以虛擬實境技術發展肩關節鏡手術訓練系統之研究

陳彥龍、蔡興國 ; 陳文儉

E-mail: 9800900@mail.dyu.edu.tw

摘 要

肩關節鏡手術（Shoulder Arthroscopy）屬於微創手術（Minimally Invasive Surgery），與傳統開放性手術比較，肩關節鏡手術擁有許多優點，如傷口較小、病人恢復時間短、對病人所造成的負擔較小等。但是和其他手術比較起來，學習肩關節鏡手術具有很大的挑戰，例如，空間感認知問題、入口選擇與關節腔進入問題、肩關節結構問題。然而，這些問題可以藉著互動式多媒體技術所設計的電腦模擬訓練系統來克服。本論文利用虛擬實境技術（Virtual Reality, 一種互動式多媒體技術）發展一套肩關節鏡手術訓練系統，其目的為幫助學醫師在進行臨床手術觀察前，具備足夠的必要知識，並提供使用者一個在訓練上能夠反覆訓練的平台。本研究並使用問卷調查進行系統的功能評估，問卷分析結果顯示，使用者對於操作本訓練系統的接受程度均屬滿意。因此，本系統適合用於訓練肩關節鏡手術醫師，在他們實際進入手術房進行臨床學習前，對於空間認知與肩關節鏡解剖結構了解的學習。

關鍵詞 : 虛擬實境 ; 肩關節鏡手術 ; 數位學習

目錄

參考文獻

[1] J. C. Huang,“ Application on the Design and Control of Cable Controlled 3-DOF Space Haptic Simulator in Virtual Reality, ” Thesis for Master of ScienceDepartment of Mechanical EngineeringTatung University, June 2006.

[2] 愛迪斯應用範例-鏡花水月, http://www.axis3d.com.cn/example/ flower.htm, August 2008.

[3] G.Lajtai, S.J.Snyder, G.R.Applegate, G.Aitzetmuller, & C.Gerber (2003). Shoulder Arthroscopy and MRI Techniques. New York: Springer-Verlag Berlin Heidelerg [4] AstroMate科學儀器網, http://www.astro.com.tw/, June 2008.

[5] 台灣脊椎中心, http://taiwanspinecenter.com.tw/, Jan. 2008.

[6] 上海關節網, http://www.jointshanghai.com/, October 2007.

[7] 華人骨科專業資訊網, http://www.chinese-ortho.com/, April 2008.

[8] 哈鴻潛，高田，台灣解剖百年史，中華民國解剖學學會，2003。

[9] A. Ziv, P. R. Wolpe, S. D. Small, S. Glick, ” Simulation-based medical education: an ethical imperative, ” The Journal of the Society for Simulation in Healthcare, vol.78, no.8, pp.783-788, August 2003.

[10] A. F. Seila,“ Medical education as a model for simulation education, ” Simulation Conference Proceedings Digital Object Identifier, vol. 2 , pp.1624 - 1629 , Dec. 10-13, Winter 2000.

[11] P. Fontelo, M. Ackerman, K. Johansen, E. DiNino, A. Khan, ” Virtual microscopy: potential applications is medical education and telemedicine in countries with developing economies, ” System Sciences 38th Annual Hawaii International Conference, pp.1- 7, 03-06 Jan. 2005.

[12] N. E. Seymour, A. G. Gallagher, S. A. Roman, M. K. O'Brien, V. K Bansal, D. K. Andersen, R. M. Satava, ” Virtual reality training improves operating room performance, ” Annals of Surgery, vol. 236, no. 4, pp.458-464, October 2002.

[13] P. D. Bamidis, M. M. Nikolaidou, S. Th. Konstantinidis, C. Pappas,“ A proposed framework for accreditation of online continuing medical education, ” IEEE International Symposium Computer-Based Medical Systems, CBMS '07, pp.693 - 700, 20-22 June 2007.

[14] E. Kaldoudi, P. Bamidis, M. Papaioakeim, V. Vargemezis,“ Problem-based learnining via web 2.0 technologies, ” IEEE International Symposium on Computer-Based Medical System, pp.391 - 396, 17-19, June 2008.

[15] Medical Readiness Trainer Team, ” An immersive virtual reality platform for medical education: introduction to the medical readiness trainer, ” Annual Hawaii International Conference on System Sciences, pp.8, Jan 4-7 2000.

[16] C. Bratsas, E. Kaimakamis, V. Koutkias, P. D. Bamidis, N. Maglaveras, ” An ontology-based approach to constructing medical

