

The Role of Juncturae Tendinum and Intertendinous Fascia in Independent Extension of Index Finger

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ABSTRACT

The roles of juncturae tendinum and intertendinous fascia between extensor digitorum communis (EDC) tendons of the index finger and the middle finger in independent extension of the index finger after extensor indicis proprius (EIP) tendon transfer were studied. In 28 hands from fresh cadavers, 1.5-kilograms pulling forces were applied on EIP tendon, index-EDC, and combined EIP and index-EDC tendons, respectively, while the angles of index finger motion were recorded. The results showed no differences in extension of the index finger (metacarpophalangeal and interphalangeal joint). After dividing the EIP tendon and pulling on the index EDC tendon while adjacent fingers were fully flexed, a reduction of the metacarpophalangeal joint extension of 20 degrees was noted. Then division of the juncturae tendinum and intertendinous fascia respectively were performed which showed no influence on extension of the index finger even with passive full flexion of the middle, ring, and little fingers. It is unnecessary to sacrifice juncturae tendinum and intertendinous fascia in the harvest or transfer of EIP tendon to increase the independent extension of the index finger.

Extensor indicis proprius (EIP) tendon transfer is essential in some types of reconstructive hand surgery. So what is the deficiency of the index finger regarding independent extension in such cases? Moore¹ believed that the index finger could be extended independently but in the case of fully flexed middle, ring, and little fingers, the index finger extension was decreased by about 10 to 20 degrees. This was due to the tethering effect of juncturae tendinum between index and middle finger extensor digitorum communis (EDC) tendons.

Juncturae tendinum or juncturae tendini is described in Dorland's Illustrated Medical Dictionary² as "narrow bands extending obliquely between the extensor tendons

on dorsum of the hand. It appears that neither the anatomy nor the function of these structures is very clear³. A detailed study of junctural anatomy revealed that the juncturae tendini are not the nebulous structures as they are usually thought to be. Their functions are as intertendinous spacers, the force distributors between the tendons, the finger extension co-ordinators, the metacarpophalangeal joint (MCP) stabilizer, and prevention of the independent extension of fingers. The structure that may be confused with the juncturae tendinum is the intertendinous fascia. It is defined as the filmy transparent layers which attach to the paratenon and tendon sheath and not the tendons, and are present between all EDC tendons regardless of whether or not a juncturae tendinum is present, and also connect to the EIP⁵. (Fig. 1)

If the juncturae tendinum and intertendinous fascia had been divided by EIP harvest or transfer, whether it can be fully and actively extended or not and the determination of its extent of motion are the purposes of our study. This study also determined the degree of independent extension of the index finger after the EIP was harvested, as well as after the juncturae tendinum and the intertendinous fascia were divided.

MATERIALS AND METHODS

Both hands of 14 randomly selected fresh cadavers, 13 males and 1 female, aged between 18-50 years were dissected. There were no previous hand problems in these hands. The joints were completely supple, and all tendinous and associated anatomical apparatus were preserved. A 3 mm. Steinmann pin was inserted through the center of the palm into the distal radius to immobilize the radiocarpal joint in the neutral position. The forearm and wrist of each specimen was secured horizontally to a testing bench with the palm facing downward over the edge of the bench. In this position, the MCP and IP joints were set in a position of rest. The tendons of the EIP and the index EDC were each pulled by a weight of 1.5 kilograms⁶. In the first

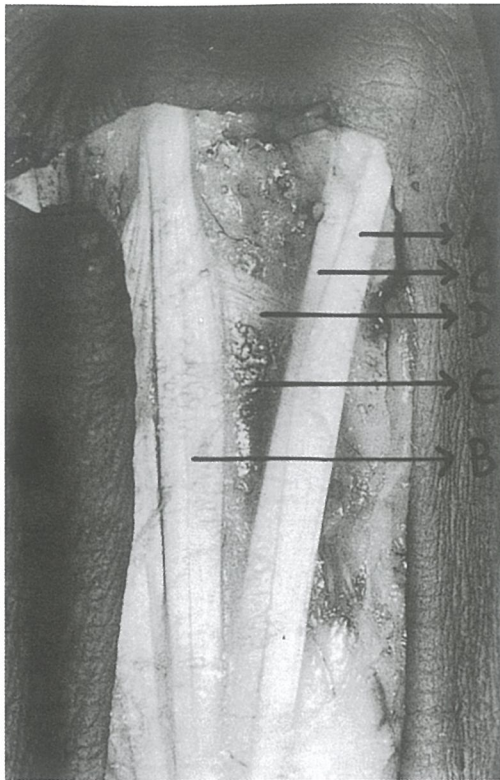


Fig 1. The anatomical position of the index EDC tendon (A), middle EDC tendon (B), EIP (C), juncturae tendinum (D), and intertendinous fascia. (E)

