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Objective—To investigate factors influencing screw loosening after triple pelvic osteotomy (TPO) and ilial wire stabilization of the acetabular segment.

Design—Retrospective case series.

Animals—227 dogs with congenital hip dysplasia or subluxated hip joints.

Procedures—Medical records and radiographs of 227 dogs that underwent 332 TPO procedures were evaluated, and data pertaining to screw type, plate position, sacral screw engagement, use of ischial interfragmentary wires, and pelvic alignment were assessed for associations with screw loosening.

Results—Complications developed in 96 of the 332 (29%) procedures. Cancellous screws without sacral engagement were associated with the lowest frequency (6%) of loosening, compared with cancellous and cortical screws engaging the sacrum and cortical screws that did not engage the sacrum. Frequency of screw loosening increased when cortical or cancellous screws engaged the sacrum and when cortical screws were used. In dogs that had surgery bilaterally, the first limb on which TPO was performed had a higher frequency of screw loosening than the second limb. Pelvic alignment loss was greatest (5.4°) when the 3 most cranial screws were loosened. Loss of pelvic alignment was significantly different between dogs that underwent surgery and had complications and those that underwent surgery and did not have complications in association with loosening of 1, 2, and 3 screws.

Conclusions and Clinical Relevance—TPO screw loosening was multifactorial and related to stability of the affected ilium, screw type, and screw position. Placing cancellous screws that do not engage the sacrum in pelvic osteotomy plate positions 1 through 3 may decrease the number of screws that loosen. (J Am Vet Med Assoc 2006;229:535–541)

Canine hip dysplasia is an inherited disease with an estimated heritability ratio ranging from 0.34 to 0.68.1 Hip joint laxity allows for development of osteoarthrosis.2,3 and continual stretching of the joint capsule and acetabular rim destruction perpetuate joint laxity and pain. Medical and surgical treatments are commonly used in the management of clinically affected dogs. Medical management is palliative in nature and may include cage rest, regular and controlled exercise, physical therapy, weight management, and administration of chondroprotective agents and anti-inflammatory medications.4,5 Surgical intervention is used to relieve signs of pain, correct gait abnormalities, and slow the development of or reduce discomfort associated with osteoarthrosis.2 The TPO procedure presently used in dogs was modeled after the procedure used in humans for treatment of congenital hip dislocation and femoral head dislocation in young adults.6,7 A stair-step osteotomy procedure described by Hohn and Janes8 in 1969 for treating canine patients evolved into a procedure in which pubic, ischial, and ilial osteotomies were created. These osteotomies allow ventroversion of the acetabular segment, which has the effect of stabilizing the hip joint by increasing femoral head coverage and articulating contact surface area.1

The postoperative complication rate associated with the TPO procedure ranges from 33% to 70%, with screw loosening being the most common complication.9,10 Early screw loosening develops in the first 2 to 6 weeks after surgery9,10,11 and is thought to be the result of decreased retention of screws in less-dense juvenile bone.12,13 Early screw loosening can lead to loss of alignment between the ilial and acetabular segments, and improper alignment and medial displacement of the acetabular segment can result in pelvic canal impingement.14,15

Studies yield various results have been performed to identify factors that result in screw loosening. It has been proposed that increasing sacral engagement with screws and increasing the number of screws engaging the sacrum can mitigate screw migration.16-18 However, those results are in conflict with findings from other studies,19,20 in which screws that spanned the sacroiliac joint were associated with unfavorable results. In an in vitro model in 1 study,21 4.0-mm cancellous screws had higher pullout strengths in immature pelvic bone than did 3.5-mm cortical screws. Screw type has not been reported to influence screw loosening.17,20,21 In other recent studies,22,23 investigators advocated application of a plate to the ventral aspect of the ilium to add rigidity to the ilial fixation and decrease screw loosening.

Stabilization with ischial wires has also been reported24,25 to decrease screw loosening. It has been speculated that the ischial interfragmentary wire adds stability to the caudal acetabular segment, thereby increasing stability of the repair. Results from the few studies24,25,26 in which the role of ischial interfragmentary...
tary wires was investigated were derived from small sample sizes. The purpose of the study reported here was to investigate the factors that influence screw loosening in the presence of ischial wire stabilization of the acetabular segment and to determine whether the wire has a role in reducing the overall complication rate associated with the TPO procedure.

Criteria for Selection of Cases

Medical records and radiographs from dogs examined at the Iowa State University College of Veterinary Medicine teaching hospital from October 1991 to November 1999 were searched for dogs that had a diagnosis of congenital hip dysplasia or hip joint subluxation and that had undergone a TPO procedure.

