

A new clinical test to identify correct rotation of the forearm

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SUMMARY

It is a common practice to label the forearm to be supinated, pronated or midprone, depending upon whether the palm is facing up, facing down or towards the body respectively, without considering the position of the humerus or the shoulder joint. It was observed that examination of the forearm in various body postures with different positions of the humerus makes the forearm appear rotated, even if the forearm had remained fixed in the same rotational alignment. A clinical test is described to help identify the correct rotation of the forearm, irrespective of the position and placement of the humerus, the shoulder and the trunk.

Key words: Supination – Pronation – Forearm rotation – Clinical test

INTRODUCTION

Supination and pronation of the forearm is conventionally described as its rotation on either side from neutral position with the arm fixed to the side of the chest of an individual standing erect, or sitting, the forearm pointing forward with the elbow flexed at 90° (Swash 1995). The forearm positioned with the palm facing up, facing down, or towards the body is considered supinated, pronated or in midprone position respectively. However, identifying the position of the forearm through the direction of the palm is often misleading, particularly if the body is maintained in an unconventional posture.

Large number of positions have been employed for various radiological examinations of the upper extremity with patients sitting, lying supine or prone while keeping shoulder and elbow joints in so many different positions. Similarly, operative intervention of various kinds like arthroscopy, internal fixations, etc., often requires the patient to be maintained in varied position of the trunk and the arm. A wrongly identified position of the forearm would not only make an incorrect description of the procedure, but, due to incorrect interpretation of its results, it may also invalidate the study for any comparison of its data with other similar studies.

For proper identification of the alignment of the forearm, it is essential that its position be described in relation to the adjacent proximal segment (i.e. humerus or the shoulder joint), rather than in relation to the trunk or as an independent parameter. The forearm may appear to have rotated with change in position of the humerus or the shoulder joint even if the forearm remains fixed in the same rotational alignment (Fig. 1). To elicit and measure the rotation of the forearm properly, it is essential that the elbow be kept in flexion, so as not to allow any rotation of the humerus at the shoulder to overlap with that of the forearm. The supination and pronation movements involve rotation of the radius taking the wrist and hand along with it around the ulna fixed at the humeroulnar articulation of the elbow. Therefore, the interrelationship between the plane of movements of wrist and elbow change continuously with the axial rotation of the forearm and the hand, and form the basis to conceptualize and evolve a clinical test to ascertain and verify the correct rotation of the forearm.

It is our observation that several studies published in different reputed journals or textbooks

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have identified the position of the forearm wrongly (Gilula and Yen, 1996; Gupta and Moosawi, 2002). The authors had relied on the conventional identification norm of palm facing up or down for describing the rotational position of the forearm, without taking into consideration the prone or side lying position of the trunk or the abducted shoulder joint, leading to a wrong identification of the position of the forearm. We propose a clinical test which is able to identify various rotated positions of the forearm accurately, even if the body at the time of examination is maintained in an unconventional or an odd body posture.

Clinical test: The test to identify the exact position of the forearm involves moving the adjoining elbow and wrist joints through their flexion extension range and assessing the plane and direction of these movements. If the plane and the direction of flexion extension movements of both wrist and elbow joints are the same, the forearm is considered supinated. The pronated forearm shows the plane of flexion and extension movements of both joints to be the same, though the direction of movements of both the joints is seen

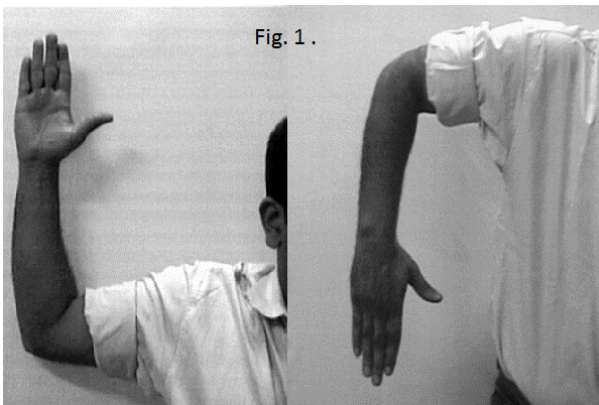


Fig. 1. Change in the appearance of forearm position is the result of rotation at the shoulder with no change in forearm rotation.

