Original Article Clinics in Orthopedic Surgery 2022;14:289-296 • https://doi.org/10.4055/cios21182

Sodium Tetradecyl Sulphate Sclerotherapy for Lateral Malleolar Bursitis of the Ankle

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Background: The aim of this study was to evaluate clinical outcomes of sodium tetradecyl sulphate (STS) sclerotherapy for conservative treatment of lateral malleolar bursitis of the ankle.

Methods: We reviewed data from 20 consecutive patients (20 ankles) who underwent STS sclerotherapy between August 2018 and June 2019. After aspiration of fluid from the lateral malleolar bursal sac, 2 mL (20 mg) STS was injected into the sac. Clinical outcomes and side effects and complications were evaluated at 2 weeks, 3 months, 1 year, and 2 years after sclerotherapy. Responses to treatment were assessed according to degree of fluctuation, shrinkage of the bursal sac, and soft-tissue swelling. The 36-item short form survey (SF-36) was completed for each patient before and after therapy.

Results: Complete response was observed in 17 patients (85%), and partial response was observed in 3 patients (15%) after STS sclerotherapy. SF-36 physical component scores improved from 62.2 (interquartile range, 5.2) before therapy to 70.0 (interquartile range, 7.9) at last follow-up ($p < 0.05$). One patient (5%) experienced transient hyperpigmentation at the injection site. No major complications occurred.

Conclusions: STS sclerotherapy was an effective and safe treatment for patients with lateral malleolar bursitis of the ankle.

Keywords: *Lateral malleolus, Bursitis, Sclerotherapy, Sodium tetradecyl sulphate*

Bursae are fluid-filled sacs lined with a synovium-like membrane, most of which are located adjacent to skin, tendons, or muscles that pass over bony prominences. Their purpose is to reduce friction between two tightly apposed surfaces.[1,2] The lateral malleolar bursa is an adventitious bursa, which is often found in people who frequently sit in a cross-legged position on hard floors and athletes who wear hard shoes or boots.[1,2]

Lateral malleolar bursitis is typically the result of repetitive microtrauma or irritation.[2,3] The main symptoms include discomfort while wearing shoes, irritation, pain, and cosmetic problems. As these symptoms are usually mild, conservative treatment, such as aspiration followed by use of a compressive bandage or injection of a corticosteroid, is usually preferred.[2] Unfortunately, the recurrence rate is quite high with standard conservative treatment; thus, many patients are dissatisfied with this approach.[4] In addition, after failure of conservative treatment, the bursa can become inflamed or distended. The mass effect of the inflamed bursa or accompanying pain can inhibit the ability to wear shoes and negatively impact the person's lifestyle and sports performance.[2] In severe cases, the bursa can become infected.

Surgical excision of a malleolar bursa may be considered when conservative treatments fail, but surgery can lead to scar pain, cosmetic problems, hyperesthesia, super-

Received November 2, 2021; Revised January 10, 2022;
Accepted January 10, 2022
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ficial peroneal nerve injury, and recurrence.[4] Sclerotherapy is a potentially superior option for managing lateral malleolar bursitis because of its safety, ease of application, and acceptable functional outcomes.[5] Moreover, use of sclerotherapy can avoid the need for surgical intervention.

Sodium tetradecyl sulphate (STS) has been widely used as a sclerosing agent since its approval by the United States Food and Drug Administration in 1946.[6] Although approved for small varicose veins, there have been numerous reports of STS sclerotherapy for other diseases.[7] STS is commonly used to treat small varicose veins of the leg, reticular veins, and venous or lymphatic malformations, although intracystic STS injection has also been used for many cystic diseases, including pyogenic granulomas, cherry angiomas, digital mucous cysts, glomangiomas, pseudocysts of the auricle, and ganglion cysts.[6-11] The purpose of this study was to evaluate the clinical outcomes and safety of STS sclerotherapy for lateral malleolar bursitis.