Procedures

Information regarding breed, weight, age, angle of CPOP used, date of surgery, and date of follow-up examination was collected from records and recorded for each surgery session. Breeds were classified as Labrador Retriever, Golden Retriever, Rottweiler, German Shepherd Dog, mixed breed, and other breeds.

Lateral and extended ventrodorsal pelvic radiographic views were used to evaluate the pelvis before surgery, after surgery, and at reexamination. Postoperative radiographs were obtained while dogs were anesthetized, and most of the reexamination radiographs were obtained with dogs heavily sedated to allow for accurate and repeatable positioning. Surgical episodes for which radiographic positioning was inconsistent were excluded from the study. Canine pelvic osteotomy plates were used for all of the procedures. Second-generation CPOPs were used in 330 procedures, and first-generation CPOPs were used in 2 procedures. The first-generation plates had cranial and caudal ilial wire holes and square corners, whereas the second-generation plates had a caudal ilial wire hole and rounded corners.

Screw holes were numbered 1 through 6 from craniodorsal to caudoventral, according to methods that have been described. Screws were numbered according to the screw hole number in which they were placed and were identified as cancellous or cortical. Screw loosening was defined as any change in screw position between the immediate postoperative and follow-up radiographs. Screws were defined as tight in the absence of radiographic changes. A screw was defined as being in the sacrum if 1 or more screw threads engaged the sacral body or sacral wing. Sacral screw depth was divided into the following groups: < 25%, 25% to 49%, 50% to 74%, and 75% to 100% of the hemisacrum. Ilial hemicerclage wires were evaluated and classified as intact, broken, or not present. The same classification scheme was used for the ischial interfragmentary wire.

Radiographs were analyzed for loss of alignment between the cranial ilial and caudal acetabular segments if any of the following were observed: at least 1 screw was loose, the ilial hemicerclage wire was broken, or the ischial interfragmentary wire was broken. Loss of hemipelvic alignment was determined from the postoperative and follow-up ventrodorsal radiographic views (Figure 1). A line was drawn connecting the left and right ilial crests (line A). A perpendicular reference line connected that line to the cranilateral aspect of the acetabulum on the operated ilium (line B). A third line was drawn from the same reference point on the acetabulum to the ipsilateral ischial tuberosity (line C). The outside angle created between the second and third lines was measured. The change in angle, as determined by comparing the post operative radiograph with the follow-up radiograph, was recorded. A dog that did not have complications associated with the TPO procedure was recorded. The same measurements were performed in both dogs in each pair.

Statistical analysis—Analyses were performed by use of statistical software. Distribution tables were used to determine means, medians, and confidence intervals for age, weight, time between surgery and reexamination, and time between surgeries for dogs in each pair.

Figure 1—Ventrodorsal radiographic view of the pelvis and femurs of a dog that underwent TPO surgery for treatment of hip dysplasia. White lines indicate measurements used to determine loss of pelvic alignment secondary to fixation screw loosening. Changes in angle were determined by comparing postoperative radiographs with follow-up radiographs. A = Line connecting the left and right ilial crests. B = Perpendicular reference line connecting line A to the cranilateral aspect of the acetabulum. C = Line from cranilateral aspect of the acetabulum to the ipsilateral ischial tuberosity. *Angle created by intersection of lines B and C.
which the surgery was performed bilaterally. A χ² test was used to evaluate screw loosening by breed, weight, age, and sacral screw depth and was also used in conjunction with a logistic regression plot for weight and age and a contingency table for breed. For dogs that had bilateral surgery, a McNemar test was used to analyze screw loosening associated with the order in which the limbs were operated. Values were determined with 1 degree of freedom. Screw loosening in association with screw type, sacral engagement, cranial ilial segment, and caudal acetabular segment was evaluated with a 2-tailed Z test. The relationship between screw loosening on the cranial ilial segment and simultaneous screw loosening on the caudal acetabular segment was assessed with the Fisher exact test. Screw loosening in relation to the CPOP acetabular segment was assessed with the Fisher exact test. Screw loosening in relation to the CPOP acetabular segment was assessed with the Fisher exact test. Screw loosening in relation to the CPOP acetabular segment was assessed with the Fisher exact test.

