Development of a chirurgical skills lab otorhinolaryngology

.. A research report ..

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Prefatory note

As a student of veterinary medicine at the University of Utrecht, one has to fulfill a research project. This paper is the final report of a research project to develop a chirurgical skills laboratory for otorhinolaryngology, carried out by Drs. C.J. Holleman at the department of Small Animal Medicine at the University of Utrecht.

At the same time this project was running, two more skills labs where developed by colleague students, for their research project. The information about these two skills labs can be found in the reports of C.F. Vermeij (Suturing and ovariectomy) and R.G.A. Metz (Urology)

After these projects were finished all three skills laboratories were evaluated by participating master students through a questionnaire. The results of this assessment can be found in the report of M.L. Kort.

Abstract

Background:
Training in clinical and surgical skills is generally accepted as an important part of veterinary educational programmes. Later on these skills represent an important part of the work of veterinary practitioners, namely diagnostic and therapeutic procedures. Nowadays it is known that clinical internships do not provide the ideal learning environment for students. Medical schools cannot rely on internships alone anymore, to provide adequate basic skills training. Surgical Skills laboratories provide a new environment for teaching these skills. The aim of this study is to produce different training models for practicing otorhinolaryngology procedures, to be used by veterinary students in their master programme.

Implementation:
To get inspiration there was a visit to the Faculty of Veterinary Medicine in Copenhagen, Denmark. Here students can already learn and practice their skills with different handmade veterinary models. Different materials were applied, bought, investigated and tested for their usability. At the end there is made a decision of what materials to use based on costs, usability, resemblance with the tissue of a living animal and the ability to replace the material after being used.

Results:
Three models for the skills lab otorhinolaryngology are made. The first can be used for practicing tracheotomy and the placement of a temporary tracheostomy tube. With the second model students can practice the surgical treatment of an othematoma. The third model can be used for the placement of an esophagostomy feeding tube. For each model there are instructions and a list of materials to replace the used parts of the model. Because for each new student, practicing on a model, only a small part has to be replaced, there are no high costs per student for practicing. The multiple-use capability of the models increases the potential cost savings.

Conclusions:
It is possible to develop a surgical skills lab with adequate models which are easy to use, can be reproduced easily and are relatively cheap. Skills laboratory training prepares students for internships and also positively influences their learning during internships. They can practice skills independently and there is no infringement at the integrity of animals.

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Introduction

1. Background

Training in clinical and surgical skills is generally accepted as an important part of medical and veterinary educational programs [1-6]. After all these skills constitute the core of the work of veterinary practitioners, namely diagnostic and therapeutic procedures. Such procedures require a set of basic competencies, like endotracheal intubation, handling instruments, inserting sutures and tying knots.

All doctors, both human and veterinary, have to acquire these skills when they are students. Many medical schools have drawn up lists of basic clinical skills, that students are required to have mastered at the end of medical training [7]. For the veterinary medicine curriculum at the University of Utrecht a set of 'knowledge, skills and professional behavior terms' has been formulated in the Program Objectives. The student has to be equipped with these terms at the moment of graduation. These Program Objectives concern the core part of the educational program as well as the various tracks. The accompanying Skills List describes the skills that a veterinary student must have mastered upon graduation, as well as the required level of mastery. This applies both for the student's own specialism as well as all other specialisms. The accompanying Symptoms List describes the different symptoms for diseases that the student must be familiar with upon graduation, as well as the level of familiarity [8]. Most of these procedures have to be learned simply by observing an expert, for example during surgeries. However, observation without involvement does not produce effective training [4]. Besides, nowadays there is more pressure on surgeons to be highly efficient in the operating room, this allows less time for teaching their students [3-5].

There are certain skills and procedures which all the students have to perform during their internship. The action is performed by students with full-time coaching by a doctor. For example neutering a cat as a basic surgery. However, this procedure may no longer be optimal for the acquisition of primary practical skills. First, there are some ethical concerns about teaching various skills and procedures on a patient. There are potential risks for the patients used as subject for training [4,5,9]. Second, the teaching hospitals are increasingly populated by patients with very serious and complex surgical problems, that demand the skills of surgeons working at high efficiency. Consequently, students have less opportunity to learn basic surgical skills and procedures on living animal patients [3,5,6,10]. Third, in a clinical setting, there may be a wide variability among educational programmes and teachers instructing the students [9].

An evaluation of internships shows that satisfaction with the level of coaching in skills correlated most strongly with overall satisfaction with internships. But when finished, most students haven't even practiced all required skills of the skills list during their internship [2,7,11]. Besides it has been shown that many students are not adequately trained in these skills [1-4]. In a survey of 152 instructors, approximately half of them felt that students need better training in the technical aspects of surgery [12]. Another review of students found that about one-third considered themselves to be incompetent in technical skills [10]. This way, clinical internships do not automatically provide an ideal learning environment for medical students. It suggests that medical schools cannot rely on internship experiences alone to provide adequate basic skills training [4,7,11]. Research with practitioners showed existing deficiencies in their skills, such as clinical breast examination. These deficiencies in their work may affect the quality of care for the patients, because of a missed diagnosis, inadequate treatment or unnecessary referral [2].

There is an increasing need to develop methods of veterinary (and also human) skill instructions that occur outside the operating room. This way there can be practiced until automaticity in basic skills is achieved. This mastery of basic skills allows trainees to focus on more complex issues in the operating room. For example knot tying; the learner who still has to think about how to tie a knot is much less likely to pick up on other teaching that transpires in the operating room, than is the learner who has mastered this simple skill [3].

An example of an instructional opportunity outside the operating room is the animal cadaver. It is generally used in medical and veterinary institutions for surgical instruction, because it closely represents the living patient from an anatomical perspective. However, the associated costs are high due to limited availability, single use and the need of freezer space for the cadavers. There is also decay of the tissues, especially after defrosting of the cadavers, which makes them less useful for surgical training [3,5,6]. In contrast, inanimate models are safe, reproducible, readily available, and generally more cost-effective than the use of cadavers or living animals [3,5]. Moreover, both bench and cadaver training were superior to reading a text with bench and cadaver training equivalent to each other [5].

Another argument for training outside the operating room is that students want more time to practice their skills. Both, they and their teachers see this as a missing link in the process of mastering a skill. The ideal of unlimited access to an expert is clearly unrealistic. A possible solution is ready access to models, supported by a written and pictorial instruction with demonstrations of good technique and if possible, examples of likely problems [4].

2. Short introduction skills lab

Worldwide an increasing number of medical and veterinary faculties introduce skills laboratories in their educational programmes. Their students learn clinical skills using simulated patients, models and mannequins. An important reason for this growing popularity of skills labs is that students can practice particular skills without full-time coaching. The students can train themselves with the help of instructional texts and possibly videos. Besides there is no infringement at the integrity of animals normally used for this purpose. Because the welfare and survival of the patient is not an issue, the use of a skills lab helps to reduce the fear that most students feel when first attempting these skills on a living animal [6].

