The Using the Scratch Collapse Test to Detect Clinical or Subclinical Peroneal Palsy in the Hospitalized Patient in Order to Prevent Falls

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Objectives: To evaluate the use of scratch collapse test in a subset of hospitalized patients to identify the presence of subclinical peroneal nerve palsy and determine if inpatient physical therapy is protective of post-discharge falls.

Design: Cohort Study.

Main outcome measurement: Comparing ground-level falls after discharge from the hospital

Results: Overall 29 of 41 patients (70.7%) were positive on SCT. Of those, 6 (20.7%) patients recorded a post-discharge fall. In the physical therapy intervention group, 2 of 14 patients (14.3%) reported a fall. While, 4 of 15 patients (26.7%) the no-intervention group who reported a fall.

Conclusion: In this study, the SCT was used to identify subclinical peroneal nerve palsy, which could potentially lead to increased falls. While larger sample sizes are required for an adequately powered study, the SCT may serve as an inexpensive, useful tool in predicting which patients could be vulnerable to a post-hospital fall due to subclinical peroneal nerve palsy.

Level of Evidence: II; Cohort

Keywords: peroneal nerve palsy, foot drop, scratch collapse test, neuropraxia, fall

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INTRODUCTION

Subclinical peroneal nerve palsy (SCPNP) has been identified as a unique cause of falls in hospitalized patients.[1] In general, hospitalized patients are at risk for developing peroneal nerve palsy secondary to prolonged periods of bed rest. This may lead to direct pressure on the common peroneal nerve with a lack of patient repositioning or an indirect tensile force with the knees remaining extended for multiple days. In a cross-sectional study involving 100 patients, 31% of hospitalized patients were found to have 2 or more physical exam findings consistent with SCPNP, which made these patients 4.7 times more likely to sustain a subsequent fall.[1]

The first description of the Scratch Collapse Test (SCT) was published in 2008.[2,3] It was originally described as a provocative test to evaluate carpal or cubital tunnel syndrome,[3], however, has recently been adapted to identify neuropathy of other peripheral nerves such as the peroneal nerve.[4] The SCT exam provides a stimulus, traditionally through physical scratching irritation, over the distribution of the affected nerve, resulting in momentary loss of volitional power in the respective distal innervated muscle group. The SCT would not be considered a noxious stimulus to normal tissue, however preexisting nerve irritation allows for an abnormal reflexive response.

Similar to Tinel's test, the SCT's utility is not limited to a specific nerve unlike Phalen's maneuver or Durkan's test.[5-10] Thus, the SCT can be used in the diagnosis of multiple peripheral neuropathies if present. To date, the scratch collapse test has been validated for the diagnosis of carpal tunnel syndrome[3,7-9], cubital tunnel syrndome[3,10,11], long thoracic nerve entrapment[12], axillary nerve entrapment[11], and peroneal nerve compression.[2,4,13] In a cohort study involving 24 subjects with a confirmed diagnosis of peroneal nerve palsy and 24 matched controls, the SCT carried a sensitivity of 0.77, specificity of 0.99, positive predictive value of 0.92, negative predictive value of 0.92, and accuracy of 0.93. Furthermore, there was no significant statistical difference between sensitivity and specificity of Tinel's test and the SCT.[4]

This study aims to investigate the utility of SCT in hospitalized patients with peroneal nerve palsy and how it may be used to prevent falls. We hypothesized that Scratch Collapse Test could identify certain patients with SCPNP at risk of falling and therefore, reduce unplanned readmissions.

METHODS

The institutional review board of our hospital approved this study and informed consent was obtained from each patient. Inclusion criteria for patients were as follows:

between the ages of 18-70 years of age, hospitalized for 5 days or longer, cognizant with the ability to participate, and baseline ambulatory status without assistive devices. Patients were excluded if they had pre-existing peripheral nerve damage, a history of knee or spinal surgery, or an acute spinal cord injury. Between May 2018 and December 2020, 41 consecutive hospitalized patients at a single academic level one trauma center were recruited for the study. All patients were admitted for a traumatic injury. Demographic and diagnostic information were collected including age, gender, length of hospital stay prior to SCT administration, the result of the scratch collapse test, laterality of positive SCTs, and whether or not a fall or near fall experience occurred.

