment that is needed for the condition. On the 3D model, we could show the curvatures of the spine, the limits of the curvatures, the possible levels of instrumentation, the pedicle screws entry points, a better view of the surgical risks and the undesirable complications that might occur during the surgery. Afterwards, we check their understanding by asking the parents to explain it back, using the 3D model, as seen in Figure 1.

This way, at the phase of signing the informed consent the patients have a wider understanding of their medical condition, of the available treatment possibilities and outcomes and the risks and complications that they might be exposed to, through the surgery.

DISCUSSION

The boundaries of a good doctor-patient communication include patients' fear and anxiety, doctor's responsibility of work, fear of prosecution, concern of verbal or even physical abuse; sadly patients' expectations concerning the treatment and its results are often unrealistic [1].

Several papers have concluded that the predominant reasons that cause patients to file a lawsuit included the desire to keep the bad incident from happening again, the need for an explanation of what happened and why, longing for financial compensation and the wish to hold doctors culpable for their actions. The major motif in these studies' conclusions was a disruption in the patient-doctor relationship, usually manifested as insufficient communication between the two [5].

According to numerous studies there is a correlation between patients' feeling of control and their ability to tolerate pain, rehabilitate from ailments, lower tumour growth and the ability to perform daily activities [1, 10-12].

For improving the doctor-patient relationship, the physician must develop better communication skills through training and introduce a collaborative



Figure 1. A 3D printed replica of a scoliotic spine in an adolescent girl is showed to the mother, while explaining the condition and the required treatment.

communication method involving the 2-way exchange of information between doctor and patient, thus managing or avoiding potential conflicts [1]. In order to obtain this, doctors must find strategies to better explain the medical condition to the patient.

3D printing is a fabrication method, that uses different types of materials, including plastic, metal, ceramics, even living cells layers. The manufacturing method consists in the fusion and depositing of these materials to produce a 3D object [8]. The 3D printer uses two-dimensional (2D) medical image data, such as x-rays, MRI images, CT-scans, that are converted to a digital 3D graphic model, using a specialized software, thus creating customized anatomical structures. Using this product, the health provider and the patient have a palpable customized 3D model, based on the patient's anatomy and medical condition, which might provide a better understanding of the disease [8].

Scoliosis is a complex pathology that associates rotation and lateral deviation of the vertebrae, leading to severe deformation of the spine [13, 14]. In severe cases, the only treatment option is surgical correction with fusion [14]. We used the 3D printed replicas of the spines to better understand the deformity, to make an improved preoperative planning, to determine the instrumentation levels, to choose more appropriate medical implants, screws and rods [15-17] and to better explain the patients and their legal tutors the pathology, the complexity of the spine deformity and the surgical intervention, before obtaining the informed consent.

Using customized 3D printed model for each patient and having a conversation and the explanations needed based on the particularities of the patient's medical condition helps a more efficient communication and a better understanding of the ailment and the treatment's out-comes. Also, this way the patient feels included in

the decision making concerning his health condition and treatment, leading to an improved compliance and satisfaction for the medical act [18, 19].

The informed consent that is needed to be taken before each medical procedure, includes an explanation of the patient's status, the possible treatment choices along with their advantages and disadvantages, the consequences of non treatment, and also the risks and complications of each form of therapy [20]. Each step of the informed consent can be better explained and understood by using a touchable object, by materializing an abstract concept.

CONCLUSIONS

Physicians cannot control all the reasons for patients pursuing legal atonement but they are able to determine the quality of their connection with the them, by improving their communication skills and techniques. Law-suits for medical negligence can be lowered or prevented by taking steps to keep patients content, thus making them more compliant to the treatment, adhering to the medical policies and procedures.

Using customized 3D printed model for each patient and having the conversation and the explanations needed based on the palpable particularities of the patient's medical condition, helps to-wards a more efficient communication and a better understanding of the ailment and the treatment's outcomes, thus reducing patients' insecurities to the medical act, preventing complaints, dissatisfaction and the malpractice accusations.

Conflict of interest. The authors declare that there is no conflict of interest.

