Evaluation of colposuspension for treatment of incontinence in spayed female dogs

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Objective—To determine the long-term effects of colposuspension in spayed female dogs with urinary incontinence and identify preoperative anatomic or urodynamic measurements associated with a successful outcome.

Design—Prospective study.

Animals—23 client-owned spayed female dogs with urinary incontinence.

Procedure—Prior to surgery, a history was obtained, and a physical examination, CBC, serum biochemical analyses, urinalysis, bacterial culture of a urine sample, vaginourethrocystography, urethral pressure profilometry, and leak point pressure test were performed. Colposuspension was performed, and preoperative tests were repeated 2 months after surgery. Clients were interviewed 2 weeks, 1 month, and 1 year after surgery.

Results—22 dogs were followed up for 1 year. Twelve had complete urinary control 2 months after surgery, and 3 had complete urinary control 1 year after surgery. Dogs with normal urinary control at 2 months had an increased leak point pressure (LPP), compared with preoperative measurements, and their LPP was the same as normal dogs. Eight dogs had complete urinary control, and 9 were considered greatly improved 1 year after surgery when medical treatment was added to the effect of colposuspension. Client satisfaction was high, with 19 of 22 (86%) owners being pleased with their decision to have surgery performed. The only predictors of complete urinary control 2 months after surgery were a more caudal position of the external urethral opening in relation to the pubis on preoperative radiographs and a longer overall urethral length.

Conclusions and Clinical Relevance—Colposuspension alone will result in complete urinary control in few dogs with urinary incontinence but may improve urinary control sufficiently that owners will be pleased. Preoperative vaginourethrocystography may be helpful in predicting response to surgery, and the LPP test correlates with improved urinary control. The long-term effects of colposuspension were studied in 22 spayed female dogs. Dogs with normal urinary control had increased leak point pressure compared to preoperative measurements. Colposuspension resulted in continence in 11 of 12 dogs, with 9 of 12 considered greatly improved at 1 year after surgery. Client satisfaction was high, with 19 of 22 owners being pleased with their decision to have surgery. Preoperative radiographs and urethral length correlated with urinary control postoperatively.
Urodynamic and radiographic studies—Food was withheld from all dogs for 12 hours before urodynamic studies were performed. Dogs were treated once with ampicillin (20 mg/kg of body weight, PO) and walked outside so that voiding behavior could be observed. Urethral pressure profiles (UPP) were then recorded with a computer-based urodynamic system; dogs were awake and gently restrained in right lateral recumbency while UPP were recorded. Briefly, an 8-F urethral pressure profile catheter was placed aseptically via the urethra into the bladder, the residual urine volume aspirated and measured, and the catheter connected to a pressure transducer zeroed at the level of the vulva. If a urine sample had not already been obtained by cystocentesis, a sample from the catheterized residual volume was submitted for urinalysis and bacterial culture. Sterile water was infused through the catheter at a rate of 5 ml/min, and the catheter was connected to a mechanical puller set to withdraw the catheter at a rate of 0.5 mm/s. The recording was marked for computer measurement of baseline pressure in the bladder, maximal urethral pressure, end urethral pressure, and total profile length. Maximal urethral closure pressure (MUCP) was calculated by subtracting baseline bladder pressure from maximal urethral pressure.

