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Thumb Tip Injuries: Meta-Analysis of Different Reconstruction Options

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ABSTRACT

Background: Thumb tip and pulp defects might cause serious morbidity for the patient. Loss of the highly specialised and sensate pulp can have a major impact on overall hand function in addition to the cosmetic abnormality.

Objective: To highlight the functional, aesthetic outcomes and postoperative complication for these surgical techniques in the treatment of thumb tip injuries.

Material and Methods: A comprehensive search of the literature via electronic databases including Pub Med/ Medline, Cochrane, Web of Science and Google Scholar. An initial search was carried out using keywords: Thumb tip injury, thumb tip amputation, Surgical flaps and Reconstruction. Studies of different modalities were analyzed and compared regarding the aesthetic outcome, sensory outcome, range of motion and rate of complications. Hand surgeons were contacted to help identifying other published and unpublished relevant studies.

Results: The main point strength in the current study is that we have systematically analyzed a wide range of local and regional thumb tip reconstruction options.

Conclusion: Local and regional options are comparable in terms of sensory, motor, and aesthetic scores, patient satisfaction. However local options are associated with significantly higher complication rates.

Key Words: *Thumb tip injuries – Surgical flaps – Thumb Reconstruction – Thumb tip amputation.*

Disclosure: No Conflict of interest.

Ethical Committee Approval: Approved by The Ethical Committee of Ain Shams Faculty of Medicine.

INTRODUCTION

Since the 1960s, numerous studies have discussed various reconstructive techniques, including secondary healing, local and regional flaps, micro vascular replantation, and toe pulp free flaps **[1]**.

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The final choice for the type of repair depends on the patient's specific defect, the mechanism of injury, age, functional needs, and goals. The range of possibilities is fairly broad. However, most would concur that the secret to success is obtaining sensate coverage of the fingertip while preserving freedom of motion **[2]**.

PATIENTS AND METHODS

Criteria for considering studies for the review:

The meta-analysis was restricted to clinical studies of these surgical techniques in the treatment of thumb tip injuries. We reviewed studies that include management of thump tip injuries with these different surgical techniques. The study compared different surgical techniques in management of thumb tip injuries. Aesthetic outcome, sensory outcome, range of motion and occurrence of complications such as: Cold intolerance, flexion contracture, infection and wound dehiscence.

Inclusion criteria:

Studies from any geographical location and English was the language of the selected studies that written between 2002 and 2022.

Study design:

Comparative (randomized or non-randomized), prospective or retrospective studies.

Population:

Humans with a thumb tip injury.

Intervention:

Possible surgical techniques regarding reconstruction ladder.

Exclusion criteria:

Non-English language, study with incomplete data or duplication, papers not published in a peer reviewed journal and published abstracts.

Search strategy for identification of studies:

A comprehensive search of the literature via electronic databases including PubMed/Medline, Cochrane, Web of Science and Google Scholar. An initial search will be carried out using keywords: “thumb tip injury”, “thumb tip amputation”, “Surgical flaps” and “Reconstruction”. Studies of different modalities will be analysed and compared regarding the aesthetic outcome, sensory outcome, range of motion and rate of complications. Hand surgeons may be contacted to help identifying other published and unpublished relevant studies.

Methods of the review:

Data extraction:

Two researchers independently assessed each included study to extract pertinent details such as the first author, publication year, origin region of the study, sample size, and outcome measures (operation time, length of hospital stay, postoperative infection, the incidence of postoperative complications).

Statistical considerations:

The outcomes from the included trials were combined using the Review Manager software. The reasons of the heterogeneity for studies will be explored. For studies which didn't report standard deviation (SD) separately, SD was estimated from the mean and range using the statistical estimation methods described by Wan et al., **[3]**.

RESULTS

In the present study, we searched Medline via PubMed, SCOPUS, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL), and Science Direct from their inception till April 2022. The search retrieved 311 unique records. We then retained 94 potentially eligible records for full-texts screening. Finally, 25 studies (No. of patients = 594 patients) were included (Fig. 1).

