Use of a Formal Assessment Instrument for Evaluation of Veterinary Student Surgical Skills

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Objectives: To (1) evaluate the design and use of a global rating scale assessment instrument in veterinary medical education and; (2) examine the effectiveness of 2 surgical techniques courses for improving the surgical skills of veterinary students.

Study Design: Instrument development; observational; survey-based.

Sample Population: Students (n = 16) registered for 2 elective surgical techniques courses were enrolled on a volunteer basis.

Methods: A 5-point global rating scale instrument was designed for the evaluation of 12 basic surgical skills by faculty evaluators and used to obtain student start and end scores during the courses. Upon conclusion of the courses, students completed a survey from which their opinions on their improvement as well as their desire for feedback were obtained.

Results: All authors agreed the instrument was easy to use. As groups, 3rd year students, 4th year students, and all students combined had significantly higher total skill scores at the end of the courses compared to the start of the courses. Individually, 10 students (63%) had significant improvement in surgical skills as a result of their participation in the courses: 4 (100%) 3rd year and 6 (50%) 4th year students. Student survey responses revealed a strong desire for feedback as well as support of formal assessment methods. Only weak agreement was found between student opinions on their improvement and the authors’ assessment scores.

Conclusions: Assessment instruments are useful for (1) student evaluation and (2) for providing students with feedback on their surgical skills.

Surgical principles and skills are often difficult to teach and evaluate and further complicated by use of live animals or surgical simulators, typically in a laboratory setting, which is expensive and necessitates a large number of faculty to be effective. However, it is highly desirable that veterinary students be well trained in surgery because veterinarians are expected to perform at least basic surgical procedures upon graduation without further specialty training.

Several methods to evaluate veterinary student clinical skill training including surgical skills have been discussed and are necessary as accreditation requirements continue to become more stringent for clinical competency outcomes assessment. Both checklist and point scoring systems have been described generally in the context of structured examinations such as the Objective Structured Clinical Examination (OSCE) rather than on observations of students in clinical settings such as the Clinical Observed Performance Evaluation (COPE). Whereas several Likert-type or global point rating scale evaluation instruments have been described for assessment of medical student surgical skills using OSCE and COPE, we are unaware that similar instruments have been used for assessment of veterinary student surgical skills.

Thus, our purpose was (1) to evaluate the design and use of a global rating scale instrument in veterinary medical education and (2) to use the instrument to examine the effectiveness of 2 week-long surgical techniques courses for improving surgical skills in veterinary students. The 2 courses used for student observation and evaluation (VTMED 6528 Equine Surgical and Anesthetic Techniques and VTMED 6529 Food Animal Surgical and Anesthetic Techniques) have been taught for many years, but have never included a formal assessment of the students’ surgical skills. Our first hypothesis was that student surgical skill scores attained by the end of the second week-long course would be significantly higher (improved) than those demonstrated at the beginning of the first week-long course. Our second hypothesis was that student opinions about their improvement in surgical skills, as determined by survey results, would agree with our findings. Both these hypotheses were based on previously reported findings from the medical education literature where medical students completing surgical skills training courses improved both their surgical skill proficiency level as well as their ability to perform accurate self-assessments of their proficiency level.

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METHODS

The University Institutional Review Board (IRB) for Human Participants reviewed this study and found it to qualify for Exemption from IRB Review according to paragraph 1 of the Department of Health and Human Services Code of Federal Regulations 45 CFR 46.101(b).

Assessment Instrument

A global rating scale instrument was designed for assessment of veterinary student surgical skills based on 2 instruments previously validated for the assessment of medical student, resident, and fellow surgical skills.12,13 Notably, we chose to use a 5-point scale with response anchors placed at points 1, 3, and 5 as it was determined that it would be too difficult to differentiate skill levels into >5 categories. The first author created the initial draft of the instrument and then met with the other authors to further refine the instrument into its final version (Appendix). Each individual skill as well as the response anchors for each skill score were discussed and agreed upon by all authors as well as by the course leaders before use of the instrument in the courses. All authors expressed concern regarding both the wording on the assessment form and our ability to score skills (hemostasis) and 12 (knowledge of the specific procedure) accurately because of the observational nature of the study and the complexity of the courses being evaluated. Both skills were kept on the assessment form, however, and their evaluation attempted.

