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Original Research

Intrabursal Doxycycline Sclerotherapy for Recurrent Olecranon Bursitis of the Elbow: A Case Control Study



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Sclerotherapy**Purpose:** This study aimed to determine the efficacy and safety of intrabursal injection of doxycycline sclerotherapy to treat olecranon bursitis (OB) refractory to conservative management.**Methods:** We retrospectively reviewed 27 patients with recurrent OB who were treated over 11 years with intrabursal injections of doxycycline. They were compared with a control group of 18 patients with recurrent OB who underwent surgical bursectomy. Patients were re-evaluated by the treating physician for recurrence of bursitis and treatment complications and completed a questionnaire to assess satisfaction, pain, and other patient-reported outcomes.**Results:** Eight patients (29.6%) undergoing doxycycline sclerotherapy had recurrence, requiring one more doxycycline lavage within the first 4 weeks of initial doxycycline treatment. Three patients (16.7%) undergoing surgery had recurrence after surgery, requiring repeat aspiration. There were no patients in either doxycycline or surgical groups with recurrence of bursitis at the final follow-up (median = 195 and 1,055 days, respectively). No patients in the doxycycline group ultimately required surgical bursectomy, and no patients undergoing surgery required repeat surgeries. A regression model controlling for covariates did not find a significant difference between groups in the likelihood of physician-identified complication or repeat aspiration after doxycycline lavage or surgical bursectomy. Of patients undergoing doxycycline sclerotherapy, 85.7% of patients reported high satisfaction (Likert score: 8–10), and 95.2% reported that they would pursue this treatment again.**Conclusions:** Use of intrabursal doxycycline as a sclerosing agent for recurrent OB was safe and effective, with high patient satisfaction and no ultimate recurrence of bursitis at the final follow-up. This may be an effective alternative to surgical bursectomy for patients with recurrent OB refractory to conservative management.**Type of study/level of evidence:** Therapeutic IV.Copyright © 2024, THE AUTHORS. Published by Elsevier Inc. on behalf of The American Society for Surgery of the Hand. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Olecranon bursitis (OB) is an inflammatory reaction of the olecranon bursa of the elbow most often caused by microtrauma or inflammatory conditions, which produce distention of the bursa with synovial fluid and may lead to pain, poor cosmesis, and possible secondary infection. Septic OB, reported in up to one-third

of OB cases,^{1,2} is most often caused by inoculation of bursa from skin flora via transcutaneous puncture. Inflammatory conditions, including gout, pseudogout, rheumatoid arthritis (RA), and systemic lupus erythematosus,³ and other comorbidities, including diabetes, obesity, and human immunodeficiency virus,^{4,5} may predispose patients to the development of chronic OB. A prominent olecranon process or osteophyte may initiate local trauma irritating the overlying bursa and also predispose to chronic OB.⁶ Olecranon bursitis is the most commonly occurring superficial bursitis⁷ with peak prevalence in 30–60 years of age and a higher occurrence in men than in women. One study estimated the incidence of

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nonseptic OB to be 10 per 100,000 persons in an ambulatory setting.⁸ Another study in a military population estimated a prevalence of 29 per 100,000 person-years.⁹

There is a lack of consensus on the management of OB based on published evidence.^{10,11} Although OB is often self-limited and may respond to activity modification, compression, orthoses, and nonsteroidal anti-inflammatory drugs (NSAIDs), various interventions have been described to treat OB, including aspiration,^{12–14} intrabursal corticosteroid injections (CSIs),^{13,15–17} intrabursal ethyl alcohol injection,¹⁸ and surgical bursectomy (open^{19,20} or endoscopic^{21–24}). In cases with a prominent olecranon osteophyte, open or endoscopic olecranon osteophyte excision has also been reported.^{6,24} All of these techniques have had significant complications reported. Although aspiration can help resolve bursitis and inform the diagnostic workup of septic OB, risks include the formation of a draining sinus tract and iatrogenic infection of the skin or bursa,^{12,14} and recurrence is common.¹³ Although intrabursal CSI has been shown to produce more rapid symptomatic relief, complications of skin atrophy, local pain, infection, and potential triceps rupture render the use of corticosteroids controversial.^{15,17} Additionally, steroid injections have not been proven superior to conservative management in efficacy.¹¹ Furthermore, steroid injection is contraindicated in septic OB, the diagnosis of which is not always known initially. Surgical complications have been reported to range from 19.7% to 27.0% of cases, with complications including infection, hematoma, seroma, recurrence, fistula formation, and wound healing problems.^{19,21,25,26} Level IV evidence has shown that nonsurgical management of OB is more effective and safer than surgical management.²⁷

