INSERTION ANGLE TEACHING FOR AN ACUPUNCTURE TRAINING SYSTEM

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Abstract: We are developing an acupuncture training system using virtual reality (VR) technology for teaching of oriental medical techniques. In this paper, special attention was paid in the insertion angle which is one of the most important actions in acupuncture. The training system and related teaching method were proposed for insertion angle training. The proposed system was evaluated with experiments, and the results were proved effective.

1 INTRODUCTION

Acupuncture among the traditional oriental medical treatments has the merit of high efficiency with almost no harmful side-effects. The effectiveness of it has been re-realized in recent years, and promotions of its use are also carried on worldwide. (Shirota, F., 2002, Textbook executive committee, 1992, Sugiyama, I., 2003).

To carry out acupuncture treatment, it is necessary in sequence to find the correct position (acupoint), to put a needle on it, and to insert the needle with proper angle. However, it has been difficult to learn the technique because that the acupoint was practically invisible, and in the acupuncture teaching text the points were figured out on a human body with only a flat 2D description while a correct insertion require 3D information containing the depth and insertion angle.

A training system using the advanced VR technology has been proposed to solve the above problems (Chen, L., 2005). The system is with a 3D acupoint human body model upon which the teaching of the 3D position of acu-points and a true-false judgment of them can be done real-timely (Kanehira, R., Shoda, A., Yagihashi, M., Narita, H., Fujimoto, H., 2008).

As one more advance to the training system, this paper studied the training method for the insertion angle upon a produced acupoint model of the human head. The correct position and insertion angle of an acupoint were provided so quantitative training becomes possible. Experiments were done to evaluate the system, and the effectiveness of the training system for a beginner to learn acupuncture was proved using the true-false judgment upon quantitative information.

2 INSERTION ANGLE

Acupuncture starts from the searching for the correct position of an acupoint and then inserting a needle. If the insertion angle cannot be taken precisely, it is difficult to obtain the expected healing effect even on a correct acupoint position. That is, the insertion angle is as important as the position itself (Mori, H., 1971).

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Insertion angles can be roughly divided into 3 types shown in Figure 1. A plumb insertion (90°) is used on positions with thicker muscle or fat such as the legs or arms. An oblique insertion (45°) is used on human body with thinner muscle such as the bent parts or the face or spine. And a subcutaneous insertion (15°) is used on parts with bones directly under the skin Yamashita, M., 2003). It can be seen that the smaller the angle is, the difficult the insertion becomes.

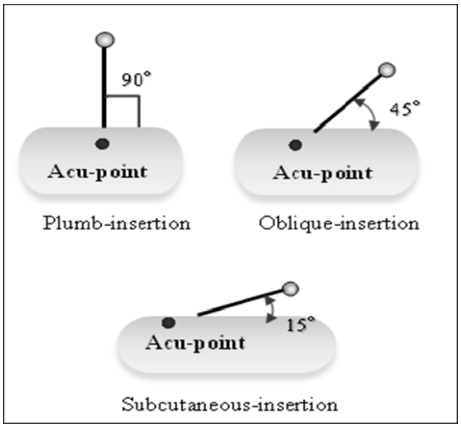


Figure 1: Insertion angle.

There are many important acu-points around the human head and neck. In this area, an oblique insertion is required, followed by a subcutaneous insertion to the acu-points (Mori, H., 1981). Therefore, a human head-neck model was chosen for this study.

Conventional training for insertion angle in acupuncture has been carried on using such methods as to insert on a fruit or a gauze ball, or on student's body of each other. In such a situation, the insertion technique can only be learnt by sense with trial and error while looking over the teacher's performance. In addition, the human body is not a flat one, and it is difficult to measure correctly the insertion angle on face or spine having concavo-convex. Furthermore, a true or false judgment on student's trial is based on experience and personal senses with variety. Thus, the proposed training system for insertion angle is expected effective in practice.