Surgical Techniques Courses

The use of animals in these courses was approved and performed according to guidelines of the Institutional Animal Care and Use Committee.

The 2 week-long courses during which the students were observed and assessed were Equine Surgical and Anesthetic Techniques (VTMED 6528) and Food Animal Surgical and Anesthetic Techniques (VTMED 6529). These elective courses offered during the winter intersession in January were only open to 3rd and 4th year veterinary students. Despite the fact that students must give up 2 weeks of vacation to participate, there has always been a strong student response to the call for registration, and the courses typically fill to the enrollment limit necessitated by available facilities, equipment, and staffing. Each course is led by a board certified large animal surgeon and by 2 licensed veterinary technicians and further instructed by other board certified large animal surgeons, large animal surgery and anesthesia residents, veterinarians, and licensed veterinary technicians. Students work in groups of 3 per animal and rotate through the positions of surgeon, assistant surgeon, and anesthetist. Students receive printed notes on each procedure before the start of each course and also have access to videos for most of the surgical procedures performed. Although the students continuously receive informal feedback from instructors, they officially receive pass/fail grades only with no formal assessment about their performance or skill level.

The equine course occurs during the 1st week and includes the following procedures on live ponies: castration (with scrotal ablation) and ventral median exploratory celiotomy with pelvic flexure enterotomy and small intestinal resection and anastomosis (general anesthesia); abdominal laparoscopic exploratory and assisted rectal palpation (standing under sedation and with local anesthesia). The ponies are euthanatized after the procedures and their carcasses are used for the remainder of the course in which students perform procedures including enucleation, split bone removal, periosteal stripping, palmar digital neurectomy, and inferior check ligament desmotomy. Additionally, students practice cast application on the limbs and have a laboratory session sponsored by Synthes Vet (West Chester, PA), in which they practice fracture repair techniques on synthetic bone models.

The food animal course occurs in the 2nd week and includes the following procedures on live animals: right paramedian abomasopexy and right paralumbar fossa exploratory celiotomy with enterotomy, typhlotomy, and omentopexy (sheep, general anesthesia); bilateral exploratory celiotomy and omentopexy or pyloropexy (cows, standing with local anesthesia); ventral median exploratory celiotomy with umbilical and apex of the bladder resection and umbilical hemiortophorrh as well as castration and enucleation (calves, general anesthesia). All animals that had general anesthesia were euthanatized after completion of the procedures. The cows that had standing surgery were sold at auction upon recovery. Additionally, students use carcasses to practice udder/teat procedures as well as foot trimming and foot surgeries.

Student Enrollment

Students registered for both courses were eligible for this study and enrolled on a volunteer basis. Preliminary enrollment occurred by email communication. Official enrollment took place once the students signed individual informed consent forms on the 1st day of the equine course. Students were informed of the purpose of the study but were not allowed to view the assessment instrument until after study conclusion and completion of the student surveys. So, students were aware that they were being assessed on their surgical skills, but were unaware of the specific skills being examined.

All students had received the same basic skills training throughout their 1st and 2nd years of veterinary school in 4 laboratories (1.5 hours each; 1/semester) on cadavers or models. The laboratories were staffed by surgeons and surgical residents and included the basic skills 1–9 and 11 included in the assessment instrument. All students had the same live animal practice in the fall semester of their 3rd year performing and assisting in feline ovariohysterectomy. Further, all students had online access to an instrument atlas, suture and suture McGregor materia patterns and atlas, as well as knot-tying procedural videos at all times during their veterinary training which they were made aware of at the start of their 1st year of veterinary school.
Use of Assessment Instrument

Four of the authors were assigned to score the students using the assessment instrument and are hereon referred to as evaluators in that context. All have taught surgical techniques courses in the past, either on large or small animals. To avoid biases, none of the evaluators were course instructors for the 2 courses in this study. Each evaluator was assigned a group of students to evaluate by the first author based on student proximity to each other. The evaluator scored that same group of students for both their start and end scores and scored each skill in the instrument. Each student was scored only once for start scores and once for end scores by that assigned evaluator.

