Does walking change the Romberg sign?

Gordon F. G. Findlay · Birender Balain ·
Jayesh M. Trivedi · David C. Jaffray

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Abstract The Romberg sign helps demonstrate loss of postural control as a result of severely compromised proprioception. There is still no standard approach to applying the Romberg test in clinical neurology and the criteria for and interpretation of an abnormal result continue to be debated. The value of this sign and its adaptation when walking was evaluated. Detailed clinical examination of 50 consecutive patients of cervical myelopathy was performed prospectively. For the walking Romberg sign, patients were asked to walk 5 m with their eyes open. This was repeated with their eyes closed. Swaying, feeling of instability or inability to complete the walk with eyes closed was interpreted as a positive walking Romberg sign. This test was compared to common clinical signs to evaluate its relevance. Whilst the Hoffman's reflex (79%) was the most prevalent sign seen, the walking Romberg sign was actually present in 74.5% of the cases. The traditional Romberg test was positive in 17 cases and 16 of these had the walking Romberg positive as well. Another 21 patients had a positive walking Romberg test. Though not statistically significant, the mean 30 m walking times were slower in patients with traditional Romberg test than in those with positive walking Romberg test and fastest in those with neither of these tests positive. The combination of either Hoffman's reflex and/or walking Romberg was positive in 96% of patients. The walking Romberg sign is more useful than the traditional Romberg

test as it shows evidence of a proprioceptive gait deficit in significantly more patients with cervical myelopathy than is found on conventional neurological examination. The combination of Hoffman's reflex and walking Romberg sign has a potential as useful screening tests to detect clinically significant cervical myelopathy.

Keywords Romberg · Myelopathy · Hoffman's reflex

Introduction

The Romberg sign demonstrates loss of postural control in the absence of visual input suggestive of proprioceptive deficit in the lower limbs [5]. When the patient sways or falls with eyes closed while standing with feet together, it is considered to be positive. A positive Romberg's test has been linked to all causes of proprioceptive deficits, including myelopathies of many causes, tabes dorsalis and sensory neuropathies.

There is still no standard approach to applying the Romberg sign in clinical neurology and the interpretation of an abnormal result continues to be debated [10]. Whether the feet should be touching each other or they should be shoulder width apart while performing the test remains a source of confusion and hence various other ways of performing Romberg tests including sharpened Romberg tests (standing with feet together in a heel-to-toe position) have also been described [14]. The interpretation of how much sway is significant has also led to difficulty in interpreting the test. Neurologists have developed various instruments to measure and record postural sway [4].

The diagnosis of cervical myelopathy is essentially clinical, based on history and neurological examination. Romberg's test is routinely used as a part of the clinical

G. F. G. Findlay
Walton Centre for Neurology and Neurosurgery NHS Trust,
Lower Lane, Fazakerley, Liverpool L9 7LJ, UK

B. Balain (✉) · J. M. Trivedi · D. C. Jaffray
RJA Orthopaedic Hospital NHS Trust, Oswestry,
Shropshire SY10 7AG, UK
e-mail: balainb@yahoo.com

examination. It has been the senior author's observation (GFGF) that conducting the Romberg test while the patient is walking is more sensitive than using the traditional Romberg test for detecting clinically significant cervical myelopathy. We decided to test this hypothesis by conducting a detailed clinical examination of 50 consecutive patients with cervical myelopathy. The secondary aim was to evaluate the usefulness of this test vis-a-vis other common clinical tests.

Materials and methods

This study was conducted at the Spinal Disorders department of the RJA Orthopaedic Hospital, Oswestry, UK. Fifty consecutive patients with clinically significant cervical myelopathy presenting to the out patient clinics were included in the study. All these had a clinical diagnosis of myelopathy made on the basis of symptoms of upper and/or lower limb involvement along with presence of upper motor neuron signs, myelopathic hand signs and/or Romberg sign. All these patients were investigated by means of radiographs and Magnetic Resonance Imaging of the cervical spine. Any patient with progressive symptoms of myelopathy in the presence of radiological cord compression was offered surgical treatment.

Exclusion criteria for the study were patients with vestibular and/or cerebellar lesions, diabetic neuropathy or patients with other peripheral neuropathies. A standardised form for recording the clinical data of each patient was used. Romberg's sign, hyper-reflexia of upper and lower limbs, Hoffmann's reflex and Babinski's sign were recorded for each patient. Joint position sense in the lower limbs and vibration sense (using a 128-Hz tuning fork) over the medial malleolus was recorded. The 30 m walking test [12] was carried out on all patients and time taken was correlated to the traditional and walking forms of Romberg sign. Finger escape sign and the ten second hand grip and release test were used to evaluate myelopathic signs affecting the upper limb [8].