3 THE TRAINING SYSTEM

3.1 Construction of the System

The system utilizes VR technology for insertion angle training, which should be with high presence and real timely. A human body model of acupoint was firstly constructed on a computer. The trainee moves the virtual needle connected with the training device, to study the insertion angle according to information provided on the computer. Figure 2 shows the system construction.

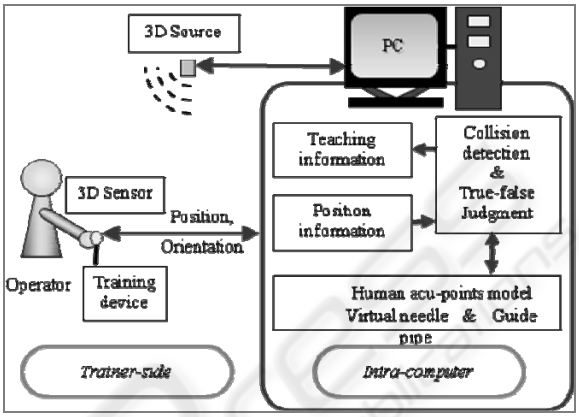


Figure 2: Configuration of the system.

3.2 Head Acupoint Model

As stated earlier, a human head-neck model was chosen for training. A head acupoint model represented was made within a computer, and its surface was attached with skin images by texture mapping method to get the most reality. Because the position is changeable according to the position and movement of a patient, the head model was also made to be able to move freely. While the acu-points in a conventional text can only be 2D-represented, our model is with a 3D representation so an acupoint can be seen even under the skin.

3.3 Teaching the Insertion Angle

A teaching method for insertion angle was proposed. A virtual needle connecting to the training device was produced and the acupoint was colored in red for an easier looking. A pipe to guide the insertion angle was then constructed. The guide pipe was put over the skin surface with the far end to act as the insert position called the insertion point. Figure 3 shows the relationship among the acupoint, the guide pipe and the insertion point.

Figure 4 shows the training device. It was equipped with a 3D sensor. When a hand is holding and moving the device, a virtual needle (Figure. 5) appears on screen of the computer, moved in correspondence.

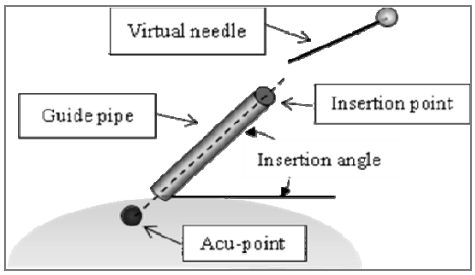


Figure 3: Relationship among the acu-point, guide pipe and insertion point.

Figure 4: Training device.

Figure 5: Virtual needle.

The judgment on true or false of an insertion angle was done according to the contact relationship among the tip of needle, the insertion point and the acupoint model. A 2-step process is required for the judgment. That is, a judgment on whether the virtual needle has been inserted into the insertion point is made first, and a blue circle is presented for a done insertion (Figure 6). The 2nd judgment on whether the insertion is with a correct angle is made sequentially. A successful insertion with correct angle is represented with double red circles (Figure 7), while an insertion with incorrect angle is with a red crisscross (Figure 8).

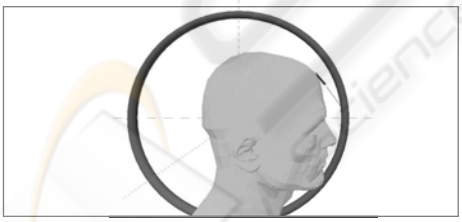


Figure 6: A successful entry to the insertion point.

Figure 7: A successful entry with right angle.

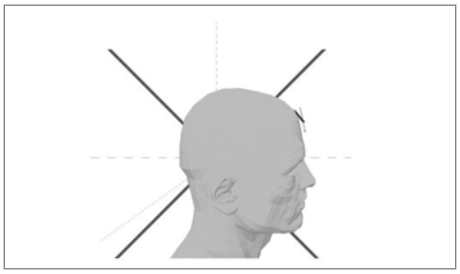


Figure 8: An entry with false angle.