Leak point pressure (LPP) was measured after UPP was recorded. Dogs were anesthetized by IV bolus administration of propofol (8 mg/kg [3.6 mg/lb]). Anesthesia was maintained by IV infusion of propofol at a rate of approximately 0.4 mg/kg/min (0.18 mg/lb/min); the infusion rate was adjusted as necessary to maintain a surgical plane of anesthesia. Supplemental oxygen was provided via an endotracheal tube. Dogs were positioned in dorsal recumbency, and a 6-F dual lumen catheter was inserted into the bladder. A large indirect blood pressure cuff was then placed loosely around the abdomen, cranial to the level of the bladder, and the bladder was infused with 75 ml of sterile water at a rate of 50 ml/min. The abdominal pressure cuff was inflated to 80 mm Hg, and additional abdominal pressure was applied by pressing on the cuff until urine leaked from the vulva. Bladder pressure at leakage was recorded as the LPP. This procedure was repeated at least twice, so that at least 3 LPP measurements were obtained. An additional 25 ml of water was then infused into the bladder (bladder volume, 100 ml), and LPP was measured at least 3 more times. An additional 50 ml of water were then infused (bladder volume, 150 ml), and LPP was again measured at least 3 more times. In a smaller dog, LPP was measured with bladder volumes of 50, 75, and 100 ml.

After LPP were measured, 25 ml of sodium iothalamate was added to water remaining in the bladder, and the urethral catheter was removed. Positive-contrast cystograms were obtained with the dogs in right lateral recumbency. Vaginourethrocystography was then performed by injecting an additional 20 ml of sodium iothalamate and 40 ml of sterile water through an 8-F Foley catheter in the vagina. Radiographic exposures were made during injection of contrast medium. On the resulting radiographs, the cranial and caudal extents of the urethra were identified as the narrow portion of the bladder neck and the insertion of the urethra in the vagina, respectively. These radiographic landmarks were compared with the cranial and caudal extents of the pubis, as viewed on the lateral radiographic projection. Urethral length, the distance from the bladder neck to the cranial extent of the pubis, and the distance from the caudal extent of the pubis to the urethral meatus were measured on a line parallel to the main axis of the pubis (Fig 1).

Anesthesia and surgery—After urodynamic and radiographic evaluations were completed, dogs were anesthetized, and a caudal laparotomy was used to expose the urinary bladder, urethra, and vagina. Colposuspension was performed as described. Analgesic drugs were administered after surgery to alleviate postoperative pain. Most dogs were discharged from the hospital the day after surgery, when it was established that surgery had not caused urinary outflow obstruction.

Postoperative evaluation—Owners of dogs included in the study were contacted by a technician by telephone 2 weeks, 1 month, and 1 year after surgery and asked questions concerning their dogs’ general health and urinary control. A scoring system for clinical response to surgery was developed, with 4 = no episodes of urine leakage after surgery, 3 = only 1 or 2 episodes of urine leakage after surgery, 2 = multiple episodes of urine leakage after surgery but frequency of episodes or volume of urine that leaked was decreased, and 1 = no improvement. During the follow-up evaluation 1 year after surgery, owners were asked to provide 2 clinical response scores: 1 for response to surgery alone without medical treatment and the other for response to surgery and medical treatment. For the latter score, owners were asked to consider frequency of episodes of urinary leakage only during the preceding 2 months. Owners were also asked whether they were satisfied with their decision to have colposuspension performed.

Two months after surgery, dogs were reevaluated at the veterinary hospital, and follow-up physical examination, urinalysis, bacterial culture of a urine sample, urodynamic studies, and positive-contrast radiography were performed. Urinary tract infections were treated. If incontinence persisted after elimination of urinary tract infection, phenylpropanolamine (1.5 mg/kg [0.65 mg/lb], PO, q 48 h) was prescribed.

Data analysis—Urodynamic and anatomic measurements were described as mean, median, SD, and interquartile range. Urodynamic measurements for dogs included in the study were compared with those for 22 clinically normal dogs with t-tests; results for these clinically normal dogs have been reported previously. Paired t-tests were used to compare UPP measurements and LPP obtained before colposuspension with those obtained 2 months after surgery. Clinical response scores for the 4 postoperative follow-up times (2 weeks, 1 month, 2 months, and 1 year) were compared by use of ANOVA for repeated measures. For data obtained 1 year after surgery, clinical response scores for surgery alone were compared with clinical response scores for surgery and medical treatment combined by use of a paired t-test. Dogs were grouped as having responded (clinical response score of
Results

One dog, a Doberman Pinscher, developed a hematoma that markedly distended the bladder 2 days after surgery. No evidence of sutures in the lumen of the bladder or urethra was seen during cystoscopy, and a cystotomy was performed to remove the hematoma. The colposuspension sutures were removed at the same time. The dog was subsequently determined to have von Willebrand factor activity typical for a carrier of von Willebrand disease. Data for this dog were excluded from all statistical analyses.