METHODS

The Institutional Review Board and Ethical Committee of Yonsei University College of Medicine approved this study (No. 4-2021-0721), and informed consent was obtained from each patient before STS sclerotherapy.

Between August 2018 and June 2019, 20 consecutive patients (20 ankles) underwent STS sclerotherapy for lateral malleolar bursitis of the ankle, the diagnosis of which was based on clinical symptoms, physical examination, and radiologic evaluation. Medical records of all the 20 patients were reviewed retrospectively, and the following data were recorded: age, sex, disease duration, number of STS sclerotherapy treatments, side of the affected lateral malleolus, follow-up duration, clinical results, subjective satisfaction, recurrence, and complications. All patients had previously undergone several aspirations to treat lateral malleolar bursitis but were unresponsive for at least 1 month to conservative treatment, including aspiration with or without intracystic corticosteroid injection. We excluded patients with thrombotic disorders, asthma, a prior allergic reaction to STS, septic bursitis, or diabetic foot ulcers.

We evaluated all patients using simple anteroposterior and lateral radiographs of both ankles at their first visit and performed ultrasonography of the bursa region before and after STS treatment (Fig. 1). The procedure for STS sclerotherapy was the same in all the 20 patients. In the outpatient clinic, 2 mL of 1% solution of STS (20 mg) was prepared in a 2-mL syringe. After puncturing the bursal sac with an 18-gauge needle attached to a syringe, we aspirated as much bursal fluid as possible while manually

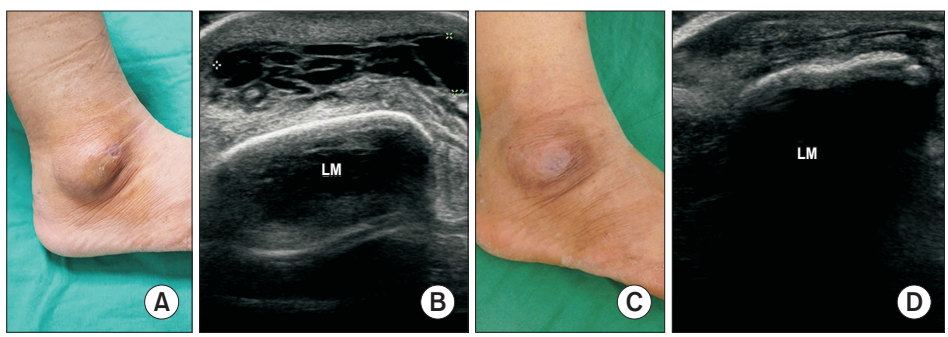

Fig. 1. Photograph and ultrasound images of the lateral malleolar bursitis. (A) Photograph of fluid collection prior to sclerotherapy. (B) Initial ultrasound image of lateral malleolar bursa with fluid collection. (C) Photograph of improved fluid collection 2 weeks after sclerotherapy. (D) Ultrasound image of lateral malleolus (LM) 2 weeks after injection, showing collapse of the bursa.

Table 1. Response Evaluation Criteria for Malleolar Bursitis of the Ankle

Response to treatment	Shrinkage	Fluctuation	Soft-tissue swelling
CR	Complete	No	None or minimal
PR	Partial	Yes	Yes
NR	No change	Yes	Yes

CR: complete response, PR: partial response, NR: no response.