The aim of skills laboratories is twofold. The first aim is a benefit for the students and teachers themselves. The students can practice different skills independently, without the need of fulltime guidance. They can improve their techniques and prepare themselves for their internship. The second aim is to decrease the use of laboratory animals and living patients for basic skills training. This has its effects on the welfare of the animals and also decreases the educational costs, because the use of laboratory animals (both living animals and cadavers) becomes increasingly expensive [6].

3. The assessment of skills training

Different studies where carried out to study the acceptance, effectiveness and usefulness of humane clinical skills laboratories. Some of them asked the participants to fill in a questionnaire or used a written test of skills [1,2,13]. Others used an assessment method like the Objective Structured Assessment of Technical Skills (OSATS), which combines a checklist and global ratings [3,4]. Or they let an independent observer evaluate the interns by completing a checklist while the intern was performing the procedure [9].

Overall, the results of these studies are promising. Students think of it as a useful training and a helping hand in understanding the basic principles of surgery. It also motivated most of the students to study more about the skills they had to practice. Overall the students enjoyed working in a skills lab [13].

Furthermore, the mean scores of a written test of skills increased with the start of implementation of skill training and the hands-on experience in the curriculum during the internships, in one study [1]. In another study with a knowledge test of skills no statistically significant differences existed between the intervention group and control group at the start. Both groups showed improvement in scores, but improvement was significantly higher for the intervention group [2].

In a study, were an independent observer evaluated the interns, is shown that a surgical skills lab course significantly improved the knowledge and skills of the course's participants, compared with the control group who were trained by traditional methods. This improvement was measured in a real clinical scenario. The course interns were more confident than traditional interns, needed less direction for their proceedings, and showed a trend for less time required to complete the procedure [9].

Unfortunately there is little information about veterinary skills labs. But considering the similarities between human and veterinary medical studies, we can expect a comparable outcome. During the writing of this report a colleague student is doing a research project, which contains an evaluation of veterinary master students about our newly implemented skills lab at the Faculty of Veterinary Medicine in Utrecht. See the prefatory note for more information.

A study performed by Holmberg et al in 1995 used a Dog Abdominal Surrogate for Instructional Exercises (DASIE) to teach basic surgical skills. This model is designed specifically for veterinary students. After using the DASIE a questionnaire was used to evaluate the acceptance of the model. The students were asked to compare a foam block, operating the DASIE and operating living animals (dogs, sheep or goats), and rate how useful each was for different learning objectives. The mean learning value of the DASIE for all learning objectives was higher compared to the use of a foam block, but lower in comparison to a living animal. The students rated working with the DASIE clearly as a good preparation for surgery on living animals [6].

But providing a quiet and non-intimidating environment to practice technical skills is not enough. A surgical skill laboratory teaching will potentially be ineffective, if all it does is to allow students to perform a technique in artificial models rather than patients, in the same way as done during the traditional methods of teaching skills. To achieve optimal effectiveness, a technical skill should be taught in a detailed, step-by-step, standardized fashion that allows in-depth understanding of the fundamental elements of the technique [9].

4. Acquiring surgical skills

The time spent during surgical training should provide the background and personal resources for continuous learning and the acquisition of new areas of expertise. This applies just as much to manual skills as to cognitive and knowledge based abilities [10].

Teaching of operative skills is constrained by the complexity of procedures, ethical and medico-legal concerns. It also takes time and, as mentioned before, this is in conflict with the need for financial restraint and the move towards more civilized hours of work for students. This way there is little opportunity for either reflection or practice during a procedure [4,5,6,10].

Until now little work has been performed to identify the perceptual motor abilities that are required during surgery. This makes it very difficult to understand which issues underpin the achievement of technical competence. But during surgery it is sure that one uses psychomotor skills, because surgical skills require the integration of decision making and mechanical processes. When taking a closer look, one can see that dexterity is a very important component of these skills.

Table 1 outlines the three stages that occur during the acquisition of a motor skill [3,4,10].

Phase	Psychomotor element	Focus of instruction
1	Cognition	Perceptual awareness
2	Integration	Comprehension of mechanical principles
3	Automation	Speed, efficiency and precision

Table 1: Stages in the acquisition of motor skills

The first stage (cognition) is an understanding of the task, the learner has to intellectualize the task: individuals who are provided with a clear description and demonstration of the task are more likely to master a new skill than those who are not. In the second stage (integration), motor skills unique to the task are applied to avoid inefficient movements, knowledge is translated into appropriate motor behaviour. The learner is still thinking, for example, how to move the hands and hold the suture but is able to execute the task more fluently, with fewer interruptions as in the first stage. In the final stage (automation) the skill becomes automatic in such a way that there is no need to think about each step or rely upon external cues. This way practice gradually results in smooth performance. The learner is now able to concentrate on other aspects of the procedure instead of thinking about how to execute a particular task. This phase of automation supports the concept of technical competence [3,10].

Some components of a task can be very difficult for experts to demonstrate, for example the tying of a knot. Nevertheless, it is necessary to deconstruct skills so that they can be taught to others. The automated elements have to be captured and unravelled, so there can be explained why certain steps in a certain procedure are necessary. It is important to make a document where the procedure is described in a detailed step-by-step fashion. You can also provide a visual example, corresponding to the text description of each step, including pictures in the document of all the structured steps [9]. And as a general principle, deliberate practice is a critical process for the development of mastery or expertise. Deliberate practice calls for the individual to focus on a defined task to improve particular aspects of performance. It involves repeated practice along with coaching and immediate feedback on performance [3,4,10]. Retention of motor skills appears to be most dependent on the degree to which the skill was perfected, rather than on variables such as the environment. This is a critical point because it implies that many of the basic skills, required for surgery, can be acquired outside the operating room [3,10].

5. The transfer of technical skills

Sophisticated materials based on latex and silicon can reproduce many characteristics of human (and animal) tissue. This allows new possibilities for training while avoiding the practical, economic and ethical issues surrounding the use of (living) animals. But what if the students have to practice their skills on a patient in a stressful clinical environment, instead of practicing on models. The key is the 'functional similarity' of a training appliance to its real-life counterpart [4].

An interesting side finding in one study was that the scores of the course students were not different when evaluated on a model or a patient. This shows that they retained their expertise gained during the course, even when asked to perform the task in a stressful clinical environment up to ten weeks later [9]. This finding is in accordance with foregoing literature about this subject, supporting the effective transfer of technical skills from inanimate to human models [5].

With these findings there is an auspicious prospect for the use of models to practice on, before entering the operating theatre.

Development of a chirurgical skills lab otorhinolaryngology

1. Aim of this project

With the introduction of a newly implemented training course for surgical education at the University of Utrecht, basic surgical skills have to be learned and practiced on models. The aim of this project is to produce different skill training models for practicing otorhinolaryngology procedures, to be used by veterinary students in their master programme. In this way the students are better prepared for their internship and the operating room experience. The models will involve skills which are marked with a '4' on the master Skills List of the students, which means that they must have executed this particular procedure before the end of their study. The additional aim is to decrease the use of laboratory animals and living patients for skills training. This has its effects on the welfare of the animals and also decreases the educational costs.

