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CASE REPORT: SURGICAL MANAGEMENT OF SYNDACTYLY USING DORSAL RECTANGULAR FLAP TECHNIQUE

General Surgery

Srijan Shailesh Pandey 3rd Year MBBS Bharatratna Atalbihari Vajpayee Medical College And Kamla Nehru Hospital, Pune.

Dr. Shivani Deodhar Intern Department Of General Surgery Bharatratna Atalbihari Vajpayee Medical College And Kamla Nehru Hospital, Pune.

Unnati Mishra 3rd Year MBBS Bharatratna Atalbihari Vajpayee Medical College And Kamla Nehru Hospital, Pune.

Dr. Ananta Kulkarni Professor And Head Department Of General Surgery Bharatratna Atalbihari Vajpayee Medical College And Kamla Nehru Hospital, Pune.

ABSTRACT

Syndactyly is one of the most common congenital hand anomalies, characterized by the fusion of adjacent fingers. Established principles of syndactyly separation are useful to determine the timing and order of syndactyly release, with the goal of surgical management being the creation of an anatomically normal webspace, tension-free closure of soft tissue, and return of normal functioning of the fingers.(1)This condition, which can range from simple soft tissue fusion to complex bony fusions, significantly affects hand functionality and aesthetics.The loss of function related to the syndactyly is usually not severe and varies according to the digital webs affected, presence or not of bone fusion and to other associated anomalies, especially when it is part of syndromes.(2)Here, we present the case of an 8-year-old male patient with syndactyly, surgically managed using the dorsal rectangular flap technique for web space reconstruction. The surgical approach involved the creation of dorsal and palmar flaps and a zigzag incision to separate the digits. The dorsal flap was employed to reconstruct the web space with successful functional and cosmetic outcomes.

KEYWORDS

Syndactyly,Syndactyly release,Dorsal rectangular flap technique,Web space reconstruction,Pediatric hand surgery

INTRODUCTION-

Syndactyly is one of the most common hereditary limb disorder which involves congenital digital malformation characterized by webbing of the fingers and toes.It has a prevalance of 4-10 every 10000 live births and it can go up as high as 20-40 every 10000 live births.(3,4) Syndactyly is genetic in origin and appears to be a extremely heterogenous developmental deformity.(5)This phenotype is present as soft tissue and/or bony fusions, or further it may be characterized as complete fusions if adjacent digits are fused until the fingertips or it may be classified as incomplete. It can be present in isolation or as a feature of more than 280 recognized syndromes.Non-syndromic syndactyly is currently classified into 9 main types and subtypes, some subtypes possessing loci with genes.(6,7)The condition can be classified as simple, complex, or complicated based on the involvement of soft tissue, bones, or other structures.It can exhibit symmetry or asymmetry and may affect one side (unilateral) or both sides (bilateral), affecting the right, left, or both sides and feet, hands, or both.(8)Surgical intervention is recommended for cases where functionality or appearance is compromised, typically between the ages of 6 months and 2 years for optimal outcomes.Flaps are employed in both simple and complex syndactly cases which may be use of rectangular, triangular, omega, and multilobed flaps.(9)In this paper, we talk about the dorsal rectangular flap technique which was used in our patient.The dorsal rectangular flap technique offers a reliable method for web space reconstruction,minimizing complications such as scar contracture, tension, and recurrence. The diagnosis of the patient relies majorly on the patient history and physical examination.It is always preferable to do surgical intervention as the benifit outweigh the associated risk of the surgical procedure.(10)In this report, we describe the surgical correction of syndactyly in an 8-year-old male patient using this technique.

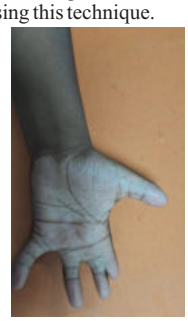

Image-Pre operative clinical image of syndactyly between first and middle finger.

Case Report And Method-

Case Presentation

Patient Demographics: An 8-year-old male of Indian origin presented with syndactyly involving the 2nd and 3rd digits of the right hand. The fusion was soft tissue-based without bony involvement, classified as simple syndactyly.

History And Clinical Examination:

The patient was born full-term with no significant perinatal complications. There was no family history of congenital anomalies or syndactyly. Examination revealed fused web spaces between the index and middle fingers, with restricted independent movement but no significant functional deficit of the hand.

Preoperative Evaluation:

Radiographic imaging confirmed the absence of bony fusion or deformity. Preoperative assessment included a thorough evaluation of vascular supply to the digits to ensure adequate perfusion post-surgery.