Sclerotherapy with tetracycline analog medications is well-established for various conditions in which fluid collections persist in membrane-lined ducts, cysts, or other spaces.^{28–45} The senior author (B.F.M.) has used doxycycline as a sclerosing agent to treat OB both as an intrabursal injection and as an adjunct to surgical bursectomy, although there have been no published reports on the outcomes of this technique. The purpose of the current study was to report the complications, recurrence rates, and patient-reported outcomes of intrabursal doxycycline sclerotherapy for recurrent OB refractory to conservative management as an alternative to surgical excision of the olecranon bursa.

Materials and Methods

Ethical approval

Our study was approved by the institutional review board at Greenwich Hospital.

Patient study group

A retrospective chart review utilizing Current Procedural Terminology and International Classification of Diseases-10 codes identified patients with recurrent OB after failed conservative management subsequently treated with surgical bursectomy or intrabursal doxycycline sclerotherapy between 2011 and 2023 (study conducted between October 21, 2011 and October 19, 2023). Failed conservative management was defined as OB recurrence after initial resolution with two or more of the following treatments: ≥ 7 days of NSAID use, use of compressive wrap or elbow orthosis for ≥ 7 days, one or more bursal aspirations, and/or one or more intrabursal CSIs following aspiration. The decision to treat patients with surgery versus doxycycline sclerotherapy was at the treating surgeon's discretion, but patients treated with surgery were generally treated earlier in the study before intrabursal doxycycline sclerotherapy was utilized as an alternative.

Technique for use of intrabursal doxycycline sclerotherapy

The technique developed by the senior author (B.F.M.) included aspiration of the accumulated synovial fluid in the posterior aspect of the elbow overlying the olecranon bursa with an 18- or 16-gauge needle and one or more 20-cc syringes. Two hundred milligrams of doxycycline powder were mixed with 20 cc of normal saline, and this solution was drawn into a separate 20-cc syringe. Once bursal synovial fluid was maximally aspirated, the needle was left in the bursa, and the syringe with doxycycline solution was coapted with this needle to lavage the mixture in and out of the bursa several times to coat the inner synovial membrane. The remaining doxycycline was then aspirated, usually leaving a small amount of doxycycline solution in the bursa, which may leave the appearance of persistent bursitis. A sterile dressing was placed on the aspiration site, and patients were instructed to maintain a compressive wrap on the elbow for 5 days. If there was recurrence of bursitis within the first 4 weeks, a second intrabursal injection of doxycycline was considered at the discretion of the treating surgeon.

Technique for surgical bursectomy

Open surgical bursectomy was performed via a 3–4 cm incision on the posterior aspect of the elbow under monitored sedation or general anesthesia with the patient in a supine or lateral decubitus position. Complete excision of the olecranon bursa was performed, and the wound was closed with nonabsorbable sutures without a drain. Doxycycline was not used as an adjunct at the time of surgery. The elbow was immobilized in 60°–90° of flexion in a posterior splint for 10–14 days after surgery until suture removal and motion was initiated.

Evaluation and documentation

Patients were followed for ≥ 1 month in the office until resolution of their bursitis, and charts were reviewed for recurrence of bursitis after the index procedure (intrabursal doxycycline sclerotherapy or surgical bursectomy), aspiration after index procedure, treatment complications, and subsequent surgical treatment. Additionally, patients were contacted by telephone, and after consenting to participate, they were administered a questionnaire asking about pain in the elbow (1–10 Likert scale), current restrictions from their OB (1–10 Likert scale), patient-reported complications from treatment, treatment satisfaction (1–10 Likert scale), and whether participants would pursue their treatment again.

