의학석사 학위논문

수부 다지증 환자에서 Modified Wassel-Flatt 분류의 결과

Outcomes of radial polydactyly according to the modified Wassel-Flatt classification

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이 논문을 의학석사 학위논문으로 제출함

2024 년 8 월

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영문요약

Purpose

Radial polydactyly is a common congenital hand anomaly. Traditionally, the Wassel-Flatt classification has been used to categorize radial polydactyly based on radiographic skeletal duplication. However, its limitations in guiding effective surgical interventions and predicting outcomes have led to proposals for a modified Wassel-Flatt classification. This study aimed to evaluate our modified Wassel-Flatt classification in terms of surgical planning and clinical outcome and to compare hypoplastic and non-hypoplastic types.

Methods

This retrospective study was conducted at a single center and reviewed medical records of 211 patients with 223 thumbs treated for radial polydactyly between October 2017 and November 2022. Demographics, surgical procedures, and clinical outcomes such as JSSH score and caregiver's satisfaction score were reviewed. Patients were classified using the modified Wassel-Flatt classification. Comparisons were made between the hypoplastic and non-hypoplastic types (type II-VII), within hypoplastic category between hypoplastic proximal (HP) type and hypoplastic distal (HD) type, and among the non-hypoplastic types.

Results

Simple excision was feasible only for the HP type, whereas the HD type required procedures related to nail issues, and the non-hypoplastic types necessitated complex procedures. Generally, the hypoplastic types were associated with better outcomes than the non-hypoplastic types. Within the hypoplastic category, the HP type achieved better appearance scores than the HD type. Among the non-hypoplastic types, comparisons revealed no significant differences; however, caregiver's satisfaction with function was significantly lower for type III compared to type II and IV.

Conclusion

The hypoplastic type not only differed in surgical methods, but also showed varied overall outcomes, especially in terms of functional scores. Distinguishing between the HP and HD type within the hypoplastic category further revealed differences in surgical approaches and cosmetic results. Using the modified Wassel-Flatt classification, appears to enhance surgical planning and effectively predict clinical outcomes.

차례

I. 서론

Radial polydactyly is among the most frequently encountered congenital hand anomalies [1]. Wassel-Flatt classification system has historically been the benchmark for categorizing radial polydactyly ,stratifying the condition into seven types based on the level of skeletal duplication ascertained through radiographic examination [2]. This system gained widespread acceptance due to its simplicity, and clarity [1, 3-7] However, despite its broad adoption, the Wassel-Flatt classification has faced criticism for its limitations, particularly in its efficacy in guiding interventions and its correlation with postoperative aesthetic and functional outcomes [5, 6, 8, 9].

In response to these challenges, we proposed a modified Wassel-Flatt classification system [10]. This modification incorporated the classification of hypoplastic types, which includes the hypoplastic proximal (HP) type and hypoplastic distal (HD) type and it refined the definition of the triphalangeal thumb, all while preserving the original classification's fundamental structure. Although our previous study demonstrated that the modified classification offers better reliability and provides clearer treatment guidance compared to the original classification, it did not investigate clinical outcomes. This study aimed to evaluate the utility of the modified Wassel-Flatt classification in surgical planning and clinical outcomes, with a particular focus on the hypoplastic category, and to compare the outcomes among non-hypoplastic types (type II-VII)

II. 본론

1. 연구방법

This retrospective study was conducted at a single center. Approval for this study was obtained from the relevant institutional review board. (2024-0346)

Participant selection

We performed a comprehensive review of medical records to identify patients who underwent surgery for radial polydactyly by one of our authors (J.K.K) at our institution between October 2017 and November 2022. Initially, we identified 229 individuals, which corresponded to 270 thumbs affected by radial polydactyly.

We excluded patients over 5 years of age at the time of surgery (two thumbs excluded), those with less than 12 months of follow-up post-surgery (38 thumbs excluded), and those with incomplete medical records (7 thumbs excluded). After these exclusions, our analysis ultimately encompassed 211 participants, totaling 223 thumbs.