Long-term follow-up was available for the remaining 22 dogs. Mean ± SD body weight at the time of surgery was 33.8 ± 12.4 kg (78.8 ± 27.3 lb); range, 7.1 to 73.6 kg [15.6 to 161.9 lb]). Only 1 dog weighed < 23 kg (50.6 lb), and this 7-kg dog was given a clinical response score of 2 one month, 2 months, and 1 year after surgery. Before surgery, 16 dogs had received medical treatment because of their urinary tract problems (phenylpropanolamine, diethylstilbestrol, antimicrobials, or combinations of these drugs) without any substantial improvement in urinary control. Ten dogs had received phenylpropanolamine alone, 2 had received diethylstilbestrol alone, and 4 had received both drugs. Six dogs had received antimicrobials prior to colposuspension.

For 6 dogs, results of bacterial culture of a urine sample collected prior to surgery were positive. Evaluation of the urine sediment revealed that only 1 dog had evidence of bacteruria or pyuria at the time of surgery, and this dog appeared to be having a favorable response to antimicrobial treatment, as evidenced by a decrease in the severity of bacteruria after 4 days of antimicrobial treatment. Another dog had > 100,000 Enterococcus colonies/ml of urine without evidence of pyuria. The other 4 dogs had < 1,000 bacterial colonies/ml of urine.

The MUCP was significantly (P < 0.001) lower for the 22 incontinent dogs (mean ± SD, 74.7 ± 32.1 cm H2O; range, 24 to 150 cm H2O; median, 70 cm H2O; interquartile range, 50 to 97.3 cm H2O) than for the clinically normal dogs (110.1 ± 20.2 cm H2O; range, 65 to 152 cm H2O; median, 109 cm H2O; interquartile range, 99 to 128 cm H2O). Leak point pressure, as an average of the 3 volumes, was also significantly (P < 0.001) lower for the incontinent dogs (93.6 ± 34.3 cm H2O; range, 37 to 183 cm H2O; median, 85.9 cm H2O; interquartile range, 75 to 102.9 cm H2O) than for the clinically normal dogs (172.4 ± 24.6 cm H2O; range, 115 to 200 cm H2O; median, 179 cm H2O; interquartile range, 152 to 194 cm H2O). Functional and total profile lengths were not significantly different between the incontinent and clinically normal dogs.

Two months after colposuspension, owners of 12 of the 22 dogs indicated that their dogs had complete urinary control (clinical response score of 4). Owners of 8 other dogs indicated that urinary control had improved (2 dogs had clinical response scores of 3, and 6 had clinical response scores of 2). Owners of the remaining 2 dogs indicated that there had not been any improvement in urinary control. Mean ± SD clinical response score was 3.6 ± 0.79 two weeks after colposuspension, 3.3 ± 1.0 one month after colposuspension, 3.1 ± 1.1 two months after colposuspension, and 2.4 ± 1.0 one year after colposuspension (score for response to surgery alone). Mean score 2 months after surgery was significantly less than mean scores 2 weeks and 1 month after surgery; mean score 1 year after surgery was significantly less than mean scores 2 weeks, 1 month, and 2 months after surgery.