Statistical analysis

Descriptive statistics (means and SD) were calculated for age (years) and time to follow-up (median and interquartile range [IQR], days). Frequencies and percentages were calculated for gender, race, ethnicity, laterality of affected elbow, septic bursitis, RA, gout, diabetes, number of prior aspirations, prior steroid injection, aspiration after index procedure, recurrence at final follow-up, and complications. In cases of early bursitis recurrence when doxycycline sclerotherapy was repeated in the first 4 weeks after initial doxycycline treatment, this was not considered recurrence of bursitis if it resolved after the second doxycycline injection in the 4-week period. An independent statistician (D.W.), not involved in patient evaluation, performed statistical analysis. Chi-square analyses, including Fischer exact tests, were used for categorical variables, and a *t* test was used to compare age between groups. A Wilcoxon rank-sum test compared follow-up time and days between procedure and survey. Logistic regressions were performed

Table 1
Baseline Patient Demographics

Variable	Surgery (n = 18)	Doxycycline (n = 27)	P Value
	Mean (SD) or Frequency (%)		
Age at Time of Injection (y)	55.5 (16.0)	64.2 (11.9)	.04*
Gender (% male)	15 (83.3%)	22 (81.5%)	1.00†
Race (% White)	17 (94.4%)	25 (92.6%)	1.00†
Ethnicity (% non-Hispanic or Latino)	0 (0.0%)	1 (3.7%)	1.00‡
Affected elbow (% right)	7 (38.9%)	18 (66.7%)	.07†
Septic bursitis (% yes)	7 (38.9%)	0 (0.0%)	< .01‡
Rheumatoid arthritis (% yes)	0 (0.0%)	2 (7.4%)	.51‡
Gout (% yes)	0 (0.0%)	2 (7.4%)	.51‡
Diabetes (% yes)	1 (5.6%)	4 (14.8%)	.63‡
Number of prior aspirations (%)			< .01†
0	8 (44.4%)	1 (3.7%)	
1	4 (22.2%)	11 (40.7%)	
≥2	6 (33.3%)	15 (55.6%)	
Prior steroid injection (% yes)	5 (27.8%)	10 (37.0%)	.52†
Aspiration after procedure (% yes)	3 (16.7%)	8 (29.6%)	.48‡
Recurrence at final follow-up (% yes)	0 (0.0%)	0 (0.0%)	n/a
Complications (% yes)	3 (16.7%)	1 (3.7%)	.29‡

* t test.

† Chi-squared test.

‡ Fischer exact test.

to compare likelihood of complications and also aspiration after index procedure between groups while controlling for covariates of age and presence of septic OB. Adjusted odds ratios were calculated from the final models. SAS 9.4 (SAS Institute) was used for all analyses. A 0.05 alpha level defined statistical significance. A power analysis was performed, and assuming that 17% of subjects in the surgery groups had complications, after applying continuity correction, the study would require a sample size of 99 for each group (a total sample size of 198, assuming equal group sizes) to achieve a power of 80% for detecting a difference in proportions of complications of 0.13 between the two groups at a two-sided *P* value of .05.

Results

Descriptive data and demographics

From 2011 to 2023, 45 patients were identified with recurrent OB refractory to conservative management who underwent either doxycycline sclerotherapy (*n* = 27) or surgical bursectomy (*n* = 18). Demographic data are summarized in Table 1. The majority in both groups were male gender, White race, and non-Hispanic or Latino ethnicity. There was no difference by study group in the proportion of patients with at least one aspiration after doxycycline sclerotherapy or surgical bursectomy (*P* = .48). There were significant differences between groups on the basis of age (patients undergoing surgery were younger), laterality of elbow treated (more right elbows were treated with doxycycline), presence of septic bursitis (more patients with septic bursitis were treated with surgery), and number of aspirations prior to treatment (patients in the surgery group had fewer aspirations prior to surgery). A single intrabursal doxycycline injection resulted in complete resolution in 19 of 27 patients, with 8 patients (29.6%) having recurrence within the first 4 weeks of treatment requiring a second doxycycline injection. In the group undergoing surgery, there were three patients (16.7%) at the final follow-up with recurrence requiring repeat aspiration. No patient in either group had recurrence of bursitis at the final clinical follow-up. The median time of clinical follow-up was 195 (IQR: 35 and 876) days in the doxycycline group and 1,055 (IQR: 103 and 2,179) days in the surgery group, which was significantly longer follow-up (*P* = .044). The surgical group was

treated earlier in the study period before doxycycline lavage was used as a treatment for OB.

