Peripheral Nerve

INTRODUCTION

Surgery through targeted deactivation of peripheral nerves at trigger sites has been one of the most significant recent advances for treatment of migraine headaches.1,2 Six main trigger sites have been identified,3–6 with the average number of trigger sites for each surgical patient reported as being 2.6 in a large series.7 Diagnosis of trigger sites is key for planning of surgical treatment. Techniques described for localization of trigger sites include response to botulinum toxin type A injection8 and clinical diagnosis through presence of a constellation of symptoms9 as well as computed tomography of the sinuses for analysis of an intranasal trigger site. More recently, the Doppler probe has been used to detect an arterial signal in the vicinity of a trigger site.10,11

We hypothesized in this study that the scratch collapse test (SCT) could potentially be used to diagnose trigger sites for surgical planning in migraine surgery. Eleven consecutive patients presenting for migraine surgery, and four patients presenting with recurrent headaches and secondary trigger sites after initial successful migraine surgery were examined with the SCT using a standard protocol to assess involvement of bilateral sites I, II, IV, V, and VI, with the carpal tunnel as a negative control. The SCT was positive bilaterally at sites I, II, IV, V, and VI for all patients presenting primarily for migraine surgery, regardless of trigger sites localized by history and other secondary modalities. The SCT, however, correlated with secondary trigger sites localized through history and examination for patients presenting with recurrent migraine headaches after previous primary surgery. The SCT is not reliable for localization of trigger sites in patients presenting primarily for migraine surgery. This likely relates to central sensitization of migraine headaches, leading to global cutaneous allodynia in the head and neck. In patients with recurrent migraine headaches, abrogation of central sensitization following the initial surgery allows diagnosis of secondary trigger sites through the SCT. (Plast Reconstr Surg Glob Open 2022;10:e4145; doi: 10.1097/GOX.0000000000004145; Published online 22 February 2022.)

The Scratch Collapse Test for Diagnosis and Treatment of Trigger Sites for Migraine Surgery

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Summary: Diagnosis of trigger sites for migraine surgery relies on history to detect a constellation of symptoms and secondarily, nerve blocks, imaging studies, and Doppler probe examination. The scratch collapse test (SCT) has been described for localization of compressive neuropathies in the upper and lower extremities. In this study, we hypothesized that the SCT could also be used to diagnose trigger sites for surgical planning in migraine surgery. Eleven consecutive patients presenting for migraine surgery, and four patients presenting with recurrent headaches and secondary trigger sites after initial successful migraine surgery were examined with the SCT using a standard protocol to assess involvement of bilateral sites I, II, IV, V, and VI, with the carpal tunnel as a negative control. The SCT was positive bilaterally at sites I, II, IV, V, and VI for all patients presenting primarily for migraine surgery, regardless of trigger sites localized by history and other secondary modalities. The SCT, however, correlated with secondary trigger sites localized through history and examination for patients presenting with recurrent migraine headaches after previous primary surgery. The SCT is not reliable for localization of trigger sites in patients presenting primarily for migraine surgery. This likely relates to central sensitization of migraine headaches, leading to global cutaneous allodynia in the head and neck. In patients with recurrent migraine headaches, abrogation of central sensitization following the initial surgery allows diagnosis of secondary trigger sites through the SCT. (Plast Reconstr Surg Glob Open 2022;10:e4145; doi: 10.1097/GOX.0000000000004145; Published online 22 February 2022.)

We hypothesized in this study that the scratch collapse test (SCT) could potentially be used to diagnose trigger sites for surgical planning in migraine surgery. The SCT was first described for diagnosis of carpal and cubital tunnel syndrome12 and subsequently shown to be efficacious for diagnosis of other compressive neuropathies in the extremities such as common13 and superficial peroneal nerve compression.14 The SCT involves lightly scratching the skin over the area of nerve compression while the patient performs active sustained shoulder external rotation. In the presence of a compressive neuropathy, there is a brief loss of muscle resistance resulting in shoulder internal rotation. The patient rapidly regains strength afterward with repeated resistance testing.

The mechanism of the SCT has been postulated to be related to hyperalgesia and cutaneous allodynia over the compressed nerve.15 Hence, a nonpainful skin stimulus over the area of nerve compression leads to inhibition in tonic voluntary muscle activity, termed the “cutaneous silent period.”16,17 This may be related to an inhibitory

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spinal reflex, which has a role in protective withdrawal of a limb from harmful stimuli.\textsuperscript{17,18}

In this study, we examined 11 consecutive patients presenting for consideration of migraine surgery and four patients who presented for treatment of secondary trigger sites after initial migraine surgery.

**PATIENTS AND METHODS**

A consecutive series of 11 patients presenting for migraine surgery were examined using the SCT. The SCT was performed bilaterally and sequentially at trigger sites, I, II, IV, V, and VI for all patients. Finally, the SCT was performed over both carpal tunnels in the hand as a negative control. All study participants provided informed consent. Patient data are provided in Table 1.

During the same study period, patients who presented with recurrent headaches linked to secondary trigger sites after previous successful primary migraine surgery were examined with the SCT in a similar fashion. Patient data are provided in Table 2.

