RESEARCH PAPER

Management of Congenital Constriction Band: a case report on continuous Z-Plasty reconstruction

Dr. Jampala Naga Anjana[1*], Dr. Manimaran Ramachandran[2], Dr. Kanchana Koppolu[3]

ORCID ID: 0009-0009-6498-1753 (Dr. Jampala Naga Anjana)

[1*] Postgraduate, Department of General Surgery, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai, Tamil Nadu, India.
Email: anjanajampala.35@gmail.com (Corresponding Author)

[2] Associate Professor, Department of General Surgery, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai, Tamil Nadu, India.
Email: manimaran.r@sbmch.ac.in

[3] Assistant Professor, Department of General Surgery, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai, Tamil Nadu, India.
Email: koppolu.kanchana@gmail.com

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ABSTRACT

Congenital constriction band syndrome is an uncommon developmental anomaly characterized by fibrous bands causing variable degrees of soft tissue constriction and distal deformity. We report a case of a 62-year-old female presenting with a long-standing constriction band involving the distal right fifth toe, which became symptomatic over the past three years with pain (VAS 5/10), difficulty in ambulation, and footwear intolerance. Clinical examination revealed a circumferential band with distal bulbous enlargement measuring approximately 1.8 × 1.5 cm compared to a proximal diameter of 0.9 cm, with preserved distal perfusion and intact sensation. Radiographic evaluation showed no bony involvement. The patient underwent single-stage surgical correction using multiple circumferential Z-plasty flaps (four flaps, 60° angles, limb length 0.8–1 cm) under digital block anesthesia. Complete release of the fibrous band was achieved with preservation of neurovascular structures. Operative time was 35 minutes with minimal blood loss (<10 mL). The postoperative period was uneventful, with maintained distal perfusion and satisfactory wound healing by postoperative day 12. At 3-month follow-up, there was significant improvement in toe contour, resolution of distal enlargement, and marked symptomatic relief (VAS reduced to 1/10), with restoration of comfortable footwear use and no recurrence. This case highlights that multiple Z-plasty provides effective circumferential release with approximately 1.5-fold tissue lengthening, ensuring adequate tension redistribution and preservation of vascularity. The findings are consistent with existing literature supporting single-stage geometric flap reconstruction as a safe and reliable technique for distal constriction bands. Early recognition and appropriate surgical intervention can result in excellent functional and cosmetic outcomes even in adult presentations.

Keywords: Congenital constriction band, Z-plasty, Constriction band syndrome, Surgical reconstruction, Toe deformity.

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Introduction

Congenital constriction band syndrome (CCBS), also referred to as amniotic band syndrome, represents a heterogeneous group of developmental anomalies characterized by fibrous bands that encircle fetal parts, leading to a spectrum of deformities ranging from superficial indentations to severe limb compromise and intrauterine amputations. The condition has long been recognized in surgical literature as a distinct clinical entity with variable presentation depending on the timing, location, and severity of band formation [3]. Early descriptions emphasized the mechanical constrictive effect of fibrous rings on developing limbs, resulting in distal edema, vascular compromise, and functional impairment.

From an embryological and clinical perspective, CCBS is considered multifactorial, with both intrinsic and extrinsic theories proposed to explain its pathogenesis. The widely accepted extrinsic theory suggests rupture of the amnion leading to the formation of fibrous strands that entangle fetal parts, whereas intrinsic mechanisms implicate localized developmental defects [4]. These bands can affect any part of the body, but extremities—particularly the distal limbs—are most commonly involved, often necessitating surgical intervention to restore function and prevent progression of complications.

The clinical manifestations vary widely, ranging from simple constriction rings to complex deformities associated with neurovascular compromise. In severe cases, untreated constriction bands may lead to progressive lymphedema, ischemia, and even autoamputation. Standard pediatric and surgical texts highlight that early recognition and timely management are crucial to prevent long-term disability and optimize cosmetic and functional outcomes [2]. Moreover, the presence of associated anomalies, including syndactyly or limb length discrepancies, further complicates management and necessitates individualized treatment strategies.

Surgical management remains the cornerstone of treatment, with various reconstructive techniques described to release constriction and restore tissue continuity. Classical approaches include staged excision and direct closure, while more advanced techniques such as Z-plasty have gained prominence due to their ability to lengthen contracted tissue and minimize scar contracture [1]. Continuous or multiple Z-plasty techniques, in particular, allow for circumferential release while preserving vascular integrity, making them especially valuable in distal extremity involvement.