Students were observed and assessed during equine abdominal surgery (exploratory celiotomy, pelvic flexure enterotomy, and small intestinal resection and anastomosis) as well as palmar digital neurectomy surgeries to obtain beginning (start) surgical skill scores. These procedures were performed on multiple days throughout the beginning of the 1st week because of interspersed laboratories not relevant to this study such as the casting laboratory. Students were observed and assessed during sheep abdominal surgery (right paralumbar fossa exploratory celiotomy, enterotomy, typhlotomy, and omentopexy) as well as calf surgical procedures (exploratory celiotomy, umbilical, and apex of the bladder resection, umbilical herniorraphy, and castration) to obtain final (end) surgical skill scores. These procedures were also performed on multiple days throughout the end of the 2nd because of interspersed laboratories not relevant to the study.

To avoid biasing the study, evaluators did not assist the students unless there was an emergency and did not correct any improper techniques observed until the final procedures after end scores had already been obtained. It is important to note, however, that although the evaluators were not assisting or correcting the students throughout the courses, the course instructors were actively assisting the students and providing instruction and feedback on a daily basis.

Student Survey

Upon completion of the courses, students were asked to complete a brief paper survey consisting of 4 “yes” or “no” questions. The first question “Do you believe that your surgical skills have improved significantly over the past 2 weeks because of your participation in VTMED 6528 (Equine Surgical and Anesthetic Techniques) and VTMED 6529 (Food Animal Surgical and Anesthetic Techniques)?” was designed to generate data for testing our 2nd hypothesis that student opinions on improvement of their surgical skills would agree with our scored findings. The 2nd question “Did you feel that your participation in this study affected your learning in any way during the courses?” was intended to determine whether or not the students felt that the presence of the evaluators and the potential pressure of observation affected their learning in any way.1 This question also included a response box which stated: “If yes, please state whether the effect was positive or negative.” The 3rd and 4th questions (“Would you like me to review your completed Veterinary Surgical Skills Assessment Forms with you?” and “Do you think that future implementation of formal assessment methods for courses such as these would be of benefit to students?”) were designed to assess student desire for feedback and student acceptance of formal assessment methods. The 4th question also included a response box which stated: “Please briefly explain the reason for your response.” Because of the authors’ use of the data generated from the 1st question to evaluate our 2nd hypothesis, student surveys were not anonymous.

Student Debriefing

At study end and completion of student surveys, a voluntary meeting was held with the students in which the first author gave a presentation on the study background, methods, and results. The results were then discussed as a group and student opinions on both the assessment instrument and the surgical technique courses were obtained. After the group discussion, the first author met with each student on a voluntary basis to discuss their own scores and provide feedback on the skills that showed improvement and the skills needing additional work.

Statistical Analyses

Our 1st hypothesis was that student surgical skill scores would improve during the 2 week-long courses. In statistical terms, our null hypothesis (H0) stated that there was no difference between start and end surgical skill scores, whereas our alternative hypothesis (H1) was that there was a significant difference (improvement) between start and end surgical skill scores. Paired t-tests were used to compare the differences in start and end scores for 3rd year students, 4th year students, and all students combined. Wilcoxon rank sum tests were used to compare 3rd and 4th year student start and end surgical skill scores as well as the differences in their start and end scores.