References

1. Ha JF, Longnecker N. Doctor-Patient Communication: A Review. *The Ochsner Journal*. 2010;10(1):38-43.
2. Hu W, Song Y, Zhong X, Feng J, Wang P, Huang C. Improving doctor-patient communication: content validity examination of a novel urinary system-simulating physical model. *Patient Prefer Adherence*. 2016;10:2519-2529.
3. Lee SJ, Back AL, Block SD, Stewart SK. Enhancing physician-patient communication. *Hematology Am Soc Hematol Educ Program*. 2002;1:464-483.
4. Brown JB, Boles M, Mullooly JP, Levinson W. Effect of clinician communication skills training on patient satisfaction. A randomized, controlled trial. *Ann Intern Med*. 1999;131(11):822-829.
5. Huntington B, Kuhn N. Communication gaffes: a root cause of malpractice claims. *Proceedings (Baylor University Medical Center)*. 2003;16(2):157-161.
6. Raveesh BN, Nayak RB, Kumbar SF. Preventing medico-legal issues in clinical practice. *Annals of Indian Academy of Neurology*. 2016;19(Suppl 1):S15-S20.
7. Singh S, Mayahi R. Consent in orthopaedic surgery. *Annals of the Royal College of Surgeons of England*. 2004;86(5):339-341.
8. Ventola CL. Medical Applications for 3D Printing: Current and Projected Uses. *Pharmacy and Therapeutics*. 2014;39(10):704-711.
9. Klein GT, Lu Y, Wang MY. 3D printing and neurosurgery—ready for prime time? *World Neurosurg*. 2013;80(3-4):233-235.
10. Roter D. L. Physician/patient communication: transmission of information and patient effects. *Md State Med J*. 1983;32((4)):260-265.
11. Greenfield S, Kaplan S, Ware JE Jr. Expanding patient involvement in care. Effects on patient outcomes. *Ann Intern Med*. 1985;102(4):520-528.
12. Greenfield S, Kaplan SH, Ware JE Jr, Yano EM, Frank HJ. Patients' participation in medical care: effects on blood sugar control and quality of life in diabetes. *J Gen Intern Med*. 1988;3((5)):448-457.

13. Morrissy RT, Weinstein SL. Lovell and Winter's Pediatric Orthopaedics. Philadelphia: Lippincott Williams & Wilkins; 2006: 693–762.
14. Janicki JA, Alman B. Scoliosis: Review of diagnosis and treatment. *Paediatrics & Child Health*. 2007;12(9):771-776.
15. Wang YT, Yang XJ, Yan B, Zeng TH, Qiu YY, Chen SJ. Clinical application of three-dimensional printing in the personalized treatment of complex spinal disorders. *Chinese Journal of Traumatology*. 2016;19(1):31-34.
16. Wu ZX, Huang LY, Sang HX, Ma ZS, Wan SY, Cui G, Lei W. Accuracy and safety assessment of pedicle screw placement using the rapid prototyping technique in severe congenital scoliosis. *J Spinal Disord Tech*. 2011;24(7):444-450.
17. Mao K, Wang Y, Xiao S, Liu Z, Zhang Y, Zhang X, Wang Z, Lu N, Shourong Z, Xifeng Z, Geng C, Baowei L. Clinical application of computer-designed polystyrene models in complex severe spinal deformities: a pilot study. *Eur Spine J*. 2010;19(5):797-802.
18. Jin J, Sklar GE, Min Sen Oh V, Chuen Li S. Factors affecting therapeutic compliance: A review from the patient's perspective. *Therapeutics and Clinical Risk Management*. 2008;4(1):269-286.
19. Elwyn G, Frosch D, Thomson R, Joseph-Williams N, Lloyd A, Kinnersley P, Cording E, Tomson D, Dodd C, Rollnick S, Edwards A, Barry M. Shared Decision Making: A Model for Clinical Practice. *Journal of General Internal Medicine*. 2012;27(10):1361-1367.
20. Satyanarayana Rao KH. Informed Consent: An Ethical Obligation or Legal Compulsion? *Journal of Cutaneous and Aesthetic Surgery*. 2008;1(1):33-35.