Article

Scar revision for incompletely or narrowly excised soft tissue sarcomas in dogs

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Abstract

Objective

Describe clinical features of dogs undergoing scar revision for incompletely or narrowly excised soft tissue sarcomas (STSs) in the absence of gross disease and to determine local recurrence rates following scar revision.

Animals

Thirty-three dogs with 33 scars.

Procedures

Medical records were reviewed to collect data on signalment, tumor details, pre-surgical diagnostic tests, surgical and pathologic findings for both the initial and revision surgeries, and clinical outcomes. Descriptive statistics were generated.

Results

For the initial excision, cytology was performed before surgery in 45.5% (15/33) of dogs, and information on surgical margins was rarely reported [4.0% (1/25) of circumferential and 12.0% (3/25) of deep margins]. Microscopic evidence of residual STS was identified in 18.2% of scars. Recurrence occurred in 3.0% (1/33) of dogs [median follow-up of 1127 d (1 to 3192 d)]; this dog had had no evidence of residual tumor in the scar revision pathology.

Conclusions

Despite the low identification rate of residual tumor, the local tumor recurrence rate was 3.0%, which is lower than what is historically reported for incompletely or narrowly excised STSs.

Clinical relevance

Scar revision for incompletely or narrowly excised STSs resulted in durable tumor remission in the dogs of this study. Pre-surgical diagnostic tests were not often performed in this study; these may be considered before the first excision to plan surgical margins for potentially reducing the incidence of incomplete or narrow excision. Surgical reports should include details on circumferential and deep margins to guide pathologic interpretation and future scar revision, if required.

Résumé

Révision des cicatrice pour les sarcomes des tissus mous incomplètement ou étroitement excisés chez le chien

Objectif

Décrire les caractéristiques cliniques des chiens subissant une révision de cicatrice pour des sarcomes des tissus mous (STSs) incomplètement ou étroitement excisés en l'absence de maladie macroscopique et pour déterminer les taux de récidive locale après la révision de cicatrice.

Animaux

Trente-trois chiens avec 33 cicatrices.

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Procédures
Les dossiers médicaux ont été examinés pour recueillir des données sur le signalement, les détails de la tumeur, les tests de diagnostic pré-chirurgicaux, les résultats chirurgicaux et pathologiques pour les chirurgies initiales et de révision, et les résultats cliniques. Des statistiques descriptives ont été générées.

Résultats
Pour l'excision initiale, une cytologie a été réalisée avant la chirurgie chez 45,5 % (15/33) des chiens, et les informations sur les marges chirurgicales ont été rarement rapportées [4,0 % (1/25) des marges circonférentielles et 12,0 % (3/25) des marges profondes]. Des preuves microscopiques de STS résiduel ont été identifiées dans 18,2 % des cicatrices. Une récidive est survenue chez 3,0 % (1/33) des chiens [suivi médian de 1127 jours (1 à 3192 jours)]; ce chien n'avait eu aucun signe de tumeur résiduelle dans la pathologie de révision de la cicatrice.

Conclusions
Malgré le faible taux d'identification de tumeur résiduelle, le taux de récidive tumorale locale était de 3,0 %, ce qui est inférieur à ce qui est historiquement rapporté pour les STS incomplètement ou étroitement excisés.

Pertinence clinique
La révision des cicatrices pour les STS incomplètement ou étroitement excisés a entraîné une rémission tumorale durable chez les chiens de cette étude. Les tests diagnostiques pré-chirurgicaux n'ont pas souvent été effectués dans cette étude; ceux-ci peuvent être envisagés avant la première excision pour planifier les marges chirurgicales afin de réduire potentiellement l'incidence de l'excision incomplète ou étroite. Les rapports chirurgicaux doivent inclure des détails sur les marges circonférentielles et profondes pour guider l'interprétation pathologique et la révision future de la cicatrice, si nécessaire.

(Traduit par Dr Serge Messier)

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Introduction

Soft tissues sarcomas (STSs) are commonly encountered tumors of the skin and subcutaneous tissues in dogs, with a reported prevalence of 15% of all skin tumors in the dog (1). Wide surgical margins are recommended for STS excision (2), specifically 2 to 3 cm circumferentially and 1 deep fascial plane (1,3). One study evaluating STSs excised in a first opinion practice reported 74% of dogs underwent a marginal or local resection, with only 9% being described as wide or radical resections (4). Despite widely published margin recommendations, referral for treatment of incomplete margins occurs frequently (5). Up to 60% of STSs occur on the limbs (4), which may increase the prevalence of incomplete margins due to lack of tissue available for closure after surgical resection with wide margins in this area.