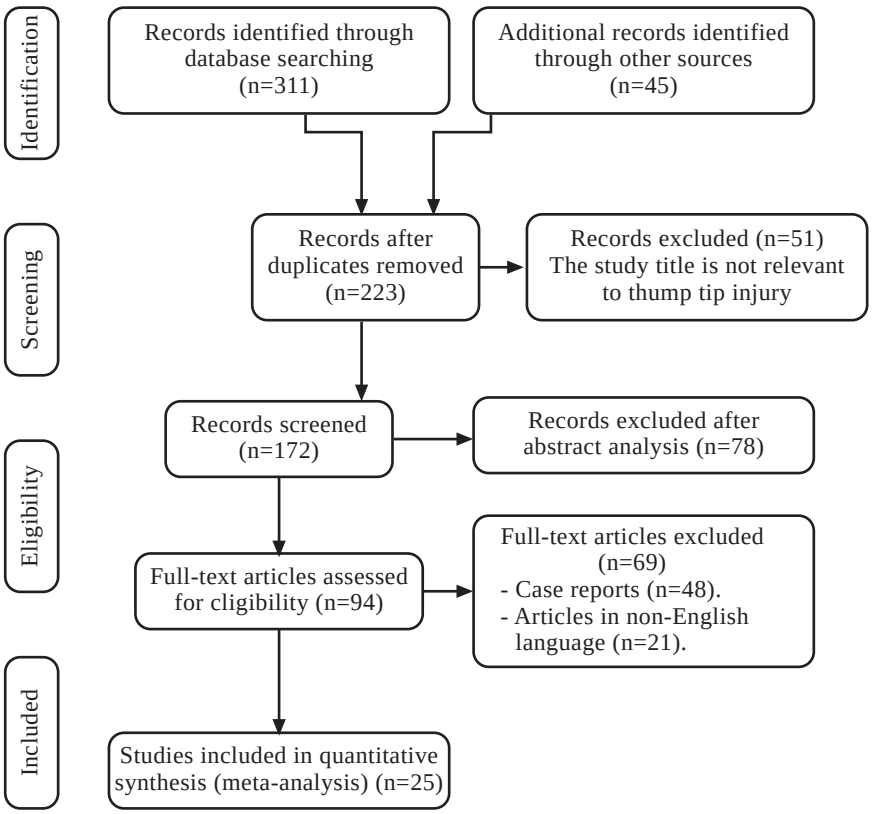

Fig. (1): Study flow chart.

Table (1): Clinical characteristics of the include studies (N=25).

Author	Year	N†	Country	Age †† (years)	Male	Flap	Category A	Category B	Flap Size	Follow-up††† (Months)
Balan	2016	7	India	30.86±12.03	7	Free toe pulp flap	Free	Free	2 x 1 to 4 x 2 cm	9
Satish and Nema	2009	9	India	28±10.2	8	First dorsal metacarpal artery islanded flap	Heterodigital	Regional	2 x 1.5 cm to 5 x 3 cm	24
Moschella and Cordova	2006	16	Italy	55.1±18.6	12	Reverse Homodigital Dorsal Radial Flap/Reverse Homodigital Dorsal Radial Flap of the Thumb	Homodigital	Local	2 x 2 cm to 5 x 4 cm	NR
Adani et al.	2019	24	Italy	36.5±12.7	21	Modified Heterodigital Neurovascular Island Flap	Heterodigital	Regional	2 x 2 cm to 6.5 x 4 cm	18
Wang et al.	2016	25	China	35±10	16	First dorsal metacarpal artery flap	Heterodigital	Regional	1.8 x 2.0-2.8 x 3.5	24
Toros et al.	2018	17	Turkey	29.8±13.2	17	Modified Heterodigital Neurovascular Island Flap	Heterodigital	Regional	NR	24
Horta et al.	2009	107	Portugal	NR	78	Moberg/Cross finger flaps	Homo/ Heterodigital	Local/ Regional	NR	NR
Chitta et al.	2020	10	India	31.5±12.5	9	Cross-finger Flap	Heterodigital	Regional	3.8 to 10 cm^2	1
Han et al.	2013	8	China	NR	6	Reverse homodigital dorsoplantar thumb flap	Homodigital	Local	1.5 X 1.5 to 2.5 X 2 cm.	8
Chi et al.	2018	18	China	34.1±10.4	12	First dorsal metacarpal artery flap	Heterodigital	Regional	NR	10
Zhao et al.	2016	51	China	32.2±7.6	35	First dorsal metacarpal artery flap	Heterodigital	Regional	NR	23
Zhang et al.	2009	9	China	33.2±10.9	6	Second Dorsal Metacarpal Artery Flap	Heterodigital	Regional	3.5 X 3.0 cm to 3.0 X 3.5 cm.	26
Chen et al.	2010	11	China	30.3±8.7	8	First Dorsal Metacarpal Artery Flap	Heterodigital	Regional	2.7 X 2.2 cm to 4.8 X 2.1 cm	32
Yang et al.	2017	6	China	25.5±8.6	5	Anterograde Homodigital Neurovascular Island flap	Homodigital	Local	NR	4
Checcucci et al.	2014	5	Italy	32±8.8	5	First dorsal metacarpal artery flap	Heterodigital	Regional	2.0 x 1.3 to 2.5 x 1.6 cm	12
Feng et al.	2017	121	China	34.5±10.6	82	First Dorsal Metacarpal Artery Flaps	Heterodigital	Regional	2.5 x 2.2 cm to 4.6 x 3.3 cm	25.3
Bao et al.	2014	8	China	27.8±14	5	Reverse Homodigital Dorsoradial Flap	Homodigital	Local	1.0 x 1.6 cm to 3.0 x 4.2 cm.	8.5
Sun et al.	2015	19	China	40.7±14.4	18	Reverse Dorsoradial Flaps	Homodigital	Local	2.0 x 1.5-5.5 x 3.0 cm	39.2
Elliot et al.	2003	3	UK	34.3±23.5	2	Homodigital switch flap of the thumb	Homodigital	Local	NR	63
Qin et al.	2020	42	China	45.6±13.6	35	Reverse Dorsoradial flap	Homodigital	Local	NR	13
Couceiro et al.	2014	10	Spain	47.5±13.8	7	First dorsal metacarpal artery flap	Heterodigital	Regional	NR	5.4
Delikonstantinou et al.	2011	14	Greece	52±15.6	14	First dorsal metacarpal artery flap/ Modified Heterodigital Neurovascular Island Flap	Heterodigital	Regional	12 X 18 mm to 20 X 40 mm.	21
Woon et al.	2008	30	Singapore	42±12	27	Cross-finger Flap	Heterodigital	Regional	NR	4.4
Erken et al.	2015	12	Turkey	33.4±13.2	12	Cross-finger Flap	Heterodigital	Regional	NR	28
Mutaf et al.	2012	12	Turkey	27.41±11.54	7	Moberg Flap	Homodigital	Local	Length between 1.8-3.5 cm	48