Our 2nd hypothesis was that student opinions on their improvement in surgical skills would agree with our scored findings. In statistical terms, our null hypothesis (H0) stated that the probability of a student finding an improvement in their skills (yes or no) would equal the probability of our scores finding an improvement (yes or no), whereas our alternative hypothesis (H1) was that the probability of a student finding an improvement in their skills would not equal the probability of our scores finding an improvement. A McNemar’s symmetry (χ²) test was used to assess the significance of agreement between student opinions and our scores above that of chance alone. A kappa (κ) coefficient was also calculated to quantify the magnitude of agreement.

All analyses were performed with software (Statistix 9, Analytical Software, Tallahassee, FL) and a value of P ≤ .05 was considered significant to reject the null hypothesis. Data are reported as (mean ± standard error (SEM); range). Results of paired t-tests are reported as t(degrees of freedom) = t-value, P = P-value. Results of Wilcoxon rank sum tests are reported as W = (lowest mean rank, P = P-value. The result of the McNemar’s symmetry test is reported as $\chi^2(degrees of freedom, N) = \chi^2-value, P = P-value.$
RESULTS

Student Enrollment

Registration for both courses was 21 students per course. Of the 21 students, 17 (81%) registered for both the equine and food animal course and were eligible for this study. Of the 17 eligible students, 16 (94%) volunteered and were enrolled in the study, 4 (25%) of which were 3rd years and 12 (75%) of which were 4th years. The 3rd year students had not completed any clinical rotations before these courses, whereas 4th year students had completed ~1 year of clinical rotations which may or may not have included surgical rotations.

Use of Assessment Instrument

As 16 students enrolled in the study, each of the designated evaluators scored 4 students. The 1st author assigned each evaluator their students based on student groups and surgery table locations so that the 4 students were as close to each other as possible, allowing for easier observation. The 1st author also provided each evaluator with an identification picture of each student as well as the printed assessment form on a clipboard. Instead of having 1 form for each student during the observation, all evaluators found it easier and more efficient to use 1 form only and to write each of their assigned student’s initials under or next to the point number given for each skill.

Overall, all evaluators found the assessment instrument itself easy to use. As anticipated, however, the evaluators had difficulty scoring skill 9 (hemostasis) because of the type of surgeries being observed and the fact that they were terminal in nature. Because the authors felt that the students justly chose to spend their limited time performing the surgical techniques such as enterotomies and resections rather than spending the time controlling hemostasis in some cases during terminal procedures, skill 9 was eliminated from the study and excluded from any analysis. For this reason, skill 9 does not appear in the results figures and the maximum possible total surgical skill score for each student dropped from 60 points as indicated on the original assessment form (Appendix) to 55 points.

Skill 12 (knowledge of specific procedure) was also challenging for the authors to score given that some procedures were more complicated than others and some of the notes and videos provided to the students for preparation were more detailed than others. Nevertheless, the authors kept to their agreed upon anchors and were able to assign a start and end score to each student. For this reason, skill 12 was kept in the study and included in the analysis.

Other challenges faced while scoring the students were the rotation of students through the positions of surgeon, assistant surgeon, and anesthetist, and that some procedures were not originally planned to be sterile in nature for the purposes of the courses such as the limb surgeries performed on carcasses. Both of these challenges necessitated the 1st author and the 2 licensed veterinarian technicians who led the courses to ask students enrolled in the study to maintain sterile technique in instances where other students were not asked to. Additionally, in rare circumstances, students that had been filling the role of anesthetist had to be asked to specifically perform a procedure so that they could be scored.

Student Surgical Skill Scores

Total Surgical Skill Scores. Each student had an end total surgical skill score that was higher than their start total surgical skill score. When the differences in total start and end surgical skill scores were compared for 3rd year students (n = 4), 4th year students (n = 12), and all students combined (N = 16), each group had a statistically significant improvement as shown in Figure 1 (3rd year students: t(3) = 5.47, P ≤ .01; 4th year students: t(11) = 6.47, P ≤ .01; all students combined: t(15) = 7.45, P ≤ .01).