Results

Of 252 records that were initially identified and evaluated, those for 19 dogs were excluded because of absence of sufficient radiographic information. Of the remaining 233 dogs that were acceptable on the basis of radiographic criteria, 6 were excluded because of incompleteness of the medical record, leaving 227 dogs that underwent 332 TPO surgeries included in the study. One hundred eighty-two dogs had hip dysplasia, and 45 dogs had subluxation of 1 or both hip joints. The TPO procedure, which includes pubic, ischial, and ilial osteotomies, was performed according to described methodology. The surgery was performed bilaterally in 150 dogs, but follow-up radiographs after both surgical procedures were available in only 105 dogs; for 26 surgeries on the left limb and 19 on the right limb, follow-up radiographs were not obtained after the second procedure at the teaching hospital or mailed by the referring veterinarian for examination. Therefore, only data from the first surgeries were collected for analysis in those dogs. Seventy-seven unilateral TPO procedures were performed, with 40 of those surgeries performed on the left hind limb and 37 performed on the right hind limb.

The 5 breeds most commonly represented were Labrador Retriever (n = 49), Golden Retriever (47), mixed breed (37), Rottweiler (16), and German Shepherd Dog (15); also included were 63 other dogs representing 28 other breeds.

Dogs that had surgery on the left hind limb had a mean weight of 30.7 kg (67.5 lb) at the time of surgery, with a range of 10.4 to 65.8 kg (22.9 to 144.8 lb). Dogs that had surgery on the right hind limb had a mean weight of 31.2 kg (68.6 lb), with a range of 10.4 to 60.8 kg (22.9 to 133.8 lb) at the time of surgery. Dogs that had bilateral surgery weighed a mean of 0.7 kg (1.5 lb) more at the time of the second procedure than they did at the first, irrespective of the side undergoing the procedure (range, 10.0 kg [22.0 lb] more to 3.2 kg [7.0 lb] less). Weight did not influence screw loosening for TPOs performed on the left side (P = 0.975), but there was a positive correlation between weight and screw loosening when TPO was performed on the right limb (P = 0.005). The r² value for the right limb was 0.042.

Median age at the time of surgery was 11 months (range, 6.0 to 26.5 months; n = 216 TPOs). Age did not have a significant impact on screw loosening. Median number of days to reexamination was 35 (range, 28 to 76 days; n = 266 TPOs), and the median number of days between surgeries in dogs that had bilateral surgery was 43 (range, 27 to 380 days; n = 100 TPOs). Certain TPOs were not included in these calculations to eliminate the error introduced by 5 dogs that returned 2 to 5 years after the first procedure to have the limb in which surgery had been performed reevaluated or to have the contralateral joint evaluated.

Ninety-six of 332 TPO surgeries were associated with complications at reexamination. Postoperative screw loosening was observed after 83 surgeries, and a broken ischial interfragmentary wire was observed after 15 surgeries. A combination of screw loosening and wire breakage developed after 2 procedures. Screw positions 1, 2, and 3 (the cranial 3 screws) were involved in 69 of 83 (83%) screw-associated complications. Nine of the 83 (11%) complications were isolated to the caudal 3 screws, and 5 (6%) involved screws placed cranial and caudal to the ilial osteotomy. There was no correlation between screw loosening on the cranial ilial segment and on the caudal acetabular segment in either limb. In cases with a single loose screw in positions 1 through 3, screw 1 was loose 87% (27/31) of the time. When screws loosened on the cranial ilial segment, 1 screw was loose in 42% (31/74) of the procedures, 2 screws were loose in 27% (20/74) of the procedures, and all 3 cranial screws were loose in 31% (23/74) of the procedures. In 13 of the 105 (12%) bilateral surgeries, screw loosening developed bilaterally. The limb that underwent surgery first had a higher incidence of screw loosening than the limb that underwent surgery second, regardless of the side on which surgery was performed first (first procedure on the right, P = 0.003; first procedure on the left, P = 0.02). The radiographic evidence indicated a 29% (96/332) complication rate associated with the TPO procedures.