† Total sample size of the study population.
†† Reported as Mean ± SD. For studies which didn't report standard deviation (SD) separately, SD was estimated from the mean and range using the statistical estimation methods described by Wan et al. (2016).
†† Reported as mean/median follow up duration.

Table (2): Clinical characteristics of the include studies (N=25).

Author	Mechanism of Injury	Objective
Balan	Crush injury N=5 Correction of finger deformity N=2	Sensory outcome Aesthetic outcome Postoperative complications (cold intolerance + Venous congestion + flap loss)
Satish and Nema	Avulsion injury	Sensory outcome Postoperative complications (necrosis of the flap)
Moschella and Cordova	Tumor excision N=8 Avulsion injury N=5 Painful scar needing reconstruction N=2 Burn lesion N=1	Sensory outcome Postoperative complications (necrosis and Venous congestion flap)
Adani et al.	No mentioned	Postoperative complications (Vascular complications + cold intolerance + wound dehiscence)
Wang et al.	Avulsion injury=11 Crush injury N=9	Sensory outcome Range of motion Postoperative complications (cold intolerance)
Toros et al.	Avulsion imputation	Sensory outcome Aesthetic outcome Range of motion Postoperative complications (cold intolerance + Venous congestion)
Horta et al.	Work related trauma or domestic accident	Sensory outcome Postoperative complications (flap necrosis and cold intolerance)
Chitta et al.	Not mentioned	Range of motion Postoperative complications (flap detachment + stiffness over the operated hand)
Han et al.	Crush with imputation N=6 Avulsion imputation N=2	Sensory outcome
Chi et al.	Sharp cut N=6 Avulsion imputation N=8 Crush injury N=4	Sensory outcome Range of motion Aesthetic outcome
Zhao et al.	Avulsion and Crush injury	Sensory outcome
Zhang et al.	Avulsion injury N=6 Crush injury N=3	Sensory outcome Range of motion Postoperative complications (cold intolerance + Venous congestion)
Chen et al.	Avulsion injury N=6 Crush injury N=5	Sensory outcome Range of motion Aesthetic outcome Postoperative complications (cold intolerance)
Yang et al.	Injury by machines	Postoperative complications
Checcucci et al.	Avulsion injury N=1 Crush injury N=4	Sensory outcome Range of motion
Feng et al.	Not mentioned	Sensory outcome Postoperative complications (cold intolerance)
Bao et al.	Traumatic injury (Crushing or sawing machine) N= 4 Thumb infection N=1 Tumor excision N=2	Sensory outcome Range of motion Postoperative complications (Venous congestion)
Sun et al.	Avulsion injury N=5 Crush injury N=13 Explosion N=1	Sensory outcome Range of motion Postoperative complications (cold intolerance and hypersensitivity)
Elliot et al.	Crush injury N=2 Dog bite N=1	Sensory outcome
Qin et al.	Crush injury N=22 Avulsion injury N=12 Sharp laceration N=8	Aesthetic outcome Sensory outcome Range of motion Postoperative complications (Venous congestion)
Couceiro et al.	Not mentioned	Sensory outcome Range of motion Postoperative complications (cold intolerance + flap congestion + flap necrosis)
Delikonstantinou et al.	Work related injury	Sensory outcome Range of motion
Woon et al.	Traumatic injury (crush and Avulsion injury) N=23 Infection (felon and pulp abscess) N=7	Sensory outcome Range of motion Postoperative complications (flap necrosis + cold intolerance + hypersensitivity)
Erken et al.	Not mentioned	Sensory outcome Range of motion Postoperative complications (cold intolerance + hypersensitivity)
Mutaf et al.	Traumatic injury (crush and Avulsion injury)	Sensory outcome Range of motion Postoperative complications (cold intolerance + hypersensitivity)