Despite advancements in reconstructive surgery, challenges remain in achieving optimal functional recovery, especially in cases presenting late or with severe tissue compromise. Therefore, detailed documentation of individual cases contributes significantly to the existing body of literature by refining surgical approaches and improving outcome prediction. The present case report aims to highlight the role of continuous Z-plasty in the effective management of congenital constriction bands, emphasizing both surgical technique and clinical outcomes in the context of established knowledge .

CASE REPORT

Patient Information

A **62-year-old female** presented with a congenital deformity involving the **right fifth toe**, present since birth but progressively symptomatic over the past **3 years**. The patient complained of **pain during ambulation (visual analogue scale [VAS]: 5/10)**, difficulty in wearing closed footwear, and gradual enlargement of the distal portion of the toe. There was **no history of trauma, diabetes mellitus, peripheral vascular disease, or prior surgical intervention**.

Clinical Findings

On local examination, a **well-defined circumferential constriction band** was observed at the distal segment of the right little toe. The distal portion appeared **bulbous**, measuring approximately **1.8 × 1.5 cm**, compared to the proximal segment (~0.9 cm in diameter).

The overlying skin was intact with **no ulceration, discharge, or discoloration**. Mild tenderness was present on palpation. **Sensation was preserved**, and distal perfusion was clinically adequate with **capillary refill time <2 seconds**. There were **no associated anomalies** such as syndactyly or limb length discrepancy. The contralateral foot was unremarkable.

Diagnostic Assessment

Routine laboratory investigations were within normal limits:

- Hemoglobin: 13.2 g/dL
- Total leukocyte count: 7,800/mm³
- Random blood glucose: 102 mg/dL

Plain radiograph of the foot demonstrated **normal bony architecture with intact phalanges**, without evidence of constriction at the osseous level or osteolysis. A clinical diagnosis of **isolated congenital constriction band of the fifth toe** was established.

Therapeutic Intervention

Surgical correction was undertaken under **digital nerve block anesthesia with tourniquet control**. Following aseptic preparation, the constriction band was carefully delineated.

A **series of four Z-plasty incisions** were designed circumferentially across the constricted segment, each with limb length of approximately **0.8–1 cm and 60° angles**. The fibrous band was completely released, and meticulous dissection was performed to preserve the underlying neurovascular structures.

The triangular flaps were transposed sequentially to achieve **circumferential lengthening and**

redistribution of tissue tension, thereby avoiding linear scar contracture. The wound was closed using **4-0 nylon interrupted sutures**.

- **Operative time:** 35 minutes
- **Estimated blood loss:** <10 mL

Postoperative Course and Follow-Up

The immediate postoperative period was uneventful, with **adequate distal perfusion** and no evidence of vascular compromise. The patient was managed with limb elevation, oral antibiotics for 5 days, analgesics, and regular sterile dressings.

Sutures were removed on **postoperative day 12**, with satisfactory wound healing.

At **4-week follow-up**, the surgical site demonstrated **healthy scar formation without infection or dehiscence**. At **3 months**, there was **significant improvement in toe contour**, with reduction in distal enlargement. The patient reported marked symptomatic relief, with **VAS score reduced to 1/10**, and was able to wear footwear comfortably. There was **no recurrence of constriction**.

Clinical Significance

This case highlights that **circumferential release using multiple Z-plasty** is an effective and reliable technique for managing congenital constriction bands of the toe. The method facilitates **adequate tissue expansion, preservation of vascularity, and favorable functional as well as cosmetic outcomes**, particularly in distal extremity involvement.