Three otorhinolaryngology models have to be developed to assess skills, including practicing tracheotomy plus placement of a tracheacanule, the treatment of an othematoma and the placement of an esophagostomy tube. These models have to be realistic enough for the students, so they can actually practice their skills for these procedures. Therefore the most important parts of the execution of the procedures must be practicable.

The attendant challenge is to develop models resist wear and, if necessary, can be reproduced relatively cheap and in a simple way. The materials to use also have to resemble the tissue as in a living animal as much as possible.

2. The implementation

Set up

First there was a literature research of studies about (veterinary and medical) skills laboratories and their benefits and/or disadvantages. The result of this research can be found in the introduction of this report and also in the implementation of the models themselves. To obtain more insight in the operational procedures, different surgeries at the Clinic for Small Animals at the Veterinary Faculty in Utrecht were visited.

Medical skills laboratory in Utrecht

To investigate the work that already has been done in existing skills labs, the skills lab at the Academic Medical Centrum (Universitair Medisch Centrum) in Utrecht was visited. They have a permanent skills lab, so it was no problem to have a look. All the models they used were expensive human models, which one can order at different companies. Such models do also exist for veterinary purpose, but these are also very expensive. The guide told us that the models they use often become defective within a short period of time and develop all kinds of shortcomings. This is exactly the opposite of the aim of this study, the model has to resist wear and it should be possible to reproduce it relatively cheap.

Veterinary Skills laboratory in Copenhagen

For more orientation we brought a visit to the Veterinary Faculty in Copenhagen. They already have an existing veterinary skills laboratory and the developer of this skills lab, Rikke Langebæk, designed all the models by herself. Once we got there she guided us through the skills lab and told us all we had to know about the materials and procedures she used for the development of her models. It were all cuddly toys which were converted in skills laboratory models, on which the most important parts of the procedures were practicable. She also showed us some instructions she made with evident pictures at each level of the skills lab. This excursion was very useful for us to learn more about the materials we could use, which were often very simple. This way we were learned to think simple, the materials are often easy to get.

Rikke Langebæk has already questioned the students for here thesis about their opinion and acceptance of the models. They all accepted it very well and thought the skills lab is an extension of the current way of teaching chirurgical skills. The students thought the models were fun to work with and reported that there is no need to make the models more realistic instead of a cuddly toy.

The development of the different models

After these orientation-based steps we all started with the investigation of all kinds of materials. To get these materials we collected samples like rubber plates, silicon tubes, polyurethane, foam rubber, fabrics and so on, by sending a sample request to different companies or just by going shopping. Fortunately, the companies were very willing to send us samples of their assortment, so we had a lot of materials to check and test. At the same time there was the development of the different models. Answering questions like what materials are best to use, which design is the most practical and how to keep the costs for the models relatively low.

There also was the question about the fidelity of the models. Should they have a high fidelity or is low fidelity enough to practice on. It is demonstrated that students who have been trained on low-fidelity models make fewer intra-operative errors when performing a laparoscopic cholecystectomy than do residents who did not have the benefit of simulation training. High-fidelity models are also available for training different procedures. However, these realistic models are all very expensive. As a general rule, the higher the fidelity and the more realistic the model, the more expensive the training tool. Fidelity may be less important at relatively junior levels of training. For example, when one group of medical students was trained with the use of a high-fidelity video endoscopic urology system and another with the use of a simple bench model, the two groups showed the same improvement in performance and showed more improvement than the control group given didactic training. Likewise, students working with a simple tubing model performed similar to those who were working with the vas deferens of a living rat. Among surgical students, improvement in performance for a variety of open procedures has been shown to be the same whether low-fidelity bench models or cadavers were used [3]. Based on these study outcomes and the outcome of the questionnaire of Rikke Langebæk we thought that the models don't have to be a hundred percent lifelike, as long as the important parts of the procedures are practicable on the model.

To perform the skills on the models there has to be an operating instrument set for the students and they also need a lot of suture material. We assembled a very economical standard operating instrument set which the students can buy themselves at the university and which costs them fifteen euro. The operating instrument set contains a Crile-Wood needle holder, two Halsted mosquito forceps, two Adson forceps, a pair of Mayo scissors and a number three scalpel holder. Afterwards they can take it home and practice some more if they want to. For replacement of suture material we found fishing wire with similar texture and characteristics as monofilament suture material. The use of non-sterile wire with separate needle, instead of commercially available sterilized suture with swaged-on needle, is very cost effective.

The instructions

Instruction text material was composed for the students, explaining the procedures step by step, aiming to reduce teaching-time and to improve individual working. For each procedure, a manual containing a written and pictorial description of the procedure was prepared. The students can find the manual on the internet, and participants are expected to have read the manual before entering the skills lab (see appendix).

Evaluation

After the models are implemented in the curriculum the participating students will be questioned with a questionnaire to assess the acceptance, usefulness and effectiveness of training in skills laboratories. Because of the timeframe of this project, there was no possibility to study the outcome of the questionnaires. For more information see the prefatory note.

Othematoma model

1. Introduction

This chapter describes the used materials and instruction of how the model for othematoma is constructed. There is also a list with an indication of the costs that have been made by designing this model. At the end of the chapter you can find the instructions for the students, which they have to study before entering the skills lab (see appendix).

The model has to be realistic enough for the students, so they can actually practice their skills for the treatment of an othematoma. Therefore, the most important parts of the treatment of an othematoma must be practicable. So I first made a list of the most important steps within the treatment of an othematoma and the materials we could use for these actions.

The first thing to do would be making an incision in the skin of the ear. A lot of different materials were tested such as leather, fake leather, fabrics and wound bandaging materials. The conclusion was that a suede like fabric is the best material for replacement of the skin of the ear. This because of the thickness of the material. The other materials were all to thick to resemble the skin of the ear. I used Dacron cotton wool as connective tissue. For connective tissue I have also tested foam rubber, but this was also to thick to resemble the tissue.

The second important step is cleansing of the othematoma. For this act I thought of two options. The first option was to fill a plastic bag with water and making this the othematoma. So while the students make there incision there is actually 'blood' coming out of the wound opening. I also filled a balloon with little pieces of foam rubber. The balloon had to represent the capsule and the foam rubber represents the blood cloths you have to take out of the hematoma. The second option is added to the instructions for practical reasons. With all the water coming out of the hematoma, it would be a little messy and this would do no good for the maintenance of the cuddly toy.

The third step is the closure of the wound. For this action there has to be an operating instrument set for the students with suture material.

