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# The Evolution of Walking-Related Outcomes Over the First 12 Weeks of Rehabilitation for Incomplete Traumatic Spinal Cord Injury: The Multicenter Randomized Spinal Cord Injury Locomotor Trial

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**Background.** The Spinal Cord Injury Locomotor Trial (SCIILT) compared 12 weeks of step training with body weight support on a treadmill (BWSTT) that included overground practice to a defined but more conventional overground mobility intervention (CONT) in patients with incomplete traumatic SCI within 8 weeks of onset. No previous studies have reported walking-related outcomes during rehabilitation. **Methods.** This single-blinded, randomized trial entered 107 American Spinal Injury Association (ASIA) C and D patients and 38 ASIA B patients with lesions between C5 and L3 who were unable to walk on admission for rehabilitation. The Functional Independence Measure (FIM-L) for walking, 15-m walking speed, and lower extremity motor score (LEMS) were collected every 2 weeks. **Results.** No significant differences were found at entry and

during the treatment phase (12-week mean FIM-L = 5, velocity = 0.8 m/s, LEMS = 35, distance walked in 6 min = 250 m). Combining the 2 arms, a FIM-L  $\geq 4$  was achieved in < 10% of ASIA B patients, 92% of ASIA C patients, and all of ASIA D patients. Walking speed of  $\geq 0.6$  m/s correlated with a LEMS near 40 or higher. **Conclusions.** Few ASIA B and most ASIA C and D patients achieved functional walking ability by the end of 12 weeks of BWSTT and CONT, consistent with the primary outcome data at 6 months. Walking-related measures assessed at 2-week intervals reveal that time after SCI is an important variable for entering patients into a trial with mobility outcomes. By about 6 weeks after entry, most patients who will recover have improved their FIM-L to  $>3$  and are improving in walking speed. Future trials may reduce the number needed to treat by entering patients with FIM-L < 4 at > 8 weeks after onset if still graded ASIA B and at > 12 weeks if still ASIA C.

**Key Words:** Spinal cord injury—Rehabilitation—Walking outcomes—Treadmill training—Locomotion.

For patients who suffer a traumatic spinal cord injury (SCI), the most visible disability is the inability to walk at all or at least with a reciprocal gait at velocities that permit community ambulation.<sup>1</sup> The Spinal Cord Injury Locomotor Trial (SCIILT) was developed from studies in animal models of recovery of hindlimb stepping after complete low thoracic SCI that employed a moving treadmill belt and limb loading.<sup>2,3</sup> These findings led to studies of locomotor training on a treadmill with partial weight support as needed by patients with complete and incomplete SCI, along with physical and cognitive cues to try to improve kinematic, spatiotemporal, and kinetic features of stepping.<sup>4,5</sup> The experimental technique has been called body weight-supported treadmill training (BWSTT).

Prior clinical studies had not compared equal amounts of BWSTT to another form of mobility training to test