1- Assessment of sensory outcomes:

A- *Static 2-point discrimination test (2-PD test):*

Twenty-one studies reported 2-point discrimination test results following the surgical treatment of thumb tip injury. The pooled analysis of the mean post-surgical 2-PD test was 7.19 (95% CI 6.09-8.28%). A heterogeneity test revealed that the heterogeneity across the included studies was 99% (p<0.001), therefore a random effect model was employed.

Thirteen studies reported 2-point discrimination test results following the regional reconstruction of thumb tip injury. The pooled analysis of the mean post-surgical 2-PD test was 6.42 (95% CI 5.12-7.72%).

A heterogeneity test revealed that the heterogeneity across the included studies was 99% (p< 0.001), therefore a random effect model was employed.

Six studies reported 2-point discrimination test results following the local reconstruction of thumb tip injury. The pooled analysis of the mean post-surgical 2-PD test was 8.35 (95% CI 5.92-10.77%). A heterogeneity test revealed that the heterogeneity across the included studies was 97% (p<0.001), therefore a random effect model was employed.

The funnel plot and Egger's test (p=0.11), which were used in the examination of publication bias, showed that there was no discernible publication bias.

B- *Semmes-Weinstein monofilament test (SMW test):*

Nine studies reported Semmes-Weinstein monofilament (SMW) test results following the surgical treatment of thumb tip injury. The pooled analysis of the mean post-surgical SMW test was 3.48 (95% CI 2.65-4.31). A heterogeneity test revealed that the heterogeneity across the included studies was 98% (p<0.001), therefore a random effect model was employed.

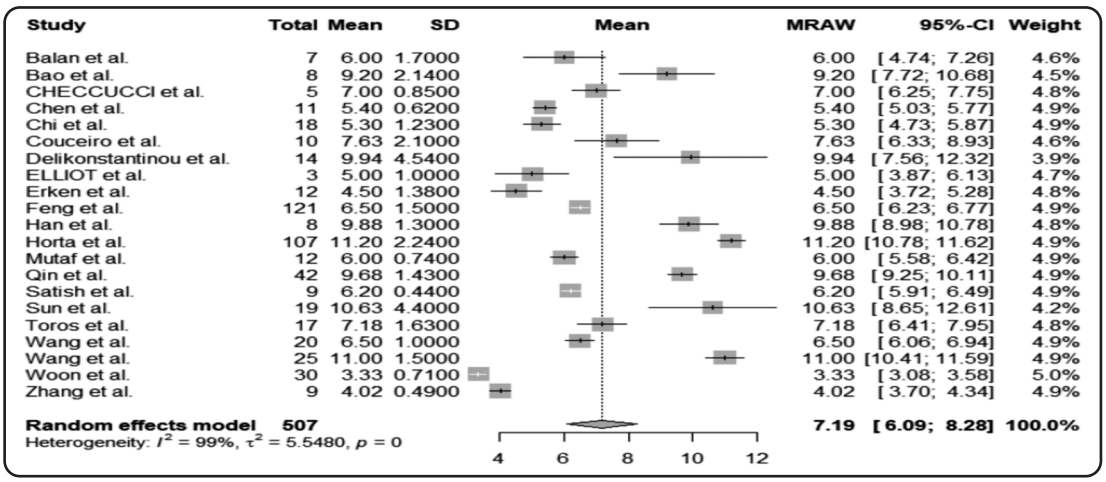

Fig. (2): Forest plot of pooled mean static 2-point discrimination (PD) test in candidates of surgical reconstruction of thumb tip injury.