2. Costs

Here is the list with the estimated costs I made to build the model:

• Cuddly toy	12,75 euro
• Sewing thread	0,50 euro
• Tying clips (for electricity purposes)	3,00 euro (1,00 euro a piece)
• Suede like fabric	0,50 euro (0,05/ear)
• Dacron cotton wool	0,02 euro (2 pieces of 10 x 10 cm)
• Balloons	1,00 euro (0,15/ear)
• Foam rubber	0,05 euro (1 piece of 10 x 10 cm)
• Fishing thread	0,05 euro (a piece 0f 50 cm)
• Staples	0,03 euro

Total costs othematoma model:	17,90 euro
Estimated total costs per training (one ear)	0,35 euro

3. How it's made

* Used materials model:

- Cuddly toy with ears
- Sewing thread and needle
- Tying clips
- Scissors

* Used materials ear:

- Fabrics
- Dacron cotton wool
- Balloons
- Foam rubber
- Stapler with staples

* Method model:

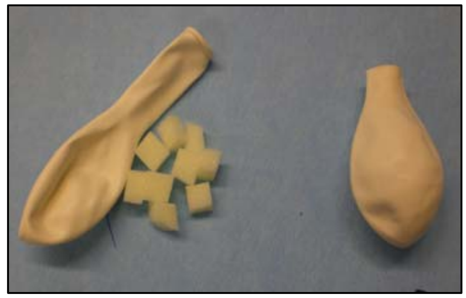
1. First cut of one ear of the cuddly toy.

2. The opening that is created by this action has to be closed by sewing a piece of fabric into the opening, so that a hole originates. You can use the fabrics of the ear you just cut of, or you can take the same fabric you are about to use for the ears. The hole has to be big enough for a new ear with an othematoma to fit in. After finishing the opening, secure a couple of tying clips in the opening. These clips are used to hold the ear in place while students are practicing their skills.

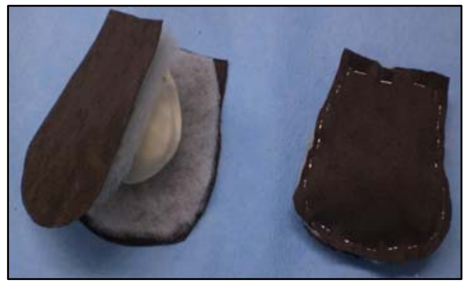
* Method ear:

1. For the shape of the ear you can use the initial ear of the cuddly toy itself. By making an example of the shape it is easy to use it again later. Cut the ear shaped form two times out of the fabric. Do the same thing twice for the Dacron cotton wool.

2. Cut of the opening of a balloon. You also have to cut a piece of foam rubber into smaller pieces. Place the foam rubber pieces into the balloon. This is the hematoma.



3. Position the fabric, cotton wool and the hematoma as you can see in the photograph. Give a little pressure on it so it is easier to staple the pieces of fabric and cotton wool at the edges together.



4. Once the ear is finished you can apply it in the tying clips. The othematoma model is now ready to use.

4. Student instructions (Dutch)

Chirurgische behandeling othematoom

The cutting edge - Chapter 15 - 15.5.2 Aural Haematoma

Het othematoom is de meest voorkomende afwijking aan de oorschelp bij hond en kat. De etiologie is niet geheel bekend, maar trauma door krabben en kopschudden, op basis van een onderliggend oorprobleem, lijkt ermee geassocieerd te zijn. De bloeding is afkomstig van een laesie van een van de takken van de grote auriculaire arterie die het kraakbeen penetreert. Het othematoom is aan beide zijden omgeven door kraakbeen. In chronische gevallen kan fibrosering optreden met 'bloemkoolachtige' veranderingen van het oor tot gevolg.

Stap 1:

a. Maak een incisie – met de potloodgreep- over het hematoom, in de concave zijde van het oor. Werk van de (nu) bovenzijde van het oor naar de basis toe.

b. Een beter resultaat wordt verkregen door de incisie S-vormig te maken.
(*Waarom S-vormig?*).

Stap 2:

Verwijder alle stolsels en fibrine uit de oorschelp. Normaal gesproken wordt hierna ook de holte gespoeld.

Stap 3:

a. Sluit de holte nu met matras hechtingen dwars door de gehele oorschelp heen.
Dit kan kriskras of in de lengterichting van het oor. De hechtingen zeker niet loodrecht op de incisie plaatsen! (*Waarom?)*

* Gebruik hiervoor een rechte naald met

hechtdraad Monocryl 2-0.

b. Begin met insteken aan de convexe zijde en steek terug vanaf de concave zijde. De knoop komt zo aan de convexe zijde te liggen, waar de huid wat dikker is en minder snel druknecrose op zal treden.

c. De gehele holte moet geadapteerd worden met hechtingen, maar let erop dat de incisie zelf licht blijft open staan om drainage toe te laten.

Op onderstaande foto's is te zien hoe het oor eruit ziet als het uiteindelijk is gehecht en wanneer het is hersteld.

Tracheostomy model

1. Introduction

This chapter describes the used materials and instruction for the making of the tracheostomy model. There is also a list with an indication of the costs that have been made by designing this model. At the end of the chapter you can find the instructions for the students.

The model has to be realistic enough for the students, so they can actually practice their skills for a temporary tracheostomy with insertion of a tracheacanule. Therefore the most important parts of the tracheostomy and placement of the tracheacanule must be practicable. So I first made a list of the most important steps within the process of temporary tracheostomy and placement of a tracheacanule, and the materials to be used for these actions.

The first thing to do would be making an incision in the skin of the neck. For this I needed something to represent the skin. But also something for the muscles and connective tissue in the neck lying underneath the skin. The materials tested for the treatment of an othematoma were also tested for this model. Here I found the wound bandaging material the best material to use. It is easy to make an incision and you can spread the 'tissue' without tearing it out to fast. It also had to be a little stronger than the fabrics we used for the othematoma model because the students have to fixate the opening with Weitlaner retractors. For the muscles and connective tissue I used Dacron cotton wool.

The next important action for the students is to make an incision in the trachea itself. To find something that would represent the trachea was very difficult. All sorts of tubes have been tested but most of them were all to hard. To make it look like a real trachea, rings in the tube were necessary to represent the cartilage rings. But all the rings within the different tubes we tested contained a metal spiral, so it was to solid to cut in with a disposable blade. There for the trachea is now a simple silicon tube, which is easy to cut in, but at the same time not too easy. And with this material you have to be really careful, just like handling a real trachea. If you stab to rough, you easily destruct the 'trachea' by cutting of a piece or making the incision to big.

For the attachment of the canule there have to be an operating instrument set for the students with suture material.