Data collection

Retrospective data were collected from the medical records, including demographic information, details of the surgery, postoperative complications, and clinical outcomes. We classified radial polydactyly according to the Modified Wassel-Flatt classification (Figure 1). We categorized the surgical procedures for polydactyly into simple excision and additional procedures. Simple excision was defined as the removal of the extra digit without any bony, tendinous, or ligamentous procedures at the attachment site or to the remaining digit. Additional procedures were separated into 14 detailed procedures, which are described in Table 1. Among them, corrective osteotomy was employed to correct the alignment of the main digit, while detachment osteotomy was used to remove the extra digit (Figure 2). Then, based on these definitions, we analyzed the surgical procedures applied to each type of radial polydactyly. For postoperative clinical outcomes, one of our authors (J.K.K) assessed all patients annually using the

Japanese Society for Surgery of the Hand (JSSH) scoring system. The JSSH scoring system evaluates three categories: functional, appearance, and subjective parameters. It comprises seven functional parameters (with a maximum of 2 points each), four appearance parameters, and two subjective parameters (with a maximum of 1 point each), culminating in a total possible score. The interpretation of the total score is as follows: a score of 0 to 13 is considered poor; 14 to 16 is fair; 17 to 19 is good; and a perfect score of 20 is classified as excellent. Caregiver's satisfaction with the function and shape was also assessed using a scale from 1 to 5, where 1 indicated 'very dissatisfied' and 5 signifies 'very satisfied', allowing for a nuanced evaluation across five levels of satisfaction. We used the most recent follow-up data for follow-up outcomes.

Figure 1. Modified Wassel-Flatt classification schema

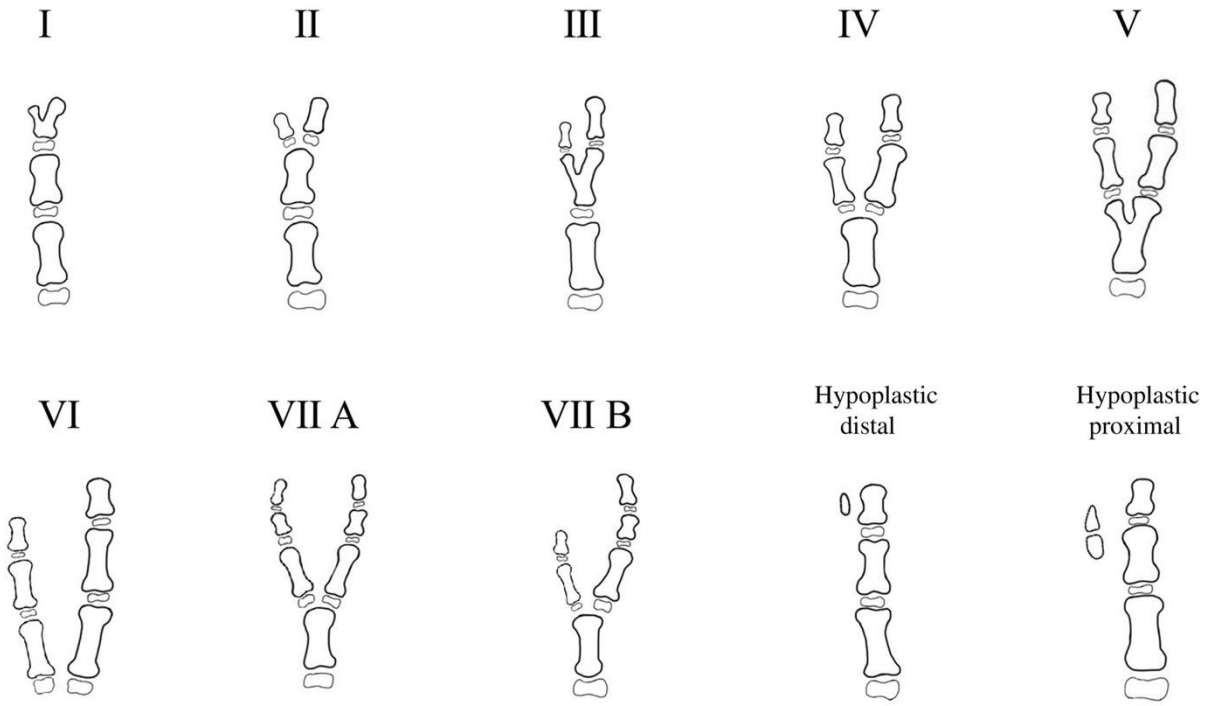


Figure 2. Illustration of detachment osteotomy and corrective osteotomy

(a) Detachment osteotomy was performed to remove the extra digit.

