SCIENTIFIC ARTICLE

An Experimental Study Comparing Active Mobilization to Passive Flexion–Active Extension–Active Flexion After Flexor Tendon Repair in Zone 2

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Purpose Both passive flexion–active extension and active rehabilitation have shown advantages and disadvantages in tendon healing. The purpose of this study was to measure the effect of a combination of these 2 rehabilitation protocols.

Methods A tendon injury model was used in white Leghorn chickens. Thirty-two animals were randomly assigned into 4 groups. We compared an unrestricted active flexion rehabilitation (UA) group with 3 groups starting passive flexion, active extension, and active flexion (PAA) at 5, 9.5 and 14 days after repair. The tensile properties and range of motion of the 3 interphalangeal joints were evaluated for 3 postoperative weeks.

Results In terms of tensile properties of the operated foot, PAA-14 was higher than any other group, and PAA-5 was the lowest. There was no significant difference between the PAA-9.5 and UA. For the range of motion, there were significant differences between all 4 groups: UA increased the most, PAA-14 increased the least, and PAA-5 increased more than PAA-9.5. For the rupture rate, UA and PAA-5 were higher than were PAA-9.5 and PAA-14.

Conclusions The results indicate that the PAA-9.5 and UA may give the best balance (tensile properties, range of motion, rupture rates) of these rehabilitation protocols. PPA-9.5 and UA had similar moderate tensile properties. When considering an increased range of motion, the UA method may be the most appropriate despite its higher rupture rate. When considering a lower rupture rate, PAA-9.5 may be the most suitable. *(J Hand Surg 2013;38A:672–676.* *Copyright © 2013 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic III.

Key words Biomechanical properties, early mobilization, flexor tendon repair, range of motion, zone 2.

THE FULL RECOVERY of digit function remains a difficult clinical problem following zone 2 flexor tendon injuries. Kleinert et al[1] developed a passive flexion–active extension regimen, and several authors[2–6] have indicated that protected passive mobilization can inhibit adhesion formation and improve tendon excursion. Silfverskiöld et al[7] suggested that a passive flexion-active extension program had more joint motion and tendon excursion than did a passive regimen clinically. Even so, it still does not produce a

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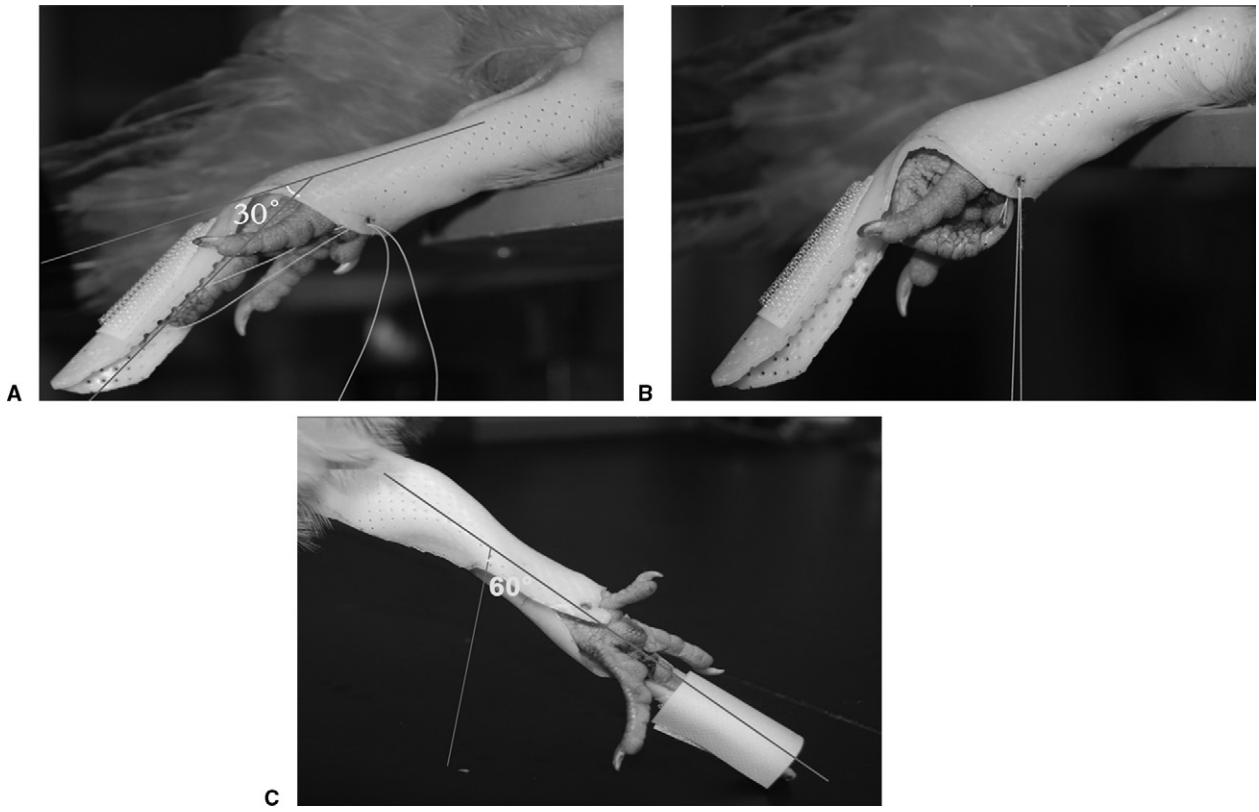