To evaluate the Romberg sign, patients were asked to stand with their feet spread at shoulder width and their body sway was evaluated with their eyes open initially and then closed. This was followed by evaluating the Walking Romberg sign. At first, the patients were asked to walk a distance of 5 m inside the office with their eyes open. They were then asked to walk the same distance with their eyes closed. At all times, the patients were escorted to prevent them from falling down. A positive walking Romberg sign was taken to be swaying, falling or failure to complete the walk due to a feeling of marked instability.

The prevalence of the walking Romberg sign was compared to that of traditional Romberg sign as well as to

other clinical signs in patients with clinically significant cervical myelopathy. Two consultants and one Specialist Registrar were responsible for collecting data on individual patients. Once all the data was collected, we also evaluated our results to see if any combination of signs was present in most of our patients.

Results

The mean age of the patients was 61.5 years. The most common clinical level of cervical myelopathy was C6, followed by C5. The level was clinically uncertain in ten patients (20%).

Of the commonly used upper limb signs used to confirm myelopathy, Hoffman's reflex (37/47, 78.7%) and upper limb hyper-reflexia (36/50, 72%) were the most prevalent (see Table 1). The 10 s grip and release test was positive in 61.7% (29/47) and the finger escape sign was present only in 48% (24/50) of cases. Of the commonly elicited lower limb signs, lower limb hyper-reflexia (31/50, 62%) and loss of vibration sense (26/43, 60.5%) were the most prevalent. Babinski's reflex and proprioceptive deficit (loss of joint position sense at the big toe) were positive in less than a third of cases.

One or other form of the Romberg test was abnormal in 38 (76%) cases. The traditional Romberg test was found to be positive in 17 (34%) cases, while the walking Romberg sign was positive in 37 (74.5%) patients (see Table 2). Both walking and traditional Romberg tests were positive in 16 patients. Twenty-one patients had only the walking Romberg test positive with the traditional test being negative. Only one patient had traditional Romberg test positive with the walking version of the test being negative.

The combination of a positive Hoffman's test and/or the walking Romberg test was positive in 96% of all patients with cervical myelopathy (see Table 3) but both were positive in only 54% of cases.

Table 1 Common clinical signs seen in our series

Clinical signs	Positive (%)
Hyper-reflexia upper limb	72
Hyper-reflexia lower limb	62
Hoffman's reflex	78.7
Babinski's reflex	30.6
Finger escape sign	48
Ten second grip and release test	61.7
Joint position sense	25.5
Vibration sense ankle	60.5
Traditional Romberg test	34
Walking Romberg test	74

Table 2 Details of the two forms of Romberg sign in our series

Romberg positive	38 (76%)
Both forms positive	16
Traditional only	1
Walking only	21
Romberg negative	12

Table 3 Details of the most common combination of clinical signs in cervical myelopathy in our series

	Both positive	Romberg's only	Hoffman's only	Both negative
Number	27	11	10	2
% age	54	22	20	4

Patients with a negative walking Romberg sign took an average of 31.5 s to complete the 30 m walk, and those with a negative traditional Romberg sign took 32.68 s. Those with a positive walking Romberg sign took a mean time of 35.13 s and those with a positive traditional Romberg test took 39.18 s. These differences however were not statistically significant. Patients with a spastic gait demonstrated much slower walking. However ataxic patients usually had some problem in starting off or at the end while stopping, but managed to walk with a decent cadence and speed in between.

Discussion

The sensitivity of the Romberg test as used in a routine clinical setting can be increased by narrowing the patient's base of support (sharpened Romberg test) or by standing on foam rubber to distort proprioceptive input from the feet [11, 14]. Even modern forms of posturography, including computerised dynamic platform posturography, have not been demonstrated to be particularly useful in distinguishing among different causes of imbalance or in localising lesions [6]. Dercum published photographs of a tabetic patient walking with eyes open and then with eyes closed; these sequential images demonstrated a dynamic form of Romberg phenomenon, with dramatic increase in ataxia when walking with eyes closed [7]. To the best of our knowledge, there has been no other description of using the Romberg test while walking in clinical practice.

