Short Communication

Head to Neck Task Trainer to Teach Palpation Skills: Back to Basic

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ABSTRACT

Background: Head and neck palpation is an essential skill for medicine, nursing and allied health professionals. Palpation is a complex task to teach. A task trainer with haptic interfaces could be a viable strategy to teach head and neck palpation.

Purpose: To describe the innovative development and reflect on the preliminary evaluation of a soft skin partial task trainer with haptic interfaces (prototype-1) to teach head and neck palpation skills.

Method: Guided by iterative modeling design and in partnership with engineers and simulation technologist specialist we (nursing and denture school) develop a prototype-1 task trainer. We then evaluated the prototype-1 with experienced clinicians during a multidisciplinary conference using diverse data collections methods.

Result: Overall, the skin and anatomy of prototype-1 was realistic. However, participants (n-11) used diverse palpation techniques in terms of time hand movement and pressure. In fact, there were differences between and among disciplines.

Conclusion: Instead of focusing on the next prototype abilities to capture accurate palpation standardized measure we might focus on enhancing students' experience in palpating different size masses. We will further discuss clinical, pedagogical and ethical implications related to the value of learning palpation skills even though new technologies, such as ultrasound are being used more frequently.

Keywords

Partial Task trainer; Palpation skills; Distal and Proximal care

Introduction

Palpation techniques of the head and neck are an integral part of the physical examination process taught in health assessment courses in nursing, medical and dental programs. Palpation applies to the practitioner's sense of touch to examine the presence of masses argued that palpation techniques cannot be taught through reading and memorizing but require a hands on approach to help build the learner's perception action loops [1-5].

Recently, there has been an increased attempt to teach palpation techniques using task trainers (breast, pelvic and neck exams) with haptic interfaces that enable the training and transfer of physical examination skills to the real world [6-13].

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A haptic sensor input can be a force or pressure over an area, such as, on a task trainer, and the output is the voltage level corresponding to that force or pressure. Our simulation technologist and engineering students developed this inexpensive and soft skin, head and neck haptic task trainer (prototype-1) to teach palpation skills.

The primary purpose of this paper is to describe the design of the prototype-1, as well as, the first iteration of evaluation outcomes received from the expert practitioners in the healthcare. Their feedback will inform the changes to be made to the prototype 1. We will further discuss clinical, pedagogical and ethical implications related to the value of learning palpation techniques even though new technologies, such as ultrasound are being used more frequently.

Method

To build the prototype-1 of the head and neck task trainer, we used a paper template to approximate the skull size and the locations of needed sensors. An iterative design model (Appendix A) was used to focus on "what's important" [14]. The notion of "what's important" helped identify the most salient features and outcomes that are required of the prototype-1 to teach good palpation techniques (e.g., pressure, hands movement, time, mass identification) [15].

In collaboration with the simulation technologist, we utilized skull radiographs for the design of the pseudo-skull and skin. The pseudo-skull included the trachea electronics and the muscle masses of the neck and supraclavicular areas. It was made from an epoxy/fiberglass composite which is strong, light, and can be easily drilled and machined for installing a wide variety of sensors. The posterior side was left open so that the sensors and other could be easily accessed and maintained. Since most currently available commercial models are made of hard plastics, we endeavored to create a prototype that is custom -built and in particular, features a soft skin to provide a more natural feel during palpation. The skin was also designed to hold the hardware while maintaining a realistic anatomy. The skin which was fitted over the skull was made from soft platinum-cure silicone. A realistic head and neck prototype-1 was required as palpation involves bilateral comparison for the presence of masses. Next, the engineering students wired five thin sensors in the submandibular area of the head and neck prototype-1. We conducted a scoping review to understand what we know about the teaching and practices of palpation. As well in collaboration with expert faculty, we determined the skills required in head and neck palpation (e.g., pressure, hands movement, time, mass identification).

Data Collection

During a Multidisciplinary (e.g., Nursing and Medical practitioners) conference in the Spring of 2017, expert feedback on the use of prototype-1 was obtained. Experts were clinicians with at least two years of experience and who approached our conference table voluntarily. We asked them to complete a demographic questionnaire including disciplinary affiliation and years of clinical experience in palpating. We then asked them to palpate prototype-1 and briefly describe their positive and negative experiences and their suggestions for change. The experts were informed that "This is a 50-year-old man with a palpable mass in the head and neck region for 10 days, write your assessment report"? (Appendix B for experts' feedback). We recorded the experts' hand movement during their palpation of the head and neck task trainer. Our goal was to use the pressures registered by the sensors, the recorded hand movements and the experts' feedback to improve our prototype-1 and better understand the palpation technique.