2. Costs

Here is a list with the estimated costs I made to build the model:

• Cuddly toy	15,00 euro
• Zipper	2,95 euro
• Silicon muffin cup	2,00 euro
• Silicon tube (13 cm.)	0,83 euro
• Foam rubber	0,05 euro
• Dacron cotton wool	0,01 euro
• Wound bandaging material	1,00 euro (1 piece of 10 x 10 cm)
• Tool clips	0,50 euro (0,25 euro a piece)
• Sewing tread and needle	0,50 euro
• Tying clips	4,00 euro (1,00 euro a piece)

Total costs tracheostomy model	26,84 euro
Estimated costs per training session:	1,84 euro

3. How it's made

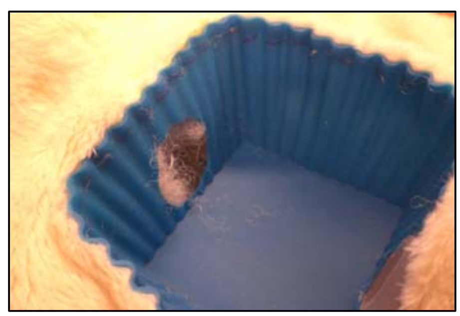
<u>* Used materials model</u>

- Cuddly toy with 'good neck' (make sure there is enough space to operate)
- Zipper
- Glue
- Scissors
- Silicon muffin cup
- Silicon tube (13 cm.)
- Foam rubber
- Dacron cotton wool
- Wound bandaging material
- Tool clips
- Sewing tread and needle
- Tying clips

<u>* Method model</u>

1. It is most easy to place the zipper first. The zipper is situated on the back of the cuddly toy. Now it is less difficult to work in the toy itself, for the attachment of the tool clips and the muffin cup for example.

2. Cut an opening in the neck of the cuddly toy, there were you want to have your trachea to be operated. It has to be big enough for the muffin cup (or other form) to fit in. To secure the muffin cup you can use glue and sewing tread. Make sure it is strong enough so it doesn't break while receiving pressure with the practicing students. Also cut two holes in de cup for the trachea to go through.



3. Attach two tool clips at the inside of the cuddly toy. One at each side of a hole you just cut out of the cup. These clips secure the trachea, so it does not move when the students are practicing. Make sure the trachea fits into the clips, because there are a lot of different sizes. You can secure the clips with some very strong glue and sewing thread. The clips have a little hole on the upper side, this is where you can use the sewing thread.

4. For more stability of the trachea within the cup you can use some foam rubber. Cut out a piece that fits in and also cut out the outline of the trachea. Get the trachea in place and secure into the tool clips.

5. Cut out a piece of Dacron cotton wool and put this over the trachea. With two pieces of foam rubber you can secure the cotton wool a little bit and it gives also more stability by filling up the empty spaces next to the trachea.

6. To cover the opening with skin, you can use the wound bandaging material. Secure the skin with tying clips (for the photograph there only was one tying clip left, but it is better to use more of them so the skin doesn't move when the students are practicing).

4. Student instructions

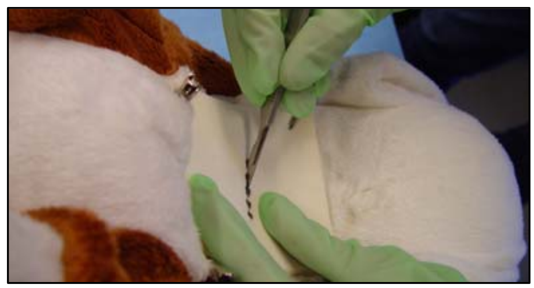
Tijdelijke tracheostomie met plaatsing tracheacanule

Small animal surgery – Chapter 28 – pp 825-826

Stap 1:

a. Voel naar de larynx en het sternum

b. Maak een transversale incisie - over de trachea - van ongeveer twee cm. op halve hoogte tussen de larynx en de borstingang. (In het model is het gemakkelijker een iets grotere incisie te maken: 3-4 cm)
(Wat zijn de indicaties voor een tracheostomie?)



*Veel teksten beschrijven een incisie in de lengterichting van de trachea. Het is echter beter om de incisie transversaal (dwars) te maken omdat dit beter geneest na verwijdering van de tube. De wond wil dan vanzelf dichtvallen (transversaal) in plaats van als een ruitje open te staan (longitudinaal). (Op sommige foto's in deze instructie is de longitudinale incisie gebruikt, laat u zich hierbij niet van de wijs brengen)

c. Spreidt de sternohyoideus en het subcutane bindweefsel met behulp van een mosquito vaatklem of weefselschaar, zodat de trachea goed zichtbaar wordt.

d. Fixeer de gemaakte opening met de weefselspreider van Weitlaner.

Stap 2:

a. Maak een steekincisie in het tracheale ligament tussen twee (denkbeeldige) kraakbeenringen van de trachea in. Doe dit met de nodige voorzichtigheid om de binnenkant van de trachea en de beademingstube (!) niet te beschadigen.

* Gebruik hiervoor de Bard-Parker scalpel

met mesje nummer 11.
b. Snijdt twee halve maanvormige delen uit de aangrenzende tracheaalringen zodat er een ronde of ovale opening ontstaat. Pak het deel van de trachearing dat je weg wilt snijden – vanuit de gemaakte incisie – vast met een gebogen Halsted mosquito vaatklem. Hiermee voorkom je dat het los te snijden stukje weefsel in de trachea terecht komt.

* Gebruik de nr. 11 scalpel om een circulaire incisie te maken rondom de pincet.

Let op: als de opening te groot wordt gemaakt, kan er lucht langs de tracheacanule lekken, waardoor er subcutaan emfyseem kan ontstaan.

Stap 3:

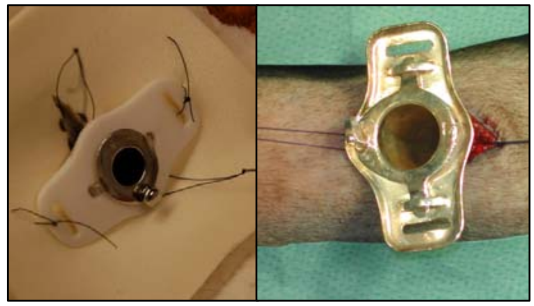
a. Plaats aan de craniale en caudale zijde van de opening een steunhechting. Steek met een gebogen naald door de wand van de trachea heen. Plaats de knoop niet op het weefsel zelf, maar ongeveer 4 cm. daarboven. Hierdoor ontstaat een lus.

b. Met de steunhechting aan caudale zijde kan de wand van de trachea iets worden opgelicht zodat de trachea canule gemakkelijk ingebracht kan worden.
Door middel van de twee steunhechtingen is de gemaakte opening ook altijd weer gemakkelijk terug te vinden (bij verlies van de canule bijvoorbeeld).

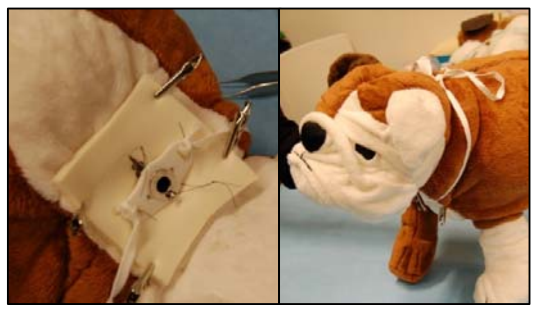
Stap 4:

a. Plaats de buitenste tracheacanule voorzichtig in de trachea. Wanneer deze op zijn plek zit kun je de weefselspreider van Weitlaner weg halen.

