

Instructions Guide for Refined Clothespin Relocation Test

The Refined Clothespin Relocation Test (RCRT) is a self-timed procedure that requires the prosthesis user to relocate three clothespins between a horizontal rod and a vertical rod. The compensatory motions made by the user to move the clothespins are graded following the test and used in conjunction with the time to complete the exercise to form a clinical assessment of the subject's functional level. Grading of compensatory motions by the clinician is based on review of a captured video of the testing session. The goal of the RCRT is to analyze the user's performance in a controlled environment and provide a measure of the expected functional level of the user outside the clinic. A clinic having a sufficient pool of user data using this assessment will also be able to predict how new users will perform on this assessment, given the type of prosthesis, terminal device, and control strategy the user employs.

Metrics

The RCRT is designed to produce both observational and time measures of performance and progress of the participating user (or able-bodied subject). Observational assessment involves analysis of the compensatory motions performed by the user to complete the test. The time it takes to perform the test serves as another metric to establish the user's improvement over time.

Equipment

A modified Rolyan Graded Pinch Exerciser (Patterson Medical) with three red clothespins (2 lbs pinch force), along with a push button timer (e.g. SHAP timer) and height adjustable table are used to perform the test. The base of the Pinch Exerciser is placed at the edge of a table, centred with the subject. The height of the table is adjusted to be at hip height (i.e. anterior superior iliac spine level). The timer is placed next to the Pinch Exerciser, on the side under assessment (left or right). A video camera is placed in front of the table to capture the user's motions in the frontal plane. The setup is shown below (Figure 1).



Figure 1. Setup for RCRT with clothespins positioned on middle horizontal rod. Both vertical rods shown, though only one is used during any test and the other is removed.

The clothespins are moved between the middle horizontal rod and one of the two vertical rods (left or right hand assessment).

The target locations on both vertical and horizontal rods consist of electrical tape (3/4 inch) wrapped around the rod at different positions. The photographs below (Figure 2) show the standardized positions to the centre of each demarcation.

