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ORIGINAL RESEARCH

Evaluation of a Simulation Training Program for Uncomplicated Fishhook Removal

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Objective.—The aim of this study was to evaluate the effectiveness of a fishhook removal simulation workshop using investigator-developed diagrams, practice models, and a teaching video.

Methods.—This was a descriptive, prospective educational study with Institutional Review Board approval. The primary outcomes were the learner's perception of ease of learning, performance ability, and amount of tissue damage for each technique. A 2¾-minute educational video, instructional visual diagrams, and a simulated model were created to teach 4 techniques: simple retrograde, string pull, advance and cut, and needle cover. Learners performed each technique on a model to assess whether they could remove the hook on the first attempt for each technique. They then rank ordered their technique preferences for ease of learning, performance, perceived tissue damage, and overall choice.

Results.—Of a total of 34 participants who completed the study, 71% of learners were emergency medicine residents or faculty, 65% were male, 42% were recreational fishers, and 68% had previous fishhook removal experience. On first attempt, more than 88% of participants demonstrated successful fishhook removal using all techniques except needle cover (47%). Simple retrograde was rated easiest to learn (74%) and perform (59%), was perceived to cause the least tissue damage (44%), and was the overall preferred technique. Needle cover was ranked hardest to learn (88%) and perform (82%), was perceived to cause the worst tissue damage (41%), and was the overall least preferred technique.

Conclusions.—This study is the first to describe a simulation training program for uncomplicated fishhook removal, and to experimentally evaluate physician learning and preferences for fishhook removal techniques. After a brief educational session, physicians could effectively use all techniques except needle cover. Simple retrograde was the overall preferred technique.

Key words: fishhook removal, simulation, emergency medicine, residents, education, simulation training

Introduction

The purpose of this study was to develop, implement, and evaluate the instructional effectiveness of a simulation workshop for uncomplicated single-barb fishhook removal. The authors developed visual diagrams and a video demonstration that were shown to participants, followed by an immediate hands-on opportunity to try to remove an embedded fishhook from an investigator-developed simulation model on the first attempt for each of 4 removal techniques.

This study was designed to offer evidence-based practice tips for uncomplicated removal of single-barbed fishhooks that could be used to train emergency medical personal for use in the field or clinical setting.

BACKGROUND

Recreational fishing is a very popular sport worldwide. In 2012, 47 million Americans, or 16.4% of all Americans over 6 years of age, participated in fishing.[1] Fishing participants made 1 billion annual outings, with an average of 21.3 days spent fishing per participant annually. The eastern north-central area of the United States, which includes Ohio, Michigan, Indiana, Illinois, and Wisconsin, has the second largest number of fishing participants (15.6%), exceeded only by the South Atlantic region (19%).[1] Freshwater fishing is most common at 39.1 million participants, followed by saltwater fishing (12 million) and fly fishing (6.0 million).[1] There is no

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information on the incidence of fishhook injuries, but experience and anecdote suggest they may be common. It is unknown what percentage of fishhook injuries present to the emergency department or other healthcare facilities and how many injuries are self-treated in the field.

Our institution is located in northwest Ohio near Lake Erie, where walleye fishing is a year-round hobby. The winter provides numerous opportunities for ice fishing, and with early spring comes walleye spawning. Numerous national professional and amateur fishing tournaments are scheduled throughout the summer and fall. Consequently, fishhook injuries are frequently seen in area emergency departments.

There is a paucity of literature related to research studies determining the best technique for routine fishhook removal. The majority of articles located were case reports, which primarily described management of eye injuries in adults or oropharyngeal/hypopharyngeal injuries in children who ingested fishhooks.[2–7] Review articles by Thommasen and Thommasen[8] and Prats et al[7] describe use of the same 5 techniques: simple retrograde, string-pull, advance and cut, needle cover, and cut it out. Similarly, Gammons and Jackson[9] suggested simple retrograde, string-pull, advance and cut, or needle cover for family physicians to use in the office setting. A letter to the editor[10] describes use of an advance and cut technique using needle holders to cut off the barb and then withdrawing the barbless hook retrograde, whereas another practice tip article advocates the string pull technique.[11] Another letter to the editor[12] describes the use of orthopedic pin cutters to separate treble hooks into single hooks when 2 or 3 barbs are simultaneously imbedded; other instruments such as ring cutters, pliers, or trauma scissors are not heavy enough to cut through nickel-plated bases on treble hooks.