In each patient a SCT was performed as described by Mackinnon et al.[4] A positive result was defined as collapse of the arm upon forced shoulder internal rotation with the elbow at the side applied by the examiner. A negative result was described as the retained ability of the subject to resist forced internal rotation applied by the examiner. Patients with a positive SCT were then randomized to either inpatient physical therapy for fall prevention therapy or no inpatient rehabilitation as a control group. The physical therapy regimen is described in Figure 1. Upon discharge from the hospital, all patients were contacted via telephone after 15 days to see if they had a fall or subjective "near fall experience". From here on the term fall will include both actual falls and "near fall experiences".

Independent sample t-tests were used to compare means of continuous and ordinal variables and p-values less than 0.05 were considered to represent a significant difference. For variables with Levene's Test for Equality of Variances less than 0.05, equal variance was not assumed. Fischer's exact test of less than 0.05 was used when any group had an n- value less than 5. Non-parametric data were compared using a Mann-Whitney Test. All analysis was performed in SPSS version 25 (IBM Corp. Released 2018. IBM SPSS Statistics for Macintosh, Version 25.0. Armonk, NY: IBM Corp).

Figure 1. The physical therapy protocol for the treatment of subclinical peroneal nerve palsy at the treating institution.

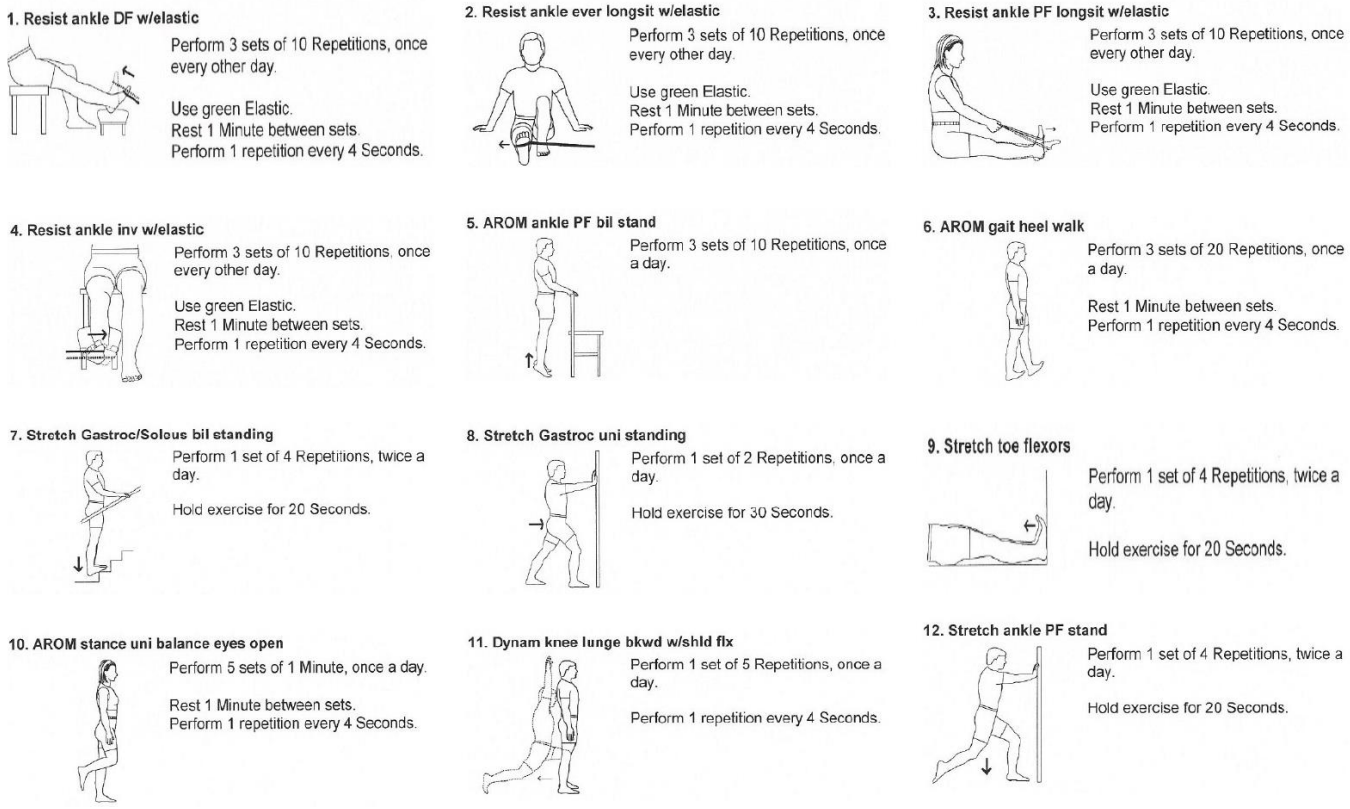

Table 1. Demographic information for included patients and characterization based on scratch collapse test results and reported post-discharge falls

	SCT (+) (n=29)	**SCT (-)** (n=12)	**Total** (n=41)	p	**Fall Reported** (n=7)	**No Fall Reported** (n=34)	p
Age (mean, SD)	48.3 ± 18.5	54 ± 18.3	50 ± 18.4	0.5	74.1 ± 7.8	45 ± 15.8	<0.005
Gender (male)	17 (58.6%)	8 (75%)	25 (61%)	0.63	3 (50%)	22 (65%)	0.37
Hospital Day Test Performed (median, IQR)	7 (4)	7 (2.5)	7 (3)	-	7 (3.5)	7 (3)	0.98

IQR = interquartile range, SCT = scratch collapse test

RESULTS

There were no differences in terms of age, gender, or length of hospital stay between patients with a positive SCT and a negative SCT (Table 1). Overall 29 patients (70.7%) recorded a positive SCT. Of those, 6 (20.7%) patients recorded a fall. Only one patient (8.3%) recorded a fall with a negative SCT. The SCT had a sensitivity of 85.7% and a 32.4% specificity in predicting which patients were likely to fall within 2 weeks of hospital discharge.