(b) Corrective osteotomy was performed to correct the alignment of the main digit

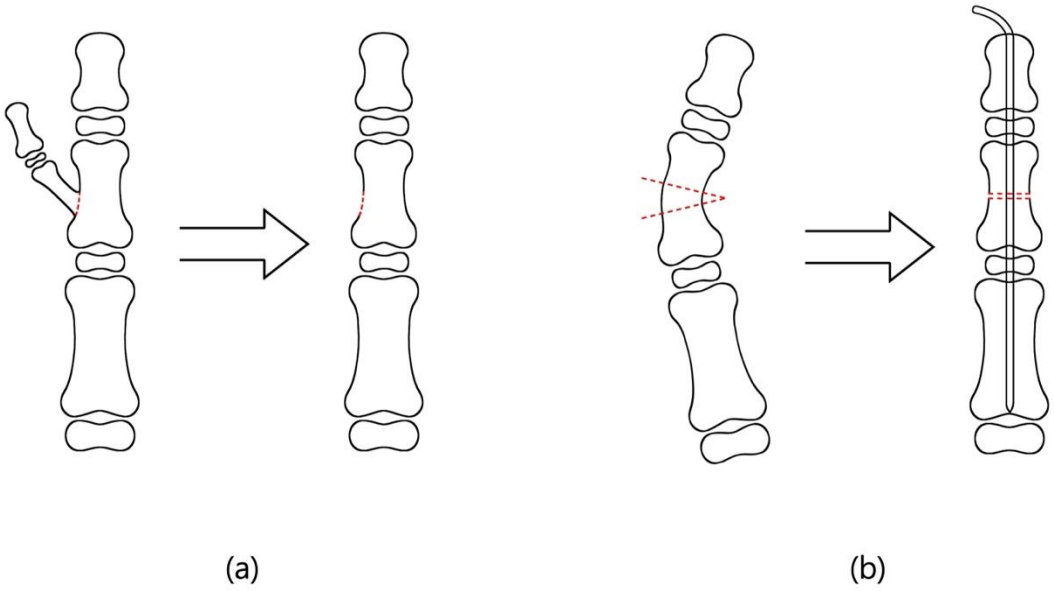


Table 1. Surgical procedures performed on polydactyly

Number	Procedures	Detail
1	IP joint plication	Collateral ligament and capsule of IP joint of the main digit is plicated or repaired.
2	IP joint ligament reconstruction	The collateral ligament, capsule, or periosteal sleeve associated with the extra digit is detached and reattached to the main digit. This surgical intervention may also encompass the articular shaving of metacarpal head of the retained digit.
3	Proximal phalanx detachment osteotomy	Proximal phalanx osteotomy was performed to remove the extra digit in type III.
4	Proximal phalanx corrective osteotomy	Proximal phalanx osteotomy was performed to correct the alignment of the main digit.
5	Metacarpal detachment osteotomy	Metacarpal osteotomy was performed to remove the extra digit in type V.
6	Metacarpal corrective osteotomy	Metacarpal osteotomy was performed to correct the alignment of the main digit.
7	MP joint plication	Collateral ligament and capsule of MP joint of the main digit is plicated or repaired.
8	MP joint ligament reconstruction	The collateral ligament, capsule, or periosteal sleeve associated with the extra digit is detached and reattached to the main digit. This surgical intervention may also encompass the articular shaving of

		metacarpal head of the retained digit.
9	Thenar muscle attachment	Thenar muscle of the extra digit is transferred to the main digit
10	Flexor tendon relocation	Flexor pollicis longus of the main digit relocated to central portion of the distal phalanx
11	Triphalangeal thumb operation	Excision, or corrective osteotomy and fusion of extraphalangeal bone
12	Skin flap	Z-plasty, etc
13	Intraepiphyseal osteotomy	Intraepiphyseal osteotomy of distal phalanx was performed to correct triangular epiphysis
14	Modified Bilhaut-Cloquet procedure	Modified Bilhaut-Cloquet procedure

IP, Interphalangeal; MP, Metacarpophalangeal

Statistical analysis

In demographics, surgical age and follow-up periods were analyzed using the Mann-Whitney U test, while sex and laterality were analyzed using the chi-square test.

Statistical analysis was performed in three parts.

Initially, patients were divided into hypoplastic (HP and HD type) and non-hypoplastic types (type II-VII). The Welch's T test was used to analyze the total JSSH scores, JSSH subscores, and satisfaction scores.

Secondly, between HP and HD types, surgical age and follow-up periods were compared using the Mann-Whitney U test, while sex and side of surgery were compared using the Fisher exact test. Total JSSH scores, JSSH subscores, and satisfaction scores were compared using the Mann-Whitney U test between HP and HD type.

Thirdly, among non-hypoplastic types (type II-VII), surgical age and follow-up period were analyzed using the Kruskal-Wallis test, while sex and laterality were compared using the Fisher exact test. Subsequently, the analysis extended to comparing total JSSH scores, JSSH subscores, and satisfaction scores across non-hypoplastic types. To address this, the Kruskal-Wallis test was used. For post-hoc analysis, the Dunn-Bonferroni test was employed to adjust for multiple comparisons and control the type I error.