The single prospective study specific to evaluating various techniques for fishhook removal was conducted in Alaska in 1990.[13] Of 100 subjects who incurred a fishhook injury, 97 were able to be treated in the emergency setting, with 3 requiring operative care. Of the 97 fishhooks, 82 were salmon hooks, which are larger than most of the recreational fishhooks used in other parts of the United States; 2 of the hooks were for halibut fishing and can cause serious injury owing to their large size; and the remaining 13 were trout hooks. Of the 97 fishhook removals done in the emergency room, successful removal occurred with simple retrograde (17), needle cover (7), string-pull (17) or advance and cut (56). Forty-seven fishhooks were in the hand, 32 in the face, 9 in the scalp, 8 in the forearms, and 1 in the leg. None was on the trunk or neck. Local or digital anesthetics were used at the physician's discretion before removal for all but 2 patients.[13]

A retrospective study looked at all-cause penetrating injuries that were treated in the emergency department over a 2-year period.[14] Of a total of 300 injuries, 33 were related to fishing. The study investigators recommended the use of appropriate imaging modalities if needed to be fully aware of the location, the contours, and the complexity of the fishhook when planning extraction. With a single operative exception, all fishing injuries were treated in the emergency room using local anesthesia. The article did not describe the injuries by location, type of hook, size of hook, or removal technique, so it is unclear whether local anesthesia was indicated for all of the fishhook removals.[14]

We were unable to find any studies on the number of fishhooks removed on the first attempt, the average number of attempts needed to remove a fishhook using each of the various techniques, or preferences related to specific techniques due to their ease in learning, ease in performing, or the amount of tissue damage. Little is known about removal practices outside the emergency department. Given that most embedded fishhook wounds are small and can be treated in the field, it is estimated that the majority of these injuries never present to the hospital for treatment unless they are particularly deeply embedded, embedded in a complicated or sensitive part of the anatomy, or infected. We were unable to locate any studies related to fishhook removal in the field or home setting.

There are several recreational fishing media resources that provide a wide range of information on fishing but did not specifically address fishhook injuries.[15] Also readily available are "how to" instruction sheets complete with diagrams from sites such as British Columbia HealthLink[16] and WebMD[17] that describe how to treat fishhook injuries at home. Of greater interest, and sometimes greater amusement, are the amateur videos made and posted on the popular Internet site YouTube[18] that demonstrate fish hook removal in the field and in the emergency department with varying degrees of success and sobriety.

Our intent was to develop and eventually distribute concise, practical, and accurate information sources for uncomplicated fishhook removal that could be safely used in the field. If first responders can be taught basic removal techniques for embedded fishhooks that do not require diagnostic imaging or local anesthesia, knowing the correct technique could save patients time and money by not having to go to the emergency department. The literature does not describe any method for training physicians in fishhook removal, nor does any article describe the use of a simulated laboratory setting to teach and evaluate fishhook removal.

FISHHOOK DESIGN

Most fishhook injuries are penetrating injuries involving small hooks. The basic parts of a fishhook are the eye, shank, bend, barb, and point (Figure 1). Recreational fishhooks may be barbless hooks or may have a varying number of barbs, ranging from a single barbed hook to a treble hook with 3 separate barbed hooks (Figure 2). This study was designed for removal of a single barbed hook only, as an embedded treble hook would be considerably more difficult to remove. Commercial and deep-sea fishing require a variety of devices that will also not be discussed here.

COMMON REMOVAL TECHNIQUES

Five common techniques—simple retrograde, string-pull, advance and cut, needle cover, and cut it out—are suggested for removing an embedded fishhook. Our study included all techniques except cut it out, which is more invasive and would generally not be attempted in a field or a home setting. For an overview of the techniques used in this study, please view the online supplementary teaching video.