A total of 7 patients (17.0%) enrolled in the study reported a fall when contacted 15 days after discharge. None of the falls resulted in major injuries or rehospitalization. Patients who experienced a fall were significantly older than those who did not ($P<0.01$). There were 14 patients (66.7%) with a positive SCT in the physical therapy intervention group. Of those 14 patients, 2 (14.3%) recorded a fall. There were 15 patients (75%) with a positive SCT in the no-intervention group. Of those, 4 (26.7%) recorded a fall. There were no falls in patients with a negative SCT in the no-intervention group. There were no statistically significant differences in terms of patients who received the intervention and those who did not ($p>0.05$).

DISCUSSION

In this study, we hypothesized that the Scratch Collapse Test (SCT) could be used to identify hospitalized patients at high risk of falling after discharge due to subclinical peroneal nerve palsy (SCPNP). When contacted 15 days after discharge, 2 patients who received the intervention and 5 patients who did not recorded a fall. Patients reporting a fall were significantly older than those who did not. The SCT had an 85.7% sensitivity and 32.4% specificity in predicting which patients would fall within 15 days of discharge from the hospital.

A major limitation to the implementation of the SCT into clinical practice is knowledge of surface anatomy about the nerve being tested.[2,4,9] The nerve being tested in this exam is the common peroneal nerve, a branch of the sciatic nerve from nerve roots L4, L5, S1, and S2. In most patients the common peroneal nerve courses posterior to the lateral head of the gastrocnemius through the posterior intermuscular septum, where it then curves around the head of the fibula just deep to the peroneus longus.[14] Knee extension can cause the nerve to stretch over the fibular head leading to neuropraxia and the described subclinical peroneal nerve palsy. Using the SCT, the examiner attempts to recreate this course by placing the thumb just posterior to the head of the fibula and proceeding to "scratch" down and around the fibular head/neck in one continuous motion before internally rotating the patient's ipsilateral upper extremity. This allows the examiner to identify SCPNP before clinical signs such as footdrop and dorsal foot numbness may be apparent.

