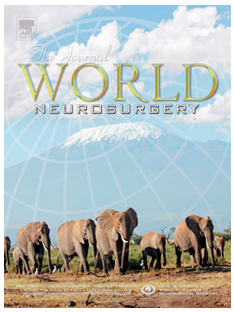
Accepted Manuscript



Review of 3-dimensional Printing On Cranial Neurosurgery Simulation Training

Vejay N. Vakharia, MRCS, Nilesh N. Vakharia, MBBS BSc, Ciaran S. Hill, MRCS MRCP

PII: S1878-8750(15)01735-0

DOI: 10.1016/j.wneu.2015.12.031

Reference: WNEU 3528

To appear in: *World Neurosurgery*

Received Date: 25 August 2015

Revised Date: 7 December 2015

Accepted Date: 8 December 2015

Please cite this article as: Vakharia VN, Vakharia NN, Hill CS, Review of 3-dimensional Printing On Cranial Neurosurgery Simulation Training, *World Neurosurgery* (2016), doi: 10.1016/j.wneu.2015.12.031.

Review of 3-dimensional Printing On Cranial Neurosurgery Simulation Training

Vejay N. Vakharia MRCS, Nilesh N. Vakharia MBBS BSc, Ciaran S. Hill MRCS MRCP

Department of Neurosurgery, Royal London Hospital, Whitechapel Road, Whitechapel, E1 1BB, United Kingdom Tel. +44 (0)20 7377 7000

Abstract

Objective - Shorter working times, reduced operative exposure to complex procedures and increased sub-specialisation have resulted in training constraints within most surgical fields. Simulation has been suggested as a possible means of acquiring new surgical skills without exposing patients to the surgeon's operative 'learning curve'. Here we review the potential impact of 3-dimensional printing on simulation and training within cranial neurosurgery and its implications for the future.

Methods - In accordance with PRISMA guidelines, a comprehensive search of PubMed, OVID MEDLINE, Embase and the Cochrane Database of Systematic Reviews was performed.

Results - In total 31 studies were identified relating to the use of 3-dimensional printing within neurosurgery, of which 16 were specifically related to simulation and training. The main impact of 3-dimensional printing on neurosurgical simulation training was within vascular surgery where patient specific replication of vascular anatomy and pathologies can aid surgeons in operative planning and clip placement for reconstruction of vascular anatomy. Models containing replicas of brain tumours have also been reconstructed and used for training purposes with some providing realistic representations of skin, subcutaneous tissue, bone, dura, normal brain and tumour tissue.

Conclusion - 3-dimensional printing provides a unique means of directly replicating patient specific pathologies. It can identify anatomical variation and provide a medium in which training models can be generated rapidly allowing the trainee and experienced neurosurgeon to practice parts of operations pre-operatively. Future studies are required to validate this technology in comparison with current simulators and show improved patient outcomes.