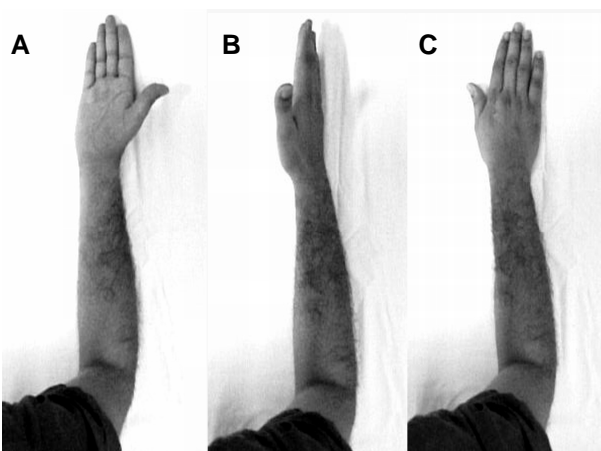


Fig. 2. The position commonly used for radiological examination of the forearm and wrist. The forearm is seen supinated (A), midprone (B) and pronated (C).

to be in the opposite direction to each other. This would mean that, in the pronated forearm, movement of wrist flexion follows the same path and direction as that of the elbow extension, while the wrist extension follows the direction of the elbow extension. In midprone position, the flexion extension movement of the wrist and elbow joint is seen to occur in a plane at right angles to each other.

MATERIALS AND METHODS

The study included four healthy volunteers with no clinical symptoms relating to their forearm. The following three body positions commonly employed for the radiological examination of the wrist were chosen: 1/ forearm placed on the table with the elbow flexed to 90° and the patient sitting on a side stool (Fig. 2); 2/ patient lying prone with the shoulder abducted overhead and the elbow flexed 90° (Fig. 3); 3/ patient lying prone with the shoulder abducted overhead and the elbow extended (Fig. 4). The right forearm in all three body positions was put to three differently rotated positions (Table 1). The proposed clinical test was applied to all three rotated positions of the forearm in all body positions so as to identify various rotated positions of the forearm correctly. The first body position is almost similar to that of the conventional description for eliciting supination and

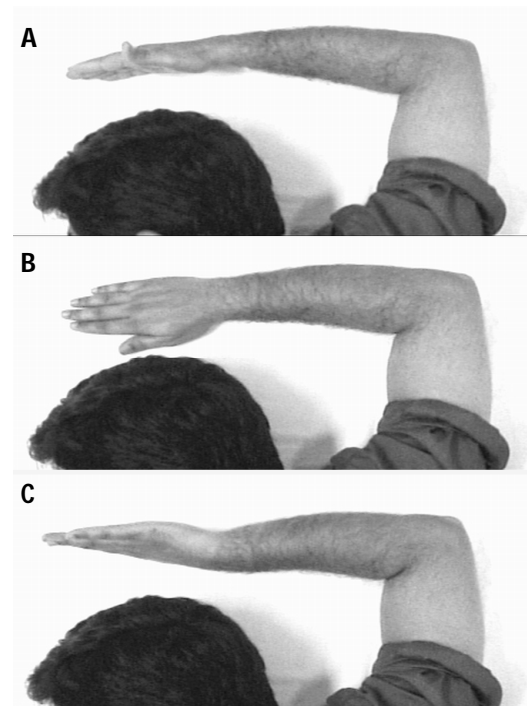


Fig. 3. Position commonly employed for CT/ MRI of the wrist with patient lying prone with shoulder abducted overhead and elbow flexed to 90°. Forearm is seen in various rotated positions. Application of the proposed clinical test demonstrated the forearm to be supinated (A), midprone (B) and pronated (C).

pronation of the forearm, and acted as the control to authenticate the efficacy of the proposed test. The so identified position of the forearm was also reassessed by determining the two extreme end positions of rotation, and these were corroborated with the conclusions of the test. It may be noted that many of these forearm positions have been shown to have variable descriptions in different studies, and have thus provided lacunae or controversies in the current literature, which the proposed clinical test has tried to settle.

