



Outcome of index finger pollicisation for the congenital absent or severely hypoplastic thumb

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Pollicisation of the index finger for absence or severe hypoplasia of the thumb has been reported as a good procedure to recreate a new "thumb" with good cosmesis and acceptable function. The purpose of this study is to evaluate the outcome of our series. Seventeen patients with 24 involved hands agreed to come back for evaluation. The mean age at operation was 12 months. In 8 hands there was also a radial club hand. Buck Gramcko's technique was used with slight modifications. The mean follow-up time was 53 months (range, 6-142 months). The outcome was determined in a variety of ways: objective assessment of function and cosmesis (measurement of thumb length, girth and nail size), and subjective evaluation of function and aspect done with a patient/parent questionnaire and a visual analogue score. The mean functional score was excellent for one hand, good for eleven, fair for five and poor for five. The mean length was 96%, the width was 93%, the nail width was 85% as compared with the contralateral thumb. There was no significantly different outcome in the syndrome-related thumbs versus the isolated cases, nor in unilateral versus bilateral cases. A significantly worse outcome was seen for function and subjective evaluation in the radial clubhand associated thumbs and for the functional score for the more severe Blauth group.

Keywords: index pollicisation; absent thumb; hypoplastic thumb.

INTRODUCTION

Pollicisation of the index finger for absence or severe hypoplasia of the thumb has been reported as

a good procedure to recreate a new "thumb" with good cosmesis and acceptable function. The original technique of Buck Gramcko (1-2) has been modified along the years (6,11,15) but is still the basis for all procedures. Except for the original author, most reported series have been limited in size, and the evaluation techniques have been different. The purpose of this study is to add our own series and to evaluate outcomes from different viewpoints. Function, cosmesis, subjective evaluation, patient's and surgeon's satisfaction were investigated and correlated with each other.

MATERIAL AND METHODS

Patients

From 1998 to 2007, pollicisation of the index finger was performed in 28 hands in 20 patients. Seventeen patients with 24 involved hands were willing to come back for evaluation: one patient (bilateral) lived abroad and preferred not to come, the two others were too involved in the care for their generalized problem and the

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parents did not wish to expose their child to too many examinations.

There were 10 boys and 7 girls, the mean age at operation was 12 months (range 5 to 54 months). There was bilateral hand involvement in 7, the left hand was involved in 4 cases, the right hand in 6 cases.

In 8 hands there was also a radial club hand. The thumb hypoplasia was part of a generalized syndrome in 10 cases: Holt-Oram in four, VACTERL in three, Fanconi in two patients and one non specified Mental Retardation (MR)/Multiple Congenital Anomalies (MCA) syndrome. Other non syndrome-related anomalies were present in two children: one congenital hip dysplasia (CDH), one cleft hand. Contralateral involvement, although to a lesser degree, was seen in two other children.

Operative technique

All operations were done by the same surgeon. Except for one patient, all children were operated before the age of 15 months. The surgical technique of Buck Gramcko was used with some minor modifications (1-3). The skin incisions used were those described in the textbook by Scheker & Cendales (15). Resection of the metacarpal and dissection of the various anatomical structures (veins, arteries, nerves, tendons and intrinsic muscles) were done according to the description in Buck Gramcko's technique. The metacarpal was rotated and fixed to the carpus (most often to the trapezoid) with a bone anchor (6). The intrinsic muscles were reinserted to balance the thumb. The extensor tendon was slightly shortened. The A1 pulley was incised. The skin was closed and a bulky dressing was applied in all cases for 3 weeks. Later on mobilisation was encouraged but physiotherapy was not prescribed.

Evaluation

The patients were evaluated by an independent examiner. The mean follow-up time was 53 months (ranging from 6 to 142). The outcome was determined in a variety of ways: objective functional assessment was done as proposed by Percival *et al* (13) (table I); cosmesis was objectivated with measurement of thumb length, girth and nail size according to Goldfarb *et al* (8). The subjective evaluation of function and aspect was done with a patient/parent questionnaire (table II). The patient's (or his caregiver's) satisfaction was expressed with a visual analogue score (VAS). The examiner's estimation was also measured with a VAS.

