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Index finger pollicization for congenital aplasia or hypoplasia of the thumb

Sensation, strength, dexterity, length, and range of motion were evaluated after index finger pollicization in 10 patients (14 hands). Diagnoses included congenital absence of the thumb (10 hands) and hypoplasia (4 hands). Average age at operation was 7 years, and follow-up averaged 9 years. Patients with unilateral pollicization averaged 67% grip strength, 60% lateral pinch, 56% palmar pinch, and 39% three-point pinch as compared with the normal contralateral hand. Manual dexterity averaged 70% efficiency as compared with normal standards defined according to age and sex. However, 55% of the patients, when stressed, used side-to-side pinch. It was noted that in those patients who used side-to-side pinch performance averaged 54% of normal standards, compared with 93% in patients who used tip-to-tip pinch for prehension. (*J HAND SURG* 1992;17A:880-84.)

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The purpose of this study was to assess the results of index digit pollicization for reconstruction of the congenitally absent or hypoplastic thumb.

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Received for publication June 1, 1991; accepted in revised form Dec. 19, 1991.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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3/1/36374

Materials and methods

Twenty-two index finger pollicization procedures were performed on 18 patients between 1976 and 1988. Fourteen pollicizations in 10 patients were analyzed for this study. Geographic constraints prevented the remaining patients from participating in the study. The average age at pollicization was 7 years (range, 2 to 12 years). Average follow-up was 9 years after pollicization (range, 3 months to 13 years). There were eight right hands and six left hands. The operation was performed unilaterally in six patients and bilaterally in four patients. The indication for index finger pollicization was congenital absence of the thumb (Blauth grade V) in 10 patients and marked congenital hypoplasia (Blauth



Fig. 1. A, Preoperative photograph of 5-year-old boy with severe right thumb hypoplasia (Blauth grade IV). B, Photograph 2 years after pollicization of right index finger.

grade IV) in four patients (Fig. 1).¹ Associated anomalies were numerous and included radial clubhand in four patients and hypoplastic thumbs on hands with five other well-formed digits in two patients (Table I).

Patients were evaluated by physical examination, x-ray films, and manual dexterity tests to assess the results of pollicization. Grip strength was measured with a dynamometer. Palmar pinch (thumb pulp to index pulp), three-point prehension, and lateral pinch were measured with a pinch gauge. The mobility of the pollicized digit was evaluated in opposition, range of

motion, and manual dexterity. Sensation was assessed by two-point discrimination, and the length of the pollicized digit was recorded with reference to the proximal interphalangeal joint of the adjacent digit.

Surgical technique

A skin incision proposed by Buck-Gramcko² to allow for appropriate thenar eminence and web reconstruction is made. The first dorsal and palmar interosseous muscles are elevated from the index metacarpal shaft, and their tendinous insertions are transected. The extensor tendons are identified and transected at the midmeta-



Fig. 2. Photograph after left index pollicization.

Table I. Associated findings

Anomaly	No. of patients
Radial clubhand	4
Five-finger hand	2
Holt-Oram syndrome	2
Congenital hip dysplasia	2
Scoliosis	1
Syndactyly	1
Anal stricture	1
Congenital elbow fusion	1
Pierre-Robin syndrome	1
Ventricular septal defect	1
Talipes equinovarus	1
Klippel-Feil syndrome	1

carpal level. The palmar neurovascular structures are isolated in preparation for transposition. The radial digital artery of the next adjacent digit is ligated, and the transverse metacarpal ligament is excised. The index metacarpal is shortened by diaphysectomy without direct physal ablation. The metacarpal head is then rotated approximately 120 degrees and the metacarpophalangeal joint is hyperextended 70 degrees before it is transfixed with Kirschner wire or nonabsorbable suture to the remaining metacarpal base.

The first dorsal interosseous muscle is sutured to the periosteum on the radial aspect of the middle phalanx to construct the short abductor. The first palmar interosseous muscle is attached to the ulnar periosteum of the proximal phalanx to function as the intrinsic ad-

Table II. Maximum active range of motion after index finger pollicization (degrees)

	Group average	Group range	Radial clubhand
Thumb abduction	62	30-90	50
Thumb adduction	19	0-80	13
MP joint flexion*	85	25-120	75
MP joint extension	8	0-50	10
IP joint flexion	34	0-105	24
IP joint extension	4	0-45	20

MP = metacarpophalangeal. IP = interphalangeal.

*MP joint refers to proximal IP joint and IP joint refers to distal IP joint of transposed index digit.

ductor. After shortening, the extensor indicis proprius is resutured end to end to provide long extensor function, and the extensor indicis communis is attached to the proximal phalangeal base to provide long abductor function. The flexor tendons are not shortened but are allowed to correct on their own. After completion of intrinsic and extrinsic reconstruction, the skin flaps are sutured into position (Fig. 2).