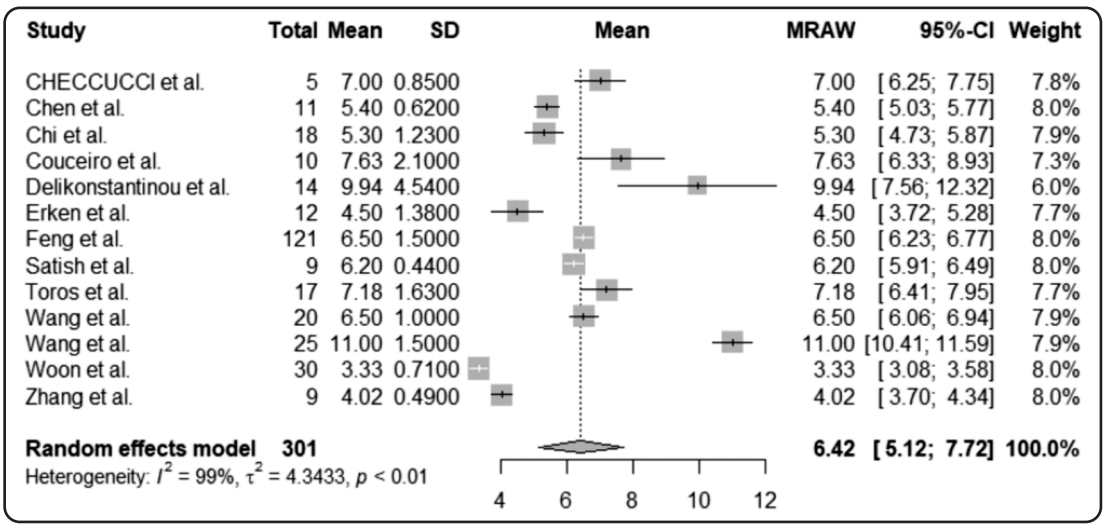

Fig. (3): Forest plot of pooled mean static 2-point discrimination (PD) test in candidates of regional reconstruction of thumb tip injury.

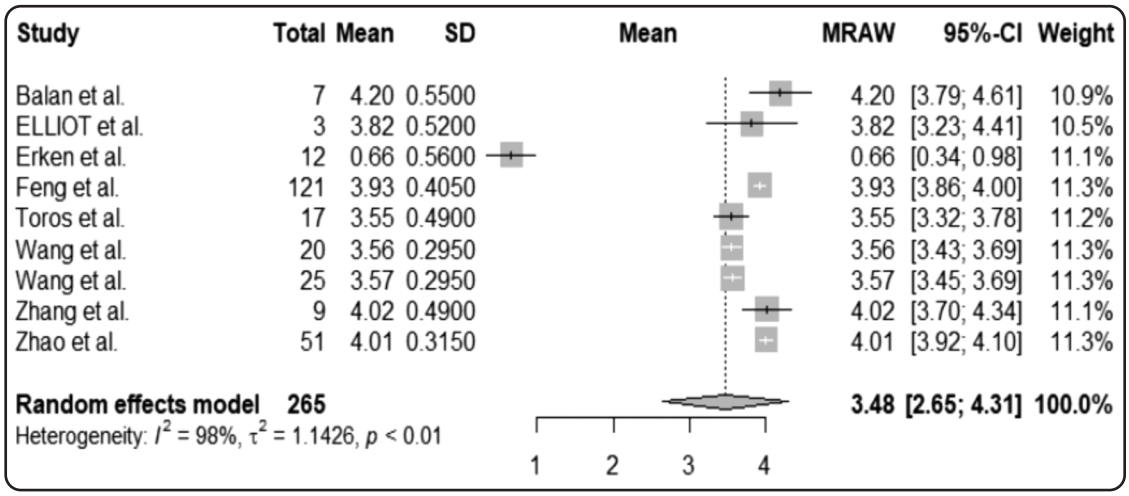

Fig. (4): Forest plot of pooled mean Semmes-Weinstein monofilament (SWM) test in candidates of reconstruction of thumb tip injury.

Seven studies reported Semmes-Weinstein monofilament (SMW) test results following the regional reconstruction of thumb tip injury. The pooled analysis of the mean post-surgical SMW test was 3.33 (95% CI 2.23-4.43). A heterogeneity test revealed that the heterogeneity across the included studies was 99% (p<0.001), therefore a random effect model was employed.

One study reported Semmes-Weinstein monofilament (SMW) test results following the local reconstruction of thumb tip injury. The mean post-surgical SMW test was 3.82 (95% CI 3.23-4.41). A heterogeneity test was not performed due to the inclusion of the results of only one study.

Assessment of complications:

Twenty-four studies reported post-surgical complications following the surgical reconstruction of thumb tip injury. The reported complications included venous congestion, necrosis, or moderate-severe cold intolerance. The pooled analysis of the post-surgical complication rate was 5.90% (95% CI 4.23-8.19%). A heterogeneity test revealed that the heterogeneity across the included studies was 0% (p=0.91), therefore a fixed effect model was employed.

Fourteen studies reported post-surgical complications following the regional reconstruction of thumb tip injury. The reported complications included venous congestion, necrosis, or moderate-severe cold intolerance. The pooled analysis of the post-surgical complication rate with regional reconstruction was 4.83% (95% CI 2.98-7.74%). A heterogeneity test revealed that the heterogeneity across the included studies was 0% (p=0.93), therefore a fixed effect model was employed.