Table I. — Percival's assessment method

<i>Tip pinch</i>	
Strength (bulb manometer ; %)	
< 25	0
25 to 75	1
> 75	2
Accuracy (pin and coin)	
Unable	0
Difficulty	1
Ease	2
<i>Pulp pinch</i>	
Strength (bulb manometer ; %)	
< 75	0
> 75	1
Accuracy (key)	
Unable	0
Able	1
<i>Opposition</i>	
Middle	1
Ring	1
Little	1
<i>Grasp</i>	
Tennis-ball	1
Table-tennis ball	1
Strength > 75%	1
<i>Mobility</i>	
CMCJ	1
MPJ	1
IPJ	1
<i>Sensation (two-point ; mm)</i>	
< 5	3
5 to 10	2
> 10	1
<i>Cosmesis</i>	
Tip to within 0.5 mm PIPJ index	1
Position	
45 to 80° abduction	1
90 to 160° rotation	1
Appearance	1
<i>Scores</i>	
> 20	Excellent
16 to 19	Good
12 to 15	Fair
< 12	Poor

CMCJ : carpometacarpal joint ; MPJ : metacarpophalangeal joint ; IPJ : interphalangeal joints ; PIPJ : proximal interphalangeal joint.

Statistics

A t-test was used to differentiate between the different subgroups. The different outcomes were correlated with a Pearson correlation coefficient. Significance was set at $p < 0.05$.

Table II. — Questionnaire for subjective evaluation

General satisfaction
Recommend operation
Do strangers notice ?
Limitations in ADL's
Eating normal
Aesthetic aspect satisfying
Button shirt or coat
Writing
Different shape of hand satisfying
Normal sensitivity
Hair combing
Ashamed of the hand
Satisfied about function
Thumb looks normal
Picking up things
Enough force
Use this hand preferentially

RESULTS

The mean functional score according to Percival *et al* (13) for the whole group was 14.7 ; there were one excellent, eleven good, five fair and five poor results (table I). One patient with bilateral thumb aplasia was excluded due to the short follow-up (6 months). The subjective evaluation score was 65 (range 29 to 85). The VAS for the examiner ranged from 7 to 9 (mean 7.8) ; for the parents it ranged from 3 to 10 (mean 7.6). The mean length was 96% (SD 29.6, range 43 to 145) (normal value 71%). The width was 93% (SD 15.4, range 67 to 114), the nail width was 85% (SD 9.9, range 70 to 100) as compared with the contralateral thumb.

The outcomes were not significantly different in syndrome related thumbs versus isolated cases, nor

in unilateral versus bilateral cases. Since all patients were operated at a relatively young age, the age of operation did not make a significant difference in outcome.

A significantly different outcome was seen for function and subjective evaluation in the radial clubhand associated thumbs and for the functional score for the more severe Blauth group (table III). Patient/parent's estimation and examiner's subjective score, length, width and nail width were not significantly different between the different subgroups.

There was a significant correlation between the Percival score, the subjective questionnaire and the global evaluation of the surgeon and the patient/parent, but not with the objective description of the pollicised index (table IV).

DISCUSSION

Severe hypoplasia or absence of the thumb has important effect of the overall function of the hand, and the resulting impairment is great, also in children. Since Buck Gramcko's publication on index finger pollicisation (2), surgeons' attitude to this problem has changed dramatically. Despite some modification the basic principles remain unchanged : transposing the index finger on its neurovascular pedicle(s), skeletal readjustment, muscular stabilisation and rebalancing and a skin incision allowing to correct visualisation and creating a wide first web.

All these are necessary to create a functional and cosmetically acceptable thumb. Assessment of this function and the aspect are difficult, specially in

Table III. — Summary data according to the radial club hand (RCH) associated thumb anomaly or according to Blauth's classification

RAD CLUB	N	PERCIVAL	N	QUEST	VAS SURG	VAS FAM	LENGTH
No RCH	14	16.1 (3.36)	16	69.25 (11.4)	8 (0.89)	7.5 (1.89)	94.1 (24.43)
RCH	8	12.4 (3.74)	8	56.5 (16.0)	7.6 (1.06)	7.75 (2.25)	97.5 (38.5)
P Value		0.027*		0.034*	0.4	0.8	0.8
Blauth < 5	10	16.7 (2.3)	10	67 (8.9)	8 (0.91)	8.1 (1.03)	103 (15.5)
Blauth 5	12	12.5 (3.8)	14	63 (17.5)	7.7 (1.00)	7 (2.65)	85.7 (38.5)
P Value		0.005*		0.5	0.5	0.2	0.2