As anticipated based on experience, the mean ± SEM start surgical skill score of 3rd year students (37.75 ± 2.78 points; range, 32–42 points) was less than that of 4th year students (40.00 ± 0.90 points; range, 36–45 points), but this difference was not statistically significant, W(4;12) = 18.00, P = .51. Although the mean end surgical skill score of the 3rd year students (46.25 ± 1.43 points; range, 44–50 points) was higher than that of the 4th year students (44.83 ± 0.96 points; range, 38–50 points), this difference also was not statistically significant, W(4;12) = 17.50, P = .46. The mean difference in start and end surgical skill scores, however, was significantly higher in 3rd year students (8.50 ± 1.55 points; range, 5–12 points) compared to 4th year students (4.83 ± 0.75 points; range, 1–9 points) as shown in Figure 2. W(4;12) = 7.50, P = .04. Interestingly, the 4th year students that had the lowest differences in start and end scores (i.e. least improvement) were those with the lowest start scores.

Individual Surgical Skill Scores. When differences in student start and end surgical skill scores were compared for individual skills, students (3rd and 4th year students combined) had significant improvement in all skills except skill 1 (surgical preparation: student) and skill 12 (knowledge of specific

![Figure 1](image-url)

Figure 1  Mean ± SEM of 3rd year (n = 4), 4th year (n = 12), and all 3rd and 4th year students (N = 16) total start and end surgical skills scores. An asterisk indicates a significance difference between start and end scores for each group as determined using paired t-tests with significance set at P ≤ .05.
Individual Student Improvement. For individual students, a 5 point or more improvement in total surgical skill score was considered a significant improvement as determined by the authors. As such, 10 students (63%) had significant improvement in their surgical skills. Importantly, all 4 of 3rd year students had significant improvement, whereas only 6 (50%) of the 4th years had significant improvement.

Student Surveys

All 16 enrolled students completed the paper surveys immediately after completion of the food animal course. In response to the 1st question, “Do you believe that your surgical skills have improved significantly over the past 2 weeks because of your participation in VTMED 6528 (Equine Surgical and Anesthetic Techniques) and VTMED 6529 (Food Animal Surgical and Anesthetic Techniques)?” 13 students (81%) answered “yes.” Of these 13 students, 9 (69%) were also considered to have significant improvement in their surgical skills based on our criteria (with significant improvement defined as a 5 point or more improvement in total surgical skill score) whereas the other 4 (31%) did not. All 3 students who answered “no” to the 1st question were 4th year students. Of these, 2 (77%) were also considered not to have significant improvement in their surgical skills based on our criteria whereas 1 (33%) had significant improvement. Using a McNemar’s symmetry test, the null hypothesis that the probability of a student finding an improvement in their skills would equal the probability of our scores finding an improvement was accepted ($X^2[1,16] = 1.80$, $P = .18$), however the calculated $k$ coefficient of 0.24 revealed only weak to moderate agreement.

In response to the 2nd question, “Did you feel that your participation in this study affected your learning in any way during the courses?” 7 students (44%) answered “no.” Of the other 9 students (56%) that answered “yes,” all felt that their participation in the study affected their learning in a positive way. The most common explanation given by the students for this response was that the study made them more conscientious of their technique. Several of the 9 students also commented that they chose the responses “yes” and “positive” in anticipation of the feedback that they would receive from the first author.

In response to the 3rd and 4th questions that assessed student desire for feedback and student acceptance of formal assessment methods, the responses were overwhelming in support of both. Fourteen (88%) of students answered “yes” to the 3rd question “Would you like me to review your completed Veterinary Surgical Skills Assessment Forms with you?” and 14 (88%) of students answered “yes” to the 4th question “Do you think that future implementation of formal assessment methods for courses such as these would be of benefit to students?” Interestingly, the 2 students who answered “no” to the 3rd question were not the same 2 students who answered “no” to the 4th question. The most common explanation for the answer “yes” to the 4th question was that the students felt that it was important to get feedback so that they would know what they needed to work on in order to improve. The 2 students that
answered “no” to this same question stated that they felt that actual assessments were not necessary for learning or improvement.