Simple Retrograde

Pliers are used to grab the curved part of the hook. Next, downward pressure is applied with the pliers so that the eye of the hook is closer to the skin. In one quick motion, the hook is pulled out in a direction that is parallel with the shank.

String-Pull

A string is wrapped around the curved portion of the hook. The barb is then disengaged by applying direct downward pressure to the shank of the hook. In one quick motion, the string is pulled while keeping downward pressure on the shank.

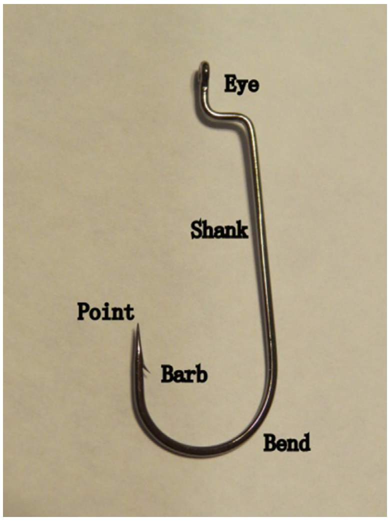

Figure 1. Parts of a fishhook.

Figure 2. Single and treble fishhooks.

Advance and Cut

Pliers are used to advance the point of the hook through the skin so that the barb is showing. Then, wire cutters are used to cut the barb, and the remainder of the hook is removed from the skin.

Needle Cover

An 18G needle is advanced through the skin with the bevel facing down until it is over the barb of the hook. The hook is then slowly removed with the needle remaining over the barb so that the barb does not contact skin as it is pulled out.

CUT IT OUT

Using a scalpel, an incision is made in the skin over the site of the embedded barb. The incision is made down to the barb, and the hook is lifted out of the skin through the incision.

EDUCATIONAL RATIONALE

The Learning Pyramid is a well-known instructional technique frequently used to improve learning retention.[19] It is thought that reading alone produces an average retention rate of 10%, whereas a demonstration increases retention to 30%, and actual hands-on experience improves learning retention to 75%. Our simulation workshop combined reading and demonstration with hands-on experience (Figure 3). Using this progressive instructional format, we wanted to investigate whether healthcare learners could remove a fishhook on the first attempt for each of the 4 techniques.

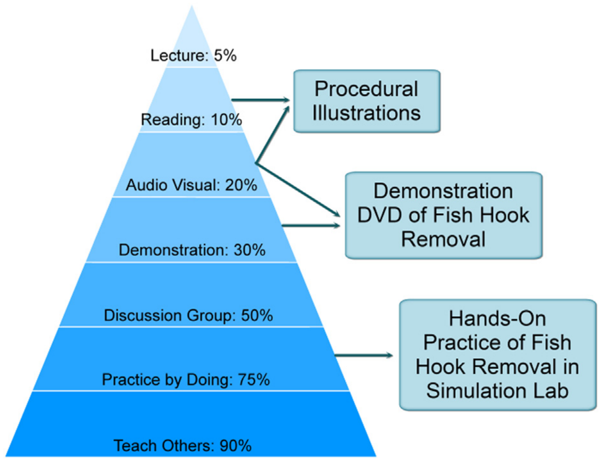

Figure 3. Correlation of simulation workshop to Learning Pyramid instructional techniques. Lab, laboratory.

OBJECTIVES

The objectives of this study were as follows: 1) to provide instructional workshops using investigator-developed visual diagrams and video demonstration followed by the opportunity to remove uncomplicated embedded fishhooks, using each of the 4 techniques, from an investigator-developed simulation model; 2) to evaluate success rate of removing an embedded fishhook on the first attempt for each of the 4 techniques; 3) to evaluate learner preference for each of the 4 techniques for ease of learning; 4) to evaluate learner preference for each of the 4 techniques for ease of performing; and 5) to evaluate each of the 4 techniques for learner perception of the technique causing the least amount of tissue damage.