Fig. 1. — Measurements for objectivation of the appearance

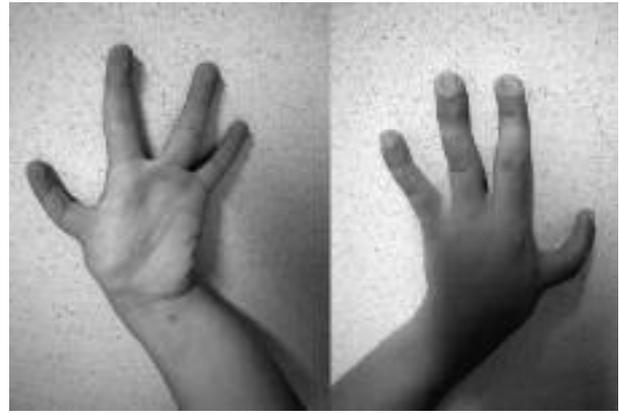


Fig. 2. — Example of excellent outcome

Table IV. — Correlation between different outcome measurements (* = significant $p < 0.01$)

QUESTIONNAIRE	0.87*			
VAS SURG	0.72*	0.81*		
VAS P&P	0.76*	0.72*	0.75*	
LENGTH	0.1	0.19	0.15	0.14
	PERCIVAL	QUESTIONNAIRE	VAS SURG	VAS P&P

younger children. The objective measurements are not always correlated to the patient's/parents' satisfaction.

We have chosen to highlight different aspects of the new thumb : function – cosmesis – satisfaction. In an ideal situation these should all be parallel to each other, but the reality however is different.

The reported series are few, most of them are small and the outcome parameters are very different between series, making comparative studies very difficult.

Egloff and Verdán (5) studied 14 cases, concentrating on sensibility, skin quality, mobility and possibility of opposition, and concluded that the procedure gave satisfactory results.

Manske and Carroll (11) reported one of the first series, which included forty pollicisations in 33 patients. The procedures were done at a relatively old age (5.5 years on average). Appearance improved, the thumb was used to grasp larger objects and could maintain smaller objects. A long

term outcome evaluation was done by Manske *et al* in 1992 (12). From their group of 28 hands, they concluded that mobility was 50% of the normal value, gripping force was 21%, pinch force was between 22 and 26% and handling of objects was 22% slower. The use of the thumb was normal or modified in 84% of 14 defined activities. Larger objects were easier to handle than smaller objects. Age of operation was not influencing the outcome. Radial club hands did more poorly than the other hands.

Roper & Turnbull (14) reviewed 9 cases, found good sensibility and a power grip of 63% and a pinch grip of 56% as compared with the contralateral side.

In 1991 Percival *et al* (13) established a method of assessment based on tip pinch, opposition, grasp, mobility, sensibility and aspect, all expressed in a numerical score. The same group (17) used this score for evaluation of their series of 30 pollicisations : 73% were graded good or excellent. In our series this is only 54%. They found better results in

Blauth groups III and IV compared to Blauth group V. This could be confirmed by our survey.

Kozin *et al* (10) had similar results in their 14 operated hands in 10 patients : 67% of gripping force, 60% key pinch force and 70% efficiency in manual dexterity.

Knabl *et al* (9) used a complex evaluation method to examine 6 patients with a pollicisation and found sensibility, strength and skill varying between 11 and 50%.

Foucher *et al* (6) were also disappointed with the reduced power of 27 pollicisations : 55% of normal pinch grip, despite the good sensibility, the growth and the high patient/parent satisfaction. They found that the new thumb was used in power grip but not for fine pinch. The surgeon's assessment was 6.5/10. In our series the surgeon's appreciation was higher, at 7.8. Based on these findings Foucher *et al* modified the technique of skin incision, fixation of the metacarpal head and balancing the muscles.

Staines *et al* (16) confirmed in their series of 10 children with 12 operated thumbs, the reduced gripping force. They also used a questionnaire and functional tests to further evaluate the results. Parents' satisfaction was high, handling small objects was difficult, the functional dexterity test was slower in operated hands, but the Jebsen hand function test was not different.

Goldfarb *et al* (8) reported an objectivation of the aesthetic outcome of the pollicised index fingers. They found in their series of 26 patients with 31 pollicisations an increased length (90% versus the normal 71% of normal controls) (in our series 96%). The VAS for the parent/patient was 7.3 (in our series 7.6) but was markedly less for the surgeon : 6.0 (in our series 7.8).