Overall, 1,992 screws were placed in plate positions 1 through 6. Eight hundred ninety-six cancellous screws and 100 cortical screws were placed in holes 1 through 3 of those, 11% (99/896) of the cancellous screws and 41% (41/100) of the cortical screws were loose in the cranial aspect of the plate. Cortical screws loosened at a greater frequency than cancellous screws (P < 0.001). A combination of cortical and cancellous screws also filled plate positions 4 through 6; in those positions, 3% (24/886) of cancellous and 2% (2/110) of cortical screws loosened. Screw type did not influence screw loosening caudal to the ilial osteotomy site (P = 0.709).
Of 193 screws with sacral purchase, 163 were cancellous screws and 30 were cortical screws. Thirty-five percent (57/163) of the cancellous screws and 63% (19/30) of the cortical screws loosened. The remaining 803 screws did not engage the sacrum; in that population, 6% (42/733) of cancellous and 31% (227/70) of cortical screws loosened. Screws engaging the sacrum were more likely to loosen than screws without sacral penetration (left limb, \( P = 0.025 \); right limb, \( P < 0.001 \)). A linear relationship between screw loosening and depth of sacral purchase was observed. As the depth of screw purchase increased, the frequency of screw loosening also increased (left limb, \( P < 0.001 \); right limb, \( P < 0.001 \)).

Information pertaining to the CPOP angle was available for 325 TPO surgeries. Plates with angles of 20° (n = 54), 30° (219), 40° (47), and 45° (5) were used. No relationship between CPOP angle and incidence of screw loosening was observed in the left or right limb (\( P = 0.121 \) and 0.637, respectively).

The ischial osteotomy site was stabilized with an interfragmentary wire in 327 of the TPO procedures; of those, 162 were on the left limb and 165 were on the right limb. Seven interfragmentary wires placed in the left limb broke, and 8 broke in the right limb. Wire breakage was complicated by screw loosening in 1 case. In that dog, cancellous screws had been placed and loosening was detected in screw positions 4, 5, and 6 (ie, in the acetabular segment). Four of the dogs with wire breakage also had at least one of the screws in positions 1, 2, or 3 in the sacrum. Of the 5 surgeries in which an interfragmentary wire was not used, screw loosening was detected in 2 instances. In those 2 instances, screw loosening was isolated to positions 1, 2, and 3; all 3 screws engaged the sacrum, and cancellous screws had been used.

The combination of screw type and sacral screw engagement in the presence of an ischial interfragmentary wire was analyzed for screw loosening. Cortical screws without sacral engagement loosened less frequently than cortical screws with sacral engagement (\( P = 0.003 \)). When both cancellous and cortical screws had sacral purchase, cancellous screws loosened less frequently (\( P = 0.002 \)). Screw loosening was not significantly different for cortical screws without sacral purchase, compared with cancellous screws with sacral purchase (\( P = 0.72 \)). Cortical and cancellous screws with sacral purchase and cortical screws without sacral purchase loosened more frequently than cancellous screws without sacral engagement (\( P < 0.001 \); Figure 2).

Radiographs in which screw loosening, a broken interfragmentary wire, or both were revealed were evaluated for a change in angle between the cranial ilial and caudal acetabular segments. An increase in angle correlated with loss of pelvic alignment as the caudal segment displaced medially. In comparison with the individually assigned dogs, the angle in dogs with 1 screw loose on the cranial ilial segment had a mean increase of 2.1° (\( P = 0.001 \)), whereas the angle in dogs with 2 screws loose underwent a mean increase of 1.8° (\( P = 0.048 \)). When all 3 cranial screws loosened, a mean increase of 5.4° in angle was measured (\( P = 0.001 \)). No significant difference in the degrees of alignment lost was detected with 1 versus 2 loosened screws, but when all 3 cranial screws were loosened, changes in angle were significantly (\( P = 0.009 \)) different from the change in angle that developed with 1 or 2 loose screws, but the change in alignment was significant for cases in which all 3 screws loosened, compared with the other 2 groups. *Significant difference from other groups.

**Discussion**

The TPO procedure is an accepted surgical treatment in dogs with hip dysplasia and is considered to prevent development of osteoarthrosis by providing increased femoral head coverage. The surgery eliminates discomfort and permits the dog to return to nearly normal function, results that are superior to those...
associated with excisional arthroplasty and conservative management. Because the procedure can slow or eliminate the progression of osteoarthritis, juvenile dogs with no radiographic evidence of osteoarthritis are considered the best candidates for TPO surgery. Changes detected in radiographs of the hip joint may not be a sufficient indicator of osteoarthritis because approximately 50% of dogs without radiographic evidence of osteoarthritis have articular cartilage abnormalities. The complication of screw loosening that could lead to loss of fixation remains the chief postoperative concern associated with this procedure. It has been hypothesized that low bone density in the immature ilium and the high activity level of young dogs potentiate screw loosening. However, screw loosening has been identified in dogs that were confined to cage rest and strict exercise restriction, suggesting that the problem may be multifactorial and possibly related to the overall stability of the ostotomized ilium, screw type, or screw positioning.