There was one physician-identified complication in the group of patients undergoing treatment with intrabursal doxycycline sclerotherapy, which was a transiently draining sinus resolving after 2 months of local wound care. There were three physician-identified complications in the group of patients undergoing surgery, including two patients with superficial infection and one with persistent elbow pain. The two patients with superficial infections resolved with oral antibiotics and local wound care, and the patient with persistent elbow pain did report ongoing pain at the final clinical follow-up. A regression model for likelihood of complications controlling for covariates of age and presence of septic bursitis did not find a difference between groups (Table 2). There were three patients who required repeat aspiration after surgical bursectomy and eight patients who required repeat aspiration in the doxycycline group, but similarly, a regression model for likelihood of aspiration after index procedure between groups controlling for covariates of age and presence of septic bursitis did not find a statistical difference between groups. All eight patients who underwent repeat aspirations after the first doxycycline injection underwent them as the initial step of a second intrabursal doxycycline injection within the first 4 weeks of the index doxycycline injection.

Follow-up questionnaires were analyzed as a function of treatment group (Table 3). The median time between procedure date and completion of questionnaire was 727 (IQR: 154 and 917) days in the doxycycline group and 1,870 (IQR: 729 and 2,651) days in the surgery group, which was significantly longer (*P* < .01). Thirteen of 18 patients undergoing surgery and 21 of the 27 patients undergoing doxycycline sclerotherapy completed the questionnaires. Among those completing questionnaires, there was a trend for patients undergoing intrabursal doxycycline injection to be older (mean = 63.6 years, SD = 11.4) than those undergoing surgery (mean = 54.5 years, SD = 17.7), but this did not reach statistical significance (*P* = .12). There were no differences among those who completed surveys as a function of gender, race, or recurrence after the final follow-up. Patients were asked to rate their restrictions on a scale of 1 to 10. Thirty-three of 34 (97.1%) patients reported very low restrictions (1 of 10). One patient reported some restriction (5 of 10); however, this patient was surveyed only 41 days after

Table 2
Multivariate Regression Models for Complications and Aspirations After Index Procedure by Treatment Group

Outcome	Variable	Adjusted Odds Ratio	95% Confidence Interval	P Value
Complications	Treatment group			
	<i>Doxycycline</i>	0.40	0.021–7.611	.54
	Surgery	Ref		
	Age (y)	1.00	0.927–1.07	.91
	Septic bursitis			
Aspiration after index procedure	Yes	4.03	0.29–56.08	.30
	No	Ref		
	Treatment group			
	<i>Doxycycline</i>	1.9278	0.29–10.81	.53
	Surgery	Ref		
	Age (y)	1.01	0.95–1.06	.80
	Septic bursitis			
Yes	0.74	0.05–10.15	.82	
No	Ref			

doxycycline sclerotherapy. Patients were asked to rate their overall satisfaction with their procedure on a scale of 1 to 10. Thirty-one patients (91.2%) were highly satisfied (Likert score: 8–10) overall, with no significant difference in those undergoing surgical bursectomy (100% highly satisfied) compared with doxycycline sclerotherapy (85.7%). Two patients in the doxycycline group reported low satisfaction (rated a 2) with their outcome. One was the same patient who was surveyed 41 days after the procedure and still reported restrictions. The second patient reported having surgery elsewhere for unrelated lateral epicondylitis. Another patient rated satisfaction as a five. Thirty-three of 34 (97.1%) reported that they would pursue their treatment again, with no difference in those undergoing surgical bursectomy (100%) compared with intrabursal doxycycline sclerotherapy (95.2%).