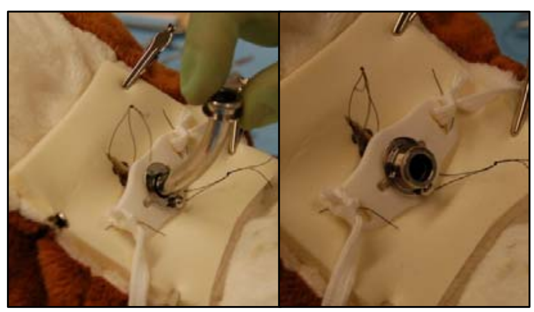
b. Hecht de buitenste canule aan beide zijden met de vleugels vast aan de huid. Gebruik hiervoor een enkelvoudige hechting.
(Welk hechtmateriaal gebruikt u?)

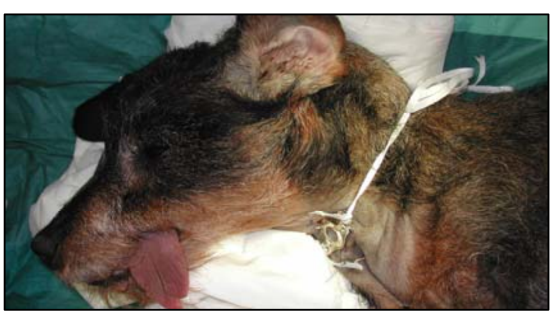


c. Om de canule aan de nek te bevestigen knoop je tevens aan beide vleugels een katoenen bandje. Deze knoop je aan elkaar aan de bovenzijde van de hals.



d. Als laatste kun je nu de binnenste (vervangbare) canule in de buitenste canule schuiven. Je kunt deze vast zetten met het kliksysteem.
(Waaruit bestaat de nabehandeling van deze ingreep?)





* Tijdelijk tracheostoma met tracheacanule bij een teckel.

Esophagostomy model

1. Introduction

This chapter describes the used materials and instruction of how the model for esophagostomy is constructed. There is also a list with an indication of the costs that have been made by designing this model. At the end of the chapter you can find the instructions for the students, which they have to study before entering the skills lab (see appendix).

The model has to be realistic enough for the students, so they can actually practice their skills for esophagostomy with the placement of a feeding tube. Therefore, the most important parts of esophagostomy must be practicable. So I first made a list of the most important steps within the process of esophagostomy and the materials we could use for these actions.

The first step to do is making an incision in the skin and oesophagus of the animal. For this I needed something to represent the skin and oesophagus. The materials tested for the treatment of an othematoma and tracheostomy were also tested for this model, such as leather, fake leather, fabrics and wound bandaging material. As with the tracheostomy the wound bandaging material is the best material to use. It is easy to make an incision in it and you can spread the 'tissue' without tearing it out to fast. For the oesophagus I took a inner tire of a bicycle. A surgeon who has developed his own model for the students uses an inner tire also and thinks it is a good resemblance with the oesophagus. An other advantage is the possibility of multiple usage of the tire. There is only a little piece of the tire necessary for one student to practice.

For the placement of an esophagus tube there is also need for an oral cavity. The cuddly toy has to have an oral cavity which you can open. To 'seal' the oesophagus/inner tire to the oral cavity I used a syringe were I have cut of the piece where you can put the needle on. This way there is enough space to go with the cramp into the oesophagus through the oral cavity.

The cuddly toy I used was hollow so it had to be filled up for more rigidity. For this I used a piece of foam rubber to fill up the animal. But other materials can also be very suitable for stuffing.

As with the tracheostomy model there is need for an operating instrument set for the students with suture material, so they can attach the tube to the skin. There also has to be a feeding tube which can be re-used by several students.

2. Costs

Here is a list with the estimated costs I made to build the model:

- Cuddly toy — 3,00 euro
- Syringe — 0,10 euro
- Inner tire of bicycle — 4,00 euro (reusable > 100 times)
- Tool clips — 0,25 euro
- Wound bandaging material — 1,00 euro (1 piece of 10 x 10 cm)
- Tying clips — 4,00 euro (1,00 euro per piece)
- Foam rubber — 0,25 euro (1 piece of 50 x 10 cm)
- Sewing thread and needle — 0,50 euro
- Feeding tube — 3,00 euro (reusable ~ 10 times)

Total costs esophagostomy model: 16,10 euro
Estimated costs per training session: 1,34 euro

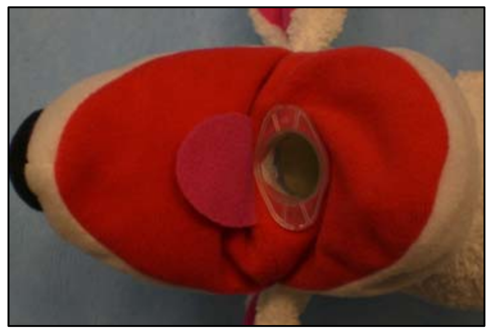
3. How it's made

<u>* Used materials model</u>

- Cuddly toy
- Syringe
- Inner tire of bicycle
- Tool clips
- Wound bandaging material
- Tying clips
- Foam rubber
- Sewing thread and needle
- scissors

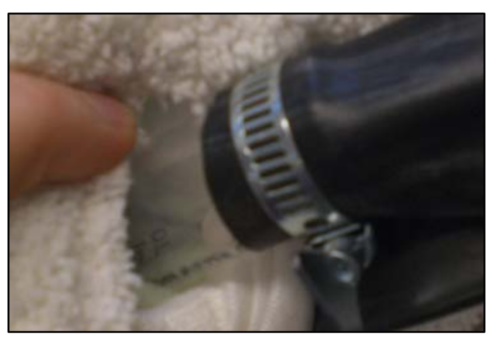
<u>* Method model</u>

1. Cut an opening in the mouth of the cuddly toy. Through this opening you can push the syringe with the cut off end. The wings at the other end of the syringe can be used to hold it in place. So make sure the opening is not too big.



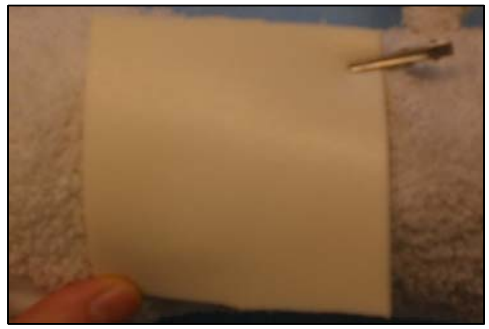
2. There also has to be cut an opening in the neck of the cuddly toy. The size doesn't really matter because it doesn't has to be a big opening. There has to be enough space for the students to make a little incision in the neck and esophagus.