An overall complication rate of 29% was observed in the present study. Twenty-five percent of the complications were the result of screw loosening, results that were similar to complication rates reported in other studies. An ischial interfragmentary wire had been placed in 99% of the TPO surgeries evaluated in the present study. The remaining 1% did not involve an ischial interfragmentary wire and included 2 instances in which screws loosened. These results imply that, independently, the interfragmentary wire does not prevent loosening of fixation screws.

The pullout strength of 4.0-mm cancellous screws in juvenile dogs is superior to that of 3.5-mm cortical screws. The outside diameter of the screw, larger thread size, or both are likely responsible for this result. With increased pullout strength, 4.0-mm cancellous screws provide additional rigidity to the initial fixation. Despite the increased rigidity associated with 4.0-mm cancellous screws, the incidence of screw loosening has not been reported to be different for cancellous screws, compared with cortical screws, in the early postoperative period. Results indicated that cancellous screws placed in positions 1 through 3 of the CPOP loosen less frequently than cortical screws placed in the same positions. However, in CPOP positions 4 through 6, screw type was not significantly related to the frequency of screw loosening, a finding that supported the results of previous studies. The ratio of frequency of cranial ilial screw loosening to caudal ilial screw loosening was 5:1, a finding that was similar to results of other studies in which reported ratios were 4:1 and 6:1. Our finding that screw loosening is more common at CPOP positions 1 through 3 than positions 4 through 6 supported findings from earlier studies. An emphasis on the type of screw placed in CPOP positions 1 through 3 is essential if the complication rate associated with the TPO procedure is to be reduced. Results of the present study and earlier studies suggest that use of cancellous screws in CPOP positions 1 through 3 should extend the rigidity of the initial fixation into the extended postoperative period and result in a decreased frequency of radiographically apparent and clinical complications.

Engagement of the sacrum with screws in plate positions 1, 2, and 3 is known to be a factor in screw loosening. In 1 study, in two thirds of TPO procedures that were complicated by postoperative screw loosening, more than 1 screw had been placed in the sacrum and the number of screws engaging the sacrum did not affect the frequency of screw loosening. Similar results have been reported in other studies. However, other investigators have reported that the number of screws in the sacrum did not play a role in screw loosening and that sacral screw engagement diminishes screw loosening. Our results indicated that there was a significant difference in the rate of screw loosening between screws placed in the sacrum and those without sacral engagement. A 65% loosening rate was observed for screws, independent of screw type, that had sacral purchase. Conversely, a 9% screw-loosening rate was observed for screws without sacral penetration. Additionally, the frequency of screw loosening increased as the depth of sacral penetration increased. Screw migration has also been associated with stabilization of sacroiliac subluxation. Screws undergo dynamic loading as they cross the sacroiliac joint and engage the sacrum. Screw migration has been reported for screws having < 60% of the sacrum engaged. No screws in the present study engaged > 25% of the total sacral width, which may explain why increasing the length of sacral purchase did not alter screw loosening.

When surgeries were performed bilaterally in a staged manner, the first limb to undergo the procedure had a higher associated frequency of screw loosening during the postoperative period, compared with the second limb. Increased loading of a limb indicates that the limb is nonpainful. It is speculated that the dogs in the present study were reluctant to increase loading of the dysplastic contralateral limb and continued to bear a large load on the side in which the procedure had been performed. During recovery from the second surgery, the load shift would be greater to the side that underwent surgery first, sparing the fixation on the second limb.

Stabilization of the acetabular segment has been proposed to counteract and minimize the forces applied to the CPOP and screws, reducing the number of screws that loosen. Ventral plate stabilization of the ilium decreases screw loosening by increasing the overall rigidity of the ostotomized ilium. Application of an ischial interfragmentary wire has also been speculated to add stability, however, it has been proposed that ischial wire application adds torque stress to the acetabular segment medially, generating additional forces that result in failure of the implants. Other studies have revealed that stabilization of the acetabular segment with an interfragmentary wire does not affect the frequency of screw migration. In the present study, stabilization with an ischial interfragmentary wire was used in 99% of the procedures and complications developed after 29% of the surgeries. The number of procedures in which an ischial interfragmentary wire was not used was insufficient to allow comparison with the outcome of procedures in which a wire was used.
The influence of screw type and sacral engagement on screw loosening has been evaluated in several studies with various results. To the authors' knowledge, screw type and extent of sacral engagement have not been evaluated simultaneously to determine the most appropriate combination. In the present study, screw loosening was dependent on the type of screw used and on whether the screw crossed the sacroiliac joint and engaged the sacrum. Cortical screws that engaged the sacrum had the greatest frequency of loosening, whereas cancellous screws without sacral purchase had the lowest frequency of screw loosening. These results suggest that use of cancellous screws and ensuring that screws do not engage the sacrum significantly reduce the frequency of screw loosening.