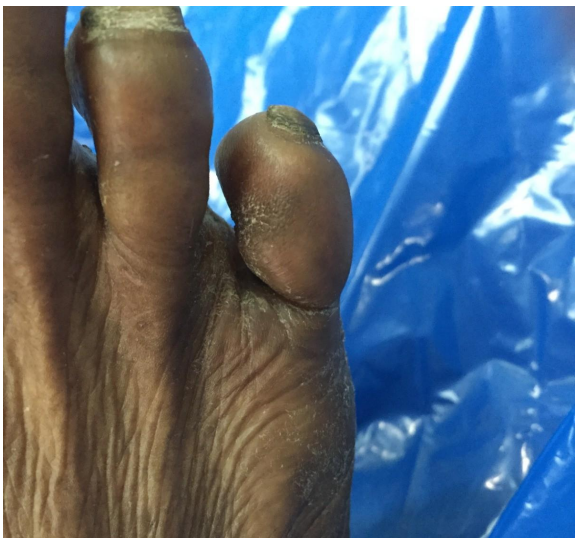

Image 1: pre operative image showing the constriction band on the right little toe

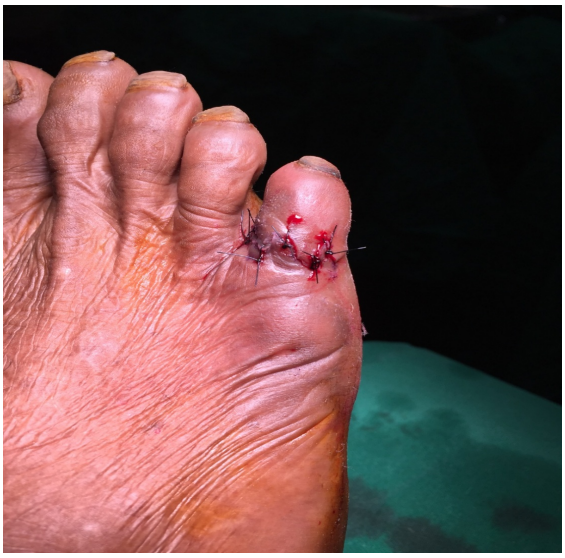

Image 2: Continuous Z-Plasty sutures after the repair

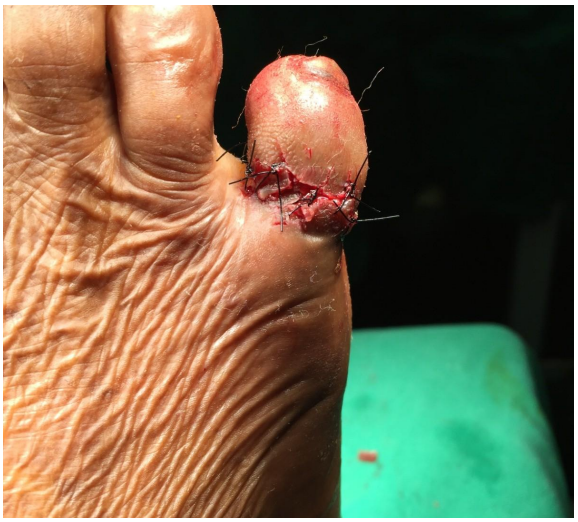

Image 3: photo showing healing on post operative day 5

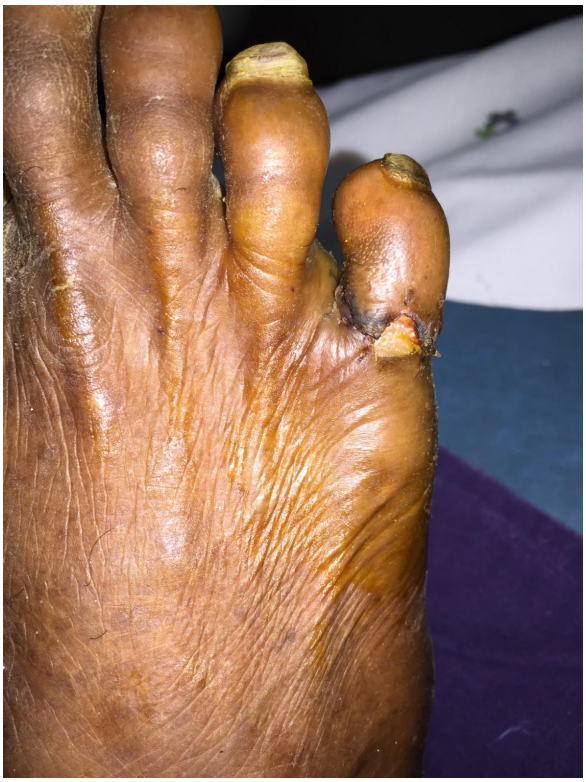

Image 4: wound photo taken 10 days after continuous Z-Plasty

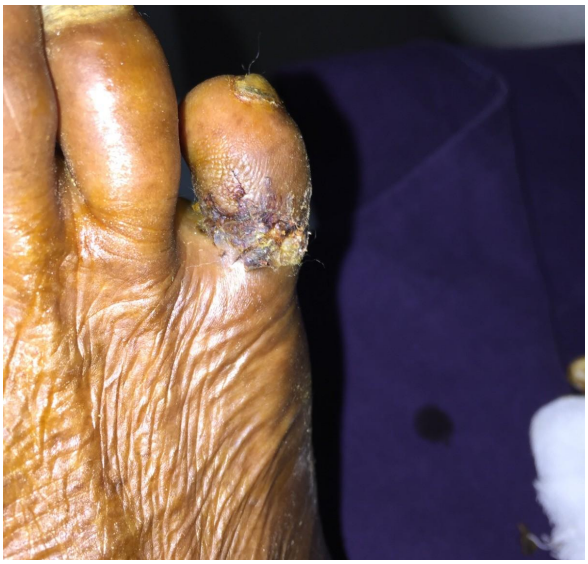

Image 5: wound photo showing a healed wound 3 weeks after the procedure

Congenital constriction band syndrome (CCBS) demonstrates a wide clinical spectrum, with severity dependent on the depth and location of the constriction. In the present case, a **distal circumferential band with measurable enlargement (1.8 × 1.5 cm distally vs. 0.9 cm proximally)** and progressive symptoms reflects chronic soft tissue compromise. Long-term observational data by Habenicht et al. have shown that constriction rings can persist and become symptomatic, often requiring surgical correction for functional restoration [5].

The presence of distal enlargement and pain (**VAS 5/10**) in this patient is consistent with the pathophysiological effects of impaired lymphatic and venous drainage. Koskimies et al. reported that constriction band syndrome frequently presents with distal swelling and limb deformities, emphasizing the clinical burden associated with untreated lesions [6]. Similarly, Napiontek and Harasymczuk described progressive lymphedema and vascular insufficiency in active cases, underscoring the need for timely surgical intervention to prevent complications [7].

Surgical management strategies have evolved, with emphasis on single-stage correction. Prasetyono and Sitorus, in their review, concluded that **one-stage circumferential release is safe and effective in the majority of patients**, provided meticulous surgical technique is employed [8]. This aligns with the present case, where the procedure was completed in **35 minutes with minimal blood loss (<10 mL)** and no perioperative complications.