3. Seal the inner tire to the syringe with a tool clip. The tool clip must have the possibility to be re-opened again. When the student is ready with the intervention the used part of the inner tire can be cut of, and a new part can be connected to the syringe again.



4. If the cuddly toy is hollow u can use some foam rubber to fill up the empty space. I used a piece of fabric to wrap around the foam rubber to keep it in shape. This made it also a lot easier to get the foam rubber in and out of the model so you can refresh the inner tire when needed. The inner tire has to be on top of the stuffing, directly under the 'skin'.

5. To cover the opening with skin, you can use the wound bandaging material. Secure the skin with tying clips (for the photograph there only was one tying clip left, but it is better to use more of them so the skin doesn't move when the students are practicing).



4. Student instructions

Oesofagostomie met inbrengen slokdarmsonde

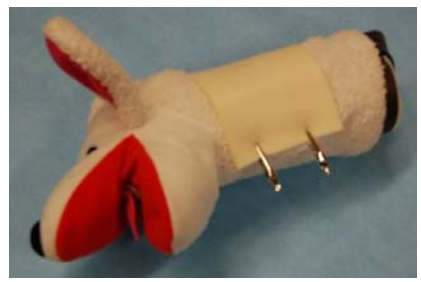
Small Animal Surgery – Chapter 11 – page 97-99 Esophagostomy tube

Sondevoeding is geïndiceerd bij anorectische patiënten en patiënten met een aandoening van de mondholte en farynx. Omdat katten in het algemeen een neussonde slecht verdragen, is het plaatsen van een percutane slokdarmsonde de meest gebruikte methode voor het toedienen van kunstmatige voeding.
Normaal gesproken wordt de sonde gemarkeerd zoals te lezen is in Small Animal Surgery, bij dit model wordt dat niet gedaan omdat het niet de juiste verhoudingen zijn en het model niet over ribben beschikt.
(Wat zijn normaal gesproken de landmarks om de lengte van de slokdarmsonde te bepalen?)

Stap 1:

Positioneer het dier zo dat het met de linkerzijde naar boven komt te liggen.

(*Waarom links?)*

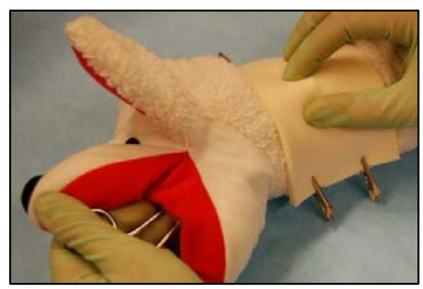


Stap 2:

Gebruik een baby mixter klem om via de mondholte – met de punt in laterale richting – de slokdarm naar buiten tegen de huid te duwen en het punt aan te geven waar er een incisie gemaakt moet worden in de huid en slokdarm.

(Waarom wordt de slokdarm op deze manier tegen de huid geduwd?)

Normaal gesproken is dit op gelijke afstand vanaf de kaakhoek en de punt van de schouder.



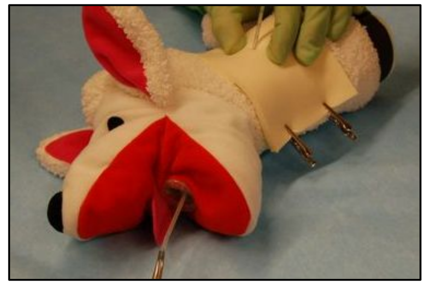
Stap 3:

Maak een kleine incisie over de punt van de klem heen totdat deze zichtbaar is (blijf dus lichte druk uitoefenen met de klem tegen de oesofagus en de huid). Duw de klem voorzichtig een klein stukje door de huid naar buiten.

<u>Stap 4:</u>

a. Open de bek van de klem en klem het uiteinde van de slokdarmsonde, wat uiteindelijk in de oesofagus komt, in het bekje

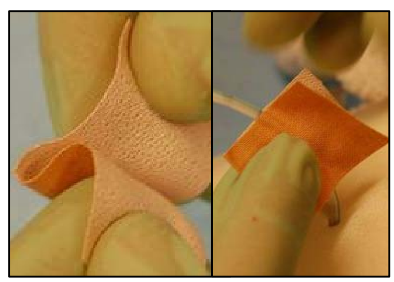
b. Dan haal je de klem voorzichtig terug uit de oesofagus en trek je de slokdarmsonde door de mondholte mee naar buiten.



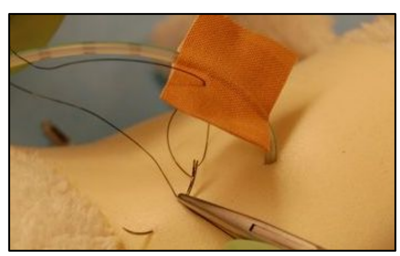
c. Breng de baby mixter klem met het uiteinde van de sonde weer terug in de oesofagus en probeer de sonde zo ver mogelijk in de oesofagus richting maag te plaatsen.

<u>Stap 5:</u>

a. Breng een pleister aan, als een zogenaamde ‘vlinder bevestiging’, rondom de slokdarmsonde waar deze door de huid naar buiten komt. Zorg dat de randen van de pleister, oftewel de vleugels van de ‘vlinder’, groot genoeg zijn om de slokdarmsonde aan de huid vast te hechten.

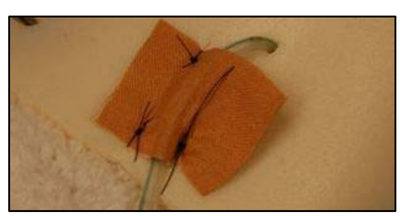


b. Hecht de pleister vast aan de huid door aan beide zijden van de sonde een knoophechting te maken door pleister en huid.



(Hoe wordt de slokdarmsonde in eerste instantie getest en waarom?)

(Hoe lang moet de sonde minimaal blijven zitten en waarom?)



Discussion

As mentioned before, surgical skills laboratory curricula using artificial models are increasingly gaining advantage over courses using living or dead animals, primarily because of cost issues and ethical considerations [9,10].

However, the methods of teaching technical skills in surgical skills laboratories are still inadequately defined. The effectiveness of such teaching is poorly documented and usually relies on subjective evaluations by the faculty or the students at the end of the course. While the value of a motor skills course seems obvious, the nature of the improvement is difficult to measure, making the effectiveness of this type of instruction difficult to establish. There is no evaluation of the psychomotor skills as is the same for the technical competence. It is very difficult, if not impossible, to standardize the operating room experience for the purpose of evaluating specific skills. Cases vary widely with respect to difficulty and complications. Flow of motion can be significantly different from person to person, but this doesn't make a particular skill a bad technical skill for one of the participants [5,9].

There are some more limitations about the different studies. First, they don't have a long-term outcome assessment. They didn't evaluate many months later if the interns retained their knowledge and competence acquired in the course. This mostly because of logistical and financial aspects [1,2,4,5,9].