Eight studies reported post-surgical complications following the local reconstruction of thumb tip injury. The reported complications included venous congestion, necrosis, or moderate-severe cold intolerance. The pooled analysis of the post-surgical complication rate with local reconstruction was 13.16% (95% CI 8.09-20.68%). A heterogeneity test revealed that the heterogeneity across the included studies was 0% (p=0.38), therefore a fixed effect model was employed.

Assessment of the motor outcomes:

Meta carpophalangeal joint (MCP) range of motion:

Nine studies reported post-surgical range of motion (ROM) of the meta carpophalangeal (MCP) joint of the thumb following the surgical reconstruction of the thumb tip injury. The pooled analysis of the MCP ROM was 72.27° (95% CI 53.08-91.46°). A heterogeneity test revealed that the heterogeneity across the included studies was 100% (p<0.001), therefore a random effect model was employed.

Following localised restoration of the thumb tip damage, six studies examined the range of motion (ROM) of the thumb's metacarpophalangeal (MCP) joint after surgery. The MCP ROM's combined analysis came out at 77.20° (95% CI 45.92-108.48°). A random effect model was used since a heterogeneity test indicated that there was 100% heterogeneity among the included studies (p 0.001).

Three studies examined the range of motion (ROM) of the thumb's metacarpophalangeal (MCP) joint after local repair of the injured thumb tip. The MCP ROM's pooled analysis came up at 62.72° (95% CI: 46.10-79.34°). A random effect model was used since a heterogeneity test indicated that 87% of the included studies were heterogeneous (p 0.001).

Inter phalangeal (IP) range of motion:

After the surgical reconstruction of the thumb tip injury, seven investigations documented the post-surgical range of motion (ROM) of the thumb's interphalangeal (IP) joint.

The IP ROM's pooled analysis came out at 70.41° (95% CI: 56.66-84.16°). A random effect model was used since a heterogeneity test showed that the heterogeneity among the included studies was 99% (*p* 0.001). Following the regional reconstruction of the thumb tip damage, four investigations reported on the interphalangeal joint of the thumb's post-surgical range of motion (ROM). The IP ROM's combined study came out at 66.08° (95% CI: 38.92-93.24°). A random effect model was used since a heterogeneity test showed that the heterogeneity among the included studies was 97% (*p* 0.001).

Following the local restoration of the thumb tip damage, three investigations reported on the post-surgical range of motion (ROM) of the inter-phalangeal (IP) joint of the thumb. The IP ROM's pooled analysis resulted in a 75.80° (95% CI 45.21-106.39°) reading. A random effect model was used since a heterogeneity test showed that the heterogeneity among the included studies was 99% (*p*0.001).

2- *Assessment of aesthetic outcomes:*

Three studies reported post-surgical aesthetic/cosmetic scores following the local reconstruction of the thumb tip injury. Chi et al., **[4]** reported the cosmetic score out of 10 as an independent post-surgical outcome. Alternatively, Chitta et al., **[5]** and Chen et al., **[6]** reported aesthetic scores asa part of post-surgical MHQ assessment. To allow for pooling of the score, all scores were standardized to be of a total of 100. The pooled analysis of aesthetic/cosmetic scores was 83.39 (95% CI 80.39-86.89). A heterogeneity test revealed that the heterogeneity across the included studies was 52% (*p*=0.13), therefore a fixed effects model was employed.

Risk of bias assessment:

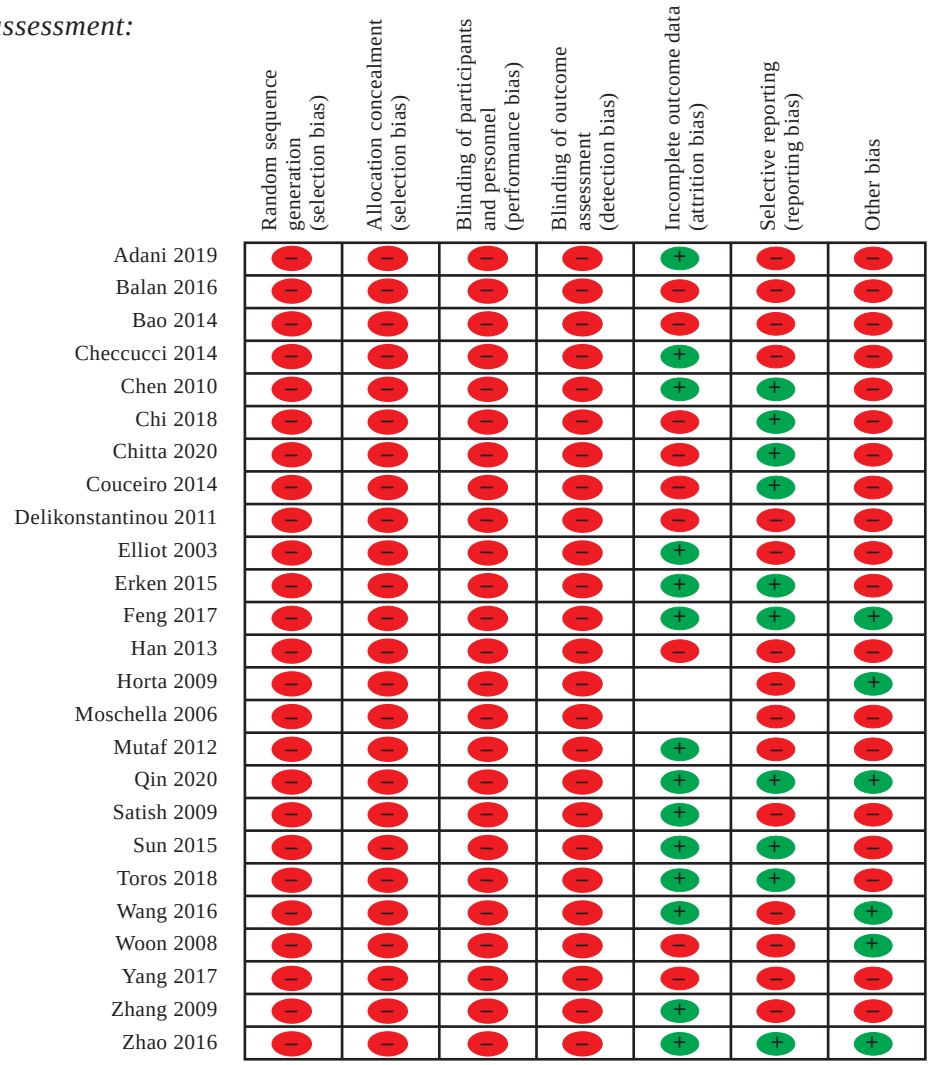

Fig. (5): Risk of bias summary for the studies assessing the surgical reconstruction of thumb tip injury.

3- *Assessment of patient satisfaction:*

Ten studies reported post-surgical patient satisfaction scores assessed using Michigan Hand Outcomes Questionnaire (MHQ) following the reconstruction of the thumb tip injury. To allow for pooling of the score, all scores were standardized to be of a total of 100. The pooled analysis of patient satisfaction scores was 87.26 (95% CI 82.85-91.68). A heterogeneity test revealed that the heterogeneity across the included studies was 52% (p<0.01), therefore a random effects model was employed.

Comparing outcomes from regional vs local reconstruction options:

Based on the current evidence of studies assessing the outcomes of reconstruction of thumb tip injuries, local and regional reconstruction options demonstrated comparable sensory outcomes in terms of 2PD test (p=0.097) and SWM test (p=0.722), MCP ROM (p=0.437), IP ROM (p=0.449), patient satisfaction scores (p=0.602). Nevertheless, local reconstruction options were associated with significantly higher rate of complications compared to regional reconstruction options (13.16% vs. 4.83%, p=0.004). A visual summary of the synthesized evidence is provided in Table (3).

Table (3): Comparing summary data estimated using the pooled data from regional vs local surgical reconstruction of thumb injury.

Outcome	Number of studies	Number of patients	Regional reconstruction	Local reconstruction	*p*-value
2 PD test	19	392	6.42 (5.12-7.72)	8.35 (5.92-10.77)	0.097 (NS) †
SWM test	8	258	3.33 (2.23-4.43)	3.82 (3.23-4.41)	0.722(NS) †
Complications	22	445	4.83 (2.98-7.74)	13.16 (8.09-20.68)	0.004 (S)††
MCP-ROM	9	170	77.20 (45.92-108.48)	62.72 (46.10-79.34)	0.437 (NS) †
IP-ROM	7	140	66.08 (38.92-93.24)	75.80 (45.21-106.39)	0.449 (NS) †
Aesthetic/cosmetic score	3	39	83.64 (80.39-86.89)		NA
Patient satisfaction	9	260	87.86 (82.70-93.03)	84.77 (-23.23-192.77)	0.602 (NS) †

† Estimated using meta-regression technique.
†† Estimated using Fischer exact test.

Table (4): Summary of the available evidence comparing the outcomes of regional vs. local reconstruction options of thumb tip injuries.

Reconstruction option/outcome	Sensory outcomes	Motor outcomes	Complication rate	Aesthetic outcomes	Patient satisfaction
Regional					
Local					

High risk | Neutral risk | Low risk

DISCUSSION

The thumb performs more than 40% of all hand functions, making it the most significant digit in the hand **[7]**. Due to differing functional requirements, reconstruction of thumb injuries is different from analogous reconstruction of finger injuries. The surgical goals of a thumb reconstruction should include covering exposed bone and tendon with soft tissue, creating a soft, sensitive, conforming surface with an aesthetically pleasing, rounded profile, preserving the essential thumb length and functional opposition, and eliminating any residual stiffness in the interphalangeal joint **[8]**.