2. 결과

Patient characteristics

Totals of 211 participants and 223 thumbs were included in the analysis (Table 2). The most prevalent categorizations were the HP type and type IV, with 84 and 83 thumbs affected, respectively. Hypoplastic type patients underwent surgery at a significantly younger age and had shorter follow-up periods compared to those with non-hypoplastic types. No significant differences were observed in terms of gender or laterality. In the comparison between HP and HD types, the only significant difference was the younger age at which patients with HP type underwent surgery; no other significant differences were noted. Among non-hypoplastic types, no significant differences were found in surgical age, follow-up period, gender, or laterality.

Table 2. Patient characteristics

	HP	HD	1	2	3	4	5	6	7
Hands,N	84	4	0	20	10	83	16	4	2
Sex (M/F)	51/33	2/2	-	6/14	6/4	50/33	12/4	2/2	1/1
Age at the times of surgery, mo	7 (3-9)	10 (9-13)	-	10 (9-10.5)	10 (10-12)	10 (9-10)	10 (9-10)	10 (9.5-11)	11 (10-12)
Follow-up period, mo	24 (12-24)	18 (12-31.5)	-	24 (24-36)	28 (24-36)	24 (14-34)	24 (12-32)	24 (12-39)	12.5 (12-13)
Side(R/L)	57/27	2/2	-	11/9	8/2	55/28	11/5	2/2	1/1

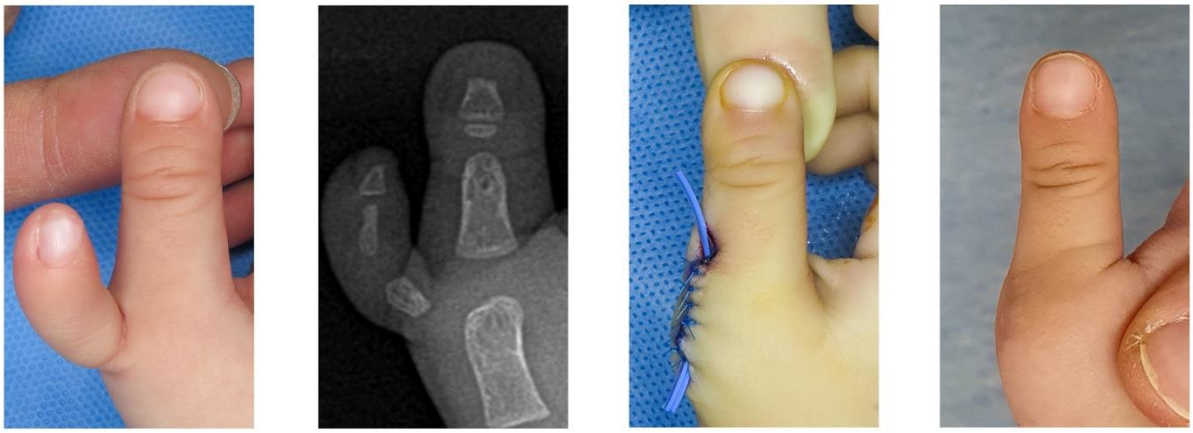
Data are shown as median (25% percentile, 75% percentile)

Surgical procedures

The surgical procedures performed for each type are summarized in Table 3. Simple excision was feasible only for the HP type, applicable in 92% of HP type cases (Figure 3). Among patients for whom simple excision alone was not feasible for the HP type, interphalangeal (IP) joint plication was required in one case, and flexor tendon relocation was necessitated in three cases. Both interventions were aimed at correcting IP joint deviation in the remaining digit (Figure 4). Metacarpophalangeal (MP) joint plication was performed in three cases as a reparative measure during the excision of the extra digit when the MP joint ligament was inadvertently damaged. In the HD type, extra digit possessed a nail, fused with the nail of main digit, necessitating the removal of the supernumerary nail and reconstruction of the nail fold through skin flap procedures (Figure 5). For non-hypoplastic types, complex procedures, such as ligament reconstruction, tendon-related procedures and osteotomy were required.

Figure 3. HP type polydactyly treated with simple excision.