Another limitation is that improved competence, as seen in the introduction, does not necessarily result in changes of performance in practice, because practical problems and organizational or social barriers may limit the application of what was learned. There also is no assurance for the quality of care in practice, while ultimately of great importance [2].

Further studies are needed to quantify the effect of the training, using objective, valid and reliable measures of outcome. Further work is also needed to address important motor-learning issues, such as whether it is preferable to practice whole operations or to practice segments of operations, and then build the whole from the segments, what practice schedules are optimal, and how to optimize the transfer of skills to the operating room.

We learned that the key to transfer skills from models to a clinical environment is the 'functional similarity'. Due to lowering of costs this has not entirely happened with the introduction of the skills laboratory we developed. To ensure the skills lab simulates the operating room environment as much as possible the models can be prepped and draped in surgical fashion. There is also the possibility to let the students wash, dress and glove themselves as necessary before a surgery.

Conclusions

Teaching technical skills is a challenging task both for the teacher and the learner. Most of the time it occurs in a stressful environment, frequently with little preparation, and not unusually at significant risk for the medium of the learning experience, the patient. Despite these downsides the traditional "see one, do one, teach one" method has become the standard of reference for learning students how to perform surgical procedures and the main method by which surgeons around the world have been taught how to operate [9].

The emergence of the concept of training in surgical skills laboratories has revolutionized the methodology of practical skills training. The clinical skills lab provides an environment for students to learn and practice psychomotor skills associated with veterinary medicine. Skills laboratory training prepares students for internships and also positively influences their learning during internships [1,13]. They can practice skills independently and there is no infringement at the integrity of animals. Inanimate models are safe, reproducible, readily available, and generally more cost-effective than living animals or cadavers [3]. It frees teachers and learners from the anxieties of being responsible for patient care while teaching. Also the opportunity to practice is more controlled and does not rely on clinical opportunities. Each component, such as learning how to use and handle instruments, is presented in its logical place. This planned approach guards against important links in the learning chain being left out [4]. It has been shown that students following a curriculum with a skills training programme practised more basic clinical skills during internships [1] and in practice [2]. Furthermore, students prefer hands-on training in skills laboratories, experience reduced stress and promote the accompanied decreased animal utilization [6,13].

Even if the concept of surgical skills laboratory-based teaching is appealing, there is little proof that it is better than the traditional method, when you look at the technical competence. The effectiveness of surgical skills training in laboratories is based on questionnaires distributed to the students, but there still isn't an objective method to review the technical side of the chirurgical procedures, the clinical outcome itself.

This way, one of the challenges of a competence-based system of education and assessment is how to establish pass or fail standards for the performance of technical skills. For veterinary education, model-based skills training is a relatively new area of research, and we are only beginning to build our knowledge in this domain.

Looking at the models designed during this research project it surely is possible to produce veterinary models that are relatively cheap, reproducible and are lifelike and challenging enough for the students to practice their skills. This way they are better prepared for the operating room environment and instead of thinking how to execute a particular task the students can concentrate on other aspects of the procedure. While practicing on the models there is also a decrease in need for animals to practice on.

Acknowledgements

I would like to thank Dr. S.A. v. Nimwegen for his effort and the opportunity he created for us to visit the Veterinary University of Copenhagen.

For this opportunity I also want to thank Rikke Langebæk who welcomed us in Copenhagen and let us take a look at the models she already made. Her hospitality was great and therefore we had a nice time during our stay.

Appendix

Studiewijzer N1 STUDENT

Het chirurgie skills lab bestaat uit een reeks chirurgische basisoefeningen die op modellen worden uitgevoerd. Ieder skills labonderdeel wordt steeds door 2 studenten tegelijk doorlopen. Van ieder model is er 1 exemplaar beschikbaar. Studenten kunnen elkaar assisteren bij de 'ingrepen' of desgewenst ieder met een apart model aan de slag gaan. Let erop dat er voorzichtig met de modellen wordt omgegaan zodat je collega's er ook nog plezier van kunnen hebben. Na afloop van de oefening graag de modellen zo goed mogelijk weer gereed maken voor de volgende studenten. Er zijn hechtnaalden en draad beschikbaar in het skills lab. Als algemene voorbereiding van het skills lab dient de zelfstudie hechtmaterialen en instrumenten. Voor het uitvoeren van de oefeningen is chirurgisch instrumentarium nodig. Daarvoor is er een goedkope hechtset beschikbaar als aanvulling op de reeds in bezit zijnde snijset. De hechtset bevat een naaldvoerder, 2 Halsted Mosquito's, 2 kleine pincetten, een schaartje en een mes en is te koop voor 15 euro. De meeste oefeningen kunnen hiermee uitgevoerd worden. Daarnaast kan er uiteraard thuis verder geoefend worden indien gewenst. Het skillslab vindt plaats in kamer 0.086 op de begane grond in de gang waar zich ook studentenzaken en pc-ruimte bevinden. Als de kamer op slot zit kan deze geopend worden door een van de onderwijsassistenten, of via onderwijszaken.

Zelfstudie: Hechtmaterialen en instrumenten
Beschrijving:
Zelfstudie met als doel dat de student zichzelf bekend maakt met de verschillende hechtmaterialen en instrumenten, als voorbereiding op het chirurgie skills lab en het coschap chirurgie. Welke hechtdraad en naald is voor een bepaalde ingreep gewenst en waarom? Welke instrumenten worden hierbij gebruikt en op welke manier?
Studiemateriaal: *Leren Opereren/the Cutting Edge* hoofdstuk 3 en 5, *Fossum Small Animal Surgery* 3rd edition p47-52, 57-63, en evt aanvullend de instructie uit blok 24:
http://www.vet.uu.nl/mcd/Zelfstudie_Chirurgie_Blok24/index.html

SL1 KNO
Beschrijving:
Oefenen tracheotomie en plaatsen tracheacanule; behandeling othematoom;
Locatie: Skills lab GD, kamer 0.086
Studiemateriaal: *Leren opereren/the Cutting Edge* § 15.5.2, *Fossum Small Animal Surgery* 3rd edition p825-826, digitale instructie (pdf).

SL2 Algemene chirurgie hechten en darmresectie
Beschrijving:
Studenten oefenen hechten en knopen gebruik makend van model buikwand (huid, subcutis en linea alba/rectusfascie); darmresectie met end-to-end anastomose.
Locatie: Skills Lab GD, kamer 0.086
Studiemateriaal: Hoofdstuk 5 'Hechtmaterialen en hechtmethoden' uit *Leren Opereren/the Cutting Edge*. Digitale instructie (pdf) en hecht- en knoop instructie uit blok 24:
http://www.vet.uu.nl/mcd/Zelfstudie_Chirurgie_Blok24/index.html

SL3 Urologie
Beschrijving:
Op modellen wordt geoefend met buikpalpatie en blaaspunctie; castratie van de mannelijke kat en hond.
Locatie: Skills lab GD, kamer 0.086
Studiemateriaal: Digitale instructie (pdf). *Fossum Small Animal Surgery* 3rd edition, p714-717.

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