Results

With the contralateral side used for comparison, patients with unilateral pollicization averaged 67% grip strength (range, 33% to 86%), 60% lateral pinch (range, 40% to 93%), 56% palmar pinch (range, 44% to 80%), and 39% three-point prehension (range, 25% to 53%).



Fig. 3. Manual dexterity was evaluated with the Perdue board after pollicization. Tip-to-tip pinch significantly improved efficiency.

Oppositional mobility results revealed that nine thumbs (64%) were able to oppose all the digits in a pulp-to-pulp manner and four (29%) were able to oppose all but one of the remaining digits. One thumb (7%) with severe radial clubhand was able to oppose only the adjacent digit. Maximum active range of motion was evaluated for abduction, adduction, flexion, and extension (Table II). Maximum abduction of the thumb was 62 degrees, and active adduction lacked 19 degrees from the neutral position. Active motion of the metacarpophalangeal joint was 8 to 85 degrees, and interphalangeal motion was 4 to 34 degrees. Radial clubhands treated with pollicization (four cases) demonstrated decreased motion in the majority of categories.

Manual dexterity was evaluated by having the patient place small circular rods into appropriate holes in a Perdue board within a specified time period.³ The patient was allowed to use only one hand and had to pick up individual circular rods one at a time (Fig. 3). The entire group of pollicized hands averaged 70% efficiency when compared with normative standards for age and sex (range, 38% to 121%), while radial clubhand extremities averaged 56% efficiency. However, 55% of the patients still used adjacent side-to-side pinch instead of tip-to-tip pinch when stressed to perform within a time limit on the Perdue board. When these patients were analyzed separately, those who continued to use side-to-side pinch averaged only 54% efficiency (range, 43% to 71%) whereas those who used tip-to-

tip pinch for manual dexterity averaged 93% (range, 76% to 121%).

Sensation in the pollicized digit was excellent in all patients, with an average two-point discrimination of 3 mm (range, 2 mm to 4 mm), and no patient demonstrated sensory impairment on physical examination. The average length of the pollicized digit measured 6 mm distal to the proximal interphalangeal joint of the next adjacent digit (range, -2 mm to 18 mm). When compared with the normal thumb length, which is just proximal to this joint, the excessive length detracted from the cosmetic appearance and normal contour of the hand. The cause of this additional length appeared on x-ray film analysis to be either incomplete ablation of the index metacarpal physis in young patients or inadequate bone resection in older patients.

Discussion

Pollicization involves a single-stage neurovascular pedicle transfer of the index digit to function as a thumb. This technique was initially described for posttraumatic thumb amputation.^{4,5} Littler,⁶ in 1953, extended this technique to children whose thumbs were congenitally absent or nonfunctioning. Children with congenital deficiency of the thumb usually have good use of their hands but lack pinch for optimum dexterity.

In this study, grip and pinch strengths of the pollicized hand were less than the contralateral hand. These differences reflect the difficulty of thumb reconstruction without appropriate intrinsic and extrinsic musculature.

Despite muscle transfers, the pollicized digit and hand will remain weaker than normal. No other methods of thumb restoration have directly measured strength; therefore our findings cannot be compared with those of other studies.

Many of our patients performed opposition pinch on request but opted for side-to-side pinch when stressed under time. Manske and McCarroll⁷ believe that patients will change their prehension technique only if the pollicized digit functions more effectively than their established presurgical pattern.

Our new thumb was longer than the normal thumb. This excessive length may result from the technical error of incomplete surgical ablation of the index metacarpal physis. Direct exposure of the physis with aggressive surgical ablation should prevent this excess length and prevent formation of a three-phalanx thumb with a shortened metacarpal.

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Congenital hypertrophy of the thenar eminence with accessory head of the abductor pollicis brevis in the forearm

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We treated a 16-year-old girl with idiopathic thenar hypertrophy. We have found only one other report of two cases that appear similar to ours—one in a 25-year-old man and the other in a 20-year-old woman.¹

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Received for publication June 1, 1990; accepted in revised form Jan. 17, 1992.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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3/1/36745

Case report

A 16-year-old girl was referred to one of us (T. S.) complaining of an enlarged left (nondominant) thenar eminence, which bruised easily. She first noted a problem in this area at the age of 13 when she was playing volleyball. The bruisability subsided during the off-season, but the enlargement persisted and increased, spreading proximally. The patient had a little bit of aching but denied any kind of trauma.

Examination revealed that the thenar eminence was soft, nontender, and quite enlarged, with a green-blue hue extending from the distal radius to the thumb metacarpophalangeal joint. There were no bruits, pulsations, or changes with elevation. The radial artery was displaced radially in the distal one fourth of the forearm. The extremity otherwise appeared quite normal. X-ray films and an arteriogram, including a venous phase, were normal. A CT scan showed only a soft tissue density. The studies seemed to preclude a possible