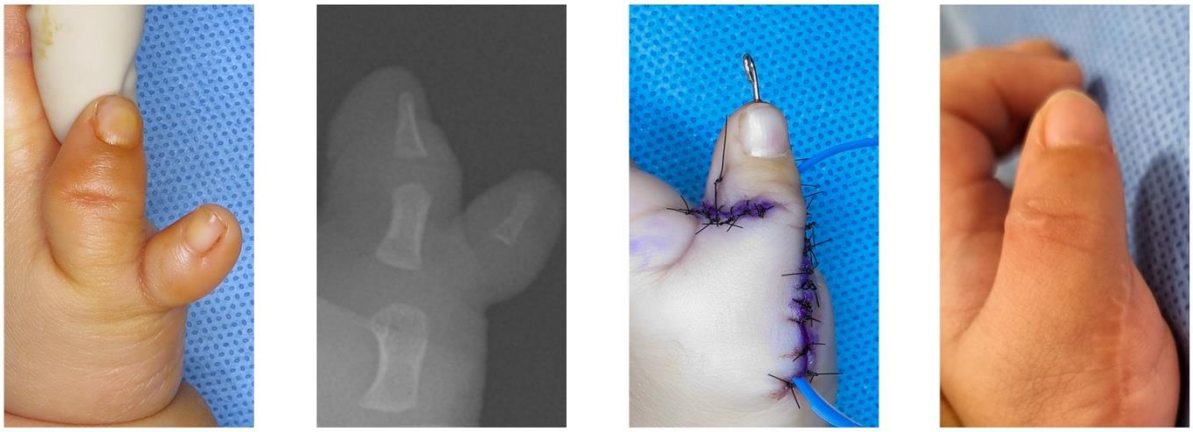
(a) preoperative clinical photograph (b) preoperative X-ray (c) postoperative clinical photograph (d) clinical photograph at 1-year follow-up



(a) (b) (c) (d)

Figure 4. HD type polydactyly treated with a skin flap

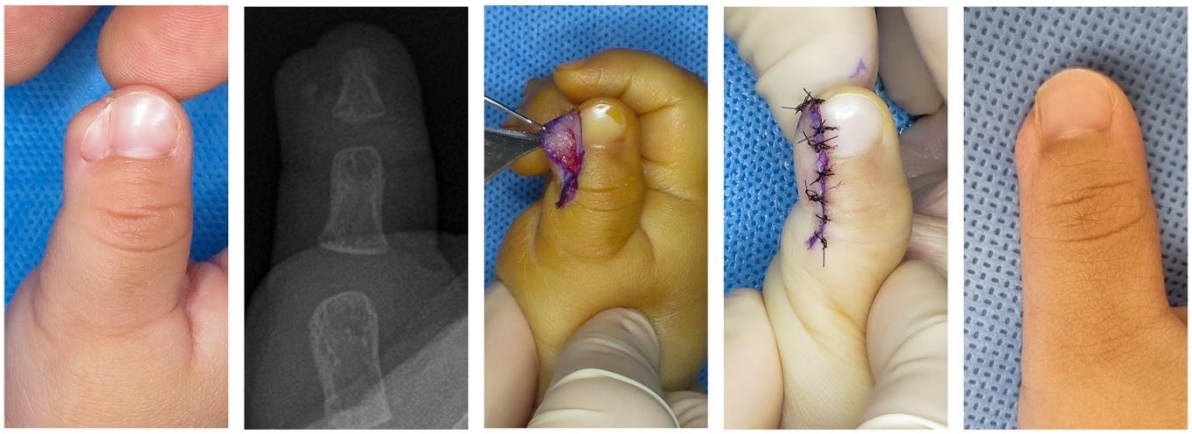
(a) preoperative clinical photograph (b) preoperative X-ray (c) skin flap (d) postoperative clinical photo (e) clinical photograph at 1-year follow-up



(a) (b) (c) (d)

Figure 5. HP type polydactyly treated with flexor tendon relocation for IP joint deviation

(a) preoperative clinical photograph (b) preoperative X-ray (c) postoperative clinical photograph (d) clinical photograph at 1-year follow-up



(a) (b) (c) (d) (e)