**RESULTS**

All patients who presented primarily (without previous surgery) for migraine surgery were found to have a positive SCT bilaterally at trigger sites I, II, IV, V, and VI. A negative SCT resulted in all cases when tested on both carpal tunnels. SCT performed in a representative patient preoperatively is shown in Video 1. (See Video 1 [online], which shows the preoperative scratch test for migraine surgery.) The positivity of all tested trigger sites in the head and neck was regardless of the trigger sites localized through history and physical examination, pinpointed as being responsible for the patient’s migraine headaches.

Patients who presented with recurrent headaches localized to secondary trigger sites were found to have a good correlation between the trigger sites localized through history and the SCT. Postoperative detection of a secondary trigger site for the patient shown in Video 1 is shown in Video 2. (See Video 2 [online], which shows scratch test for migraine surgery in the immediate postoperative period.) An example of an SCT performed in another patient 13 months after initial successful surgery with recurrent migraine headaches at a trigger site is shown in Video 3. (See Video 3 [online], which shows the scratch test for migraine surgery 13 months postoperative.) Following surgery with complete resolution of migraine headaches, SCT was negative.

**DISCUSSION**

The SCT was originally described for localization of sites of compressive neuropathy in the upper and lower extremity.\textsuperscript{12–14} Patients with migraine headaches, however, appear quite

### Takeaways

**Question:** Diagnosis of trigger sites for migraine surgery can be inaccurate.

**Findings:** The scratch collapse test was found to not be reliable for localization of trigger sites in patients presenting primarily for migraine surgery. In patients with recurrent migraine headaches, abrogation of central sensitization following the initial surgery allows for diagnosis of secondary trigger sites through the SCT.

**Meaning:** The scratch collapse test can be used to localize secondary trigger sites in patients with recurrent migraine headaches.

### Table 1. Characteristics of Patients Presenting for Migraine Surgery

| No | Age (y) | Gender | Duration of Sx (y) | Trigger Sites |
|----|---------|--------|-------------------|---------------|
| 1  | 43      | Woman  | 10                | B/L I, I, II, B/L I, II, B/L II |
| 2  | 20      | Woman  | 15                | B/L I, I, II, IV, V, VI |
| 3  | 70      | Woman  | 20                | B/L I, I, II, IV, V, VI |
| 4  | 34      | Man    | 10                | B/L I, I, II, IV, V, VI |
| 5  | 42      | Woman  | 2                 | B/L I, I, II, IV, V, VI |
| 6  | 42      | Woman  | 10                | B/L I, I, II, IV, V, VI |
| 7  | 45      | Woman  | 5                 | R IV, V, VI |
| 8  | 70      | Woman  | 1.5               | L IV, V, VI |
| 9  | 69      | Man    | 40                | B/L IV, V, VI |
| 10 | 54      | Woman  | 48                | B/L IV, V, VI |
| 11 | 57      | Woman  | 15                | B/L V, V, VI |

*B/L, bilateral; L, left; R, right; Sx, symptoms.

### Table 2. Characteristics of Patients with Recurrent Migraine Headaches Localized to Secondary Trigger Sites

| No | Age | Gender | Original Trigger Sites Treated | Time to Recurrent Symptoms (mo) | Trigger Sites |
|----|-----|--------|-------------------------------|--------------------------------|---------------|
| 1  | 65  | Woman  | B/L I, B/L II                | 22                             | B/L I, I, B/L III, B/L I (III could not be tested) |
| 2  | 18  | Woman  | B/L IV                        | 1                              | R II, IV, VI |
| 3  | 45  | Woman  | R IV                         | 0.25                           | B/L IV, V, VI |
| 4  | 49  | Woman  | B/L IV                        | 13                             | B/L IV, V, VI |

*B/L, bilateral; L, left; R, right.
different. Cutaneous allodynia and hyperalgesia in most migraine patients spreads globally throughout the head and neck following central sensitization of second and third order trigeminovascular neurons. Clinically in many patients, this manifests as a propagation of headache pain from an inciting trigger site, resulting in pain throughout the entire head and neck. As such, history taking is focused on the precise localization of pain at the beginning of the onset of a migraine headache to localize the actual trigger sites. As pain intensity increases, the area involved often enlarges with the pain outlasting the evoking stimulus even without increased input from the original trigger site.

Hence our finding that the SCT is not reliable for localizing the inciting trigger site in primary patients who have not had surgery before is entirely consistent with the phenomenon of central sensitization, with global cutaneous allodynia throughout the head and neck in our entire cohort.

More interestingly, we found that after primary migraine surgery in patients presenting with secondary trigger sites, the SCT was accurate and corresponded to history and physical examination for localizing inciting trigger sites. This has an interesting corollary to published data that botulinum toxin type A when injected in trigger sites. This has an interesting corollary to published data that botulinum toxin type A when injected in migraine patients preferentially targets C fibers, blocks neurotransmitter release, inhibits peripheral sensitization and indirectly reduces central sensitization, as assessed through intradermal capsaicin evoked nociceptive fibers, and indirectly reduces central sensitization likely results following primary migraine surgery.

Findings from this study provide further evidence to support the efficacy of migraine surgery focused on treating trigger sites and suggests that surgery results in inhibition of peripheral and central sensitization of headaches. With inhibition of central sensitization and prevention of global cutaneous allodynia in the head and neck, patients with recurrent headaches present with less severe symptoms. Although not useful in diagnosing trigger sites in the migraine patient primarily presenting for surgery, the SCT can be used to diagnose trigger sites in patients with recurrent migraine headaches after primary surgery.

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