Methods

Institutional Review Board approval was obtained. The design was a prospective, descriptive, educational study utilizing simulation. We used a convenience sample of residents, faculty, and medical personnel associated with a single institution's emergency medicine residency program. All workshops were held in an on-site educational classroom. No power analysis was done, and there was no randomization of subjects. All participants received the same educational content and simulation opportunities.

The primary outcome measure was the effectiveness of the educational materials and the simulated model for learning uncomplicated single-barb fishhook removal as evidenced by responses to a survey. Participants reported their ability to remove the fishhook on the first attempt for each of the 4 techniques; they also reported ease of learning the techniques, ease of performing the techniques, technique causing the least amount of tissue damage, and overall preferred technique.

All educational materials were developed by the investigators and included visual diagrams with pictorial and written instructions for removing fishhooks using each of the techniques, a video demonstrating each of the 4 techniques, and a portable, inexpensive simulation model for embedding and removing fishhooks. Each learner attended a single workshop where they were provided the visual diagrams and the 3-minute video describing each of the 4 techniques. Learners were then given the latex model with embedded fishhooks and were asked to remove fishhooks using simple retrograde, string-pull, needle cover, and advance and cut techniques.

Success at the first attempt at removal was recorded, but participants were allowed multiple attempts to improve learning retention and skill technique. Each participant completed an evaluation form immediately after the session. A rank order scale was used to list the techniques they found easiest to learn and perform, which caused the least tissue damage, their overall preferred technique, and which technique they would most likely use for a fishhook to the face versus an extremity.

Data analysis was limited to frequency counts, percentages, and modes.

Results

A total of 34 participants completed the study. Basic demographic characteristics indicated that 71% of learners were emergency medicine residents or faculty, 65% were male, 42% were recreational fishers, and 68% had previous fishhook removal experience.

Relative to fishhook removal on the first attempt, 88% to 94% of participants reported that they were successful using all techniques except needle cover (47%). Simple retrograde was rated easiest to learn (by 74% of participants), easiest to perform (59%), and caused the least tissue damage (44%). Needle cover was ranked hardest to learn (88%), hardest to perform (82%), and caused the most tissue damage (41%). The overall preferred technique was simple retrograde (41%), and needle cover was the least preferred (65%) (Tables 1–3).

This study required intensive time and effort to develop the educational materials for the workshop: visual diagrams, an instructional video, and an inexpensive practice model that could be easily transported and stored. (The development and use of these materials

Table 1. Participant demographics (n = 34)

Demographics	*Frequency (%)*
Residency program	
Emergency medicine	24 (71)
Other	10 (29)
Training level	
Postgraduate year 1	9 (26)
Postgraduate year 2	4 (12)
Postgraduate year 3	10 (29)
Faculty	6 (18)
None of the above	5 (15)
Sex	
Male	20 (65)
Female	11 (35)
Missing data	3
Recreational fisher	14 (42)
Previous experience fishhook removal	23 (68)

is described in the Discussion.) Workshop results indicate that healthcare professionals had little difficulty with the majority of techniques. Educational time was minimal, easily fitting into a 45-minute didactic spot for resident education. Each of the educational materials was easily integrated into the workshop. Participants were able to review the visual diagrams and watch the teaching video within 5 minutes and spend the majority of time practicing with the model, reinforcing and improving their technical skills, as described in the Learning Pyramid model. We did not evaluate learner perception regarding the realism of the model during the study, but anecdotally, participants with prior fishhook removal experience on humans stated the model provided a comparative experience.

Discussion

Our primary obstacle in beginning the project was to find an inexpensive, realistic, and easily transportable simulation model for the study. Our initial attempts and educational materials were done using life-size robotic simulation models that were due for “new skins.” These provided the most realistic look and feel, but were impractical for workshops owing to their cost, size, and weight. We then experimented with several types of bovine parts, but they did not have a realistic feel for skin resistance during removal, and their use in an educational workshop relative to ethnic and religious beliefs of learners limited this option.