Table 3. Surgical procedures in each type

	HP	HD	II	III	IV	V	VI	VII
Simple excision	77(92)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
IP joint plication	1(1)	1(25)	0(0)	0(0)	19(23)	0(0)	0(0)	1(50)
IP joint reconstruction	0(0)	0(0)	18(90)	6(60)	0(0)	0(0)	0(0)	0(0)
Modified Bilhaut-Cloquet procedure	0(0)	0(0)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)
Intraepiphyseal osteotomy	0(0)	0(0)	0(0)	0(0)	3(4)	0(0)	0(0)	0(0)
Proximal phalanx detachment osteotomy	0(0)	0(0)	0(0)	5(50)	0(0)	0(0)	0(0)	0(0)
Proximal phalanx corrective osteotomy	0(0)	0(0)	7(35)	3(30)	15(18)	2(13)	1(25)	0(0)
Metacarpal detachment osteotomy	0(0)	0(0)	0(0)	0(0)	0(0)	16(100)	0(0)	0(0)
Metacarpal corrective	0(0)	0(0)	0(0)	0(0)	3(4)	4(25)	1(25)	0(0)

osteotomy								
MP joint plication	3(4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
MP joint ligament reconstruction	0(0)	0(0)	0(0)	1(10)	78(94)	3(19)	0(0)	2(100)
Thenar muscle reattachment	0(0)	0(0)	0(0)	1(10)	65(78)	12(75)	3(75)	1(50)
Flexor tendon relocation	3(4)	0(0)	2(10)	3(30)	29(35)	0(0)	2(50)	1(50)
Triphalangeal thumb operation	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(50)
Skin flap	0(0)	4(100)	8(40)	1(10)	0(0)	0(0)	0(0)	0(0)

Data are shown as N(%)

Clinical outcome

When comparing the hypoplastic (HP and HD types) and non-hypoplastic types (type II-VII) collectively, the hypoplastic types demonstrated statistically significant superiority in both the overall JSSH score and the JSSH functional subscore. This superiority extended to caregiver satisfaction regarding both function and shape (Table 4).

In the comparison between HP and HD types, the HP type presented significantly better outcomes in the JSSH appearance subscore. While not statistical significant, there was a trend towards higher caregiver satisfaction with shape in the HP type. No significant differences were observed in the overall JSSH score and other JSSH subgroups (Table 5).

In the analysis among non-hypoplastic types, there were no significant differences between groups in terms of the overall JSSH, JSSH subgroups, and caregiver satisfaction with shape. The only exception was caregiver satisfaction with function, where post hoc analysis revealed type III had significantly poorer outcomes compared to type II and IV in caregiver satisfaction with function (Table 6).

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Table 4. Clinical outcome in hypoplastic and non-hypoplastic type.

	Hypoplastic (n=88)	Non-hypoplastic (n=135)	P-value
JSSH score	19.83 (19.73-19.93)	18.61 (18.32-18.90)	<0.001
Function	13.95 (13.90-14.00)	12.80 (12.56-13.06)	<0.001
Appearance	3.90 (3.83-3.96)	3.83 (3.76-3.90)	0.160
Subjective	1.98 (1.95-2.00)	1.95 (1.91-1.99)	0.244
Satisfaction of function	4.88 (4.76-4.99)	4.59 (4.45-4.74)	0.003
Satisfaction of shape	4.64 (4.48-4.79)	4.35 (4.18-4.52)	0.016

Data are shown as average (95% confidence interval)

Table 5. Clinical outcome in HP and HD type

	HP (n=84)	HD (n=4)	P-value
JSSH score	20 [20-20] 19.86 (19.76-19.95)	19 [19-19.5] 19.25 (18.45-20.00)	0.33
Function	14 [14-14] 13.95 (13.90-14.00)	14 [14-14] 14 (14-14)	0.915
Appearance	4 [4-4] 3.93 (3.87-3.98)	3 [3-3.5] 3.25 (2.45-4.00)	0.019
Subjective	2 [2-2] 1.98 (1.94-2.00)	2 [2-2] 2 (2-2)	0.946
Satisfaction of function	5 [5-5] 4.88 (4.77-4.99)	5 [4.5-5] 4.75 (3.95-5.00)	0.581
Satisfaction of shape	5 [4.5-5] 4.67 (4.51-4.83)	4 [3.5-4.5] 4.00 (2.70-5.00)	0.079

Data are shown as median [25% percentile, 75% percentile], average (95% confidence interval)

Table 6. Clinical outcome among non-hypoplastic types.