**Student Debriefing**

Five students (36%) who responded “yes” to the 3rd survey question attended the voluntary evening meeting. Four other students who could not attend the meeting because of clinical rotation obligations contacted the first author to obtain feedback via email. During the meeting, the first author gave a brief presentation on the study background, methods, and results, and then discussed the study with the students as a group. Through this discussion, valuable insight was gained that was not obtained through the student surveys. For example, whereas none of the students who responded “yes” to the 2nd survey question “Did you feel that your participation in this study affected your learning in any way during the courses?” qualified their response in a “negative” way, several of the students at the meeting admitted that the presence of the authors performing the scoring and standing at their surgery table made them very nervous and that at times they felt that this nervousness took away from their experience in the courses. All of the students present at the meeting also expressed their frustration at not being able to ask the evaluators for help when they were standing right there at their table. Whereas this was a concern of the authors from the beginning, this was the first time that such a feeling was voiced by the students. Despite such feelings, all students expressed gratitude for the author’s initiative to create an objective assessment method for evaluating their surgical skills and for providing them with feedback on their performance and how they could improve in the future.

The debriefing meeting with the students also yielded valuable feedback about the importance of access to videos of procedures for student preparation. For example, whereas students had access to videos of the procedures that they were assessed on for their start surgical skills scores, they did not have access to videos for some of the procedures on which they were assessed for their end surgical skills scores including the umbilical and apex of the bladder resection, and umbilical herniorrhaphy. Students felt that this was the likely reason why their end scores for skill 12 (knowledge of specific procedure) were lower than their start scores.

**DISCUSSION**

Our purpose was to both evaluate the design and use of a global rating scale instrument in veterinary medical education and to use this instrument for the first time to examine the effectiveness of 2 surgical techniques courses for improving the surgical skills of veterinary students. Although all evaluators found the instrument easy to use, some of the surgical skills were more difficult to assess than others. Also, the nature of the 2 surgical techniques courses created several challenges in performing the assessments. That students were evaluated during different surgical procedures to obtain start and end scores may have had an impact on our results. Nevertheless, this study provides readers with the basis of an assessment instrument which can be modified for use in specific veterinary colleges and/or specific courses. Additionally, our data reveals valuable insights into student desire for objective assessment methods and formal feedback mechanisms.

We believe that there is a clear need for assessment instruments like this in veterinary medical education. In designing such an instrument, we hoped to provide colleagues with one that would be easy to apply with or without minor modifications. For this reason, we chose to use a global rating scale instrument, which has been shown to be more reliable and consistent than checklist systems, and to only include important basic surgical skills that would be easy for veterinarians of all levels of training to evaluate. The summation of the individual skill scores, as previously described, also allows for an overall evaluation of surgical skill proficiency. However, as we experienced, what seems like a basic surgical skill can be difficult to evaluate, particularly in the setting of a COPE which lacks the structure and consistency of an OSCE. Because of challenges faced during assessment in these particular surgical techniques courses, we were forced to eliminate the critical surgical skill of hemostasis from the evaluation. Had the students been assessed one at a time performing a more simple recovery procedure such as a feline or canine ovariohysterectomy, we believe this particular skill could have been evaluated without difficulty. It would perhaps be better to use an instrument like this, especially initially, during a course in which each student performs an entire basic surgery by themselves in the context of a COPE or during a standardized surgical exercise in the context of an OSCE. Another option for using this instrument would be to have the students each perform one standardized basic surgical procedure before the start of the course and then again at the end of the course on which all evaluations would be made.