Discussion

Although OB typically responds to conservative management including immobilization or compressive wraps, NSAIDs, aspiration, or CSI, some patients may have bursitis, which is recurrent after and/or nonresponsive to these treatments. The current study sought to determine the outcomes of intrabursal injection of doxycycline in a cohort of patients with recurrent OB and compared the results with another cohort undergoing surgical bursectomy. Sclerotherapy with tetracycline analog medications, including tetracycline, bleomycin, or doxycycline, has been effectively utilized to treat various conditions in which fluid persistently accumulates in membranes, ducts, sacks, or cysts, including malignant pleural effusions, recurrent pneumothoraces, hydroceles, and various other lymphatic and venous malformations,^{28–45} but there have been minimal previously reported data on these medications for the treatment of bursitis. The results of the current study suggest that intrabursal doxycycline sclerotherapy is an effective and safe treatment in patients with recurrent OB failing conservative management. Although roughly one-third (26.9%) of patients undergoing intrabursal doxycycline sclerotherapy had an early recurrence of bursitis in the first 4 weeks of initial doxycycline injection requiring a second doxycycline injection, none had recurrence at the final clinical follow-up (median = 195 days). These results are comparable with that of a 1994 pilot study using intrabursal tetracycline sclerotherapy for the treatment of chronic OB in patients with RA.⁴⁶ In this series, seven patients with longstanding, symptomatic OB refractory to prior aspiration, CSI, treatment with antirheumatic medication underwent aspiration and injection of the bursa with 250 mg of tetracycline solution in 5–10 mL of normal saline followed by a compression bandage for the following 12 hours, and after a single tetracycline injection,

bursitis was resolved in three of seven patients with repeated injections required in another three patients, resulting in resolution of OB. One patient failed treatment and ultimately required surgical bursectomy. At the final follow-up, one complication reported was persistent local pain presumed to be due to the irritant effect of tetracycline. This is the only prior published study, we are aware of, that reported on tetracycline analog sclerotherapy to treat OB. Differences in this study population relative to the current data include chronic bursitis present for many years (median: 12 years, range: 4–30 years) and a population of patients with RA. Tetracycline has recently become commercially unavailable in the United States due to increased stringency of manufacturing guidelines, and use of doxycycline as a tetracycline analog has been deemed as a safe, cost-effective alternative to tetracycline, and a superior alternative both to more costly bleomycin and talc, which can induce granuloma formation, as a sclerosing agent for malignant pleural effusions or lymphoepithelial cysts.^{28,30,41,47} Doxycycline is inexpensive and readily available from pharmacies with compounding capability but requires reconstitution in normal saline.

There was a relatively low complication rate of intrabursal doxycycline sclerotherapy in the current study. In the 27 patients undergoing intrabursal doxycycline sclerotherapy, there was one complication of a transient draining bursal sinus that resolved by 1 month of treatment compared with three complications in the 18 patients undergoing surgical treatment (two patients with superficial infection that required antibiotics and one with persistent elbow pain), a difference that was not statistically significant in the regression model. Previously published literature has reported significant complications from surgical bursectomy, including infection, hematoma, seroma or fistula formation, wound healing problems, and skin loss and recurrence requiring repeat surgery.^{19,21,25,26} For instance, one retrospective review of 37 cases of olecranon bursectomy found that 27.0% of patients had prolonged postsurgical drainage, 21.6% had recurrence, 13.5% had a postoperative hematoma, and 8.1% required revision surgery for infection and/or a lateral arm flap for coverage.¹⁹ Another study examined 191 patients with OB who underwent olecranon bursectomy and found a 4.2% rate of delayed wound healing, a 4.2% rate of osteomyelitis, and an 11.5% rate of revision surgery with 2.6% requiring coverage with a flap.²⁶ Although we did not compare intrabursal doxycycline sclerotherapy with CSI as an alternative treatment for recurrent OB, significant complications have also been reported with CSIs for OB including skin atrophy, pain, infection, and triceps tendon rupture.^{15,17} In one systematic review that included 29 studies (1,278 patients) examining nonsurgical and surgical treatment of OB, the use of CSI for nonseptic bursitis was associated with significantly increased complications overall,

Table 3
Questionnaire Data

Variable	Surgery (n = 13) Frequency (%)	Doxycycline (n = 21) Frequency (%)	P Value
Pain (1–10) (1 = low and 10 = high) (%)			.33
1	12 (92.3%)	20 (95.2%)	
3	1 (7.7%)	0 (0.0%)	
9	0 (0.0%)	1 (4.8%)	
Restriction (1–10) (1 = low and 10 = high) (%)			.47
1	8 (61.5%)	9 (42.9%)	
5	0 (0.0%)	1 (4.8%)	
No answer	5 (38.5%)	10 (52.4%)	
Patient-reported complications (% yes)	1 (7.7%)	0 (0.0%)	.38
Treatment satisfaction (1–10) (1 = low and 10 = high) (%)			.57
<8	0 (0.0%)	3 (14.3%)	
8–10	13 (100.0%)	18 (85.7%)	
Would you pursue again (% yes)	13 (100.0%)	20 (95.2%)	1.0

and skin atrophy compared with conservative treatment without CSIs.²⁷ Another systematic review of nonsurgical treatment of nonseptic OB found that although CSIs significantly decreased the duration of symptoms, there was a higher number of complications.⁴⁷ Intrabursal doxycycline sclerotherapy may avoid the potential complications reported with either surgical bursectomy or CSI.