Loss of alignment between the cranial ilial and acetabular segments is a reported sequelae of screw loosening. When alignment between the 2 ilial segments is lost, the acetabular segment can displace medially and compromise the pelvic canal diameter. We found a substantial loss of alignment for dogs with loosening at screw positions 1, 2, and 3 in the CPOP. There was a mean increase in pelvic angle of 2.2° and 1.8° for loosening of 1 and 2 screws, respectively, but when all 3 screws were loosened, the mean change in angle was 5.4°. Measurement error is likely responsible for the 0.4° difference in angle between procedures with 1 and 2 loosened screws. Those results suggest that loss of alignment is minimal when 1 or 2 screws are loosened but is more substantial when all 3 screws loosen. Screw loosening and loss of alignment between ilial segments have resulted in surgical failure. In other reports, ilial segment alignment was maintained and osteotomy sites healed with no complications, even when screw loosening developed. Results of our study suggest that the radiographic outcome is dependent on the number of screws that loosen.

The present study was limited by the fact that results were derived solely from evaluation of radiographs. Radiographic rotation of the pelvis can hide screw heads, making evaluation of screw positions difficult. Postoperative radiographs were obtained with dogs under general anesthesia, and most of the reexamination radiographs were obtained with dogs heavily sedated to allow for accurate and repeatable positioning. Dogs with improper positioning were excluded from the study to minimize this limitation. Because of the radiographic origin of the study, clinical implications can only be speculative in nature. Therefore, whether there is any clinical difference between the 2.2°, 1.8°, and 5.4° of medialization of the caudal acetabular segment associated with loosening of 1, 2, and 3 screws, respectively, could not be determined. A study in which clinical outcome is evaluated against various degrees of screw loosening and caudal acetabular segment medialization is warranted.

Results suggest that cancellous screws placed in CPOP positions 1 through 3 that do not engage the sacrum will reduce the number of screws that loosen. The role of the ischial interfragmentary wire in preventing screw loosening could not be determined in this study because of insufficient numbers of cases in which the wire was not used. Loss of alignment between the cranial and acetabular segments is dependent upon the number of screws that loosen. Dogs in which 1 or 2 screws loosen have minimal loss of alignment, whereas loosening of all 3 screws in the cranial CPOP segment resulted in more loss of alignment and potentiated failure of the repair.

References

b. SAS statistical software, Jmp 5.0, SAS Institute, Cary, NC.
Selected abstract for JAVMA readers from the American Journal of Veterinary Research

Clinical, microbiological, and molecular characterization of methicillin-resistant *Staphylococcus aureus* infections of cats
Daniel O. Morris et al

**Objective**—To compare clinical information obtained from medical records of cats with methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-susceptible *S. aureus* (MSSA) infections, evaluate antibiograms of MRSA and MSSA for multiple-drug resistance (MDR), and characterize the strain type and staphylococcal chromosome cassette (SCC)mec type of each MRSA.

**Sample Population**—70 *S. aureus* isolates obtained from 46 cats.

** Procedures**—Clinical information obtained from medical records, including signalment, clinical signs, histologic examination of affected tissues, and outcomes, was compared between the 2 groups. Composite antibiograms of MRSA and MSSA were compared statistically. The MRSA strains were characterized by use of pulsed-field gel electrophoresis and SCCmec typing.

** Results**—No statistical differences in signalment or subjective differences in clinical signs or outcomes were detected between groups with MRSA or MSSA infection. Significant differences in antimicrobial resistance were detected, with MRSA having complete resistance to fluoroquinolone and macrolide antimicrobials, whereas MSSA maintained a high frequency of susceptibility. Seven pulsed-field patterns were observed in 15 MRSA strains; all but 1 were highly related. All MRSA isolates contained a type II SCCmec element.

**Conclusions and Clinical Relevance**—Because MDR cannot be predicted in staphylococcal infections in cats on the basis of clinical signalment, culture and susceptibility testing are recommended whenever initial empirical treatment is unsuccessful. Molecular characterization of MRSA strains suggested that there has been reverse zoonotic transmission from humans.


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**References**