RESULTS

The first body position, as seen in Fig. 2 and which also acted as the control, confirmed the concept of the proposed test, as no discrepancy was discovered during the application of the test to its three rotated positions of the forearm (Fig. 2a, b, and c). The rotation of the forearm identified by the test was found to be the same as that in the conventional description. Positions of the

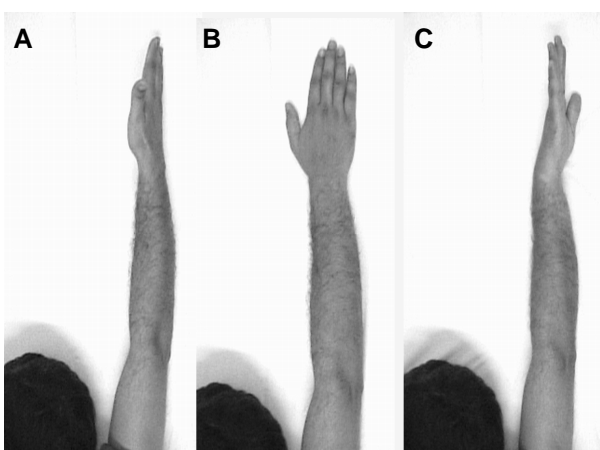


Fig. 4. Overhead arm with extended elbow in prone position showing another position employed for doing CT/ MRI of the wrist. Forearm is seen in various rotated positions. Application of the proposed clinical test demonstrated the forearm to be supinated (A), midprone (B) and pronated (C).

forearm as identified by the proposed test in the other two body positions are shown in Fig. 3 and Fig. 4. The forearm with palm flat on the table in the second body position (Fig. 3b) was found to be midprone, though the same has been described to be pronated (Gupta and Moosawi, 2002). All subjects demonstrated substantial movement in the direction of pronation from this wrongly described pronated position, which reaffirmed the position to be midprone. Similarly, the forearm in a prone lying subject as in the third body position with the thumb pointing up and the palm facing medially (Fig. 4a) was found to be supinated, though it is described to be midprone (Gilula and Yen, 1996).

DISCUSSION

The last decade has seen great interest in the kinematics of the distal radio-ulnar joint, with considerable published material on studies evaluating the effect of forearm rotation on TFCC, ulnar variance, etc. (Nakamura et al., 1999; Weinberg et al., 2000; Pfirrmann et al., 2001; Pomianowski et al., 2001; Yeh et al., 2001; Moore et al., 2002). It is imperative for such radiographic study to have a detailed and accurate description of the position of the forearm for uniformity of the results and valid comparison of its data with other similar studies.

Controversy relating to forearm position in Fig. 4a arose due to the occurrence of further rotation in the direction of supination from this so described midprone position. It was observed that a major part of such a supination is actually contributed by the external rotation of the humerus, rather than any actual movement of the forearm. Upward elevation of the arm requires obligatory external rotation of the humerus to avoid tuberosity impinging under the acromian process. This axial rotation of the humerus accompanying shoulder movements may cause the forearm to also appear rotated, causing misinterpretation of its rotational alignment.

Table 1. Various rotations of the forearm in three different body positions commonly employed for radiological tests

Different body positions	Position of the forearm		
	Supination	Midprone	Pronation
Patient sitting on a side stool with shoulder adducted and arm resting on the table	With palm facing the roof and thumb pointing laterally (Fig. 2a)	With palm facing medially and thumb pointing towards the roof (Fig. 2b)	With palm flat on the table and thumb pointing medially (Fig. 2c)
Patient lying prone with shoulder abducted overhead and elbow flexed to 90°	With palm facing the head and thumb pointing towards the roof (Fig. 3a)	With palm flat on the table and thumb pointing towards the head (Fig. 3b)	With dorsum of the hand facing the head and thumb pointing towards the floor (Fig. 3c)
Patient lying prone with shoulder abducted fully and elbow 180° extended	With palm facing medially and thumb pointing towards the roof (Fig. 4a)	With palm flat on the table and thumb pointing medially (Fig. 4b)	With palm facing laterally and thumb pointing towards the floor (Fig. 4c)

The mode and the sequence of injury patterns of various wrist and forearm injuries have rotation of the forearm as an important component of the many compounding factors. A wrongly identified position of the forearm may bring out wrong interpretations of the various forces involved in producing a particular injury pattern.

Determining the plane and the direction of wrist and elbow movements should always be part of the examination identifying rotational alignment of the forearm. This acquires significance in the light of uncommon positions being increasingly used to evaluate the carpals with latest modalities such as MRI or CT etc.

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