One dog died of a liver abscess 10 months after colposuspension. Although the client indicated that clinical response score for this dog was 4, this dog was not included in analyses of scores 1 year after surgery. One year after colposuspension, 3 dogs were given clinical response scores of 4 on the basis of results of surgery alone, 7 were given response scores of 3, 7 were given response scores of 2, and 4 were given response scores of 1. At the same time, 8 dogs were given clinical response scores of 4 on the basis of results of surgery and medical treatment, 9 were given scores of 3, 3 were given scores of 2, and 1 was given a score of 1. Eleven of the 21 dogs were treated with phenylpropanolamine after surgery; 1 was also treated with oxybutynin. Two of these 11 dogs were eventually weaned from phenylpropanolamine treatment; 1 was given a clinical response score of 4, and the other was given a score of 3. One year after surgery, mean clinical response score based on surgery and medical treatment (3.1 ± 0.8) was significantly (P < 0.002) higher than mean score based on surgery alone (2.4 ± 1.0). For the 11 dogs receiving medical treatment 1 year after surgery, the clinical response score based on surgery and medical treatment (3.2 ± 1.1) was significantly (P < 0.004) higher than the score based on surgery alone (1.9 ± 0.9). Nineteen of 22 owners indicated 1 year after surgery that they were satisfied with their decision to have surgery on their dogs, 1 was dissatisfied, and 2 were equivocal. The dog owned by the dissatisfied individual had been incontinent prior to undergoing ovariohysterectomy and did not have any improvement in urinary control after colposuspension.

Two months after surgery, 5 dogs had a urinary tract infection, and 15 had no evidence of urinary tract infection, as evidenced by results of bacterial culture (n = 10) or a urinalysis (5). Neither urinalysis nor bacterial culture was performed in 2 dogs. Clinical response scores for dogs with a urinary tract infection were not significantly different from those for dogs without evidence of infection. One dog with persistent urinary tract infection resistant to antimicrobial treatment was reexamined 11 months after undergoing colposuspension. The cranial portion of the bladder was retroflexed dorsally, as though it was entering a perineal hernia. No hernia was detected, but this cystic flexion was thought to have inhibited bladder emptying. The bladder was repositioned, and cystectomy was performed. This dog was given a clinical response score of 4 before cystectomy and a score of 2 after cystectomy.
When results of urodynamic and radiographic evaluations were compared with values obtained before surgery, significant increases in LPP (mean ± SD, 93.6 ± 34.3 cm H2O before surgery vs 136.4 ± 55.7 cm H2O after surgery), functional profile length (8.4 ± 3.2 cm before surgery vs 10.3 ± 3.8 cm after surgery), total profile length (8.8 ± 3.3 cm before surgery vs 10.6 ± 3.8 cm after surgery), and distance from the bladder neck to the cranial extent of the pubis (15.8 ± 16.8 mm before surgery vs 25.4 ± 13.4 mm after surgery) and a significant decrease in distance from the caudal extent of the pubis to the urethral meatus (16.0 ± 8.5 mm before surgery vs 8.6 ± 4.8 mm after surgery) were found. In contrast, neither MUCP nor urethral length was significantly changed.

On the basis of clinical response scores 2 months after surgery, 12 dogs were classified as having responded, and 10 were classified as having responded poorly. The LPP was significantly increased 2 months after surgery, compared with preoperative pressure, in dogs that responded (93.3 ± 34.3 cm H2O before surgery vs 132.4 ± 52.4 cm H2O after surgery) but not in dogs that responded poorly (94.0 ± 36.1 cm H2O before surgery vs 117.2 ± 56.0 cm H2O after surgery), and the LPP 2 months after surgery in the 12 dogs that responded was not significantly different from that for the clinically normal dogs (172.4 ± 24.6 cm H2O). Results of UPP measurements 2 months after surgery were not significantly different from preoperative results for dogs that responded or for dogs that responded poorly.