stage of the procedure, the tendons of EIP, index EDC, and combined EIP-index EDC were pulled, respectively. In the second stage, the EIP tendon was sacrificed at the sagittal extensor hood, then the index EDC tendon was pulled

while the middle, ring, and little fingers were fully flexed. In the last stage, after the juncturae tendinum and the intertendinous fascia between index and middle finger EDC tendons were cut, the index EDC tendon was pulled while adjacent fingers were in full flexion. (Fig. 2)

The angle of movement in degrees of MCP, PIP, and DIP joints were recorded three times for each joint and stage. Angles and positions dorsal to the neutral position were defined as negative (-) values, whereas palmar to the neutral position were defined as positive (+) values.

RESULTS

Twenty-eight hands had one EIP tendon and one index EDC. The EIP tendon was situated on the ulnovolar aspect of the index EDC tendon, which was nearly the same size. The juncturae tendinum between the index and middle finger EDC tendons consisted of a filamentous region within intertendinous fascia defined as type 1 according to von Schroeder⁵. The results of weight pulling on EIP, tendon index EDC, and combined EIP and index EDC tendons in the first stage procedure showed no different values in angle extension. Hyperextension occurred at the MCP joint, while the PIP and DIP joint still flexed 27 and 10 degrees, respectively (Table 1 and Fig. 3).

The second stage procedure revealed flexion of the MCP joint of the index finger of 28 degrees when the adjacent fingers were flexed. However, when the adjacent fingers were free, the MCP joint of the index finger extended about 8 degrees (Table 2 and Fig. 4). The third stage procedure showed no differences in index finger extension, with or without sacrifice of the juncturae tendinum and intertendinous fascia (Table 3 and Fig. 5).

Table 1. Degrees of MCP, PIP and DIP joint position of the index finger in the resting position and being pulled tendon in stage 1

Steps	MCP (mean $\pm$ S.D.)	PIP (mean $\pm$ S.D.)	DIP (mean $\pm$ S.D.)
Rest	+41 $\pm$ 6	+39 $\pm$ 7	+15 $\pm$ 13
Pulled EIP	-8 $\pm$ 8	+27 $\pm$ 8	+10 $\pm$ 3
Pulled index EDC	-8 $\pm$ 8	+28 $\pm$ 9	+10 $\pm$ 3
Pulled EIP and index EDC	-7 $\pm$ 7	+27 $\pm$ 9	+10 $\pm$ 3

Table 2. Degrees of MCP, PIP and DIP joint positioning of the index finger in the stage 2 procedure with and without flexion of index adjacent fingers.

Steps	MCP (mean $\pm$ S.D.)	PIP (mean $\pm$ S.D.)	DIP (mean $\pm$ S.D.)
Adjacent fingers free	-8 $\pm$ 8	+27 $\pm$ 9	+10 $\pm$ 3
Adjacent fingers flexed	+28 $\pm$ 9	+20 $\pm$ 5	+10 $\pm$ 1

