INTRODUCTION

Brachioradialis (BR) to flexor pollicis longus (FPL) tendon transfers are common for restoration of thumb flexion and, therefore, key pinch function in patients with spinal cord injuries. Typically, these transfers are performed by releasing the BR tendon from its attachment on the distal radius and proximally along its muscle belly. The released muscle is then volarly attached to the FPL tendon. A primary limitation of this procedure is the inability to pronate in patients who lack functional pronation muscle groups. This limits the number of patients who can benefit from this procedure. The purpose of this study was to demonstrate biomechanically that the BR muscle can be transferred to restore both thumb flexion and forearm pronation.

METHODS

Nine fresh-frozen cadaver specimens (age: 80 ± 8 years; ulnar length: 26.3 ± 1.9 cm) were thawed to room temperature for this experiment. Using a dual-mode servomotor (Model 310BR-LR, Aurora Scientific, Aurora, Ontario, Canada), BR tendon excursion was measured from 60º of supination to 60º of pronation in 15º increments under the following conditions: first, the BR tendon unit was tested in its native configuration, second with the BR tendon volarly transferred to the FPL tendon, and third with the BR tendon dorsally transferred to the FPL through the interosseous membrane. Finally, maximum excursion was measured (maximum forearm supination with wrist and thumb extended to maximum forearm pronation with wrist and thumb flexed).

Muscle path was represented by a 2-0 nylon suture passing through a custom-made eyelet attached to the midpoint of the humeral origin of the BR muscle fibers. This suture was attached to the proximal third of the BR tendon and did not interfere with tendon excursion in any of the tested configurations. The ulna and distal humerus were rigidly secured to a custom-made jig at 90º of elbow flexion. Forearm pronation and supination were measured with an inclinometer secured to the distal radius. During the volar and dorsal transfer conditions, the distal interphalangeal joint was fixed at 30º of flexion. Using Steinman pins, the proximal interphalangeal joint, carpometacarpal, and scaphoradial joints were fixed in neutral and the wrist was fixed in 20º of extension.

Three tendon excursion trials were averaged for each testing configuration before data were fit with quadratic polynomials ($r^2 = 0.97 - 0.99$). Curves were then differentiated to compute pronation-supination moment arms under each condition. [1] Comparison of maximum excursion and moment arm between trials was made with two-way repeated measures analyses of variance (ANOVA). When significant main effects or interactions were observed, post-hoc Tukey tests were made at each joint position to determine where differences existed. The results are presented as mean ± standard error, and significance level ($\alpha$) was set to 0.05.

RESULTS

Maximum muscle excursion from supination with wrist and thumb extension to pronation with wrist and thumb flexion was nearly identical between transfer conditions (volar: 9.0 ± 1.1 mm vs. dorsal: 8.9 ± 0.9 mm). However, when pronation-supination motions were isolated, significant differences were observed between the native BR configuration and both transfer conditions ($P < 0.001$; Fig. 1). At 60º and 45º of supination, all transfer conditions were significantly different from one another while the dorsal transfer was different from the native and volar conditions from 30º of supination to 60º of pronation. Pronation-supination moment arms were also significantly different between the native BR configuration and both transfer conditions ($P < 0.001$; Fig. 2). The dorsal transfer condition produced larger pronation moment arms compared to the volar transfer at all forearm positions. Similarly, the dorsal transfer produced larger pronation moment arms compared to the native BR from 30º of supination through 60º of pronation. Perhaps most interesting was that the dorsal transfer produced a pronation moment arm from 60º of supination through 30º of pronation in contrast to the volar transfer where pronation moment arm was zero by 30º of supination.

ACKNOWLEDGEMENTS

Funding for this project was provided NIH grants AR40539 and HD044822, the United Cerebral Palsy Foundation and the Department of Veterans Affairs, as well as Swedish Research Council Grant 11200, and Göteborg University.

REFERENCES


**Department of Hand Surgery, University of Göteborg and Sahlgrenska University Hospital, Göteborg, Sweden.

DORSAL TRANSFER OF THE BRACHIORADIALIS TO FLEXOR POLlicis LONGUS Muscle
POWERS THUMB FLEXION AND FOREARM PRONATION

*Ward, SR; *Peace, W; **Fridén, J; +Lieber, RL

*Department of Orthopaedic Surgery, University of California and VA San Diego Healthcare System, San Diego, CA
email: rlieber@ucsd.edu

Figure 1. Muscle excursion (mm) as a function of pronation-supination forearm angle (deg). § indicates significant difference between all three testing conditions ($P < 0.05$) and † indicates significant difference between dorsal and volar transfer conditions ($P < 0.05$).

Figure 2. Pronation-supination moment arm (mm) as a function of forearm position (deg). § indicates significant difference between dorsal and volar transfer conditions ($P < 0.05$) and † indicates significant difference between the dorsal transfer and other two groups ($P < 0.05$).

52nd Annual Meeting of the Orthopaedic Research Society
Paper No: 1885