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Clinical Study of Syndactyly

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ABSTRACT

Background: Syndactyly, defined as the congenital fusion of two or more digits, results from failed differentiation or incomplete separation during embryonic development. It is recognized as the second most frequently occurring congenital anomaly of the upper limb, with an estimated prevalence of 1 in every 2,000 to 3,000 live births. This study aims to explore the clinical and anatomical characteristics associated with congenital syndactyly.

Methods: This retrospective analysis included patients diagnosed with congenital syndactyly and admitted to the Department of Plastic and Reconstructive Surgery at GMCH, Guwahati, over a 20-month period. Following ethical committee approval, relevant clinical data and patient images were retrieved from the hospital's medical records and departmental documentation.

Results: Twelve patients with congenital syndactyly were evaluated. Findings indicated a higher prevalence among male patients, frequent occurrence of bilateral and symmetrical involvement, and most commonly, the involvement of the third interdigital space. Three patients were diagnosed with Apert syndrome. Additional anomalies, including brachydactyly and polydactyly, were noted in four patients.

Conclusions: The observations in this study closely align with previously published data. This investigation enhances the understanding of the clinical profile and anatomical patterns associated with syndactyly.

Keywords: Syndactyly, Congenital Syndactyly, Apert Syndrome

INTRODUCTION

Syndactyly refers to the congenital union of two or more fingers or toes, typically resulting from disrupted differentiation or incomplete separation during embryonic development. It can be classified as either **primary**, originating from developmental failure, or **secondary**, resulting from postnatal factors like trauma or burns that cause digit fusion. It is regarded as the second most common congenital anomaly affecting the upper limb, with a reported incidence of approximately 1 in every 2,000–3,000 live births.[1]

The condition results from a failure of mesenchymal tissue to differentiate properly during the sixth to eighth week of gestation. In normal development, this period involves interdigital cell necrosis, which, if absent or incomplete, results in digit fusion.[2] Syndactyly can be categorized as **simple**, involving only soft tissue fusion, or **complex**, where bony elements, tendons, and neurovascular structures are also involved.[3–4] Fusion may be **partial** or **complete**, depending on the extent of involvement.

Males are more frequently affected, and syndactyly may occur as an isolated anomaly or in association with genetic syndromes such as Apert, Poland, cleft hand, or Down syndrome.[5] Although sporadic mutations are the most common cause, approximately 40% of cases show autosomal dominant inheritance with variable expression.[6]

The third and fourth interdigital spaces are most commonly affected, followed by involvement of the second and fifth digits. Fusion between the thumb and index finger is rare due to early embryological separation of the thumb.[5] Symmetrical and bilateral presentation is frequently observed.

Functionally, adequate interdigital web space is essential for hand dexterity, including flexion, extension, and abduction

movements. As syndactyly restricts autonomous digital motion and can result in cosmetic concerns, surgical correction is generally recommended to restore both aesthetics and functional mobility.

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AIMS AND OBJECTIVES -

Aim:

- To evaluate the clinical presentation and anatomical characteristics of congenital syndactyly.

Objectives:

- To assess the clinical features associated with congenital syndactyly.
- To classify the types and patterns of syndactyly observed.
- To identify any associated congenital anomalies or syndromic conditions.

SUBJECTS AND METHODS -

This retrospective observational study included patients diagnosed with congenital syndactyly who were admitted to the Department of Plastic and Reconstructive Surgery at Gauhati Medical College and Hospital (GMCH), Guwahati, between January 1, 2021, and August 31, 2022 — a period of 20 months. The study was initiated following approval from the Institutional Ethics Committee.

Clinical data and photographic records of the patients were retrieved from the Medical Records Department as well as departmental archives. The study excluded cases of secondary syndactyly resulting from trauma or burns.

A total of 12 patients were included in the analysis. Data collected included demographic information, presence of associated syndromes or anomalies, affected side, laterality, symmetry, total number and classification of syndactylies (simple or complex, partial or complete), and involvement of specific interdigital spaces. Outcomes of surgical intervention were not assessed in this study. Collected data were compiled and analyzed using descriptive statistical methods.