FIGURE 1: A, B Weight was attached to the long toe by a thread so that the tip of the operated toe nearly touched the plantar surface of the foot. The extensor muscles could contract and extend the interphalangeal joints. **A, C** A dorsal splint held the ankle in 60° of plantar flexion and the metatarsophalangeal joint in 30° of flexion and allowed full interphalangeal joint extension.

satisfactory result. Other authors[7–9] indicated that an early active mobilization program with more effective tendon gliding and less adhesion formation[10] produces more joint motion but results in unacceptably high rupture rates.

Both passive flexion-active extension and active rehabilitation have shown advantages and disadvantages. The purpose of this study was to combine these 2 rehabilitation protocols to identify their ideal balance after flexor tendon repairs in zone 2 at 3 weeks of healing.

MATERIALS AND METHODS

Animal surgeries and postoperative care

All experiment protocols were approved by the local animal care and use committee. Both the housing and surgeries were carried out in facilities meeting the standards of local and national regulatory bodies. Thirty-two adult white Leghorn chickens (Dahuanong Animal Health Products Co., Ltd., Guangdong, China) weighing 1.3–1.5 kg were anaesthetized by xylazine (5–10 mg/kg, injected intramuscularly), and lidocaine hydrochloride (0.5%, 1 mL) was injected into the third toe of the left foot. Under aseptic conditions, zigzag incisions were made on the plantar surface of the left third digits over zone 2. The flexor sheath was opened longitudinally between the proximal and distal pulleys. The flexor digitorum profundus tendon was isolated, and a transverse complete laceration was made to both the superficial and deep tendons with a scalpel blade. Under an operating microscope at 10× magnification, only the flexor digitorum profundus tendon was repaired with the modified Kessler[11] technique with a 5-0 suture. The sheath was completely repaired using a 7-0 suture, and then the skin was closed. The third digit was then placed in a dorsal low-temperature thermoplastic splint with the ankle plantar flexed at 60°, the metatarsophalangeal joints flexed to 30°, and the interphalangeal joints extended fully (Fig. 1). The unoperated control foot was left free to allow for ambulation.

The 32 chickens were randomly assigned into 4 equally sized groups with different rehabilitation regimens. All of the operated digits were immediately immobilized in the splint for 3 days.

Twenty- to 60-gram weights attached to the long toe were added gradually until the tip of the operated toe

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