	II (n=20)	III (n=10)	IV (n=83)	V (n=16)	VI (n=4)	VII (n=2)	P-value
JSSH score	19 [18.5-20]	18 [17-20]	19 [18-20]	20 [18.5-20]	17 [14.5-19.5]	15 [12-18]	0.094
	19.15	18.3	18.64	18.81	17.00	15.00	
	(18.77-19.53)	(17.29-19.31)	(18.31-18.96)	(17.53-20.00)	(12.32-20.00)	(0.00-20.00)	
Function	13.5 [12.5-14]	13 [12-14]	13 [12-14]	14 [13-14]	11.5 [9-14]	10 [8-12]	0.146
	13.25	12.80	12.80	13.00	11.50	10.00	
	(12.85-13.65)	(11.92-13.68)	(12.50-13.09)	(11.90-14.00)	(6.91-14.00)	(0.00-14.00)	
Appearance	4 [4-4]	4 [3-4]	4 [4-4]	4 [4-4]	4 [3.5-4]	3 [2-4]	0.131
	3.90	3.60	3.87	3.81	3.75	3.00	
	(3.76-4.00)	(3.23-3.97)	(3.79-3.95)	(3.60-4.00)	(2.95-4.00)	(0.00-4.00)	
Subjective	2 [2-2]	2 [2-2]	2 [2-2]	2 [2-2]	2 [1.5-2]	2 [2-2]	0.429
	2.00	1.90	1.95	1.94	1.75	2.00	
	(2.00-2.00)	(1.67-2.00)	(1.90-2.00)	(1.80-2.00)	(0.95-2.00)	(2.00-2.00)	
Satisfaction of function	5 [5-5]	4 [4-5]	5 [5-5]	5 [4.5-5]	4.5 [2.5-5]	4.5 [4-5]	0.010
	4.90	3.90	4.66	4.50	3.75	4.50	
	(4.76-5.00)	(3.04-4.76)	(4.49-4.83)	(3.94-5.00)	(0.74-5.00)	(0.00-5.00)	

Satisfaction of shape	5 [4-5]	3.5 [2-5]	5 [4-5]	5 [4.5-5]	5 [3-5]	4.5 [4-5]	0.135
	4.35	3.40	4.42	4.63	4.00	4.50	
	(3.97-4.73)	(2.38-4.42)	(4.21-4.63)	(4.20-5.00)	(0.82-5.00)	(0.00-5.00)	

Data are shown as median (25% percentile, 75% percentile), average (95% confidence interval)

3. 논의

The HP type and type IV radial polydactyly accounted for much of the study sample. Patients with the HP type underwent surgery at a younger age, with 92% being treatable through simple excision. When comparing hypoplastic and non-hypoplastic types, the hypoplastic type had superior outcomes in terms of overall JSSH score, JSSH functional subscore, and caregiver satisfaction. Within the hypoplastic category, the HP type was associated with better appearance scores than the HD type. Among non-hypoplastic types, no significant differences were noted, except that type III was associated with significantly worse caregiver satisfaction with function compared to type II and IV.

Previous literature has acknowledged the hypoplastic type. It was initially introduced by Orgino et al. [6] as a floating type, and further explored by Chung et al. [1], Hung et al. [11], and Zuidam et al. [12]. Chung et al. [1] defined the hypoplastic type as having no definite origin around the main digit, and found that it constituted 7% of all cases. Evanson et al. [13], adopting the same definition as Chung et al., reported that the hypoplastic type accounted for 18% of all cases, and Chen et al. [14], defining the hypoplastic type by its soft tissue connections, found it constituted 20% in their study. Our research contrasts with earlier studies that included only floating or redundant types under the hypoplastic category. The modified Wassel classification, considering cases to be of the hypoplastic category in the absence of bony or ligamentous connections, resulted in a higher incidence in our cohort compared to previous studies. In our previous study [10], 34% of our patients were diagnosed with the hypoplastic type, whereas our current study found a 39.4% incidence.

According to our definition, a key difference between the hypoplastic types and non-hypoplastic types is the involvement of joints or bones. This characteristic leads the non-hypoplastic type to require more complex procedures like joint reconstruction and osteotomy. This anatomical complexity and the resulting surgical complexity have a significant impact on clinical outcomes. In our study, the hypoplastic type yielded better outcomes in terms of both total JSSH score, JSSH functional subscores. Moreover, caregiver satisfaction regarding function and shape was significantly higher in association with the hypoplastic type. In line with these findings, Chen et al. [14] reported a tendency toward higher

overall JSSH scores in association with hypoplastic types compared with other types. Similarly, Chung et al. [1] presented results using the Tada score, observing good outcomes in all hypoplastic cases. Evanson et al. [13] reported an absence of reoperations for patients with hypoplastic types.