The investigators then worked with our simulation laboratory coordinator to develop a model consisting of a piece of polyvinylchloride pipe wrapped with an insulated foam pipe cover. The foam was covered with a 1.5-mm layer of latex secured around the insulation with staples. The fishhooks were then embedded in the latex. However, because of the risk of latex allergies, the latest version has been designed with a nonlatex resistance band commonly used by physical therapists (Figure 4). The approximate cost for this model, including 25 fishhooks, was $10. The pipe provides needed weight, strength, and resistance for the model while the insulation and latex coating provided durable padding and some movement. Variations to model construction include not wrapping the insulation completely around the pipe, leaving a nonrolling base. Purchasing foam

Table 2. Self-reported success for first attempt fishhook removal (n = 34)

Fishhook removal technique	*Frequency (%)*
Simple retrograde	32 (94)
String-pull	30 (88)
Needle cover	16 (47)
Advance and cut	30 (88)

Table 3. Rank order of fishhook removal techniques (n = 34)

Rank order	*Mode and rank chosen by most learners*
Easiest to learn	
Simple retrograde	1—Easiest; 74% of learners ranked this technique no. 1
String-pull	2—Tie
Needle cover	4—Hardest; 88% of learners ranked this technique no. 4
Advance and cut	2—Tie
Easiest to perform	
Simple retrograde	1—Easiest; 59% ranked this technique no. 1
String-pull	2
Needle cover	4—Hardest; 82% ranked this technique no. 4
Advance and cut	3
Least tissue damage	
Simple retrograde	1—Least damage; 44% ranked this technique no. 1
String-pull	2
Needle cover	4–Most damage; 41% ranked this technique no. 4
Advance and cut	3
Overall preference	
Simple retrograde	1—41% ranked this technique no. 1
String-pull	2
Needle cover	4—Least preferred; 65% ranked this no. 4
Advance and cut	3

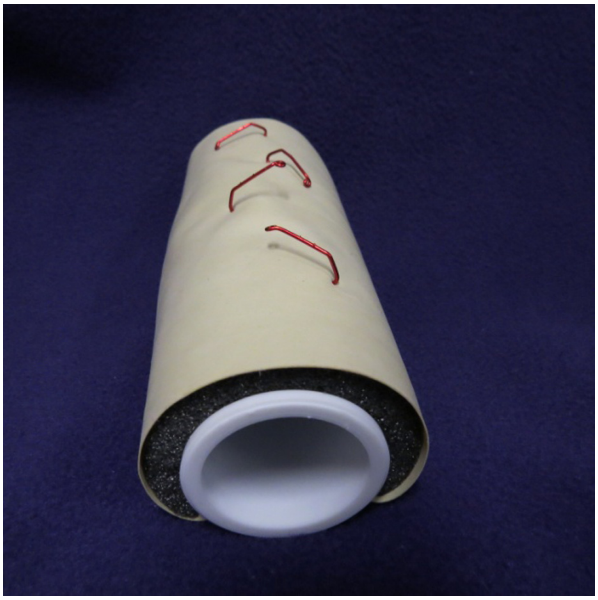

Figure 4. Simulation practice model for fishhook removal.

pipe covers that fit the size of polyvinylchloride pipe allows for a secure fit as it curves around the pipe.

The demonstration video was filmed in our simulation laboratory by the investigators and edited on a home computer. The intent was to concisely demonstrate each of the techniques in a stepwise fashion that matched the visual diagrams and the testing sequence. The 2-minute, 45-second video includes a slide for discussion of wound management, including wound care, tetanus administration if needed, prophylactic antibiotics if indicated, reviewing signs and symptoms of infection, and instructing the patient on follow-up care. The visual diagrams consisted of investigator-taken photographs with written instructions to reinforce the video information and for use as a "to go" reference in a field or clinical setting (Figures 5–8).