Recurrence rates for incompletely or narrowly excised STSs have been reported to range from 17 to 37% (6–9). Other studies report recurrence rates of 21 to 29% for dogs undergoing surgical resection of STSs, but the margins status prior to local recurrence was not reported and may have included some dogs with complete resections (4,10). In addition, a follow-up period of 2 y is recommended, as recurrence of STSs has been shown to occur over long periods of time and short follow-up times likely lead to underestimation of recurrence rates (11,12). Grade is a predictor of recurrence for STSs, with lower recurrence rates in low-grade tumors compared to high-grade tumors (9).

It has been recommended to not use terminology such as clean, dirty, close, or narrow, but rather to report a numerical margin distance in pathology reports (13). Most published literature converts this numerical margin length to definitions of complete, narrow, or incomplete (9,14–17). However, the definition of a narrow margin in canine STS varies among studies (18). Narrow margins have been defined as anywhere from < 3 mm to < 1 cm (9,14–16). When inadequate resection of an STS occurs, scar revision is the preferred treatment if the scar location is amenable to a second resection (5,15). The difficulty lies in the definition of inadequate, as studies also vary widely on the definition of an adequate margin (9,14–16). A recent study specifically evaluated the risk of local recurrence between clean, narrow, and incomplete margins and reported the hazard of local recurrence increased 3.2 times with narrow margins (< 3 mm) compared to clean margins and 6.2 times with incomplete margins compared to clean margins (17). The overall rate of local recurrence with a 3-year follow-up in that study was 7.1% with clean margins, 22.5% with narrow margins, and 41.2% with incomplete margins. If scar revision is not possible, microscopic residual disease can be treated with radiation therapy (1). Active surveillance is another treatment option; frequent scar palpation allows for identification of local recurrence early so that additional treatment can be considered at the time of regrowth. With scar revision surgery, the rate of identification of residual STS cells within the excised tissue has been reported to be 22% (5). The authors subjectively appreciate that there is a large number of dogs with no residual tumor identified after scar revision for incompletely or narrowly excised STSs in the absence of gross disease.

The objective of this study was to describe clinical features of dogs undergoing scar revision for incompletely or narrowly excised STSs in the absence of gross disease and to determine rates of local recurrence after scar revision. The hypothesis was that neoplastic cells would be identified on scar revision in less than 33% of scars and that local recurrence would occur in $< 10\%$ of dogs.

Materials and methods

A retrospective medical record review was conducted at 2 veterinary teaching hospitals (University of Georgia and Oregon State University) to identify dogs undergoing a scar revision for a previously incompletely or narrowly excised STS initially operated on in a first-opinion practice. Incomplete excision was defined by a histologic tumor-free margin of 0 mm; narrow excision was defined by a histologic tumor-free margin of $>$ 0 mm and $<$ 3 mm. Dogs were excluded if gross disease was present at the scar, if scar revision had previously been performed, or if the original excision was not performed in a first-opinion practice. Data collected from the medical record included signalment, tumor grade and subtype (if reported), tumor location (head/neck, limb, trunk), diagnostic tests prior to the first excision, date of first excision, surgical information and pathologic findings related to the first excision, date of scar revision, staging results, length of the scar, confirmation or absence of gross disease at the scar, surgical information and pathologic findings related to the scar revision, adjuvant therapy, date of last follow-up, and presence of recurrence at time of last follow-up. When multiple tumor-free margin lengths were reported, the narrowest margin was chosen for analysis. Follow-up was obtained by contacting primary care veterinarians for medical records or by contacting owners to determine if recurrence occurred. Local recurrence was suspected when a mass was present at the site of the scar and was confirmed when cytologic or histopathologic evaluation was consistent with STS.

Data were tested for normality by visual inspection of the normal quantile plot. Normal data are expressed as mean $\pm$ SD, non-normal data are expressed as median (range).

Results

Thirty-three scar revision surgeries in 33 dogs were included. The average age of all dogs at the time of scar revision was 8.9 $\pm$ 2.5 y. There were 18 spayed females, 13 castrated males, and 2 intact males. The most common breeds were mixed breed dog (8/33, 24.2%) and Labrador retriever (5/33, 15.2%) with 16 other breeds represented. The average body weight was 25.7 $\pm$ 12.8 kg. Location of the tumor was trunk (15/33, 45.5%), limb (11/33, 33.3%), and head/neck (7/33, 21.2%). The tumor was reported to be present for a median of 10 d (range: 2 to 52 d) before the first excision. Mass size at the time of initial excision was reported for 15 masses with a median of 3 cm (1 to 8 cm).