Most of the literature focuses on surgical decompression of peroneal nerve palsy, however, there are several studies demonstrating efficacy of physical therapy alone as a treatment modality. While there were no statistically significant differences between the intervention and no intervention groups, the SCT of the common peroneal nerve did have a sensitivity of 85.7% for predicting falls, suggesting it may serve clinical utility. In addition, the SCT requires no additional equipment and takes only a few moments to perform

in the hands of an experienced examiner. Physical therapy protocols begin with warm towel compresses to increase the mobility of fascial superficial connective tissue.[15] The first few weeks of therapy focus on soft tissue mobilization to help break down scar tissue[15] and neural mobilization to reduce pressure on the affected nerve.[16] Following these passive range of motion exercises, rehabilitation shifts to focus on dorsiflexion with simultaneous knee flexion and plantar flexion with simultaneous knee extension.[14,15] Home stationary bike riding exercise may be a helpful supplement to assist with neural mobilization throughout the protocol.[15] Additionally, a custom foot orthosis may also be helpful to assist with ambulation in more symptomatic cases.[14] After appropriate mobilization has been achieved, the focus of therapy transitions into the final stage of strengthening of the affected leg beginning with the foot plantar flexors and inverters.[14] The physical therapy regiment used in this study focused on active range of motion and muscle strengthening with minimal required equipment so it could be easily completed at the patient's bedside.

Since the enactment of the 2012 Hospital Readmission Reduction Program (HRRP), there has been increased interest in methods to reduce 30-day unplanned readmission to the hospital.[17-21] The HRRP (part of the Affordable Care Act) reduces Medicare payments to hospitals with excess readmissions for certain conditions and procedures. Before the implementation of the HRRP, all-cause readmission rates were reported to be as high as 20%.[17,20] In general, age, hospital length of stay, severity of injury, and surgical complications are all correlated with increased hospital readmissions.[17,18,21] In particular, orthopedic trauma patients were found to have a significantly higher readmission rate than other subspecialties, likely due to the emergent nature of the injuries, non-elective nature of the procedures, and inability to optimize the patient's comorbidities prior to the procedure.[17,18] Similarly, we found that patients recording a fall were significantly older than those who did not suggesting that older patients may need special attention and fall reduction education prior to discharge. Falls are a common reason for unplanned readmission and, therefore, fall prevention represents an opportunity for hospitals to improve their readmission metrics. Utilization of the SCT to detect subclinical peroneal nerve palsy in prolonged hospital stay may serve as an indicator for physical therapy intervention and thus prevention of future falls and readmissions.

This study had several limitations. Our data analysis had a relatively small sample size, which may have led to non-statistically significant results. A larger study would be needed to see if the SCT could truly be used to reduce following discharge. Second, the examiner was non-blinded, meaning they knew who was in the intervention and who was in the control group. While there was no statistical significance between the numbers of patients with a positive SCT in each group, this could have led to a possible confirmation bias. Lastly, while the SCT has been validated for peroneal nerve palsy and peroneal nerve palsy has been correlated with falls, the SCT has never been validated for fall prediction and further studies are needed.

CONCLUSION

The SCT has been used in the diagnosis of several motor neuropathies. It is particularly effective at diagnosing subclinical neuropathies, which may be missed with other focused physical examination tests. This study utilized the SCT to identify subclinical peroneal nerve palsy, a risk factor for potential fall after discharge. Patients with a positive SCT were assigned to physical therapy to prophylactically prevent subsequent falls. While the low sample size included limits generalizability, the SCT was found to be 85.7% sensitive in predicting subsequent falls, required no additional equipment, and only takes an extra minute to perform by a skilled examiner. Therefore, the SCT may be useful in predicting at-risk patients for an early post-discharge fall and should the initiation of targeted inpatient physical therapy protocol.

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