computational problems for use in electronic medical education, ” IEEE International Symposium on Computer-Based Medical Systems, pp.669 – 674, June 2007.
[17] H. K. Muhsin, ” The using of e-learning techniques to improve the medical education, ” Information and Communication Technologies: From Theory to Applications, International Conference on 7-11, pp.1 - 5, April 2008.
[18] M. M. Triola, M. A. Hopkins, M. Phil, M. J. Weiner, W. Holloway, R. I. Levin, T. S. Riles, M. S. Nachbar , ” Surgical interactive multimedia modules: a novel, non-browser based architecture for medical education, ” Computer-Based Medical Systems, (CBMS ’ 4) IEEE Symposium on 24-25, pp.423 – 427, June 2004.
[19] L. Vanda, ” Take into account knowledge constraints for design of TEL environments in medical education, ” IEEE International Conference Advanced Learning Technologies, Eighth IEEE International Conference on 1-5, pp.839 - 841, July 2008.
[20] H. Aoki, C. M. Oman, D. A. Buckland, A. Natapoff, ” Desktop-VR system for preflight 3D navigation training, ” Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, pp.841-847, 21 December, 2008.
[21] J. M. Rosen, H. Soltanian, R. J. Redett, D. R. Laub, “ Evolution of Virtual Reality, ” IEEE engineering in medicine and blology, March/April, 1996.
[22] J. M. Rosen, D. R. Laub, S. D. Pieper, A. M. Mecinski, H. Soltanian, M. A. McKenna, D. Chen, S. L. Delp, J.P. Loan, C. Basdogan, ” Virtual reality and medicine: from training systems to performance machines, ” Proceedings of the 1996 Virtual Reality Annual International Symposium (VRAIS '96), pp.5-8, 1996 [23] R. Ziegler, R. Fischer, W. Muller, M. Gobel, ” Virtual reality arthroscopy training simulator, ” Comput. Biol. Med., vol.25, no.2, pp.193-203, 1995.
[24] B. Reitinger, A. Bornik, R. Beichel, D. Schmalstieg, ” Liver surgery planning using virtual reality, ” Published by the IEEE Computer Society, November/December 2006.
[25] P. A. Heng, C. Y. Cheng, T. T. Wong, Y. Xu, Y. P. Chui, K. M. Chan , S. K. Tso, ” A virtual-reality training system for knee arthroscopic surgery, ” IEEE transaction on information technology in biomedicine, vol.8, no.2, June 2004.
[26] G. Zhang, S. Zhao, Y. Xu, ” A virtual reality based arthroscopic surgery simulator, ” Proceedings of the 2003 IEEE International Conference on Robotics, Intelligent Systems and Signal Processing , Changsha, China - October 2003.
[27] A. Sourin, O. Sourina, H. T. Sen, ” Virtual orthopedic surgery training, ” Lawrence Rosenblum and Michael Macedonia, May/June 2000.
[28] A. Neubauer, S. Wolfsberger, M. T. Forster, L. Mroz, R. Wegenkittl, K. Buhler, ” Advanced virtual endoscopic pituitary surgery, ” IEEE transaction on visualization and computer graphics, vol.11, no.5, September/October 2005.
[29] C. Y. Lo, Y. P. Chao, K. H. Chou, W. Y. Guo, J. L. Su, C. P. Lin, ” DTI-based virtual reality system for neurosurgery, ” Proceedings of the 29th Annual International Conference of the IEEE EMBS Cite Internationale, Lyon, France, pp.1326-1329, August 23-26, 2007.
[30] J. Xia, H. H. S. Ip, N. Samman, H. T. F. Wong, J. Gateno, D. Wang, R. W. K. Yeung, C. S. B. Kot, H. Tidema, “ Three-dimensional virtual-reality surgical planning and soft-tissue prediction for orthognathic surgery, ” IEEE transaction on information technology, vol.5, no.2, June 2001.
[31] J. D. Lee, T. Y. Lan, L. C. Liu, S.T. Lee, C.T. Wu, B. Yang, “ A remote virtual-surgery training and teaching system, ” 2007 IEEE.
[32] V. Vuskovic, M. Kauer, G. Szekely, M. Reidy, “ Realistic force feedback for virtual reality based diagnostic surgery simulators, ” Proceedings of the 2000 IEEE International Conference on Robotics & automation, pp.1592-1598, Changsha China - October 2003.
[33] R. McColl, I. Brown, C. Seligman, F. Lim, A. Alsaraira, “ Haptic rendering & perception studies for laparoscopic surgery simulation, ” Proceedings of the 28th IEEE International Conference, USA, pp.833-936, Aug.30-Sept.3, 2006.
[34] S. Bayonat, M. Garciat, C. Mendozat, M. Ferniindezt, “ Shoulder arthroscopy training system with force feedback, ” Proceedings of the International Conference on Medical Information Visualisation—BioMedical Visualisation (MediVis'06), 2006.
[35] P. Dario, M. M. Carrozza, M. Marcacci, S. D ’ Attanasio, B. Magnami, O. Tonet, G. Megali, ” A novel mechatronic tool for computer-assisted arthroscopy, ” IEEE transactions on information technology in biomedicine, vol.4, no.1, pp.15-29, March 2000.
[36] Z. Du, M. Wang, M. Kong, L. Sun, ” Virtual reality-based teleoperator of robot-assistant setting-bone surgery, ” Proceedings of the 2006 IEEE International Conference on Mechatronics and Automation, Luoyang, China , June 25 - 28, 2006.
[37] Z. Du, Z. Jia, K. Minxul, ” Virtual reality-based telesurgery via teleprogramming scheme combined with semi-autonomous control, ” Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference Shanghai, China, September 1-4, 2005 [38] J. Funda, R. H. Taylor, S. Gomory, K. G. Gruben, ” Constrained cartesian motion control for teleoperated surgical robots, ” IEEE transaction on robotics and automation, vol.12 , no.3, pp.453-465, June 1996.
[39] U. Kuhnapfel, H. K. Cakmak and H. Maas, ” Endoscopic surgery training using virtual reality and deformable tissue simulation, ” Computers & Graphics, vol.24, pp.671-682, 2000.
[40] B. Panchaphongsaphak, R. Burgkart, R. Riener, ” Three-dimensional touch interface for medical education, ” IEEE Transactions Information Technology in Biomedicine, vol.11, no.3, pp.251 – 263, May 2007 .
[41] A. N. Khalid, W. B. Murray, ” Simulation of the airway, ” Operative Techniques in Otolaryngology, vol.18, pp.134-139, 2007.
[42] R. Riener, M. Frey, T. Proll, F. Regenfelder, R. Burgkart, ” Phantom-based multimodal interactions for medical education and training: the munich knee joint simulator, ” IEEE Transactions Information Technology in Biomedicine, vol.8, no.2, pp.208 – 216, June 2004.