Results

Thirty individuals approached our table but only 11 met eligibility criteria. Participants were from diverse healthcare disciplines and the majority were satisfied with the prototype-1. The majority of practitioners (n=13) were excluded as they were not performing palpation, but relying more on ultrasound. The five sensors located in the submandibular area turned on a green light when the practitioners' manual pressure reached 100; The output from prototype-1 was not in conventional units of measure, rather it was an internal pressure that the sensor indicates.

To ensure that the Prototype-1 skin is of appropriate thickness and that the sensors were not mistaken for masses, participants were asked to actively search for masses on prototype-1. Most, did not find any palpable masses, indicating that it is unlikely that the sensors would be mistaken for pathologic masses. Three of the eleven participants mistook the superior orbital bridge, the posterior mandibular angle, and the skin anterior to the axillary sinus to feel mass-like or swollen respectively.

We believe that the palpation outcomes assessed on the prototype-1 (pressure, time, hand movement, identify mass) will assist us in providing feedback for prototype-2. Other evaluative findings were that a Pressure of 25-300 was exerted on the skin with an average of 55. The recordings also revealed that experts used different hand movements. Most (n=8) used both hands simultaneously and bilaterally. The practitioners' assessment time to rule out that there was no mass ranged between 3-22 minutes. Most practitioners (n=6) walked behind the prototype 1 while palpating. Some (n=6) experts suggested constructing a model able to flex and turn. Some (n=2) suggested constructing a model that is able to open and close its mouth, as this movement is believed to allow better detection of certain masses. There was also a suggestion to use better algorithms to display the data in a meaningful form.

Discussion

It is very common to train clinicians using haptic-enabled task trainers as it improves palpation performance in a safe environment [9]. While there are commercially available haptic task trainers for the rectal and breast examination, they remain prohibitively costly and none exist for the head and neck. Thus, development of a low cost head and neck trainer would fill an important gap in this area of medical education.

The majority of our participants did not locate the sensors in the submandibular area and this is ideal because it may cause confusion, and appear to be a mass. An otolaryngologist praised the value of the prototype-1 to teach how to practice small mass identification. He explained that parotid mass and supraclavicular masses are often missed and family physicians should be further trained in palpation techniques of the head and neck with haptic task trainers. All participants agreed that the haptic task trainer was safe and provided a better teaching tool than students practicing on each other.

Moving forward, one significant challenge in designing the prototype-2 will be in reaching consensus for what constitutes the gold standard for head and neck palpation. There seems to be no single ideal way to palpate the head and neck. While some dentists and an otolaryngologist valued the flexion of the head during palpation, two pediatricians and two ICU nurses did not. In fact, a review of the literature reveals that palpation can be taught and/or performed differently, between and even within each discipline [16]. To complicate matters further, neither the degree of expertise nor the clinician's confidence predicted higher accuracy in palpation [2]. Moreover, reliability for any given technique may also be low [11,17,18]. For example, Xu [11] found that the size of the mass (> 2mm) rather experience was correlated to successfully locating a mass. Some advocated for further performance standards and additional investigation of the relationship between hands-on performance and rate of accuracy during a clinical assessment [9,19].

Currently, there is a shift to using more ultrasound approaches which are more accessible, safe and accurate than relying on manual palpation [2,20,21], an emergency physician, argued that this shift can be costly and compromise patient's quality care because if clinicians can do good assessment not everyone will need ultrasound. Replacing palpation with ultrasound approaches might also mean abandoning the teaching of palpation skills in our curriculum. Malone [22] named this "distal nursing" [21,23] and linked it to ethics. She argued that the physical exam are opportunities to be with our patients [22-24] and abandoning it may impact on patient's outcomes, but also our moral decision making, as we care less for patients in a proximal way.

We want to advocate shifting the focus of prototype-2 from developing an accurate standardized measurement (time, hand movement, pressure) to enhancing the students' experience. This iterative design model could allow us to create a task trainer that focuses on students' palpation experiences with various size masses. After students acquire these tactile skills, other elements around palpation skills can be introduced such as better relating to patients, taking an appropriate health history and considering the context within the physical exam.

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