Two preoperative radiographic measurements for the 12 dogs that responded were significantly different from measurements for dogs that responded poorly. Dogs that responded had a more caudal position of the external urethral opening in relation to the pubis on preoperative radiographs, compared with dogs that did not respond (distance from the caudal extent of the pubis to the urethral meatus, 20.0 ± 9.2 mm [range, 10.5 to 37.9 mm] for dogs that responded vs 12.2 ± 5.8 mm [range, 3.9 to 21.8] for dogs that responded poorly), and longer urethral lengths (10.1 ± 1.9 cm for dogs that responded vs 8.3 ± 1.5 cm for dogs that responded poorly). No other preoperative urodynamic or anatomic measurements were significantly different between dogs that responded and dogs that did not respond. In dogs that responded and in dogs that responded poorly, distance from the caudal extent of the pubis to the urethral meatus was significantly decreased 2 months after surgery, compared with preoperative values.

**Discussion**

In the present study, only 12 of 22 (55%) dogs were continent (clinical response score of 4) 2 months after undergoing colposuspension, and only 3 of 21 (14%) were continent 1 year after surgery. However, 7 of 21 (33%) dogs were classified as greatly improved (clinical response score of 3) 1 year after surgery, and when responses to surgery and medical treatment combined were considered, 8 (38%) dogs were considered continent, and 9 (43%) were considered greatly improved. In addition, only 1 owner was unhappy with the decision to have the dog undergo colposuspension.

In contrast, other authors have reported that 53 and 58% of dogs followed up for at least 6 months were cured (presumably equivalent to a clinical response score of 4) and that the severity and frequency of incontinence were substantially reduced in approximately 80% of the remaining dogs, with approximately 20% of the remaining dogs having no improvement after colposuspension. Approximately 67% of dogs with urinary incontinence respond to estrogen treatment, and 73% respond to treatment with α-adrenoceptor agonists. Medical treatments must be given for the remainder of the dog’s life, although dosage adjustments may permit owners to reduce the frequency of administration while still maintaining urinary control.

When reviewing success rates for treatment of incontinent dogs, it is useful to review similar studies involving incontinent women. In women, success rates are greatly affected by the criteria used to define success and by the individual interviewing patients or interpreting survey data; the most important criterion for success is whether the patient herself is pleased with her quality of life. In the present study, surveys were conducted by technicians associated with the project, and not by the surgeon, in an effort to reduce any bias provided by the surgeon’s interpretation of client responses. Quality of life for the dog was subjectively judged on the basis of whether the client was happy with the postoperative effects of the surgery.

Intrinsic sphincter incompetence (or dysfunction) is usually identified as the cause of urinary incontinence in dogs by recording UPP or measuring LPP. Spayed female dogs with urinary incontinence in the present study had significantly lower MUCP and LPP than did clinically normal dogs. In fact, the 25th percentile of MUCP for the clinically normal dogs (99 cm H2O) was similar to the 75th percentile for the incontinent dogs (97.3 cm H2O), and the 25th percentile of LPP for the clinically normal dogs (132 cm H2O) was 50% greater than the 75th percentile for the incontinent dogs (102.9 cm H2O). Other investigators have also found that MUCP is low in spayed dogs with urinary incontinence, and MUCP is typically low in women in stress incontinence. Previous studies have involved recording UPP in dogs anesthetized or sedated with a variety of protocols; in the present study, UPP were recorded while dogs were awake and unsedated. Values for LPP and MUCP in spayed female dogs with urinary incontinence, as well as the fact that urinary control in such dogs is typically improved with phenylpropanolamine treatment, would support the suggestion that sphincter dysfunction is a major cause of urinary incontinence in these dogs.

Most dogs in the present study were large, with only 1 weighing < 23 kg. Larger dogs have been reported to have a higher incidence of urinary incontinence (30% in dogs weighing > 20 kg [44 lb]) than do smaller dogs. Colposuspension is used to treat stress incontinence in women in whom incontinence is associated
with an anatomic mechanism, urethral hypermobility.\textsuperscript{12} Results of the present study suggest that although sphincter dysfunction is important in spayed dogs with urinary incontinence, anatomic position of the bladder and urethra may also play a role. The only predictors of surgical success in this study were anatomic; dogs that responded had a more caudal position of the external urethral opening in relation to the pubis on preoperative radiographs, compared with dogs that did not respond, and longer urethral lengths. Future clinical studies should include retrograde vaginourethrocytography so that the location of the external urethral opening can be evaluated.