We found the walking Romberg test to be more useful than the traditional Romberg test in patients with cervical myelopathy. When the patient is asked to walk with eyes open, any weakness or spasticity would suggest involvement of the anterior cord by the compressive lesion. When the patient then walks with eyes closed, and the patients

gait or balance deteriorates, we believe that it suggests a proprioception deficit over and above the anterior cord involvement related changes in their gait. Not all patients had a normal gait to start with, and in these a positive walking Romberg test was taken to be a further obvious swaying, loss of balance or inability to complete the walk.

The walking form of this test was positive in 74% of patients as opposed to only 34% patients with a positive traditional Romberg test. Every patient, barring one (16/17), with a positive traditional Romberg test had the walking Romberg test positive as well. There were 55.3% patients (21/38) who had a positive walking Romberg test with a negative traditional Romberg test. Only 6 of these 21 patients with a positive walking Romberg test had a normal joint position sense at the big toe and vibration sense at the medial malleolus using a 128-Hz tuning fork. The rest had either one or both of these absent suggestive of posterior column involvement. This would suggest that more patients have a proprioceptive deficit than is suggested by the traditional Romberg test. Perhaps the walking Romberg test is the most sensitive way to detect this proprioceptive deficit, as is evidenced by our findings. We also believe that doing the test this way makes it easier to determine significant swaying. Though not statistically significant, there was a trend to support this as the mean times taken to complete the 30 m walk were highest for those with a positive traditional Romberg test, indicative of worst proprioceptive deficit, followed by those with a positive walking Romberg test and then for those with negative forms of either types of Romberg test.

Cervical spondylotic myelopathy is a constellation of long tract signs in the upper and lower limbs resulting from mechanical compression and/or vascular compromise of the cervical spinal cord [9]. Patients who do not have cord compression statically may compress the cord dynamically, leading to the development of myelopathic symptoms [1]. Patients typically present with symptoms of clumsiness in the hands and lower limbs along with increasing difficulty with balance and gait. Upper motor neuron signs such as hyper-reflexia and abnormal reflexes like Hoffmann's reflex, along with radicular signs may help in localising the lesions.

In our series, the most prevalent test in patients of cervical myelopathy was found to be the Hoffman's reflex (78.7%). The other upper limb clinical sign commonly found was upper limb hyper-reflexia (72%). These findings are similar to the ones reported by other authors [3, 15]. The walking Romberg test was the second most prevalent clinical sign (see Table 1). Joint position sense and Babinski reflex were the least commonly prevalent signs. Of the lower limb signs, lower limb hyper-reflexia (62%) and vibration testing using a 128-Hz tuning fork at the medial malleolus (60.5%) were the most commonly positive signs.

All patients known to have peripheral neuropathies and diabetes were excluded from our study. The high prevalence of loss of vibration may suggest subclinical peripheral neuropathies, but we believe that this most likely represents an early sign of myelopathy due to the involvement of dorsal columns.

Sung et al. found the presence of a positive Hoffmann's reflex in 16 asymptomatic patients strongly suggestive of an underlying radiological cervical pathology, though not warranting further evaluation [13]. Sensitivity of the Hoffmann sign relative to cord compression was found to be 58%, specificity 78%, positive predictive value 62% and negative predictive value of 75% in a group of 124 patients [2]. These authors also reported that although attractive as a simple method of screening for cervical spinal cord compression, the Hoffmann sign on its own, in the absence of other clinical findings, is not a reliable test. Hence we tried to evaluate the prevalence of a combination of signs.

In 96% of patients with cervical myelopathy in our series, Hoffman's and/or walking Romberg test were positive. They represent upper limb and lower limbs neurological function respectively, and are easily performed and interpreted, requiring no special instruments. The high prevalence of either of these two would suggest that this combination might be useful as an effective screening test to rule out cervical myelopathy. This information may be useful in a wide variety of clinical situations such as evaluation of patients with fibromyalgia, bilateral carpal tunnel syndrome and complex shoulder and neck problems. However this needs to be verified using suitable negative controls, which has not been included as a part of this study. Further studies would be required to evaluate this and also to confirm the repeatability of the walking Romberg sign. However, our findings do suggest that the severity of proprioceptive dysfunction in the lower limbs of patients with cervical myelopathy will be underestimated by simple neurological examination at rest.

Patients with cervical myelopathy are always at risk of falling in the dark and sustaining significant injuries. We believe that walking Romberg test detects this problem with proprioception early in the disease process. It is also one of the most prevalent signs in our series. The combination of Hoffmann's reflex and walking Romberg test may be used as good screening tests, but this needs to be evaluated with further studies. We recommend that the walking Romberg test should be used routinely in elderly

patients with a history of multiple falls or in whom cervical myelopathy is suspected.

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