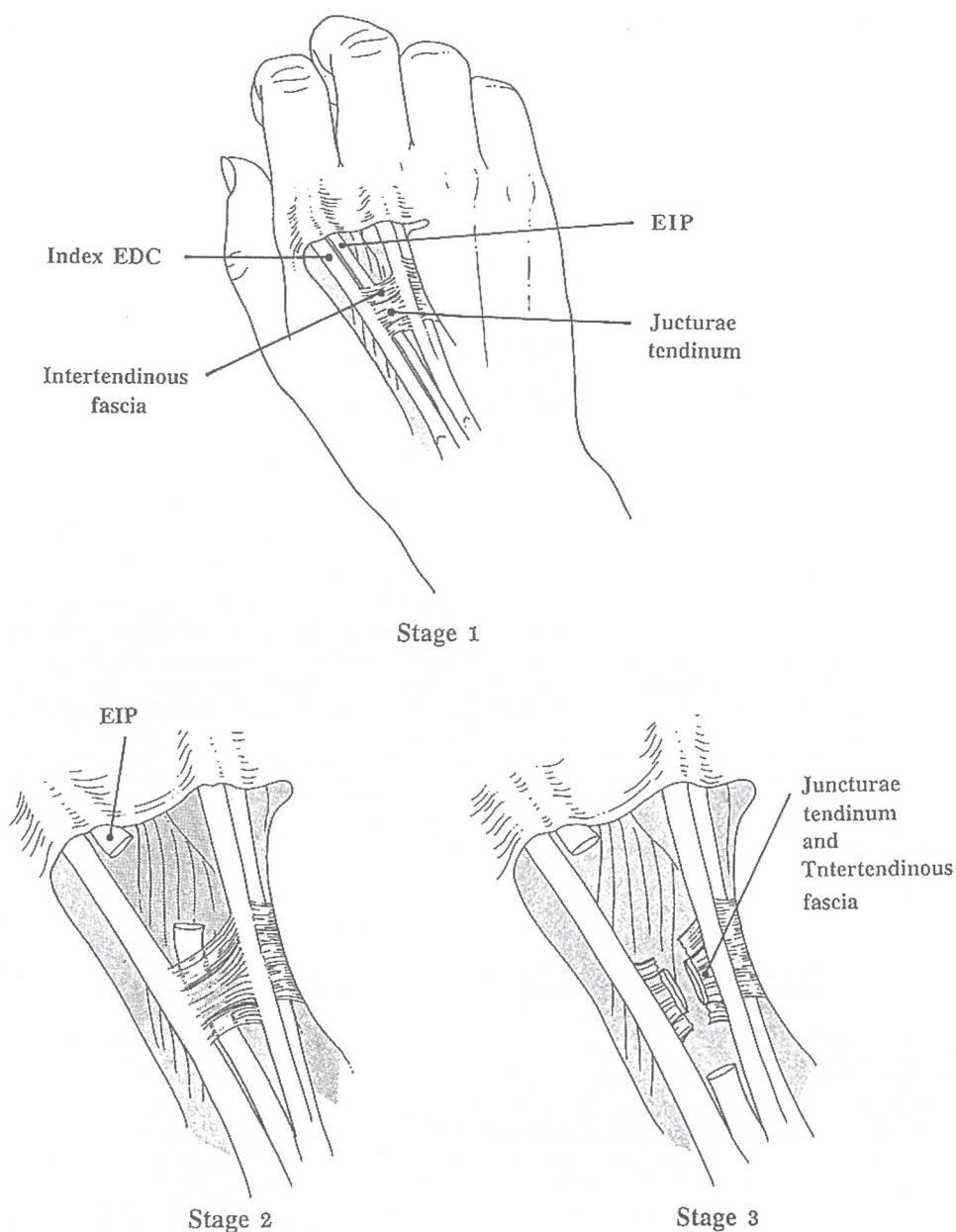


Fig 2. The stage procedures of experiment ; stage 1 in normal anatomy, stage 2 sacrificed EIP tendon, and stage 3 sacrificed juncturae tendinum and intertendinous fascia.

Table 3. Degrees of MCP, PIP, and DIP joint positioning of the index finger in the stage 3 procedure (before and after sacrifice of juncturae tendinum and intertendinous fascia)

Steps	MCP (mean $\pm$ S.D.)	PIP (mean $\pm$ S.D.)	DIP (mean $\pm$ S.D.)
Intacted	+28 $\pm$ 9	+20 $\pm$ 5	+10 $\pm$ 1
Sacrifice Juncturae tendinum	+28 $\pm$ 9	+20 $\pm$ 6	+11 $\pm$ 2
Sacrifice Juncturae tendinum and Intertendinous fascia	+28 $\pm$ 9	+20 $\pm$ 6	+11 $\pm$ 2