Analysis of patient questionnaires revealed no significant difference in the rate of patient-reported complications between groups, with one patient in the surgery group reporting a complication of treatment versus zero patients in the doxycycline group reporting a complication at the final follow-up. Patient-reported satisfaction with intrabursal doxycycline sclerotherapy was generally high, with 85.7% of patients reporting high satisfaction (Likert score 8–10) and 95.2% reporting that they would pursue this treatment again, compared with 100% of patients reporting high satisfaction with surgery and 100% reporting that they would pursue surgery again. Of the two patients undergoing doxycycline sclerotherapy who did not report high satisfaction, one patient had subsequent surgery by another surgeon for an unrelated condition of lateral epicondylitis, and this same patient was the only patient undergoing doxycycline sclerotherapy reported that they would not pursue doxycycline sclerotherapy again.

The precise mechanism of tetracycline analog sclerotherapy is unknown, but an inflammatory reaction has been reported to result in fibrosis and fusing of the inner membranes and eventual involution of endothelial-lined cavities.^{30,35,48} In animal models, this resultant reaction has been shown to cause collagen and fibrin deposition, leading to tissue adhesions and fibrosis.⁴⁹ Furthermore it has been reported to inhibit matrix metalloproteinase and cell proliferation, as well as suppression of vascular endothelial growth factor–induced angiogenesis and lymphangiogenesis.⁵⁰

This study does have several limitations that limit its conclusions. The sample sizes were small (27 and 18 patients in the doxycycline and surgical groups, respectively), limiting statistical power to compare the results of sclerotherapy versus surgery. Power analysis revealed that to detect differences in complication rates between doxycycline sclerotherapy and surgical bursectomy, the study would require a significantly larger sample size. Given that recurrent OB refractory to conservative management is relatively rare, it was not possible in our population to collect that number of patients even over a 12-year study period. Additionally, there was a longer time between treatment and both clinician and questionnaire follow-up for the surgical group compared with the doxycycline group, potentially introducing recall bias in patients treated with surgery compared with intrabursal doxycycline sclerotherapy. Since treatments were not blinded, there was

potential performance bias in that patients knowing they have had surgery may perceive their experience differently than those undergoing less invasive treatments. There was potential selection bias, given that those selected for surgery were different in some baseline characteristics (older age and the presence of septic bursitis in 38.9% of patients undergoing surgery versus 0% in the doxycycline group); it is likely that the treating surgeon may be more likely to recommend surgery in those with infection (septic bursitis) or in younger, healthier patients who could better tolerate anesthesia. Furthermore, patients treated with doxycycline sclerotherapy were treated with a compressive bandage for 5 days compared with those undergoing surgical bursectomy who were immobilized more rigorously with a posterior elbow splint, creating the potential for differences in outcome based on immobilization rather than surgical treatment. Despite these concerns, this group of patients represents a useful historical control group on the basis that some comparisons can be made regarding relative safety and efficacy. Also, in the analysis of this study, recurrence was treated as a binary variable. In reality, recurrence occurs along a spectrum ranging from mild and barely perceptible to more severe accumulation of fluid, and evaluating recurrence quantitatively could be instructive. Future randomized control trials that mitigate potential biases present in this study could be informative. Economic evaluations of the cost, time, and resources consumed by doxycycline sclerotherapy treatment and surgical treatment could be instructive, given the potentially high costs of surgery, time off from work, and clinic follow-up for wound care in patients undergoing surgery compared with doxycycline sclerotherapy, which can more conveniently be performed in the office. Nonetheless, the current data suggest that intrabursal doxycycline sclerotherapy to treat recurrent OB maybe is a simple, effective, and safe alternative to surgery.

Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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