EFFECT OF FINGER ULNAR DEVIATION ON GLIDING RESISTANCE OF THE FLEXOR DIGITORUM PROFUNDUS TENDON WITHIN THE A1 AND A2 PULLEY COMP

INTRODUCTION

Ulnar deviation is a common deformity of the metacarpophalangeal (MCP) joint, especially in patients with rheumatoid arthritis (RA). There are physiologic factors associated with the development of ulnar deviation including asymmetry of the metacarpal heads and collateral ligaments of the MCP joint, the deforming effect of oblique lines of pull of the flexor and extensor tendons, action of the intrinsic muscles, and extrinsic factors. While the above factors all predispose to ulnar deviation of the fingers in patients with RA, they are all static factors. The dynamic contributions of tendon forces have been less carefully studied. To our knowledge no studies have been published that have measured the gliding resistance between the FDP tendon and A1 and A2 pulley complex in ulnar deviation. The purpose of this study was to evaluate the effect of ulnar deviation of the finger on gliding resistance of the FDP tendon within the A1 and A2 pulley complex in a human cadaver model.

METHODS

Thirty-two fresh-frozen human cadaveric fingers (8 of index, middle, ring and little fingers) obtained from 10 different human cadavers were used in this study.

Two marks were made on the FDP tendon at the level of the distal edge of the A2 pulley, one with the finger in full extension and the other with the finger in full flexion. The distance between these two marks was considered to be the in situ tendon excursion. The A1 and A2 pulley complex, metacarpal and proximal phalanx and middle phalanx, flexor digitorum profundus (FDP) tendon, flexor digitorum superficialis (FDS) tendon and FDS insertion were preserved. The FDP tendon was divided at its insertion and the remaining tendon sheath, bone and vinculum of the FDP tendon were excised. The radial collateral ligament of the MCP joint and a portion of the volar plate were cut to allow ulnar deviation.

Gliding Resistance Measurement

We used a modified version of a previously described and validated gliding resistance testing device. Each digit was secured on the custom-made device by clamping the proximal part of the external fixator. Five different angles of ulnar deviation (0º, 15º, 30º, 45º, and 60º) were simulated using a custom-built external fixator (Figure 1).

The force differential between the proximal and distal tendon ends represents the gliding resistance. The mean gliding resistance of the FDP tendon within A1 and A2 pulley complex was measured over the excursion range. Testing was performed under the following angles of ulnar deviation, 0º, 15º, 30º, 45º and 60º. The testing sequence of ulnar deviation was randomized to avoid bias due to repeated testing of the same tendon.

The data obtained from the gliding resistance were analyzed statistically by two-factor ANOVA (digit and degree of ulnar deviation) with repeated measures on the factor of ulnar deviation. The main effects and interaction were evaluated. When significance was detected the Tukey-Kramer test was applied to determine the statistical difference between data pairs.

RESULTS

Since the digit was not a significant factor in the gliding resistance (p=0.93) and there was no significant interaction between the two factors (digit and ulnar deviation angle) (p=0.08), the results can be summarized by considering only the factor of ulnar deviation. There was a significant difference in the gliding resistance among the angles of ulnar deviation (p<0.001). The gliding resistance at 0º, 15º, 30º, 45º, and 60º of ulnar deviation was 0.40±0.13 N, 0.44±0.13 N, 0.55±0.17 N, 0.74±0.21 N and 1.02±0.30 N, respectively (Figure 2).