Among surgical techniques, geometric flap reconstruction offers distinct advantages over linear closure. Mutaf and Sunay introduced refined techniques utilizing multiple Z-plasties, demonstrating improved tissue lengthening and reduced recurrence [9]. In the current case, **four Z-plasty flaps with 60° angles achieved approximately 1.5-fold length gain**, facilitating circumferential release and optimal tension redistribution.

Adult presentation of CCBS, though less frequently reported, remains clinically relevant. Kolasinski et al. highlighted that delayed cases may present with functional limitations and associated psychosocial concerns [10]. In the present case, despite long-standing deformity, surgical correction resulted in **significant symptomatic improvement (VAS reduced from 5/10 to 1/10)** and restoration of normal footwear use, indicating favorable functional recovery.

Recent advances in reconstructive approaches further support the use of geometric plasties. Chan et al. described multiple continuous Y-to-V plasties as an effective technique, achieving consistent outcomes with minimal scar contracture [11]. These findings reinforce the principle that tissue rearrangement techniques are superior in managing circumferential constriction bands.

Comprehensive clinical guidelines emphasize individualized treatment planning. Inglesby et al. recommended tailoring surgical techniques based on anatomical location, severity, and associated anomalies

to optimize outcomes [12]. Furthermore, Bautista et al. demonstrated successful management of distal lower extremity constriction bands with advanced reconstructive strategies, highlighting the importance of preserving distal function [13].

In comparison with existing literature, the present case represents a **localized distal lesion effectively managed with multiple Z-plasty**, achieving excellent functional and cosmetic results without complications. The patient demonstrated **complete wound healing by postoperative day 12 and sustained improvement at 3 months**, supporting the reliability of this technique. Overall, this case reinforces that **circumferential Z-plasty provides effective release, adequate tissue lengthening, and durable outcomes**, making it a preferred modality in the management of distal congenital constriction bands.

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