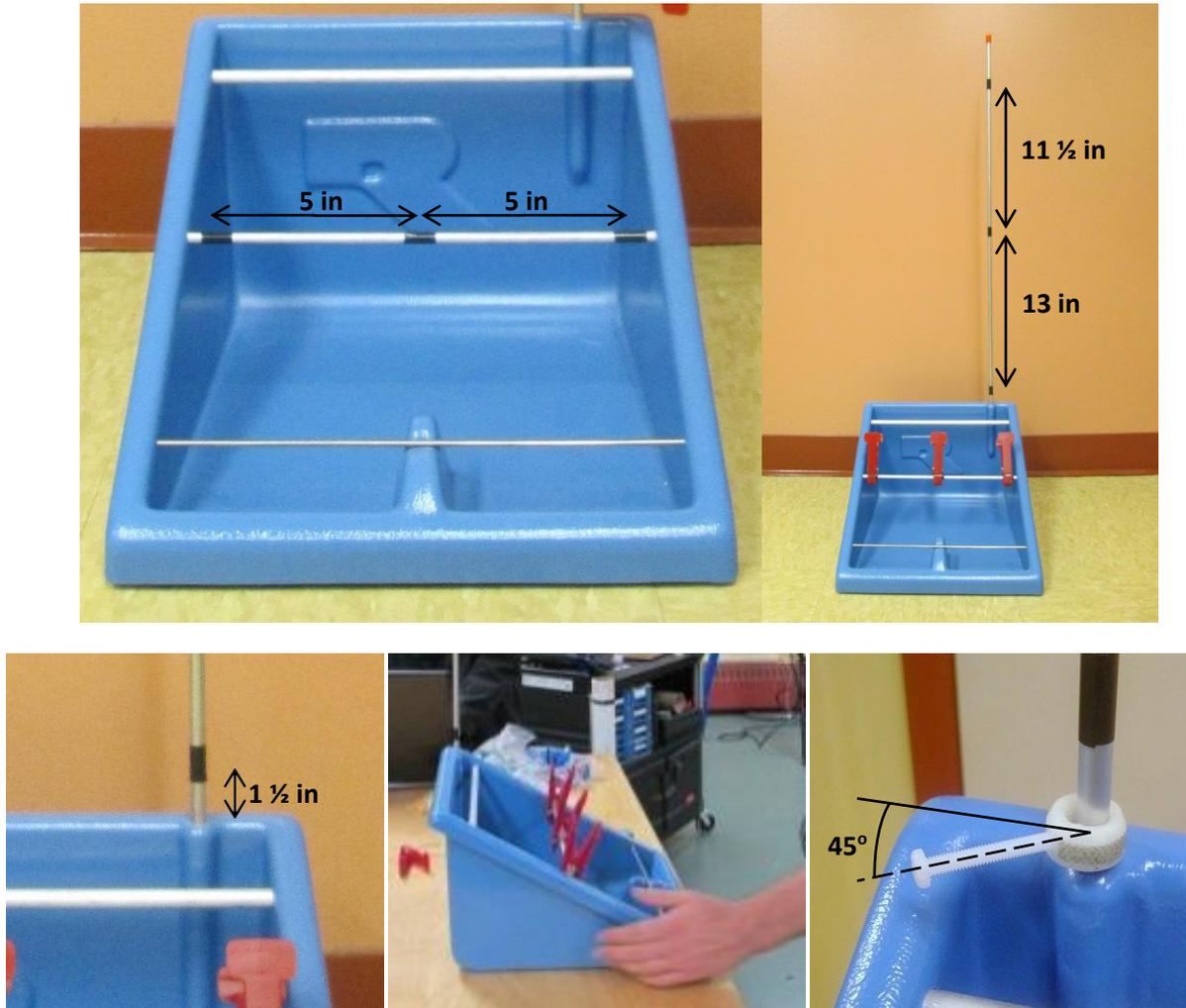


Figure 2. Target location setup of clothespins.

The user can preposition their terminal device with the hand not under assessment before starting trials, but the chosen position must be maintained throughout the test or changed through the control strategy of the prosthesis, and not through use of the opposite side limb. All subjects receive a single practice trial.

Testing Procedure

The testing procedure requires that the direction and the order of the clothespin travel are established. The direction is either upwards or downwards. The order that the three clothespins are moved in is described below. A trial consists of the subject starting a timer, moving all clothespins to their target locations, and stopping the timer. 5 upward trials and 5 downward trials are performed with the clinician recording the time to complete of each trial (in seconds) after the timer has been stopped.

The RCRT can be performed for either right hand or left hand assessment. The diagrams below (Figure 3) indicate the order in which clothespins are to be moved (1 is first, 3 is last) and the arrows indicate the target location. The clothespins on the horizontal rod are ordered in such a way as to prevent a user from reaching across a clothespin or having to place their prosthetic hand in between two adjacent clothespins. The space between the clothespins on the horizontal rod is small and the chosen order prevents a user from having to perform further compensations to orient their hand to grasp the clothespin.

The order and direction of clothespin motion are described as inside-out (upward) and outside-in (downward).