Cytological examination was carried out before initial surgery in 15 tumors (15/33, 45.5%). In 1 dog, the cytology was evaluated by a clinical pathologist, and in 1 dog, it was unclear if the sample was evaluated by a clinical pathologist; the remaining 13 samples were not evaluated by a clinical pathologist. Results for the 15 tumors that underwent cytologic evaluation were consistent with sarcoma (4/15, 26.7%) or lipoma (3/15, 20.0%), with 1 each (1/15, 6.7%) of hyperplastic lymph node, mast cell tumor, hemorrhagic fluid, undescribed fluid, inflammation, no evidence of neoplasia, non-diagnostic, or report unavailable. No dogs had an incisional biopsy completed before the first excision.

Initial excision

Medical records were available for 25 (25/33, 75.8%) initial excision procedures. Circumferential surgical margins were reported for 1 initial excision procedure (1/25, 4.0%) and were 1 cm in length and deep surgical margins were reported for 3 initial excision procedures (3/25, 12.0%) and included subcutaneous tissue (n = 2) or muscle (n = 1). A grade was reported for 28 tumors after the initial excision (28/33, 84.8%) and included Grade I (9/28, 32.1%), Grade II (16/28, 57.1%), and Grade III (3/28, 10.7%). Subtype was reported for 20 tumors: peripheral nerve sheath tumor (n = 6), fibrosarcoma (n = 4), hemangiopericytoma (n = 3), hemangiopericytoma or nerve sheath tumor (n = 3), liposarcoma (n = 2), rhabdomyosarcoma (n = 1), and neurofibroma (n = 1). Two dogs (2/33, 6.1%) had immunohistochemistry done on the initial excision specimen. In 1 dog, this resulted in a subtype diagnosis of a poorly differentiated rhabdomyosarcoma. In the second dog, the panel was used solely to rule out melanoma with a final diagnosis of a poorly differentiated spindle cell sarcoma. Circumferential margins were provided in the pathology report for 31 initial excisions (31/33, 93.9%) and were incomplete (17/31, 54.8%), narrow (12/31, 38.7%), or complete (2/31, 6.5%). Deep margins were reported for all 33 initial excisions (33/33, 100.0%) and were incomplete (19/33, 57.6%), narrow (13/33, 39.4%), or complete (1/33, 3.0%). In total, 19 dogs (19/33, 57.6%) had at least one incomplete margin, and 14 dogs (14/33, 42.4%) had at least one narrow margin after the initial excision.

Scar revision

Length of time between the initial excision and the scar revision was a median of 29 d (range: 5 to 352 d). Thoracic imaging was performed in 29 dogs, and local lymph node evaluation was conducted in 7 dogs, with no evidence of metastasis in any dog. The length of the scar was reported in 19 dogs (19/33, 57.6%) and measured an average of 6.0 cm $\pm$ 3.7 cm. Eight dogs had a CT scan of the scar for surgical planning.

Circumferential surgical margins for the scar revision surgery were reported for 26 scars (26/33, 78.8%) with margins of $<$ 1 cm (1/26, 3.8%), 1 cm (4/26, 15.4%), 1.5 cm (1/26, 3.8%), 1 to 2 cm (1/26, 3.8%), 2 cm (4/26, 15.4%), 2 to 3 cm (2/26, 7.7%), and 3 cm (13/26, 50.0%). Deep surgical margin tissue type was reported for 29 scars (29/33, 87.8%) and was fascia, bone/periosteum, or the entire compartment in all cases.