The procedural technique ranked hardest to learn, hardest to perform, and perceived to cause the most tissue damage was needle cover. This technique requires the insertion of a large needle into the skin bevel side down and manipulating the bevel over the barb to cover it, a procedure that is invasive and uncomfortable. Dexterity is required to smoothly remove the needle and fishhook together in a single unified movement. This technique needs to be tested for efficacy in more complicated hook removal situations where the other methods are less effective. For simple, uncomplicated fishhook injuries, this study indicates that the other methods are preferable.

Advance and cut consistently ranked in third place for easiest to learn, easiest to perform, and perceived amount of tissue damage; and tied with string-pull for second place for first attempt success and easiest to learn. This

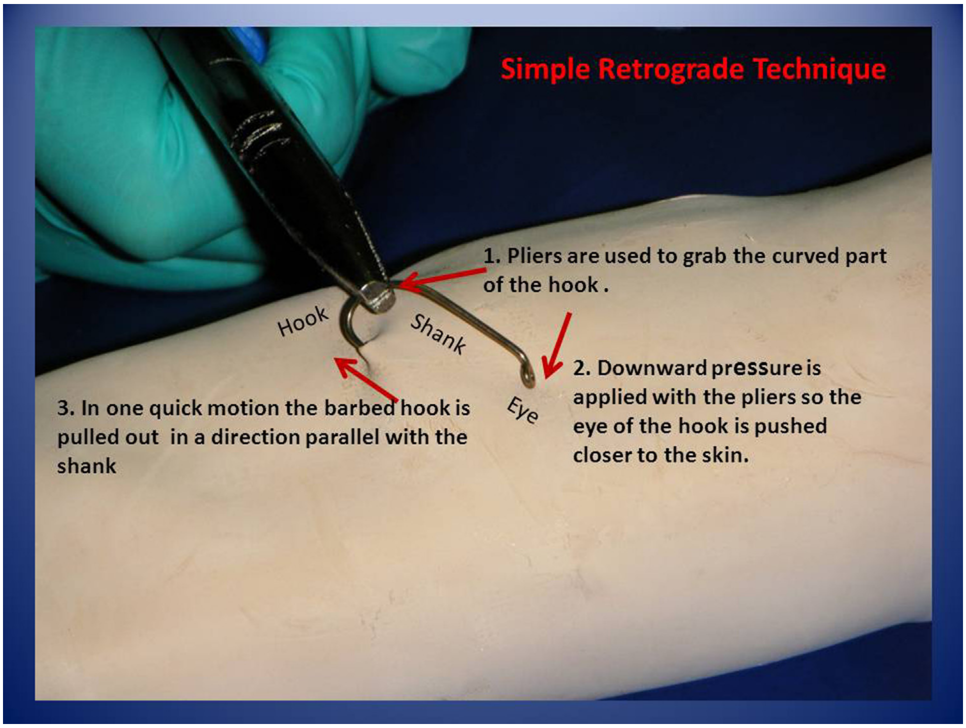

Figure 5. Simple retrograde technique.