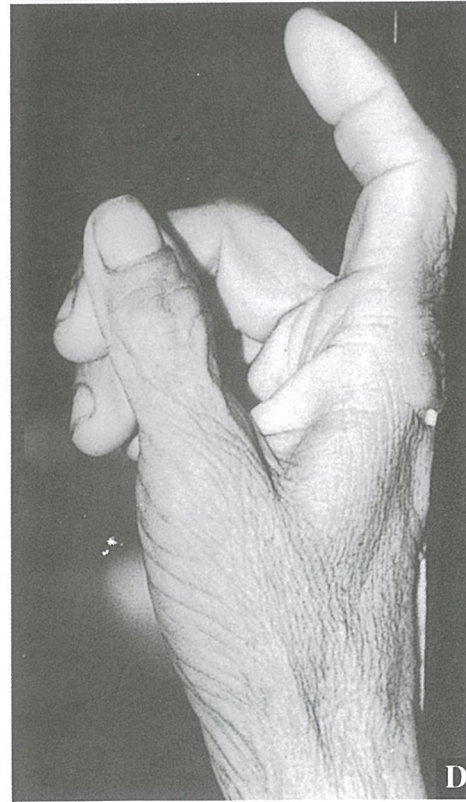
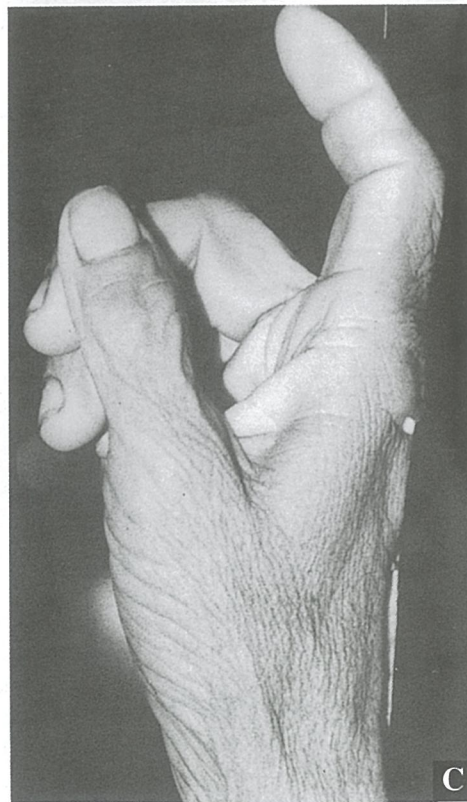
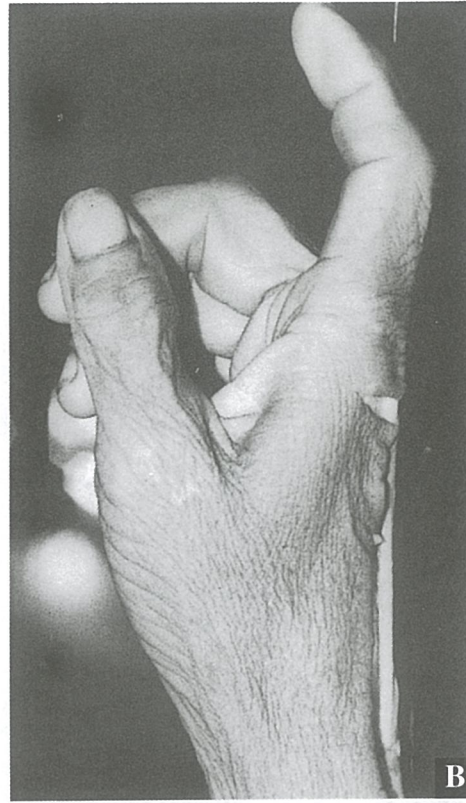
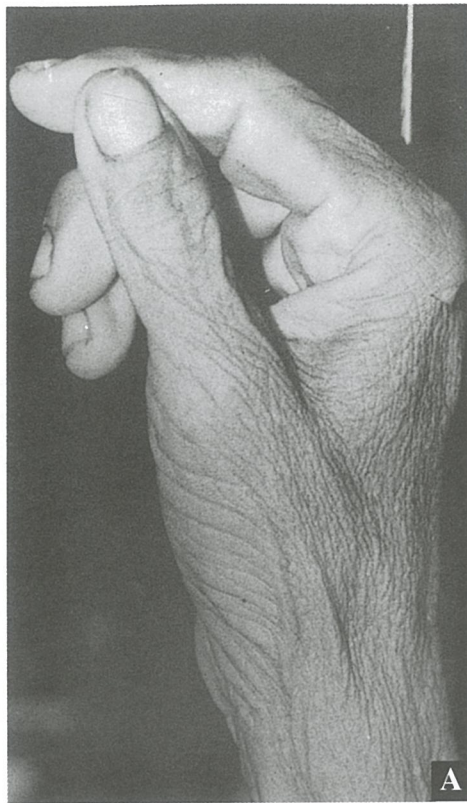