Surgical Technique-

The surgical approach utilized was the dorsal rectangular flap technique. The steps included:

1. **Flap Design:**
A rectangular flap was marked on the dorsal side, extending from the metacarpal heads to two-thirds the length of the proximal phalanx. On the palmar side, a corresponding rectangular flap was marked to aid in web space reconstruction.

2. **Incisions:**
A zigzag incision was employed to separate the fused digits, ensuring proper distribution of tension and prevention of linear scarring. Care was taken to avoid injury to the neurovascular bundles.

3. **Flap Elevation And Web Space Reconstruction:**
The dorsal flap was carefully elevated and transposed into the newly created web space. The palmar flap was integrated to complement the reconstruction, creating a natural-appearing web with adequate depth.

4. **Closure:**
The incisions were closed using fine absorbable sutures, ensuring

minimal tension at the edges. A meticulous approach was taken to achieve optimal aesthetic and functional outcomes.

5. Postoperative Care:

The hand was immobilized in a functional position using a custom splint for two weeks. Antibiotics and analgesics were administered, and dressings were changed weekly under aseptic conditions.

Outcome and Follow-Up

The patient had an uneventful postoperative recovery. At a 6-week follow-up, the surgical site demonstrated good healing with no signs of infection or complications. The reconstructed web space was functionally and cosmetically satisfactory, with independent movement of the separated fingers. The patient and family expressed high levels of satisfaction with the outcome.Long-term follow-up is planned to monitor for scar contracture or recurrence.

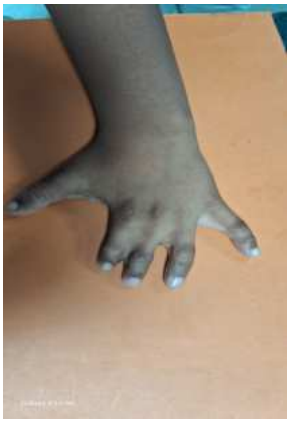

Image- Pre operative clinical image of syndactyly between first and middle finger.

DISCUSSION-

Syndactyly is a very common hand anomaly, classified as a failure of differentiation in the segments.Syndactyly may involve fusion of the soft tissues with or without bony fusion. It mainly occurs due to the failure of differentiation between adjacent digits caused by the absence of apoptosis in the interdigital mesenchyme during the early period of gestation likely 7^{th} or 8^{th} week of gestation.(11,12)As mentioned earlier,the classification of syndactyly can be simple and complex, complete and incomplete are simple anatomical classification , the non syndromic syndactylies are of 9 types- SD1/Zygodactyly- subtypes-Zygodactyly 1,2,3,4,SD2/Synpolydactyly-subtypes-SPD1,2,3,SD3 (ODDD spectrum),SD4/Haas type,SD5,SD6/Mitten Hand,SD7/Cenani-Lenz,SD8,SD9/Mesoaxial Synostotic.(13) Syndactyly I-a has cutaneous webbing of 2nd and 3rd toes without the hand involvement. Syndactyly I-b has Bilateral bony or cutaneous webbing of 3rd/4th fingers and 2nd/3rd toes.Syndactyly I-c has Bilateral bony or cutaneous webbing of 3rd/4th fingers, with normal feet. Syndactyly I-d has bilateral cutaneous webbing of the 4th and 5th toes.(14)Syndactyly II-a has distinct combinations of syndactyly and polydactyly. Syndactyly II-b has metacarpal and metatarsal synostoses.Syndactyly II-c has cutaneous webbing, abnormal metacarpals. (15) Syndactyly III has bilateral complete syndactyly of the 4th and 5th fingers. Syndactyly IV has complete cutaneous syndactyly of all fingers. Syndactyly V has synostotic fusion of metacarpals. Syndactyly VI has fusion of 2nd–5th fingers of the right hand. Syndactyly VII has bony fusion of all digits. Syndactyly VIII has fusion of metacarpals 4/5.Syndactyly IX has phalangeal reduction. (16) There are various genetic factors underlying the case of syndactyly. Missense mutations in HOXD13 have been linked with SPD1, which possibly affects the stability of the HOXD13 protein(17). The FBLN1 has been linked with SPD2, as mutations in this gene have been reported to result in a complex type of SPD(18).Molecular evidence for SD3 has been confirmed in a family with SD3 and was linked to a locus at chr.7q36.3 (19).the duplication of 115.3 kb at a locus called ZRS (limb-specific cis regulator) on chromosome 7 has been linked with SD4 (20).A missense mutation (c.950A>G;p.Q317R) in the HOXD13 has been confirmed to cause SD5.(20)SD7 has been linked with the LRP4 gene in several studies.(21)In the case of SD8, a mutation in FGF16 on the locus chrXq21.1 is the main cause, as two nonsense mutations (p.R179X and p.S157X) in FGF16 have been linked with SD8.(22)A mutation in BHLHA9 present on chromosome 17q13.3 has been linked with the SD9.(23)Syndactyly can be best diagnosed by different diagnostic tools and genetic makeup of the person and xray and sonography can be used additionally to diagnose the deformity.Surgical correction of syndactyly requires a careful balance between functional restoration and aesthetic improvement. The dorsal rectangular flap technique is advantageous as it provides a robust flap with excellent vascularity, reduces the risk of web creep, and creates a natural contour. While other designs, such as triangular or multilobed flaps, are also effective, the rectangular flap offers simplicity and reliability, particularly in older pediatric patients.In this case, the technique was successfully adapted for an 8-year-old patient, highlighting its versatility. Although the optimal age for syndactyly release is earlier, delayed intervention in this case yielded excellent outcomes. The use of zigzag incisions further minimized the risk of linear scarring and contractures.So we establish that dorsal rectangular flap technique is one of the best techniques for the surgical intervention in the pediatric case.