It is important when using an assessment instrument that all evaluators agree on every skill and every response anchor to avoid any confusion or inconsistencies in scoring. Although similar instruments used in human medical education have yielded excellent inter-rater reliability results, we should have tested the inter-rater reliability of this instrument for use in veterinary medical education. This could have been performed on a trial group of students each performing the same surgical procedure and being evaluated by multiple evaluators whose scores were then compared. This also could have been tested by having the evaluators rate overlapping groups of students throughout the course of the study and then comparing the scores of the overlapping students assigned by the different evaluators. One potential way to make the process of multiple evaluators assessing the same student easier, and perhaps also make the assessment process more appealing would be to videotape students during surgery and then perform the assessments using videotapes. Not only would this allow for more flexibility in scheduling, it also allows the evaluators to go back and watch a student multiple times before assigning a point value for a specific skill. Because each of the evaluators in this study had to assess 4 students simultaneously, there were certainly times...
when skill scores were assigned based on a single observation. Had students been videotaped, each performance of a specific skill could have been observed multiple times allowing for a more accurate assessment. In addition, had assessments been made from videotapes, student frustration at not being able to ask evaluators for assistance during surgery would have been avoided. It is important to note, however, that the use of videotapes alone to perform evaluations can be problematic as it is difficult to get the full perspective by camera on the performance of skills such as preparation of student and patient, especially scrubbing and draping.

Despite the previously described issues caused by the nature of the courses examined and the surgeries that the evaluators observed, the authors were able to draw several important conclusions from the data regarding student improvement in surgical skills and student acceptance of formal assessment methods. Whereas results based on only four 3rd year students must be interpreted with some degree of caution, a statistically significant difference between 3rd and 4th year students was found when comparing improvement in total surgical skill scores with 3rd year students having a 1.75 times greater improvement than 4th year students in terms of points. In addition, all 3rd year students had individual improvement in their total surgical skill scores compared to only 50% of 4th year students. Whereas it might have been expected that the 4th years students who had the least improvement where the ones that started with the highest start total surgical skill scores (i.e. those who did not have much room for improvement), this was not the case. The 4th year students that had the least improvement in their total surgical skill scores were actually the ones with the lowest start total surgical skill scores. There are a couple of possible explanations for this finding. The first is that these 4th year students may have had the unfortunate opportunity to learn incorrect surgical skills or “bad habits” before these courses either on clinical rotations or in other settings in which they may have received less guidance than they did in these courses. These “bad habits” would then be harder to correct whereas 3rd year students who are essentially starting de novo soon after their live animal practice are easier to train.1,20 The 2nd possible explanation is that because of the increased number of 4th year students compared to 3rd year students, we were able to detect several 4th year students who perhaps lack natural surgical ability or manual dexterity.7 Had we examined a comparable number of 3rd year students, a similar phenomenon in which several 3rd year students displayed little improvement in surgical skills despite the intensive learning environment of the surgical techniques courses may have been found. The significant difference between 3rd and 4th year students we observed raises some interesting questions about which students benefit most from surgical techniques courses such as these and suggests that such courses may be more effective earlier in the curriculum. This finding needs further examination in a larger group of students before any definitive conclusions can be made.

A strong and consistent theme throughout this study was student desire for feedback. Tied into this concept is student acceptance of formal objective assessment methods because they will result in meaningful feedback. This desire was evident in all aspects of the study from student enrollment through student survey results and information obtained during the student debriefing meeting. Students felt strongly that they needed more formal and regular feedback to know where they needed to improve. They also stressed that this feedback would be most useful if it could be given halfway through a course or clinical rotation while there is still time for improvement and preferably opportunities for re-evaluation. The benefit of feedback on long-term improvement in the surgical skills of human medical students has been previously reported21,22 and there is no reason to believe that this would be any different for veterinary students. The use of an objective assessment instrument as we described, provides an excellent opportunity to give formal feedback either in a written format or verbally through meetings with students. That only a weak to moderate agreement was found between student opinions on their improvement in surgical skills and our assessment scores underscores this need for feedback.