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In this post, we'll learn about the Barbeau test and the reverse Barbeau test. The Barbeau test or Allen's oximetry test is a modification of Allen test to assess vascular patency of the hand. Instead of observing the palm's color, the Barbeau test analyzes plethysmography tracing. Barbeau test can be defined as a modified version of Allen's test using pulse oximetry and plethysmography to evaluate the collateral circulation of the ulnar artery. According to a study, this test is more sensitive to detect the adequacy and patency of the palmar arteries, excluding only 1.5% of the patient. Hence qualifying more patients for transradial procedures. Purpose of Barbeau test The purpose of the Barbeau test is to assess the adequacy of collateral circulation of the ulnar artery before undergoing transradial procedures and wrist surgeries How to perform Barbeau test Explain the procedure to the patient and obtain verbal consent Place the sensor on the thumb or index finger and note the initial plethysmography waveform and oxygen saturation on the monitor Next, the examiner occludes the radial and ulnar arteries simultaneously to block blood flow. It should flat line the plethysmography waveform tracing. Examiner then releases the pressure on the ulnar artery while keeping pressure on radial artery. Then analyzes the plethysmography tracing for 2 minutes. Barbeau Test Classification and Interpretation The interpretation of the Barbeau test is based on changes that appear on plethysmography tracing. These changes are classified into four types according to plethysmography tracing responses. The initial response is analyzed immediately upon releasing pressure on the ulnar artery and at 2 minutes. Barbeau test classification is tabulated below. Classification Description Type A Upon releasing pressure on the ulnar artery, the shape and amplitude of the plethysmography tracing becomes normal immediately Type B Pulse waveform temporarily reduces the amplitude and returns to normal amplitude within 2 minutes Type C Immediately shows a flat line and slowly waveform returns at 2 minutes. But the amplitude is dampened. Type D Shows a flat line on plethysmography tracing throughout 2 minutes. Which indicates inadequate ulnar artery circulation Advertisements Classification of the Barbeau test If the responses are either type A, B, and C demonstrate the patency of the ulnar artery. Which ulnar artery alone is adequate to perfuse the hand. Hence, that hand is eligible to undergo transradial procedures such as radial artery cannulation and cardiac catheterization. However, patients with type D responses should avoid transradial procedures on that wrist due to inadequate ulnar collateral flow. Also, they are at high risk of ischemia in event of radial artery complications. Reverse Barbeau Test Like reverse Allen's test is performed in the same manner as Allen test, reverse Barbeau test is also performed in the same manner as Barbeau test. The only difference is this time you release the pressure on the radial artery instead of the ulnar artery. Hence, the purpose of the reverse Barbeau test is to evaluate the patency of the radial artery to perfuse the hand in the event of injury or damage to the ulnar artery. How to perform Reverse Barbeau Test Step 1 to 3 are the same as the Barbeau test. In the 4th step, you release the pressure on the radial artery instead of the ulnar artery. Then observe the plethysmography tracing for 2 minutes. Also, the interpretation of findings is the same as the Barbeau test. Barbeau test vs Allen test Barbeau test is one of the modified and more quantitative versions of the Allen test which uses pulse oximetry and plethysmography. On the other hand, Allen test is the original method which employs a more qualitative approach to evaluate collateral blood circulation to the hand. Advertisements The similarities and differences of the Barbeau test and the Allen test are tabulated below. Allen test Barbeau test Description - Original method of assessing collateral blood circulation to hand. - Observes palmar color changes - Modified version of Allen test. - Uses pulse oximetry and plethysmography tracing Purpose - To assess the collateral circulation of the arteries of the hand. - Allen test assess ulnar artery's patency. - Reverse Allen test assesses radial artery's patency. - To assess the collateral circulation of the arteries of the hand. - Barbeau test assesses ulnar artery's patency. - Reverse Barbeau test assesses radial artery's patency Technique Observes time taken to return hand's normal color after releasing the releasing pressure off the artery Analyzes plethysmography tracing for 2 minutes after releasing pressure off the artery Interpretation - If the hand's color returns to normal pinkish color within 5-15 seconds - Positive Allen test (i.e., ulnar artery's collateral circulation is adequate) - If the hand's color does not return to normal pinkish color after 15 seconds - Negative Allen test (i.e., ulnar artery's collateral circulation is inadequate) - Responses of plethysmography tracing is classified into 4 types; either A, B, C, or D. - A is normal - In case of B and C, the artery can be used for transradial procedures - In case of D, transradial procedure should be avoided on that wrist Conclusion To sum up, the Barbeau test is modified Allen test with