Table 2. Patient Characteristics and Clinical Outcomes

Patient no.	Sex	Age (yr)	Side	Duration of disease (mo)	No. of previous aspirations	No. of STS treatments	Follow-up (mo)	Comorbidity	Clinical outcome	SF-36 PCS		SF-36 MCS	
										Pre	Post	Pre	Post
1	M	46	R	3	1	1	32	-	CR	83.4	86.3	86.6	89.7
2	M	85	R	12	1	2	31	HTN, DM	CR	61.9	72.5	74.7	79.1
3	F	55	R	3	1	3	30	-	CR	65.3	70.6	72.8	72.8
4	F	59	R	6	2	3	30	-	CR	60.0	65.3	72.5	72.5
5	M	65	L	3	2	1	31	-	CR	52.8	64.4	66.3	70.9
6	M	46	R	36	5	2	30	-	CR	74.1	78.8	78.8	78.8
7	M	77	R	4	1	1	30	-	CR	60.0	69.4	75.6	77.2
8	F	53	R	4	1	1	29	Hypothyroidism	PR	64.1	64.1	72.5	72.5
9	F	51	R	6	1	2	28	-	CR	71.9	77.5	83.4	83.4
10	M	81	L	2	1	1	25	HTN	CR	61.3	69.4	77.2	78.8
11	F	60	L	24	5	3	24	Hypothyroidism	CR	62.5	65.3	78.8	77.2
12	M	60	R	12	3	2	24	-	PR	64.1	74.4	78.8	80.3
13	M	52	L	1	1	2	24	-	CR	73.8	80.6	83.4	85.0
14	M	69	L	6	1	1	26	HTN, PAOD, CAOD, DM, ESRD	CR	56.3	56.3	69.4	70.9
15	M	78	R	6	1	2	24	HTN	CR	60.3	70.6	75.0	72.5
16	F	54	L	12	3	2	25	-	CR	61.3	72.5	72.8	72.8
17	M	63	R	3	2	2	25	HTN, DM	CR	64.1	70.6	83.4	85.0
18	F	73	L	2	1	2	24	HTN, DM, CAOD	CR	60.6	61.9	73.1	70.9
19	F	57	R	6	1	1	24	-	CR	65.6	69.4	79.1	81.9
20	F	70	L	6	1	2	25	ESRD	PR	51.6	56.3	67.5	66.3
Mean ± SD		62.7 ± 11.3		7.9 ± 8.3	1.8 ± 1.3	1.8 ± 0.7	27.1 ± 2.9						

STS: sodium tetradecyl sulphate, SF-36: 36-item short form survey, PCS: physical component score, MCS: mental component score, R: right, CR: complete response, HTN: hypertension, DM: diabetes mellitus, L: left, PR: partial response, PAOD: peripheral artery occlusive disease, CAOD: coronary artery occlusive disease, ESRD: end-stage renal disease, SD: standard deviation.

compressing the sac. STS was then injected from the STS-containing syringe into the bursal sac through the same needle used for aspiration. After injection, we applied a compressive dressing with a Coban bandage for 2 weeks. The procedure was repeated at 2-week intervals if there was no symptom improvement or if the fluid collection did not decrease. The maximum number of STS injections was three.

The average follow-up period was 27.1 months (range, 24–32 months) after the last STS injection. We examined each patient at 2 weeks, 3 months, 1 year, and 2 years after the last sclerotherapy. Clinical outcomes were evaluated using response evaluation criteria modified from the guidelines for response to treatment of solid tumors.[12] Clinical assessment was performed by one of the authors who did not perform the injection (SHH). The response evaluation criteria included degree of fluctuation, shrinkage of the bursal sac, and soft-tissue swelling, as shown in Table 1. The complete response was defined as when no fluid collection and swelling of bursal sac was visible on ultrasound. The partial response was defined

Table 3. Clinical Outcomes of Sodium Tetradecyl Sulphate Sclerotherapy for Malleolar Bursitis

Response to treatment	No. of patients (%)
CR	17 (85)
PR	3 (15)
NR	0

CR: complete response, PR: partial response, NR: no response.