RESULTS

Four (33.3%) were female and eight (66.6%) were male of the 12 patients with congenital syndactyly. Nine patients (75%) had no associated syndromes, while three patients (25%) had Apert syndrome. (Figure-5) In six patients (50%) the condition was bilateral, and in four of these cases (66%) it was symmetrical and the rest asymmetrical. (Figure-4) Four patients (66.6%) were affected on the right side, while two (33.3%) were on the left. (Table-1)

Table 1 - Characteristics of the patients with Syndactyly

	NO. OF CASES (n - 12)	PERCENTAGE
GENDER		
MALE	8	66.6%
FEMALE	4	33.3%
ASSOCIATED SYNDROME		
YES	3	25%
NO	9	75%
LATERALITY		
BILATERAL	6	50%
UNILATERAL	6	50%
SYMMETRY IN BILATERAL (n - 6)		
SYMMETRICAL	4	66.6%
ASYMMETRICAL	2	33.3%
AFFECTED SIDE IN UNILATERAL (n - 6)		
RIGHT	4	66.6%
LEFT	2	33.3%

Table 2 - Characteristics of syndactylies

	NO. OF CASES (n - 31)	PERCENTAGE
AFFECTED SPACE		
FIRST WEB SPACE	3	10%
SECOND WEB SPACE	8	25.6%
THIRD WEB SPACE	11	35.4%
FOURTH WEB SPACE	9	29%
TYPE		
SIMPLE	20	65%
COMPLETE / PARTIAL	13 / 7	65% / 35%
COMPLEX	11	35%

The third web space was affected 11 times (35.4%), followed by the fourth space nine times (29%), the second space eight times (25.6%), and the first space three times (10%). There were a total of 31 syndactylies. Of the syndactylies, 35% (11) were complex and 65% (20) were simple. Of the syndactylies, 65% (13) were complete and 35% (7) were partial. (Table-2, Figures-1 and 2) Of the 9

patients (75%) without any associated syndrome, 4 (44.5%) had other abnormalities, and 5 (55.5%) had solitary syndactyly. They had polydactyly and brachydactyly. (Figure-3)