In the current meta-analysis, twenty-five studies with a total of 610 patients who underwent surgical reconstruction for thumb tip injuries using homodigital or heterodigital reconstruction options were included with the aim to assess sensory, motor, aesthetic outcomes, postoperative complications, and patient satisfaction for different variations of local and regional reconstruction options.

The analysis of baseline clinical and demographic characteristics of the included studies demonstrated apparent trends. The majority of the studies were performed in China (11 studies, 44%). Most of the included patients were males (454

patients, 74.4%). The average mean age of the included patients ranged between 25.5 to 52 years.

One of the main objectives of thumb reconstruction is to produce a sensate, non-tender thumb tip **[9]**.

In the current meta-analysis, post-surgical sensory outcomes were assessed using 2PD and SMW tests. The overall mean of 2PD test for the assessed studies was 7.19mm. Despite the lack of statistically significant differences between local vs regional reconstruction (p=0.097), we found a trend toward a higher mean 2PD test in local vs regional options (mean 2PD test 8.35, 6.42, respectively). Based on these findings, the Modified American Society for Surgery of the Hand Guidelines for Stratification of 2PD give a favourable assessment of sensory recovery **[10]**.

According to the updated American Society for Surgery of the Hand standards, 2PD scores are divided into four categories: Excellent, 6mm; good, 6-10mm; fair, 11-15mm; and poor, >15mm. We hypothesize that the slightly better sensory outcomes associated with regional reconstruction options is primarily related to the advancement of innervation techniques to the heterodigital flaps. For instance, Liu et al., **[11]** demonstrated mean 2PD scores as low as 5.3mm following an innervated heterodigital flaps for thumb tip reconstruction.

Through the current meta-analysis, patient satisfaction following the thumb tip reconstruction was estimated by pooling the results of MHQ satisfaction domain and satisfaction assessed by Likert scale after normalizing to 100 points to allow for pooling the reported means of the individual studies.

The current estimates of patient satisfaction through the current meta-analysis should be interpreted with great caution for many reasons. First, the degree of satisfaction is confounded by the percent of females in the individual studies. For instance, Couceiro et al., **[12]** compared 5 cases of Holevich type flaps vs. 5 cases of Foucher flaps.

Second, many studies utilized subjective assessment of patient satisfaction using a subjective and non-validated Likert scale from 0-5 (0=poor, 5=excellent), which may adversely affect the validity and reliability of their results **[13,14,15]**.

Third, the majority of the included studies for heterodigital reconstruction options applied first dorsal metacarpal artery flap (9 studies, 56.25%). This flap has an advantage of wide arc of rotation, This makes it simple to restore thumb distal pulp deficiencies. Additionally, the flap's blood supply is extremely dependable, its available size is sufficient, and donor site morbidity is minimal. One year following surgery, Frequently, total cortical reorientation is achieved (compared with incomplete cortical reorientation in the littler neurovascular flap) **[16]**.

It is still unclear whether the concluded good to excellent satisfaction with heterodigital reconstruction is due to the predominance of first dorsal metacarpal artery flaps in the included studies or this pattern of satisfaction is truly maintained with other heterodigital reconstruction options.

The main point strength in the current study is that we have systematically analyzed a wide range of local and regional thumb tip reconstruction options. To the best of our knowledge, this analysis is the first meta-analysis to perform a head-to-head comparison of the current local vs regional reconstruction strategies. However, several limitations do exist.

First, a relatively large unexplained variability in the estimated effect sizes of the studied outcomes as demonstrated by I^2 which ranged between 0-100% through our analysis. The inclusion of many different variations of reconstruction options, different geographical areas, and a wide time frame of the included studies could explain the significant heterogeneity attained for the pooled effect sizes. However, the inclusion of such a wide range of studies could not be avoided due to the very low sample size adopted in each of the included studies (most of the included studies utilized a sample size between 3-27 patients).

The low sample size of the individual studies is associated with higher standard errors of the estimated effect sizes; which means lower reliability of the results **[17]**. Therefore, we included a relatively large number of studies in order to compensate for the limited sample size per individual study, to improve the reliability of our results. Another limitation of the current analysis is the significant risk of bias. This is attributed to the fact that all of the included studies were either a case series, observational cohort, or cross-sectional studies and none of them was a randomized controlled trial, and this entails a significant risk of selection, performance, and detection biases.

Conclusion:

Local and regional options are comparable in terms of sensory, motor, and aesthetic scores, patient satisfaction. However local options are associated with significantly higher complication rates.

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