Table 4. Response after STS Sclerotherapy for Malleolar Bursitis

Patient no.	No. of STS treatments	2 wk	4 wk (2 wk after 2nd treatment)	6 wk (2 wk after 3rd treatment)	3 mo	1 yr	2 yr or last follow-up
1	1	CR	Unchecked	Unchecked	CR	CR	CR
2	2	PR	CR	Unchecked	CR	CR	CR
3	3	NR	PR	CR	CR	CR	CR
4	3	PR	PR	CR	CR	CR	CR
5	1	CR	Unchecked	Unchecked	CR	CR	CR
6	2	NR	CR	Unchecked	CR	CR	CR
7	1	CR	Unchecked	Unchecked	CR	CR	CR
8	1	PR	Unchecked	Unchecked	PR	PR	PR
9	2	NR	CR	Unchecked	CR	CR	CR
10	1	CR	Unchecked	Unchecked	CR	CR	CR
11	3	NR	PR	CR	CR	CR	CR
12	2	CR	NR (Recur)	PR	PR	PR	PR
13	2	PR	CR	Unchecked	CR	CR	CR
14	1	CR	Unchecked	Unchecked	CR	CR	CR
15	2	NR	CR	Unchecked	CR	CR	CR
16	2	PR	CR	Unchecked	CR	CR	CR
17	2	PR	CR	Unchecked	CR	CR	CR
18	2	PR	PR	Unchecked	PR	CR	CR
19	1	PR	Unchecked	Unchecked	PR	CR	CR
20	2	PR	PR	Unchecked	PR	PR	PR

STS: sodium tetradecyl sulphate, CR: complete response, PR: partial response, NR: no response.

as when minimal fluid collection and decreased swelling was visible on ultrasound and fluctuation was observed by inspection and palpation. No response was defined as no change found in fluid collection on ultrasound. To evaluate subjective satisfaction of patients, we used the Medical Outcomes Study 36-item short form survey (SF-36), a health status questionnaire for assessing functional status and quality of life.[13] We also assessed procedure-related complications, including skin atrophy, hyperpigmentation, pain, tissue necrosis, allergic or anaphylactic reaction, local redness, local or joint infection, fever, numbness, and scarring.

SF-36 scores before and after STS sclerotherapy were compared using the Wilcoxon signed-rank test. Statistical analyses were performed using IBM SPSS ver. 26.0 (IBM Corp., Armonk, NY, USA). A $p < 0.05$ was considered statistically significant.

RESULTS

The study included 11 men and 9 women, with a mean age of 62.7 years (range, 46.0–85.0 years) (Table 2). Twelve patients had right ankle bursitis and 8 had left ankle bursitis. The mean duration of disease was 7.8 months (range, 1–36 months). Nine patients (45%) had comorbidities, including hypertension (n = 6), diabetes mellitus (n = 4), hypothyroidism (n = 2), end-stage renal disease (n = 2), and peripheral or coronary artery occlusive disease (n = 2). There was no obvious association between clinical outcomes and patient comorbidities.

At last follow-up, all patients had a complete or partial response. Complete response was observed in 17 patients (85%): 6 (30%) responded after the first sclerotherapy, 8 (40%) responded after the second sclerotherapy, and 3 (15%) responded after the third sclerotherapy (Tables 2 and 3, Fig. 1). Three patients (15%) experienced a partial response. One of these patients (5%) had recurrence of lateral malleolar bursitis 1 month after the first sclerotherapy but exhibited a partial response after the second STS sclerotherapy, another patient had a partial response after the second sclerotherapy, and the remaining patient had residual swelling after the first sclerotherapy but refused another injection (Table 4). However, all 3 patients with a partial response were satisfied with their results and requested no further treatment.

SF-36 scores (median and interquartile range [IQR]) are shown in Table 5. SF-36 physical component scores improved from 62.2 (IQR, 5.2) before treatment to 70.0 (IQR, 7.9) at last follow-up ($p < 0.05$). SF-36 mental component scores did not change significantly ($p = 0.08$).

One patient who received 3 STS sclerotherapy treatments experienced hyperpigmentation after the first treatment, which resolved spontaneously within 2 weeks. No other complications occurred after STS sclerotherapy, including skin atrophy, infection or abscess formation, scar formation, tissue necrosis, anaphylactic reaction, facial flushing, systemic fever, or numbness.

DISCUSSION

In this study, we report satisfactory results of 20 patients who received STS sclerotherapy for lateral malleolar bursitis and were followed up for at least 2 years. Complete response was observed in 17 patients (85%) and partial response was observed in 3 patients (15%), with no major complications. Additionally, SF-36 physical component scores improved significantly after sclerotherapy. Although the SF-36 mental component score did not improve significantly, all patients were satisfied with their outcome and requested no further treatment.