Fig 3. The position of the index finger in the stage 1 procedure.
 A. Resting position of the index finger
 B. Pulled EIP tendon
 C. Pulled index EDC tendon
 D. Pulled combined EIP and index EDC tendon.

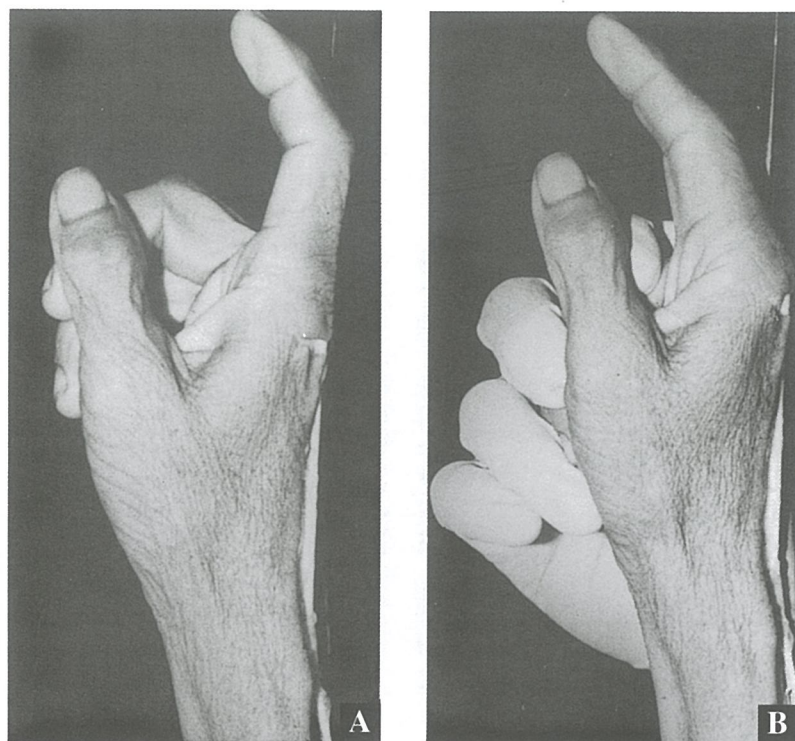


Fig 4. The position of the index finger in the stage 2 procedure.