4 EVALUATION TO THE SYSTEM

4.1 Experiment

Evaluation of the system, as an initial step of effect evaluation, was done by operating/dialogizing method by questionnaire over 6 persons (2 males and 4 females of the 20th) on operating of plumb insertion (90°), oblique insertion (45°), subcutaneous insertion (15°), respectively.

4.2 Method

Experiment was done as the following.

1) Starting from plumb insertion, operating when the guide pipe was represented.
2) Plumb insertion operating without the guide pipe representation.
3) The same as above for oblique insertion and subcutaneous insertion operating.
4) Questionnaire to the trainee on plumb insertion, oblique insertion and subcutaneous insertion, respectively.

Questionnaire questions are listed as Table 1.

Table 1: Questions for questionnaire.

No.	Questions
1	Is operation easy?
2	Remember the insertion angle?
3	Keep the insertion angle?
4	An insertion with the guide map?
5	An insertion without guide map?

4.3 Evaluation

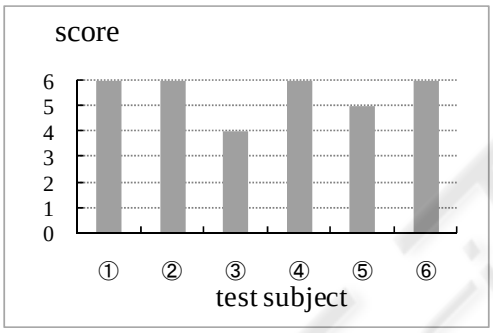
The SD method is used in evaluation (Nagamachi, M., 1989). The SD method is one to analyze/evaluate the psychological image using words of sensitivity. A 7 levels of sensitivity with

words “very good”, “good”, “so-so”, “yes and no”, “not so bad”, “bad”, “too bad” and point from 6 to 0 were used in evaluation.

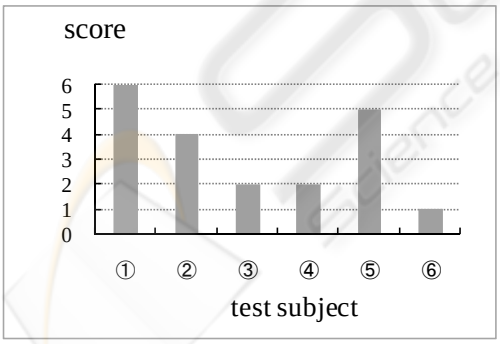
4.4 Results and Discussion

The results were summarized and compared for each insertion angle. It is seen that higher scores were got with plumb insertion and oblique insertion than subcutaneous insertion, indicating the former two are relatively easier to learn. Lower scores were obtained for subcutaneous insertion, because the latter is more difficult due to the very small insertion angle.

The results are further divided according to answers to questions 4 and 5 over 6 persons, with and without the use of a guide pipe. The use of a guide pipe results in higher scores in all insertion angles (90°) (45°) and (15°). The result of the subcutaneous insertion (15°) is shown in Figure 9.



(a) with guide pipe



(b) without guide pipe

Figure 9: Results of experiment (15°).

It is evident by comparing (a) and (b) in Figures 9 that higher scores are obtained with the use of guide pipe particularly for subcutaneous insertion. It can be said that the use of guide pipe is much helpful for an insertion with right angle. Further, lower scores appear for the difficult operation of subcutaneous insertion so progress should be made for an improvement of training effectiveness in subcutaneous insertion.

5 CONCLUSIONS

A training system using VR technology was presented for teaching the insertion angle in acupuncture. A training environment having a 3D head model with high presence and real-time response was constructed within a computer. A guide pipe was presented for a real-time true-false judgment on the insertion angle. The system was evaluated by operators using the method of questionnaire, and the improvement on training of insertion angle was confirmed.

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