pulse oximeter and plethysmography performed to check patency of the ulnar artery. And the reverse Barbeau test assesses the patency of the radial artery. Advertisements The findings of the test are classified into either A, B, C, or D. Categories A, B, or C means patient can undergo transradial procedures on that hand. And ulnar artery's collateral circulation is adequate to prevent that hand's ischemia in case of an adverse event followed by the transradial procedure or wrist surgeries. In contrast, if the result is D, transradial procedure should be avoided on that wrist. CLICK HERE to learn the purpose and technique of the Allen test. Reference Abu-Fadel, M. (2016). Arterial and Venous Access in the Cardiac Catheterization Lab. United States: Rutgers University Press. Advanced Practice and Leadership in Radiology Nursing. (2019). Springer International Publishing. Advertisements Bhatt, D. L. (2015). Cardiovascular Intervention: A Companion to Braunwald's Heart Disease, E-Book. Elsevier Health Sciences. Interventional Radiology: Fundamentals of Clinical Practice. 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LEER MÁS View PDF rights and content Continuous monitoring of critically ill patients requires an important procedure as arterial puncture. The first site of choice for arterial puncture is radial artery. To minimize the risk of ischemic damage to the hands as a radial artery puncture complication, many experts suggest confirming adequate collateral circulation before puncture. Assessment of hands' collateral circulation can be done by modified Allen's test (MAT) and Barbeau test (BT). To compare between MAT and BT for the assessment of hands' collateral circulation before arterial puncture among critically ill patients. A descriptive research design was used. The study was conducted at three general intensive care units at university hospital, Egypt. Subjects: A convenience sample of 100 newly admitted patients on the first day and aged from 18 to 60 years old was included. Exclusion criteria were patients with unstable hemodynamics, surgery or burn in upper limbs and arteriovenous shunt. "Hands' collateral circulation assessment" was used. MAT and BT were done once by the same researcher for all patients. The studied patients showed that 70% had a positive MAT, and 84 % had a positive BT with significant difference between the results of the two tests (p = 0.009). Higher percentages of the patients with a positive BT had normal heart rate (58%), mean arterial blood pressure (58%), body temperature (34%), peripheral pulse (50%), capillary refill time (73%) and warm skin (54%). BT can predict and is more sensitive than MAT in assessing hands' collateral circulation before arterial puncture. Hands' collateral circulation Endovascular specialist Dr. Christopher Beck demonstrates how to do the Barbeau Test, a quick way to determine if a patient is a candidate for radial access. Radial access has become increasingly popular with interventional radiology procedures and is particularly helpful with certain patient populations who may have femoral arteries which are difficult to access because of atherosclerotic disease, body habitus or existing groin infection. The Barbeau Test is an important technique to assess patency of the radiopalmar arch. Understanding the patient's circulation will aid in the decision making process of choosing the appropriate access site for the procedure. How to Perform the Barbeau Test 1. Start with a pulse oximeter on the patient's index finger and then compress the radial and ulnar arteries at the same time. 2. Once the waveform is flat for two cycles, release the ulnar artery. 3. In the next two minutes, watch for the waveform to return, at this point, the Barbeau Test is complete. Barbeau Test Results The Barbeau Test is used to classify radial artery compression patterns into one of four categories: Type A: No damping of pulse tracing immediately after compression Type B: Damping of pulse tracing Type C: Loss of pulse tracing followed by recovery of pulse tracing within 2 minutes Type D: Loss of pulse tracing without recovery within 2 minutes Using the Barbeau Test to Inform Radial Artery Access Application of the Barbeau Test varies in practice. Some operators suggest performing radial access in only Barbeau A, B and C patterns. Some interventionalists advocate that all Barbeau patterns are candidates for radial access, and some operators forego the Barbeau test entirely and move forward with radial access regardless. The Barbeau test can be used to better understand the patient's circulation, but is just one tool in the assessment for radial access. Learn more on the BackTable VI Podcast BackTable is a knowledge resource for physicians by physicians. Get practical advice on Radial Access and how to build your practice by listening to the BackTable VI Podcast. Ep 148 Radial vs. Femoral for Prostate Artery Embolization with Dr. Blake Parsons Stay Up To Date Disclaimer: The Materials available on BackTable.com are for informational and educational purposes only and are not a substitute for the professional judgment of a healthcare professional in diagnosing and treating patients. The opinions expressed by participants of the BackTable Podcast belong solely to the participants, and do not necessarily reflect the views of BackTable.

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