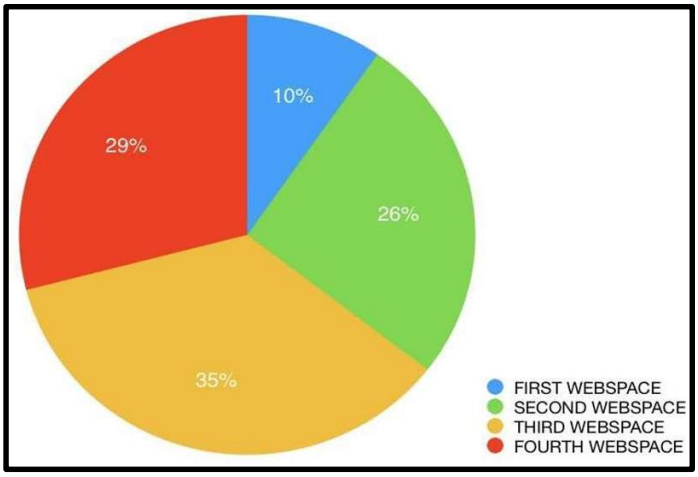

Figure 1 - Distribution chart of affected space in syndactylies

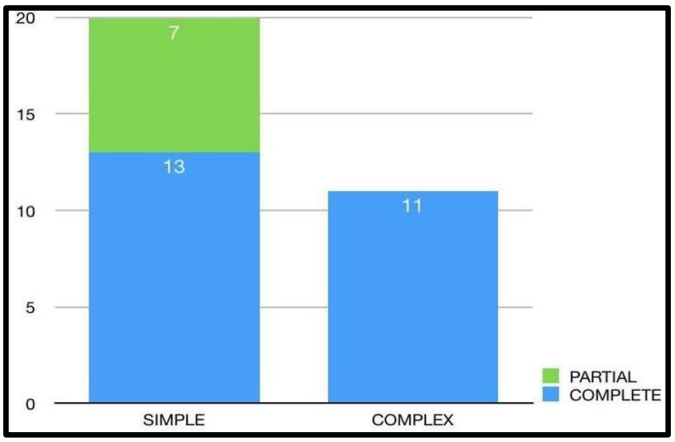

Figure 2 - Distribution chart of type of syndactyly

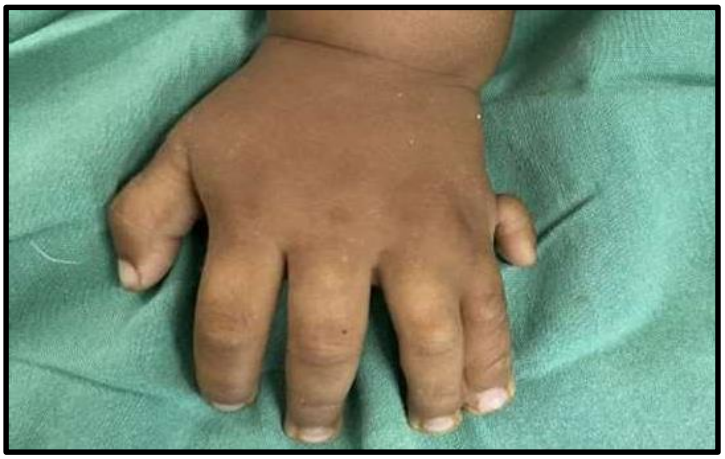

Figure 3 - Clinical image of syndactyly associated with polydactyly

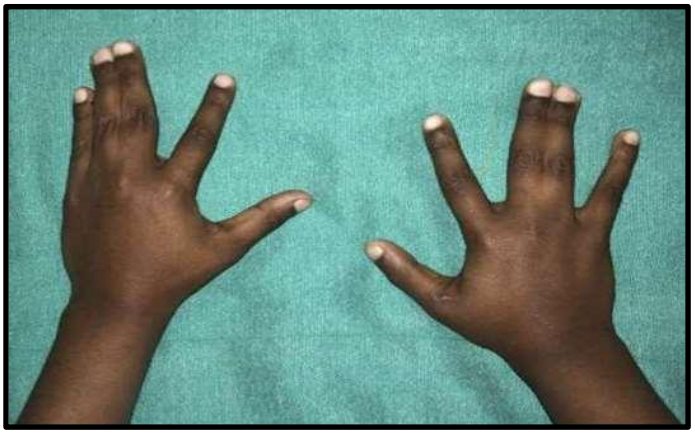

Figure 4 - Clinical image of bilateral asymmetric syndactyly

Figure 5 - Clinical image of bilateral syndactyly in a case of Apert syndrome

DISCUSSION

Compared to similar studies, the present research includes a relatively larger sample size.[7–8] Our findings align well with existing literature, showing that congenital syndactyly is more prevalent among males and frequently presents as bilateral and symmetrical. The third interdigital space was the most commonly affected site in our cohort.

In our series, **simple syndactyly** was the predominant form. It manifested in two subtypes: one involving fusion up to the second phalanx, and the other extending to the first phalanx. Some cases demonstrated **complete simple syndactyly**, characterized by soft tissue union without skeletal involvement, making surgical correction relatively straightforward.

These results differ from the findings of Mandarano-Filho et al. (2013), who reported a higher incidence of **complex syndactyly** (41%), followed by simple complete (38.35%) and simple partial forms (20%).[3] In contrast to simple

syndactyly, the complex type often involves additional structural anomalies such as fused bones, missing or extra digits, delta phalanges, and shortened phalanges.[9]

Furthermore, tendon anomalies may be present, including absence, duplication, or abnormal insertion patterns. Vascular abnormalities are also noted, such as atypical branching of the common digital artery, presence of a single artery, or even complete absence of arterial supply within the web space.[10] **Complicated syndactyly** refers to conditions where additional bones or abnormal skeletal elements exist between digits. No such cases were identified in our study.

In our cohort, three children were diagnosed with Apert syndrome, and an additional four patients had other anomalies (e.g., brachydactyly and polydactyly) despite the absence of a defined syndrome (Figure 5). Among congenital hand anomalies, syndactyly is most frequently associated with Apert Syndrome — a condition first described by Eugène Apert in 1906.[11] It follows an autosomal dominant inheritance pattern with variable expression and is often caused by sporadic mutations. Apert syndrome is characterized by craniosynostosis, midfacial hypoplasia, exophthalmos, and symmetrical syndactyly of the hands and feet.[12–14]

The surgical goal in syndactyly correction is to achieve a functional interdigital commissure and independent digital movement. The data presented here lay the groundwork for future studies evaluating how surgical techniques and associated anomalies impact both functional and aesthetic outcomes.

LIMITATIONS OF THE STUDY:

- The study was conducted at a medical college and hospital which is a tertiary centre, therefore the demographic and clinical data of the cases may not be a representative sample of the population of the region.
- The short duration of the study.
- The small number of cases in comparison to the burden of the anomaly.

RECOMMENDATIONS OF THE STUDY:

- We recommend that further studies need to be done on a large scale and for a prolonged duration in a population-based setting.

CONCLUSION

Syndactyly remains one of the most frequently observed congenital malformations of the hand. The objective of this study was to examine and interpret the clinical and anatomical aspects of this condition. The results obtained are largely consistent with findings reported in existing literature, reinforcing the credibility of our observations. This analysis contributes to a deeper understanding of syndactyly and highlights the clinical patterns associated with its presentation, providing a foundation for improved diagnosis and future research.

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