Pathologic evaluation of the scar revealed no evidence of disease in 26 scars (26/33, 78.8%), STS in 6 scars (6/33, 18.2%), and unable to differentiate residual disease from scar tissue in 1 scar (1/33, 3.0%). All dogs with STS diagnosed from the scar revision had both incomplete circumferential and deep margins from the initial excision. For dogs with residual STS, a grade was assigned to 2 scars and was consistent with the grade from the initial excision in 1 dog (Grade II) and was assigned a lower grade than the initial excision in the other dog (decrease from Grades II to I). Subtypes were assigned to 4 of the scar revisions with residual STS and were fibrosarcoma (n = 2), neurofibrosarcoma (n = 1), and hemangiopericytoma (n = 1). The hemangiopericytoma and the neurofibrosarcoma were

previously diagnosed as peripheral nerve sheath tumors from the original excision specimen, 1 fibrosarcoma was diagnosed as a peripheral nerve sheath tumor or hemangiopericytoma, and the other fibrosarcoma was previously also diagnosed as a fibrosarcoma. Circumferential histologic margins were reported for 5 scar revision cases (5/6, 83.3%) with residual STS and were complete (n = 3), narrow (n = 1), or incomplete (n = 1). Deep histologic margins were reported for 4 scar revision cases (4/6, 66.7%) with residual STS and were complete (n = 3) and narrow (n = 1). In total, for cases with residual STS identified in the scar, margins were complete (3/6, 50.0%), narrow (1/6, 16.7%), or incomplete (1/6, 16.7%). For the dog in which residual STS could not be differentiated from scar tissue, both circumferential and deep margins were complete.

Follow-up

One dog with no evidence of disease in the scar revision tissues received chemotherapy (doxorubicin) following scar revision surgery due to the high mitotic index of the original tumor ($>$ 20/hpf), although a grade was not assigned to this tumor at the time of the initial excision. Another dog received vinblastine for a concurrent mast cell tumor. No other dogs received chemotherapy after surgery. One dog received radiation therapy of the scar following scar revision due to concern over the deep margin, despite no evidence of disease seen on pathologic evaluation of the scar.

Median follow-up for all dogs was 1127 d (range: 1.000 to 3192 d). Twenty-two scars (22/33, 66.7%) had follow-up of $>$ 2 y (median: 1567 y, range: 745 to 3192 d), 3 scars (3/33, 9.1%) had follow-up of $<$ 2 y but $>$ 1 y (median: 564.0 y, range: 541 to 644 d), and 8 scars (8/33, 24.2%) had follow-up of $<$ 1 y (median: 48.50 y, range: 1 to 170 d). A single dog experienced local recurrence 201 d after scar revision surgery; the tumor in this dog was a Grade III STS, and there was no evidence of disease in the scar revision specimen. The initial excision also revealed a Grade III STS in this dog. Local tumor recurrence rates were 3.0% (1/33) for all dogs, 4.0% (1/25) for dogs with $>$ 1 y of follow-up, and 4.5% (1/22) for dogs with $>$ 2 y of follow-up. The single dog with incomplete margins on the scar revision pathology was lost to follow-up at 14 d. The dog with narrow margins on the scar revision pathology had follow-up of 644 d with no evidence of local recurrence.

Discussion

In this study of dogs undergoing scar revision for previously incompletely or narrowly excised STSs, evidence of residual tumor was identified in only 18.2% of scars, thus the hypothesis that neoplastic cells would be identified on scar revision in less than 33% of scars was accepted. This is similar to a previous report in which residual disease was identified in 22% (9/41) of scars (5). Although identification of residual tumor was uncommon in the dogs of this study, the 1 dog with confirmed recurrence had no evidence of disease on the scar revision tissues.

In veterinary medicine, the full submitted specimen is not routinely evaluated microscopically, and a consensus has not been reached on the ideal technique to evaluate submissions for margins (13). Because of the retrospective nature of this study, the method of sectioning was unknown and was chosen at the discretion of the attending pathologist. Other methods to assist with margin assessment, such as optical coherence tomography, have been evaluated and shown promise for margin assessment in canine STSs, but this method requires specialized equipment and training (19). Assessment of scar revision tissues for STSs may be particularly onerous as fibrous tissue from the scar can be difficult to differentiate from a low-grade STS, as evidenced by 1 dog in this report in which a determination could not be made. Although immunohistochemistry can be used to differentiate subtypes of STSs, there is no consensus on the combination of stains needed to define various subtypes (18). In addition, myofibroblasts predominate in healing after surgery and in the development of scar tissue and may be difficult to distinguish from fibrosarcoma cells in low-grade tumors (20,21).