A. index EDC was pulled

B. index EDC was pulled with passively flexed index adjacent fingers

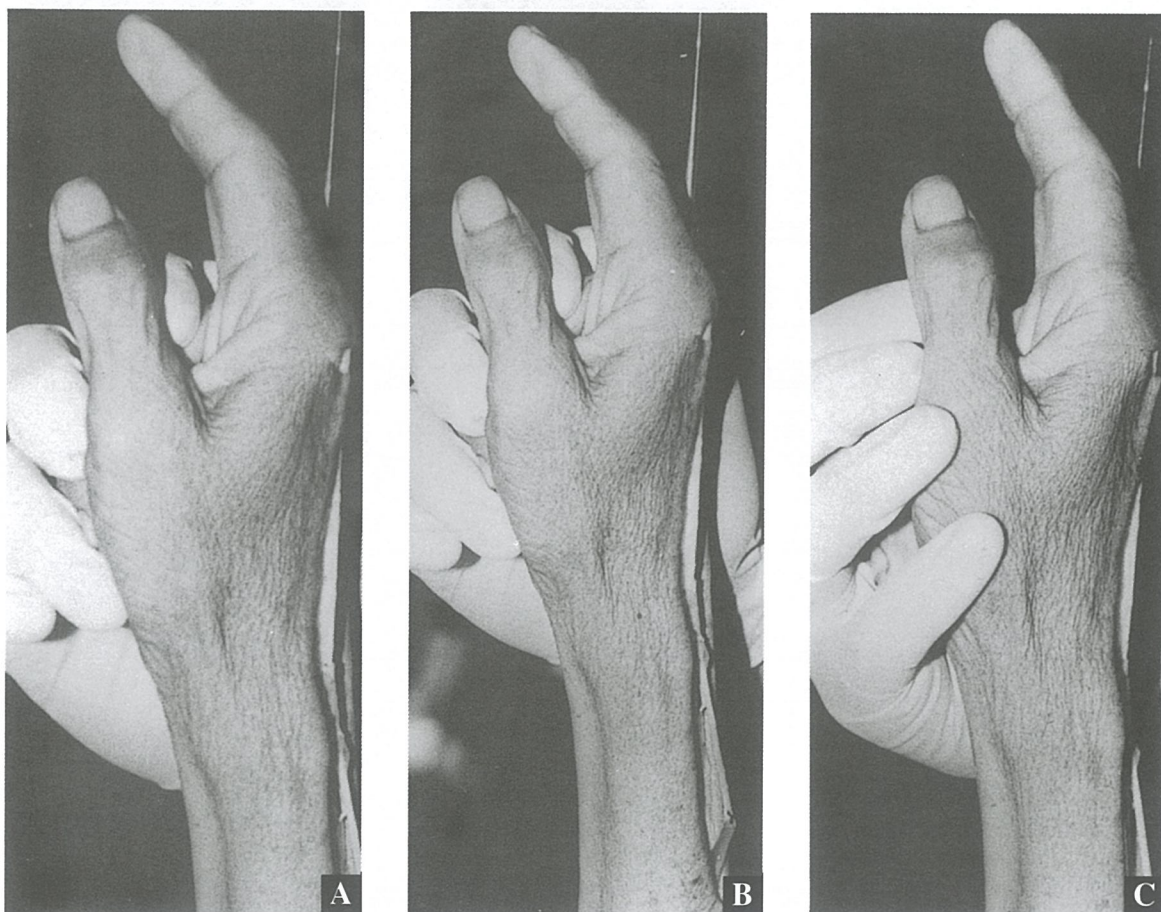


Fig 5. The position of the index finger in the stage 3 procedure with passive full flexion of index adjacent fingers.

A. intact juncturae tendinum and intertendinous fascia

B. juncturae tendinum was sacrificed

C. juncturae tendinum and intertendinous fascia were sacrificed

DISCUSSION

There were one EIP and one index EDC tendon in our 28 studied hands. The probability of having for two EIP tendons is 10 percent⁷ and 2 percent⁸ for the index EDC. Von Schroeder⁵ described the type 1 juncturae tendinum as consisting of a filamentous region within the intertendinous fascia attached between the index and middle finger EDC tendons. This type presented in 88% and was absent in 12%.

The EIP and index EDC tendons showed the same qualified action on MCP joint hyperextension, but showed less effect on the extension of the PIP and DIP joints due to checkrein effect of dorsal aponeurosis⁹. Indeed, the MCP joint hyperextension and the lack of full extension of IP joints in this study resulted in a claw hand position similar to that seen in an ulnar and median nerve palsy in which there is no intrinsic and flexor balance. This hyperextension, although unphysiologic, demonstrated the specific contribution of the long extensors to finger motions⁶.

The EIP muscle tendon unit has gained wide popularity as a donor for tendon transfer because of its ease of

exposure, consistent action, and ability to provide a variety of motor functions for the hand. Moore¹ found that after 27 cases of EIP transfer, 20 patients could extend the index finger independently while the other fingers were held fully flexed. In the other 7 patients, the tethering effect of index and middle finger juncturae tendinum resulted in an independent extension lag varying from 10 to 20 degrees. In our study, the independent angle of extension of the index finger when the adjacent fingers were fully flexed was revealed to be nearly the same as after sacrifice of the juncturae tendinum and intertendinous fascia. This phenomenon demonstrates that despite complete release of the juncturae tendinum and intertendinous fascia with full flexion of the index adjacent fingers, full independent extension of the index finger MCP joint is not obtained. It suggests that extracapsular palmar constraints may limit independent extension of the index MCP joint. Therefore, sacrifice of juncturae tendinum and intertendinous fascia between index-middle finger EDC tendons in EIP tendon harvest or transfer procedure is not recommended.

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