The function of bursae is to facilitate motion between two different structures.[1] Bursa can be classified as anatomic or adventitious.[1] Anatomic bursae are usually absent at birth but develop over time in response to normal friction between tendons and adjacent structures.[1] Adventitious bursae are subcutaneous and develop in response to constant irritation and repeated trauma.[1,2] Lateral malleolar bursae are a type of adventitious bursa that develops as a protective response to persistent pressure over the lateral malleolus.[2,3] With continuing irritation, synovial proliferation occurs, and the synovial sac becomes filled with newly synthesized synovial fluid.[14]

Table 5. SF-36 Scores before and after Sodium Tetradecyl Sulphate Sclerotherapy for Malleolar Bursitis

Type of SF-36 score	First visit	Last follow-up	*p*-value
Physical component score	62.2 (5.2)	70.0 (7.9)	< 0.05
Mental component score	75.3 (6.1)	77.2 (8.2)	0.08

Values are presented as median (interquartile range).

Lateral malleolar bursitis is a common disorder in the orthopedic clinic. Conservative treatment is generally preferred because symptoms are usually mild unless infection occurs. First-line treatment for lateral malleolar bursitis includes lifestyle changes, consecutive aspiration and corticosteroid injections, and use of compressive bandages.[2] However, many patients experience recurrence with these forms of nonoperative management.[1,4] In recurrent and symptomatic cases unresponsive to conservative treatment, operative excision can be considered, but there are a number of potential complications of operative treatment, including wound problems, superficial peroneal nerve injury, and skin necrosis.[1,2,4,15] Lee et al.[15] reported wound healing problems in 15% of 26 patients undergoing open bursectomy. In another study of 11 patients, open excision of lateral malleolar bursitis caused superficial peroneal nerve injuries in 2 patients, skin necrosis in 1 patient, and wound healing problems in 1 patient.[4] Therefore, more effective and safe treatment is required, and various treatment options have been introduced. Recently, several studies reported promoting effect for wound healing of platelet-rich plasma and satisfactory results of platelet-rich plasma injection for refractory greater trochanteric bursitis.[16,17] Likewise, platelet-rich plasma injection may be applicable for lateral malleolar bursitis alternatively. Park et al.[5] previously reported results of treating malleolar bursitis with OK-432 (Picibanil) sclerotherapy, which produced excellent results: 95% of 20 patients experienced complete resolution with OK-432 sclerotherapy. In their study of 24 patients with malleolar and olecranon bursitis treated with 50% ethyl alcohol injections, Hong et al.[14] reported complete resolution in 54% and partial resolution in 46%. The results of the current study suggest that STS sclerotherapy is among the most effective treatment options for malleolar bursitis.

STS sclerotherapy has many advantages over other conservative treatments, as well as surgery. First, STS sclerotherapy is a fast and simple procedure, requiring only aspiration and injection into the bursal sac. Second, STS sclerotherapy requires no anesthetic procedure or hospitalization. Third, STS sclerotherapy has a low complication rate. In previous study of 20 patients treated with OK-432 sclerotherapy, complications were relatively common: 6 patients developed a low-grade fever and 9 patients experienced local redness, swelling, and injection-site pain.[5] Goh et al.[3] reported favorable results (89.8% of 49 patients experienced complete resolution and recurrence rate of 2% [1/49]) using intracystic injection of triamcinolone acetonide, but side effects such as transient hyperglycemia (8.2%) and skin atrophy (6.1%) occurred. In our study, transient hyperpigmentation occurred in 1 patient, and no other complications or side effects were observed. Finally, STS sclerotherapy has a lower recurrence rate than other standard conservative methods. Previous studies reported recurrence rates of 43.7% (7/16) with lifestyle modifications and 35% (21/60) with simple aspiration plus compression.[1,4] In contrast, the recurrence rate observed in our study was only 5% (1/20).