Despite the lack of consensus for margin assessment in veterinary medicine, the 1 dog in this study that experienced recurrence had no evidence of disease in the scar revision tissues. This could be due to interpretation of the tissues as being related to the scar, rather than residual tumor, or could be due to a low residual volume of tumor cells that were not identified due to sectioning methods. Thus despite 78.8% of dogs having no evidence of disease on evaluation of the scar revision specimen, it is possible that residual tumor cells were removed even if they were not identified histologically. It may also be possible that small numbers of microscopic cells are unable to survive or are more easily recognized and removed by the immune system. It may be helpful to inform owners that although tumor cells may not be identified in the tissues submitted following scar revision, performing the scar revision may still result in a decreased risk of local recurrence. In addition, completeness of excision is not the only factor influencing risk of recurrence, as increasing tumor grade has been shown to increase the recurrence rates for STSs (4,7). The dog in this report with local recurrence had a Grade III tumor diagnosed after the initial excision.

Local recurrence of STSs has been reported in 17 to 37% of dogs after STS excision (6–9), with incompletely or narrowly excised tumors having a higher recurrence rate (7,11,12). Although most studies group incomplete and narrow excision together, 1 group showed that narrowly excised tumors are more likely to recur locally than completely excised tumors, as this group looked at incompletely and narrowly excised tumors independently (17). Although the hazard of local recurrence was higher (6.2 times) with incompletely excised tumors compared to completely excised tumors, there was a 3.2 times risk of local recurrence for narrowly excised tumors compared to completely excised tumors. Follow-up of at least 2 y has been recommended to maximize detection of recurrence as time between excision and local recurrence can be long with incompletely excised STS (11,12). The recurrence rate in the present study for dogs with $\geq$ 2 y of follow-up was 4.5% which is lower than the previously reported study evaluating scar revision for inadequately excised STS (15%, 6/41 dogs) (5).

One reason for incomplete resection after primary excision is lack of knowledge of the nature and extent of the tumor leading to improper surgical planning, also known as unplanned surgery. In the present study, cytology was performed in only

46% of tumors before the initial excision and led to a correct diagnosis of STS in only 27%, with only 1 sample having been evaluated by a clinical pathologist. This is similar to a previous report in which only 12% of STS were correctly diagnosed on in-house cytology (5). In another study of dogs presented to a veterinary teaching hospital, 62.5% of aspirates led to a correct diagnosis of STS, whereas 15.0% led to an incorrect diagnosis and 22.5% were non-diagnostic (22). Mesenchymal cells do not exfoliate well for cytology, which may be one reason the success rate of cytology is low. The technique used to perform the fine-needle aspirate (using suction or not) was not reported and may have influenced the results. In addition, cytology cannot provide information on tumor grade, and it can be difficult to distinguish normal mesenchymal cells from cancerous cells. Veterinarians may consider having slides sent for review by a clinical pathologist to increase the sensitivity of cytologic evaluation.

An incisional biopsy was not performed in any dog before the initial excision herein, although biopsy has been previously recommended prior to excision of subcutaneous masses (3,5). Biopsy results can also aid definitive surgical resection by providing information on the type of mass, allowing the surgeon to plan for a resection with wide and deep margins chosen based on the expected biological behavior (*i.e.,* invasiveness) of the specific tumor and grade. Although biopsy before definitive resection can provide information on grade for STS, it is important to note that grade can change upon evaluation of the entire resected tumor specimen, and in tumors in which the biopsy sample and final excision sample disagreed, the biopsy sample underestimated grade in most cases (23). In cases in which a pre-surgical biopsy was performed, the tumor should be re-submitted for histopathologic evaluation after definitive resection. Providing the pathologist with a larger sample for evaluation leads to more accurate grading and allows for assessment of circumferential and deep margins after definitive resection. A higher risk of incomplete excisions is expected if pre-surgical planning with cytology or biopsy is not carried out (4).

A scar revision procedure must be planned based on knowledge of the tumor type and grade from the initial excision and knowledge of the surgical margins from the initial excision. In the dogs herein, circumferential and deep surgical margins were reported in only 4.0% and 12.0% of dogs, respectively. Knowledge of the initial excision can greatly enhance a surgeon's ability to perform a scar revision, thus it is important that information from the initial surgery is reported in the medical record. If the surgical margins from the initial excision are unknown, the surgeon performing the scar revision does not know which tissues have been previously disturbed as they plan the scar revision procedure. Although cross-sectional imaging can be helpful for scar revision planning, the costs associated with this can be high and residual inflammation from the initial excision may confound interpretation.