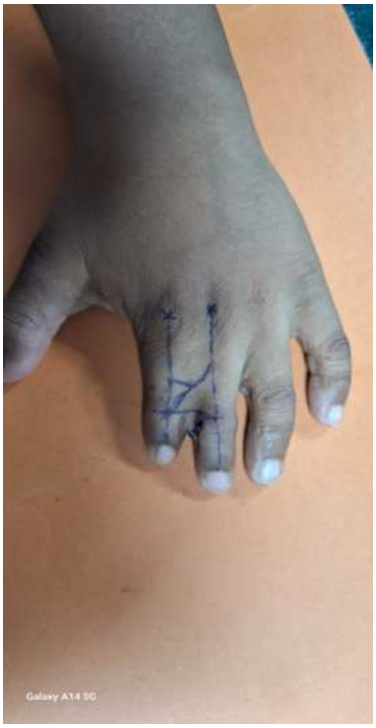

Image- Intra operative clinical image of syndactyly between first and middle finger with markings for dorsal rectangular flap technique.

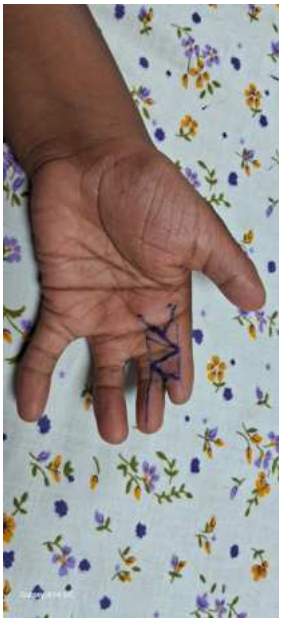

Image- Intra operative clinical image of syndactyly between first and middle finger with markings for dorsal rectangular flap technique.

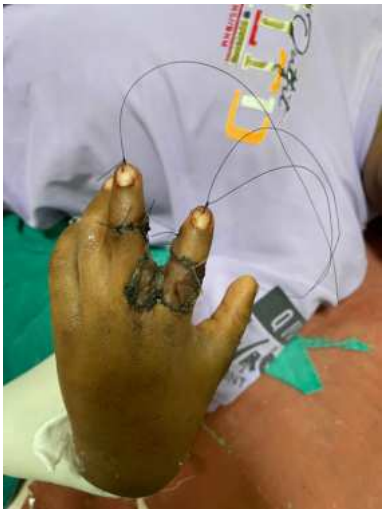

Image- Post operative clinical image of syndactyly release.

Image- Post operative clinical image of syndactyly release.

CONCLUSION-

The dorsal rectangular flap technique is a reliable and effective surgical method for the correction of syndactyly, particularly for reconstructing web spaces. This case demonstrates its applicability in older pediatric patients, achieving both functional restoration and aesthetic improvement. Further studies are warranted to explore long-term outcomes and comparisons with other surgical techniques.Further syndactyly is a great area to study the interaction between genetic mechanisms, epigeneticevents, pleiotropy and how there is great clinical heterogeniety that is seen in various patients.We have encountered a total of 5 patients in a time duration of 2 yrs and dorsal rectangular flap technique was used for the surgical management of all the cases and it has yielded great results in reconsruction of web spaces.

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