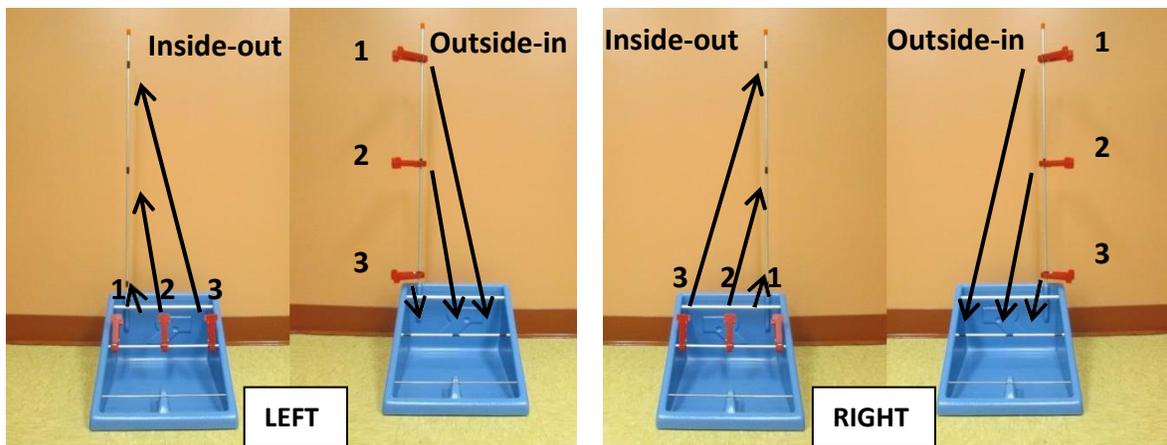


Figure 3. Upward and downward assessment order for right and left handed RCRT. Numbers indicate the order in which the clothespin are to be moved.

Before the timer is started, the subject uses the hand that is not under assessment to grasp the side of the Pinch Exerciser (Figure 1). The hand under assessment is held at the user's side. Prosthesis users begin with their prosthetic hand in the closed position. The clothespins are evenly placed across the horizontal rod. Whenever the clinician sets up the clothespin, the metal rod should always contact the circular groove on the clothespin ensuring a secure fit (Figure 4). The subject is instructed to move at a comfortable pace, and place the clothespins as close to the corresponding demarcations on the vertical rod as possible (or the horizontal rod if the clothespins are being moved downward).



Figure 4. Clinician places clothespins to ensure the metal rod sits within circular groove.

During the upward test, the clinician should set up the clothespin on the horizontal rod at a 90 degree angle to the slope of the open face of the Pinch Exerciser (Figure 5). In some previous protocols of this test, the clothespins have been angled at 45 degrees towards the user with respect to the table top as a horizontal. There are two reasons to use 90 degrees shown here.

First, it is easier for the clinician to set up the clothespins at 90 degrees by using the slope of the Pinch Exerciser as a reference between trials. During testing, the clinician stands to the side of the table, facing the side of the Exerciser. It is difficult to gauge the 45 degree angle to the table top, without asking the subject to step away. This can change the position of their feet between trials, changing the distance from the timer and clothespins. The 90 degree angle can provide more consistency and reduce variation between trials.

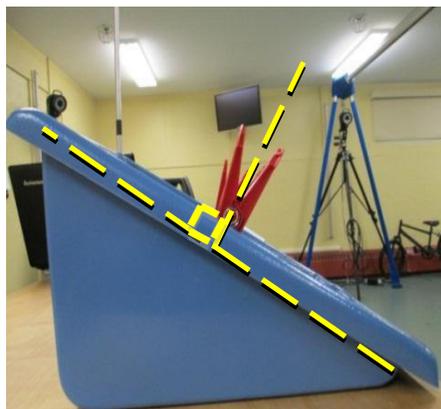


Figure 5. Clothespins are set at a right angle to the open face before the upward trial.

The second reason to use the 90 degree angle has to do with the terminal device. If a hook is used instead of a hand, the user may employ the hook to push down the clothespin, rotate it towards their body, and then grasp the ends to release it from the rod. This means that the RCRT elicits an outcome that will be different for hands and hooks and this will be reflected in the time to complete and the associated score achieved on the assessment.

When moving the clothespins in either direction, the trial is repeated only if the dropped or non-secured clothespin is one that is required for scoring (see Appendix A2 Grading Compensation). On the upward trial, repeat if both the first and second clothespins are dropped. On the downward, repeat if third clothespin is dropped. If the clinician judges that any dropped clothespin occurred too early in the movement and using the trial would unfairly decreased the time to complete, the trial is repeated. If there is any doubt, the trial (either up or down or both) should be repeated.

If the order of the clothespins is confused, a grade of 1 is given.

Following an upward test, the clinician records the time (Appendix A3 - Subject Testing Form), resets the timer and adjusts the clothespins for the downward test. The subject is not told the time to complete, to prevent/reduce the level of competitiveness.

In the downward test, the clinician should set up the clothespin on the demarcations of the vertical rod, angled at 45 degrees towards the hand under assessment, and the subject moves clothespins downward to the horizontal rod. Figure 1 shows a Delrin ring with a nylon screw that is set up at 45 degrees from the horizontal prior to the testing session. This is used as a quick reference for preparing the clothespins for the downwards direction.