Although evaluation of margins is important for tumor resection, it is known that margin shrinkage occurs throughout the resection and fixation process, with the circumferential margin reducing to 42% of the grossly normal surgical margin in STS excisions (24). Pathologic evaluation of resected specimens remains complicated and is limited by trimming techniques used on the specimen. Providing the pathologist with as much information as possible, specifically surgical margin size and tissue type of the deep margin, will aid in interpretation of the results. Although fascia is recommended as the deep margin for STS resection, fascia is not always obvious on pathology and is typically quite thin (15); the pathologist may report a narrow margin if fascia is not identified histologically. Although the thinness of the fascia may lead to a diagnosis of a narrow excision, if the surgeon is confident fascia was removed, this would be considered a complete excision, as fascia is considered a barrier to tumor spread. In human oncologic surgery, barriers to tumor invasion such as fascia and bone are classified as either thick or thin barriers (25). Regardless of the actual width of the barrier, thick and thin barriers are assigned an equivalent normal tissue width of 3 and 2 cm respectively, indicating their resistance to tumor invasion. Although equivalent normal tissue width has not been assigned to tissue barriers in veterinary medicine, the concept is similar in that if the tumor extends to the fascia but not through it, a narrow deep margin that includes fascia could be considered complete and not close. Despite this, the pathologist often does not know if fascia was taken, and deep margins are instead interpreted based on width. Given the issues with interpreting margins based on width in terms of narrow excision, this is not ideal (26). Prospective studies with long-term follow-up are needed to more fully evaluate deep and circumferential margins based on width and tumor grade to determine risk of recurrence.

In human medicine, margin categorization is based on the TNM residual tumor classification system, R-classification. In this system, margins with no residual tumor are assigned R0, margins with microscopic residual tumor are assigned R1, and margins with macroscopic residual tumor are assigned R2 (27). There is debate about how to classify margins when tumor cells extend to within 1 mm of the surgical margin, and a separate classification scheme, the International Union Against Cancer UICC-classification has been defined to indicate a resection margin $>$ 1 mm as R0, margin $<$ 1 mm as R1, and macroscopic residual tumor as R2 (28). One study reported that local control rates were improved with an R0 resection with the UICC-classification compared to an R0 resection with the R-classification system (28). Despite this, in humans with STS, margins $<$ 2 mm behave more similarly to incomplete margins, whereas margins ranging from 2 mm to 2 cm behave as complete margins (29). Although the comparative histopathology of canine and STS is similar, more work needs to be done to determine if canine STS can be used as a translational model for human STS (30,31). Because of this, veterinary studies evaluating incomplete margins are necessary to determine appropriate treatment for dogs.

Limitations of this study include its retrospective nature. Although the pathology report was available for every initial excision, the method of pathologic evaluation was unknown, the reports varied in their detail reporting margin assessment, and the pathologists evaluating the specimens differed. Although standardized pathologic evaluation would be ideal, this is less clinically relevant to everyday practice. The surgical

report was not available for every case; however, even in cases with this information, the surgery report was either absent or lacked details regarding surgical margins. Although the overall follow-up was > 2 y, 11 dogs had follow-up < 2 y and the median follow-up time for dogs with < 1 y of follow-up was low (48.50 d). Referring veterinarian records were evaluated for local recurrence. If no mention of this was made and the physical examination of the integument was recorded as normal, the dogs were considered not to have local recurrence. This may have led to underestimation of local recurrence. When referring veterinarian records could not be obtained, owners were contacted but not all responded. Owner perception of local recurrence may underestimate the true rate of recurrence. The narrow margin, as defined for this study, was chosen based on past reports in the literature, but it is important to note that this is an arbitrary definition and other factors such as the location of the scar, ability to improve margins with a second procedure, and the biology of the tumor based on its diagnosis and grade are also important to consider.

In the dogs reported here, scar revision in the absence of gross disease for incompletely or narrowly excised STSs led to identification of residual tumor in only 18.2% of scars. Despite this low identification rate of residual tumor, the local tumor recurrence rate was 3.0% which is lower than what is historically reported. In the 1 dog with local recurrence, no evidence of residual tumor was identified in the scar revision specimen. Scar revision for incompletely or narrowly excised STSs for the dogs in this study resulted in a low recurrence rate, lower than what is previously reported for incompletely excised STS (6–9). In addition, if pre-surgical cytology is unrewarding, a pre-surgical biopsy should be considered to assist in surgical planning of the initial excision. Surgical reports should include details specific to the surgical dose and intent (wide or marginal excision), circumferential surgical margins, and the tissue type taken as the deep surgical margin to assist with margin interpretation on the pathology report, and in the event of incomplete resection, to aid in planning scar revision surgery. CVJ

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