Veterinary surgical skill assessment instruments like the one we designed are useful for student evaluation and for providing feedback they can use to improve as veterinary surgeons. Furthermore, formal assessments are necessary for objective student assessment as accreditation requirements continue to become more stringent for student learning outcomes. Additional work needs to be performed to determine the most efficient way to incorporate these assessments into the curriculum either through COPEs or OSCEs, and possibly with the use of videotaping. Additional work needs to be performed to determine how surgical techniques courses can be used most effectively to improve the surgical skills of veterinary students. Whereas our results suggest that these courses are more effective earlier on in the curriculum than after the students have already started their clinical rotations, the sample size is small and the courses examined are very specific advanced courses that may not be generalizable to all surgical techniques courses. In conclusion, we have developed a surgical skill assessment instrument that can be readily adapted and incorporated into outcomes assessment of a veterinary curriculum.

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REFERENCES

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## APPENDIX: VETERINARY SURGICAL SKILLS ASSESSMENT FORM

Date __/__/____ Student Name _____ DVM Class _____ Course #:_____ Evaluator______

1. Surgical preparation (student): scrubbing, gowning, and gloving
   - Improper technique, unable to maintain sterility
     - 1
   - Mostly proper technique, hesitates/inefficient
     - 3
   - Consistently demonstrates proper technique, efficient
     - 5

2. Surgical preparation (patient): scrubbing, four corner draping
   - Improper technique, incorrect use or placement of drapes
     - 1
   - Mostly demonstrates proper technique and drape placement, hesitates/inefficient
     - 3
   - Consistently demonstrates proper technique and drape placement, efficient
     - 5

3. Scalpel handling
   - Holds incorrectly, changes grip often
     - 1
   - Holds correctly some of the time, occasional awkward movements
     - 3
   - Smooth, sure movement, depth even
     - 5

4. Process of making an incision
   - Disjointed, unsure movements, depth uneven
     - 2
   - Somewhat smooth, occasional unsure movements, depth generally even
     - 4
   - Smooth, sure movement, depth even
     - 5

5. Use of forceps on tissue
   - Holds incorrectly, awkward or inappropriate use
     - 1
   - Holds correctly some of the time, occasional awkward use
     - 3
   - Holds correctly consistently, uses forceps with precision
     - 5

6. Needle handling with needle holder
   - Repeatedly handles and loads needle incorrectly, i.e. not perpendicular to driver and/or not 2/3 up needle shaft
     - 2
   - Mostly acceptable handling and loading, occasional incorrect use
     - 3
   - Consistently smooth handling, loads needle properly, clamps driver onto needle
     - 5

7. Needle handling when suturing
   - Incorrect use and placement of needle, does not follow curve of needle
     - 2
   - Mostly acceptable use and placement, occasionally does not follow curve of needle
     - 3
   - Consistently correct orientation and distance from incision, follows curve of needle
     - 5

8. Quality of finished sutures
   - Poor quality (not square) knots, incorrect knot tension, asymmetric
     - 2
   - Most knots correct, tension sometimes incorrect, partially symmetric
     - 4
   - Square knots, appropriate tension, symmetric
     - 5

9. Hemostasis
   - Rarely exposes vessels, uses incorrect technique to obtain hemostasis
     - 2
   - Sometimes exposes vessels and uses correct technique
     - 3
   - Consistently exposes vessels and uses correct technique to obtain hemostasis
     - 5

10. Use of assistant
    - Rarely uses assistant strategically, poor communication with assistant
     - 2
    - Sometimes uses assistant strategically, generally good communication with assistant
     - 3
    - Consistently uses assistant strategically and communicates effectively with assistant
     - 5

11. Knowledge of instruments
    - Rarely uses correct instruments, unable to identify instruments
     - 2
    - Sometimes uses correct instruments, not always familiar with instruments
     - 3
    - Consistently uses and is familiar with correct instruments
     - 5

12. Knowledge of specific procedure
    - Deficient knowledge in majority of steps, needs guidance at each step
     - 2
    - Knows important aspects of most steps, sometimes needs guidance
     - 3
    - Knows all important steps, does not need guidance to know what to do next
     - 5

TOTAL SCORE (Out of 60) _____