Unlike other studies, we have divided hypoplastic category into HP and HD types, recognizing that while both types share the commonality of not being connected with bone and joint, they possess distinct characteristics warranting separate consideration. The differentiation between HP and HD types reflects various aspects, including the timing of surgery, surgical methods, and outcomes. The HP type, primarily amenable to simple excision, appears to have facilitated surgical intervention at a younger age compared to other types. Regarding surgical methods, in contrast to the simple procedures often applicable to the HP type [1,6,11,14,15], the HD type presented with more complex surgical needs due to the presence of nail fold formations, necessitating the raising of skin flaps in all cases. This necessity for additional surgical considerations can potentially lead to increased scarring and cosmetic challenges [15,16]. Consequently, HP type has shown significantly better outcomes in terms of JSSH appearance subscores, with a trend towards greater satisfaction in shape. Based on these findings, the HP and HD type exhibit distinct characteristics and prognoses, especially regarding cosmesis.

Previous efforts to assess outcomes based on types of radial polydactyly have shown varied results. For instance, Larsen et al. [17], employing the Wassel-Flatt classification and Tada scoring, indicated poorer prognoses for types with joint bifurcation. Orgino et al. [6], who separated the floating type as a distinct category within the Wassel-Flatt classification and used the modified TADA scoring for analysis, reported unsatisfactory results for type III, V, and VI. Almeida et al. [18], using Wassel-Flatt classification, associated type VII with a poor prognosis due to its association with residual deformity. Our study found that, among non-hypoplastic types, there were no statistically significant differences observed, with the exception of caregiver satisfaction with function. Specifically, compared with type II and IV, type III was associated with significantly lower caregiver's satisfaction with function. This observation may align with our previous reports indicating type III's high rate of unscheduled reoperation due to IP joint deviation [19]. A larger patient cohort for future comparisons could potentially clarify these findings.

Limitations

There were some several limitations to this study. First, JSSH score evaluation by a single surgeon might introduce bias. Second, the follow-up period was a minimum of 1 year, suggesting a need for longer-term studies to assess factors like pinch grip and revision rates more thoroughly. Third, a limited number of patients were included for certain types; type I patients were not included, and there were only two patients with type VII. Finally, certain surgical techniques like Bilhaut-Cloquet were relatively less represented due to surgeon preference.

III. 결론

This study contributes to the understanding of radial polydactyly treatment outcomes. Our findings suggest that the hypoplastic type is associated with better outcomes than non-hypoplastic types. Within the hypoplastic category, the HP type showed differences from the HD type. Comparisons among non-hypoplastic types generally revealed no significant differences. The modified Wassel classification is anticipated to enhance surgical planning and the evaluation of clinical outcomes for patients with radial polydactyly.

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국문요약

목적

수부 다지증은 흔한 선천성 수부 기형 중 하나이다. 이전부터 수부 다지증을 분류하는 기준으로는 방사선학적으로 분지 위치에 따라 분류를 하는 Wassel-Flatt classification을 가장 흔히 사용하였다. 그러나 이 분류는 수술 계획을 하거나 결과를 예측하는데 한계가 있어 modified Wassel-Flatt classification이 소개되었다. 본 연구는 modified Wassel-Flatt classification이 수술 계획 및 임상 결과 평가를 하는 데에 효과적인지 평가하고 non-hypoplastic type들을 비교하는 데에 있다.

방법

이 retrospective 연구는 단일 병원에서 수행되었으며, 2017년 10월부터 2022년 11월까지 수부 다지증으로 치료받은 211명의 환자와 223개의 엄지손가락에 대한 의무기록을 검토하였다. 환자는 modified Wassel-Flatt classification을 이용하여 분류되었다. Hypoplastic과 non-hypoplastic (Type II-VII) 간, hypoplastic type 내에서 Hypoplastic proximal (HP) type과 Hypoplastic distal (HD) type간, non-hypoplastic type간 비교를 시행하였다.

결과

단순 절제는 HP type 에서만 가능하였으며, HD type 은 손톱 관련 수술이 필요하였고 Non-hypoplastic type 은 복잡한 수술이 필요하였다. Hypoplastic type 은 일반적으로 non-hypoplastic type 보다 더 나은 결과를 보였으며, Hypoplastic type 내에서는 HP 형이 HD

형에 비해 더 나은 외관 점수를 보였다. Non-hypoplastic 형 내에서는 대부분 유의미한 차이가 없었으나, 보호자의 기능 만족도는 II 형과 IV 형에 비해 III 형에서 유의미하게 낮았다.

결론

Hypoplastic type 은 수술 방법 뿐 아니라 전반적 결과, 특히 기능 점수에서 차이가 있었다. Hypoplastic type 내에서 HP 형과 HD 형을 구분함으로써 수술적 방법의 차이와 미용 결과에서 차이를 확인할 수 있었다. Non-hypoplastic type 간에는 대부분의 결과에서 유의미한 차이가 있지 않았다.