Goldfarb *et al* (7) and our group (4) studied the normal length of children's thumb. Goldfarb *et al* (8) demonstrated that most pollicised index fingers were too long, but this was the length recommended by Buck Gramcko (3). To aim at the level of the PIP of the middle finger seems inappropriate, and more shortening of the index finger should perhaps be purchased if this does not compromise function, as suggested by Goldfarb *et al* (8).

This series confirms most of findings of previous studies : the aspect and function is usually judged

satisfactory, the length is excessive, radial club hands and thumb aplasia have poorer outcome. We found a good correlation between different outcome evaluations, meaning that function and subjective evaluation are parallel, but that excessive length does not seem to be that important.

REFERENCES

1. **Buck-Gramcko D.** [Pollicisation of the index finger in aplasia and hypoplasia of the thumb. Indications, methods, results.] (in German). *Handchir* 1971 ; 3 : 45-59.
2. **Buck-Gramcko D.** Pollicisation of the index finger. Method and results in aplasia and hypoplasia of the thumb. *J Bone Joint Surg* 1971 ; 53-A : 1605-1617.
3. **Buck-Gramcko D.** Pollicisation. In : *Congenital Malformations of the Hand and Forearm*. Buck-Gramcko D. (Ed). Churchill Livingstone, London, 1998, pp 379-402.
4. **Decramer A, De Smet L.** Clinical measurement of normal thumb length in children. *J Pediatr Orthop* 2007 ; 16-B : 66-69.
5. **Egloff D, Verdan C.** Pollicisation of the index finger for reconstruction of the congenital hypoplastic or absent thumb. *J Hand Surg* 1983 ; 8 : 839-848.
6. **Foucher G, Medina J, Lorea P, Pivato G, Szabó Z.** Pollicisation in congenital differences. *Handchir Mikrochir Plast Chir* 2004 ; 36 : 146-151.
7. **Goldfarb CA, Gee AO, Heinze LK, Manske PR.** Normative values for thumb length, girth, and width in the pediatric population. *J Hand Surg* 2005 ; 30-A : 1004-1008.
8. **Goldfarb CA, Deardorff V, Chia B, Meander A, Manske PR.** Objective features and aesthetic outcome of pollicised digits compared with normal thumbs. *J Hand Surg* 2007 ; 32-A : 1031-1036.
9. **Knabl JS, Maitz PK, Deutinger M, Millesi H, Meissl G.** [Analysis of hand function with the Millesi examination scale in patients with pollicisation after aplasia or hypoplasia of the thumb]. (in German). *Handchir Mikrochir Plast Chir* 1998 ; 30 : 317-324.
10. **Kozin SH, Weiss AA, Webber JB et al.** Index finger pollicisation for congenital aplasia or hypoplasia of the thumb. *J Hand Surg* 1992 ; 17-A : 880-884.
11. **Manske PR, McCarroll HR Jr.** Index finger pollicisation for a congenitally absent or nonfunctioning thumb. *J Hand Surg* 1985 ; 10-A : 606-613.
12. **Manske PR, Rotman MB, Dailey LA.** Long-term functional results after pollicisation for the congenitally deficient thumb. *J Hand Surg* 1992 ; 17-A : 1064-1072.
13. **Percival NJ, Sykes PJ, Chandraprakasam T.** A method of assessment of pollicisation. *J Hand Surg* 1991 ; 16-B : 141-143.
14. **Roper BA, Turnbull TJ.** Functional assessment after pollicisation. *J Hand Surg* 1986 ; 11-B : 399-403.

- 15. Scheker L, Cendales L.** Correcting congenital thumb anomalies in children : opponensplasty and pollicisation. In : Gupta A, Kay S, Scheker L (ed). *The Growing Hand*. Mosby, London, 2000, pp 171-182.
- 16. Staines KG, Majzoub R, Thornby J, Netscher DT.** Functional outcome for children with thumb aplasia undergoing pollicisation. *Plast Reconstr Surg* 2005 ; 116 : 1314-1323.
- 17. Sykes PJ, Chandraprakasam T, Percival NJ.** Pollicisation of the index finger in congenital anomalies. A retrospective analysis. *J Hand Surg* 1991 ; 16-B : 144-147.