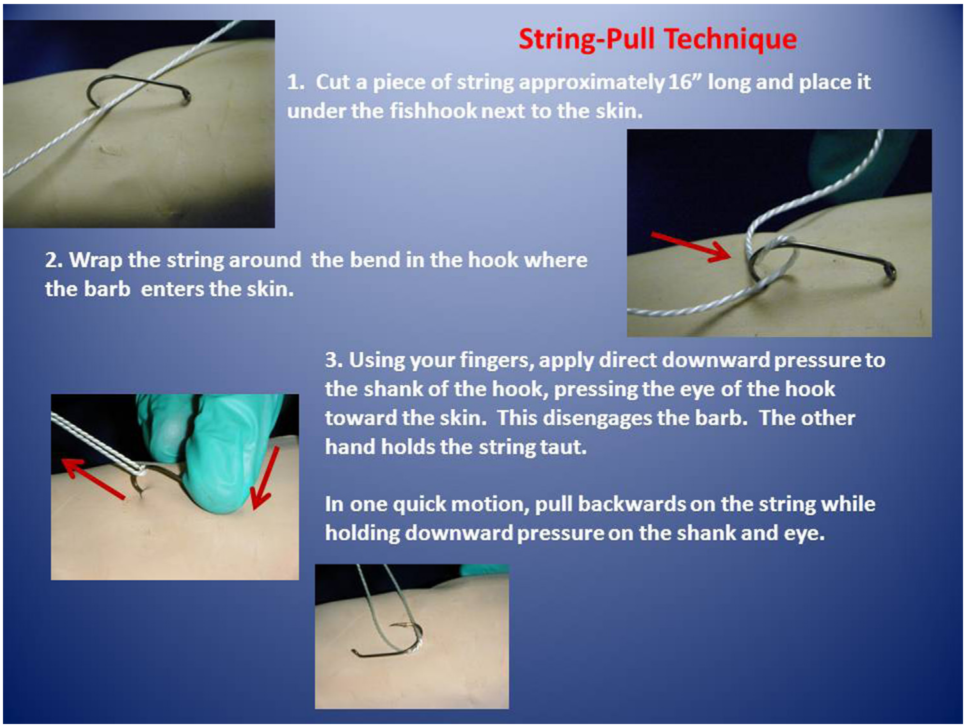

Figure 6. String-pull technique.

technique requires the barb to be advanced forward through the skin so the barb can be cut off before the hook is withdrawn backward. Although that may cause some forward tissue damage, it may be less damaging than dragging the barb out backward or incising the area open for removal. As for needle cover, the efficacy of

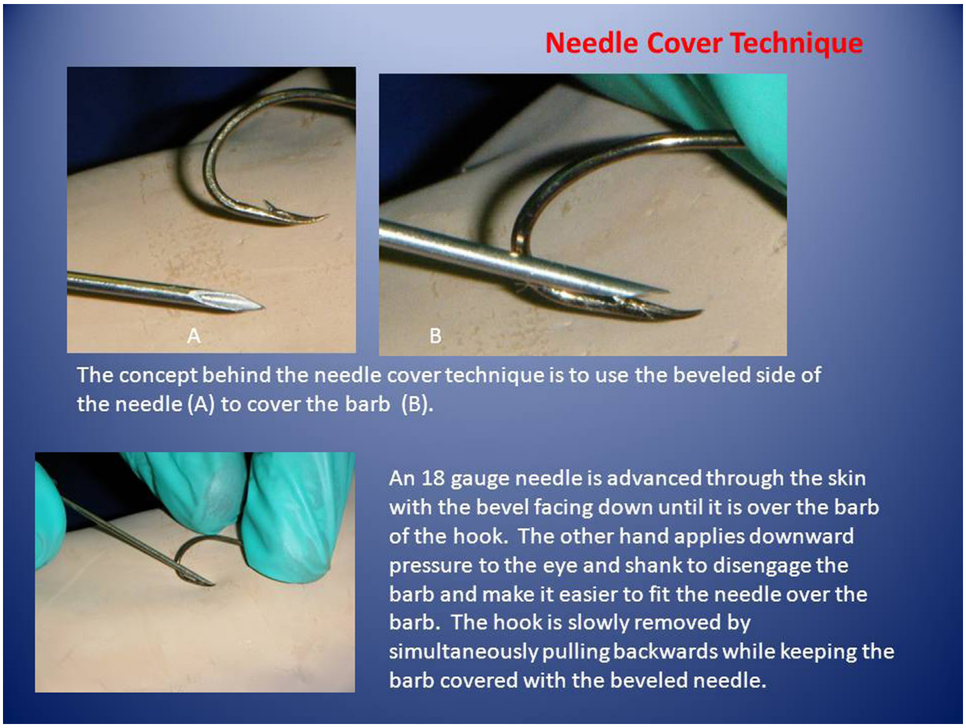

Figure 7. Needle cover technique.