It is interesting to speculate about how location of the external urethral opening could have an effect on urinary continence in recumbent, relaxed, or sleeping dogs. Potential factors might be related to pressures being exerted on the bladder or stretching of sympathetic nerves. In this study, total and functional profile lengths were significantly increased 2 months after colposuspension, and a similar increase in urethral length immediately after colposuspension has been reported. Colposuspension resulted in a significant cranial movement of the external urethral opening in the present study in dogs that responded and in dogs that did not respond, and a caudally located bladder neck (pelvic bladder) has been reported as a contributing factor in dogs with urethral sphincter mechanism incompetence.\textsuperscript{3,12} On the other hand, dogs with normal urinary control can also have a caudally located bladder neck.\textsuperscript{12}

The LPP increased significantly in dogs that responded to colposuspension, and the LPP 2 months after surgery in dogs that responded was not significantly different from that of clinically normal dogs. However, LPP was not significantly increased 2 months after surgery in the dogs that did not respond. In contrast, MUCP did not increase after surgery, and the MUCP 2 months after surgery was significantly different from that for clinically normal dogs. Holt and Gregory also observed that MUCP was not a predictor of surgical success, and incontinent women, MUCP tend to overlap values for clinically normal women, so that MUCP is not considered a reliable indicator of stress incontinence.\textsuperscript{17,20,21} Importantly, anatomic and urodynamic studies were repeated only 2 months after surgery in the present study. Longer-term studies are needed, particularly considering the apparent decrease in surgical success rate with time.

A worrisome observation in the present study was that the amount of improvement in urinary control after colposuspension progressively decreased over time. Our experimental design prevented determining whether the urethra and its opening into the vagina moved caudally after the 2-month examination. During colposuspension, a polypropylene suture is passed through the vaginal wall, and it is possible that this suture may have broken or become dislodged from the vaginal wall or that the vaginal wall stretched. A braided suture may be more appropriate, as braided suture material is frequently used when a comparable Burch procedure is performed in women. Because the success rate is modest, another reposition procedure may be preferred, as is done in women.\textsuperscript{12}

Colposuspension does not seem to be widely used for treatment of female stress urinary incontinence in spayed dogs in the United States, and results of the present study provide some insight into this apparent lack of popularity of the procedure. Because only slightly more than half the dogs in previous studies were improved after colposuspension, veterinarians may question the need for this procedure. On the other hand, if colposuspension does result in some improvement in anatomic positioning of the bladder and urethra, then some dogs may benefit from this procedure, either because lifelong medical treatment may be avoided or because the dosage of drugs that are required may be reduced.

\textbf{References}


### New Veterinary Biological Products

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<tr>
<th>Product name</th>
<th>Species and indications for use</th>
<th>Route of administration</th>
<th>Remarks</th>
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<td>Mycoplasma Hypopneumoniae Antibody Test Kit (IDEXX Laboratories, Inc, Westbrook, Maine, US Vet Lic No. 313)</td>
<td>Mycoplasma hypopneumoniae antibody test kit is used for the detection of antibody to Mycoplasma hypopneumoniae in porcine serum or plasma to provide serologic identification as well as assessment of exposure.</td>
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<td>Arthrobacter Vaccine, Live Culture (Mr. Jerry Zinn, Buhl, Idaho, US Vet Permit No. 335)</td>
<td>For vaccination of healthy salmonids, as an aid in the prevention of bacterial kidney disease (Renibacterium salmoninarum).</td>
<td>IP</td>
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