In our study, intralesional injection of STS successfully resolved the lateral malleolar bursitis in the majority of patients without causing major complications. STS is an anionic detergent sclerosant that disrupts the phospholipid outer membrane of cells.[6,18] It produces maximum endothelial damage by various processes, including decreased surface tension of endothelial cells, disruption of intercellular cement, interference with cell surface lipids, and extraction of cell surface proteins and cell membrane phospholipids.[7,18] STS sclerotherapy is also effective for cystic lesions with a synovial lining but no true endothelial lining. For wrist ganglions, Chatterjee et al.[19] reported that STS sclerotherapy was superior to corticosteroid injections, resulting in a lower recurrence rate. Audebert[8] reported excellent results when using STS sclerotherapy for digital mucous cysts: 13 of 13 patients were cured, and no complications were observed. The exact mechanism of action of sclerosants in cystic disease has not been established. Li and Barankin[9] reported that sclerosing agents directly destroy cellular membranes and damage the endothelial lining to induce embolization of vessels supplying digital mucous cysts. Audebert[8] suggested that STS obstructs synovial fluid tracts leading from joints to digital mucous cysts. For intractable malleolar bursitis unresponsive to standard conservative methods, there is a high likelihood of communication with the joint or proliferation of the synovium and neovascularization.[14,15] Thus, one or both mechanisms suggested for digital mucous cysts may apply to lateral malleolar bursitis as well.

Known complications of STS sclerotherapy include pain, tissue necrosis, skin ulceration, hyperpigmentation, and allergic reactions.[7,18] Although hyperpigmentation was a minor, transient side effect in our study, it has been reported as a major complication, which was likely due to excessively high concentrations of STS or fragile veins, rather than being an intrinsic drawback of the technique.[18] STS may also extravasate into the surrounding tissues, leading to tissue necrosis and skin ulceration.[10] Therefore, it is important to maintain the correct needle position when changing the syringe after aspirating the bursal sac and while injecting STS. Potentially fatal complications include anaphylaxis and thrombotic events.[18] However,

the incidence of allergic reactions with STS (estimated at 0.3%) is lower than that for other sclerosants.[10] Although thrombotic complications have been reported to occur more commonly with large volumes of concentrated sclerosants, the true incidence of these complications has not been established.[18] Despite its rarity of fatal complications, previous history of allergic reaction to STS and thrombotic disorders are absolute contraindications to use.[18] In previous studies, STS concentrations ranging from 0.1% to 3% have been used for various cystic diseases.[6] In the current study, we used a relatively low concentration of STS (1%) and achieved satisfactory results with no major complications.

As mentioned above, we used 1% STS solution with a 2-week interval. The treatment protocol was established this way to allow the least number of complications and to maximize the effectiveness of complication management. Park et al.[10] used 1% solution for ganglion cysts in fingers and 3% solution for toe lesions and obtained favorable results of 80% of resolution. In another previous report for ganglion cysts by Audebert,[8] skin necrosis, hemorrhagic reaction, and nail dystrophy were observed after use of 3% solution although its prevalence was low. After careful consideration, we decided to use 1% solution to minimize the risk of complication. As for the follow-up interval, 5 to 7 days of interval between treatments is recommended in instructions for use. And in previous reports, it took 1 to 2 weeks for spontaneous resolution of relatively common minor complications such as superficial necrosis.[10] So we decided the 2-week interval due to ease of both observation of complications and repetitive sclerotherapy.

This study has some limitations. It is a retrospective study and involved a relatively small number of patients. There was no control group of patients who received standard conservative treatment, such as corticosteroid injections, for comparison. Prospective, randomized studies with larger patient groups are required to confirm our results.

In conclusion, this is the first report of the clinical application of STS for lateral malleolar bursitis of the ankle. Our results showed that STS sclerotherapy is an effective conservative method for treating this condition. Complete or partial response was observed in all patients, without the occurrence of major complications.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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