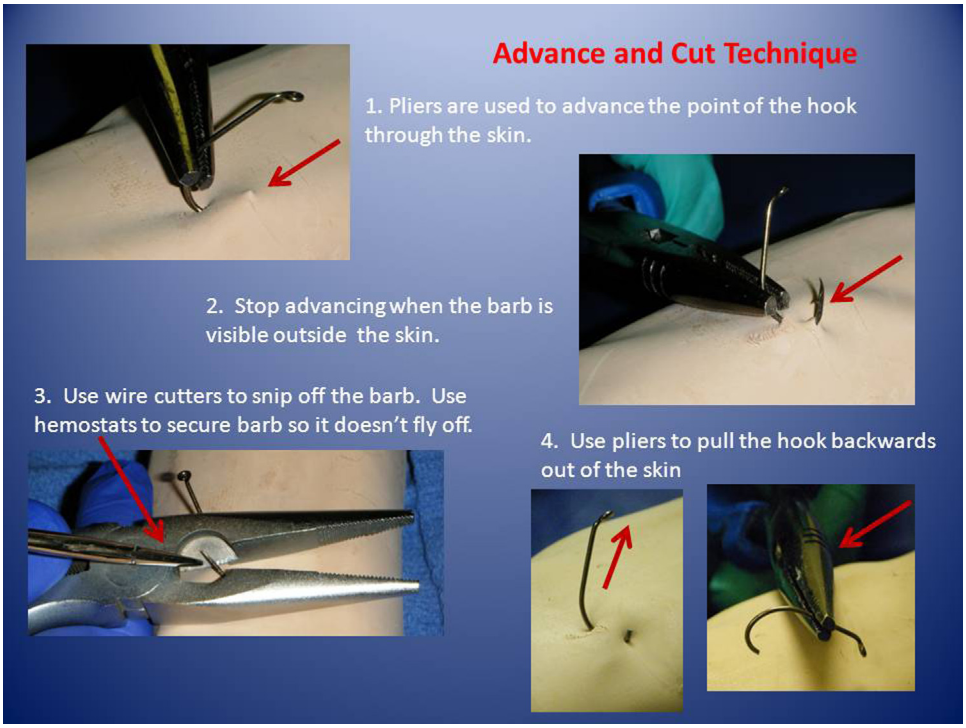

Figure 8. Advance and cut technique.

this technique should be studied in the future relative to more complicated injuries.

STUDY LIMITATIONS

There are several limitations to the study. First, the small number of participants primarily consisted of emergency medicine personnel, many of whom had prior fishhook removal experience. This study needs to be repeated with novices who have never removed a fishhook. Second, all participants used the same latex model during the study, but owing to the risk of exposure for those with latex allergies, the model has since been redesigned with a nonlatex covering. The new model needs to be tested for long-term durability with repeated use.

Originally, the investigators planned to evaluate the educational effectiveness of the diagram, the video, and the hands-on session as it related to the Learning Pyramid. Faculty members believed this was a proven educational concept that has been incorporated into our program's educational culture and institutional commitment to simulation training, however, and there was no new generalizable knowledge to be gained by asking whether the audiovisual and hands-on practice enhanced participants' ability to learn the techniques. The investigators also did not evaluate the perceived realism of the model compared with actual human skin, and that could be the focus of a future study using the new nonlatex model.

IMPLICATIONS FOR FUTURE PRACTICE

There are no studies regarding procedural techniques for removing multiple-barbed recreational fishhooks. No studies were located using procedural techniques based on the size and type of recreational fishhook or the location of the fishhook. Future studies should evaluate the effectiveness of the workshop design and teaching materials for learning more complicated fishhook removal. We are also considering a study to assess the efficacy of teaching simple removal techniques to the lay public during a similarly structured workshop.

Conclusion

To our knowledge, this study is the first to describe a resident simulation training program for uncomplicated fishhook removal. The educational materials developed are appropriate for use by medical professionals, including first responders, for use in both the field and the clinical setting. The simulation workshop can be inexpensively reproduced and effectively taught within a short time to train healthcare providers in uncomplicated fishhook removal.

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Supplementary Video

A supplementary video associated with this article can be found in the online version at 10.1016/j.wem.2014.06.001.

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