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Original Research Article

Clinical Outcomes of Treatment of Congenital Constriction Rings in Lower Limbs of Children: A 5 Years Study

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Abstract:

Background: Congenital constriction rings are manifestations of amniotic band syndrome that may cause soft tissue deformity, distal lymphedema, neurovascular compromise, and limb amputation. Surgical release aims to restore function and improve limb contour.

Aim: To evaluate the clinical, functional, and aesthetic outcomes of staged surgical release of congenital constriction rings of the lower limbs in children.

Materials and Methods: A retrospective observational study was conducted on 40 children treated at the Department of Plastic and Reconstructive Surgery, Guwahati Medical College and Hospital, between January 2021 and December 2025. All patients underwent two-stage release, with half of the constriction ring released at each stage, 6–9 months apart. The procedure involved fibrotic tissue excision, fascial release, subcutaneous undermining, and multiple Z-plasties. Outcomes were assessed using the Joseph Upton and Cissy Tan criteria.

Results: The study included 24 males (60%) and 16 females (40%), with a mean age of 10 months. Bilateral involvement was observed in 21 patients (52.5%) and unilateral involvement in 19 (47.5%), accounting for 44 surgical releases. Associated deformities included clubfoot (17 patients) and syndactyly (4 patients). Wound infection and dehiscence occurred in 5 patients, skin necrosis in 2, and persistent oedema in 2. No hypertrophic scarring, scar contracture, or recurrence was observed. Of the 44 releases, 35 yielded excellent, 7 satisfactory, and 2 poor results.

Conclusion: Two-stage surgical release with fibrotic tissue excision, fascial release, and multiple Z-plasties provides favourable anatomical and aesthetic outcomes. Staged decompression may reduce the risk of distal vascular compromise and is a useful approach for congenital constriction rings of the lower limbs.

Keywords: Amniotic band syndrome; Congenital constriction ring; Lower limb; Staged release; Z-plasty; Lymphedema.

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Introduction

Congenital constriction ring is one of the infrequent congenital conditions which is distinguished by fibrous amniotic bands that encircle the developing fetal extremities causing deformations, malformations, compromised vascularity and in some cases, distal amputations of extremities [1]. The effects are varying degrees of soft tissue constriction, distal lymphedema, neurovascular compromise, acrosyndactyly, and, in severe cases, intrauterine amputation. This condition can involve only skin or advances up to deeper structure-like bones potentially resulting in foot gangrene or auto amputation [2].The disorder occurs sporadically and is generally considered non-hereditary. In live newborn, the incidence of this condition varies from one in 1,200 to one in 15,000 [3]. The etiology of this syndrome is multifactorial and till date the exact cause is not properly known [4,6].

Two principal theories have been proposed. Streeter's intrinsic theory suggests that localized

defects in embryonic germ plasm result in abnormal tissue development and subsequent formation of constriction rings. In contrast, Torpin's extrinsic theory attributes the deformity to early rupture of the amnion, producing fibrous amniotic bands that entangle developing fetal parts, resulting in mechanical compression and vascular disruption [7,8]. It may be due to prenatal environmental factors resulting inexcessive contraction of the uterine muscles and haemorrhages from marginal blood sinus [5]. The children born with sequelae of amniotic bands syndrome are at a serious risk of developing multiple congenital anomalies sometimes incompatible with life. Amniotic band syndrome can be described by Patterson classification into following types [9].

Type 1: Simple constriction ring
Type 2: constriction bands accompanied by deformity of the distal part with or without lymphedema
Type 3: constriction bands accompanied by fusion of the distal parts (acrosyndactyly)
Type 4: Intrauterine amputation.

The current modalities of treatment for infants with congenital constriction ring without distal gangrene are :-

1. Single stage circumferential release by excision, fascial release and closure by Z plasty/W plasty in series.
2. Two stage release with each stage comprising of excision of half circumference of constriction ring , fascial release and Z plasty/ W plasty in series .

The present study was undertaken to evaluate the clinical outcomes of treatment of congenital constriction rings in lower limbs of children.

Materials and Methods

A retrospective study was conducted to evaluate the clinical outcomes of surgical treatment of congenital constriction ring in lower limbs of children.

The study period was between January 2021 and December 2025 and included patients who were admitted in the Department of Plastic and Reconstructive Surgery, Guwahati Medical College & Hospital, Guwahati, Assam, India.

Aims and Objectives

1. To study demographics of the patients with constriction rings
2. To assess the association between preoperative severity and anatomical characteristics
3. To document the number of constrictions operated
4. To evaluate postoperative anatomical outcomes and aesthetic outcomes and document the postoperative complications.

Relevant family, prenatal, and neonatal histories were obtained from the patients and their parents. The patients were also evaluated for functional impairment caused by the constriction bands. Clinical examination included assessment of associated anomalies, and any vascular or neurological deficits. When the contralateral limb was unaffected, it was used as a reference for comparative measurements.

Timing of surgery: Patients presenting with severe lymphedema or impending gangrene underwent surgery immediately. Those with mild to moderate lymphedema were prepared and underwent surgery in 1- 2months of presentation.

Surgical technique: A two-stage approach was adopted for all patients, with half of the constriction band released during the initial procedure and the remaining half released during the subsequent procedure, each stage 6-9 months apart.

We avoided single stage circumferential release for the possible risk of vascular compromise. All patients were operated under general anasthesia. The skin edges on either side of the constriction band were approximated to plan the incision. A perpendicular incision was made through the skin and constricting fibrous tissue up to the fascia. The constricted area was carefully released with meticulous dissection to prevent damage to the neurovascular structures. All fibrotic tissue was excised, followed by fascial release.

The subcutaneous tissue was then separated from the fascia for 1.5 cm on either side, followed by a series of Z plasties along the length of the ring. The fascia was not sutured, allowing the subcutaneous fat to redistribute naturally. The skin was closed primarily using 4-0 or 5-0 Vicryl Rapid sutures.

Follow up: Postoperative evaluation was performed at 3 and 6 weeks, 3 and 6 months, at 1 year, and anually thereafter. The outcome of surgery was assessed with respect to functional status, recurrence of the constriction, aesthetic results, and improvement in the symptoms present before surgery.

Results

A total of 40 children with congenital constriction rings involving the lower limbs underwent surgical treatment during the study period. The age of the patients ranged from 4 months to 16 months, with a mean age of 10 months. There were 24 males (60%) and 16 females (40%).

The right lower limb was involved in 11 patients, the left lower limb in 8 patients, and bilateral

involvement was observed in 21 patients. Associated deformities found were clubfoot in 17 patients and syndactyly in 4 patients. Those with clubfoot had limb length discrepancy.

Table 1: Preoperative clinical characteristics

Parameter	Categories or measurement
Number of patients with constriction rings	Single site= 27 patients Multiple site = 13patients
Total Number of rings operated	Thigh= 7 + 3 =10 Leg= 11 + 10=21 Ankle= 9 + 4 =13 Total = 44
Depth of constriction and circumferential extent	Superficial= 10 Deep= 34 Partial = 4 partial= 11 Circumferential = 6 circumferential= 23
Distal oedema in patients	Present=28 Absent= 12
Distal perfusion abnormality	Present= 3 Absent= 37
Skin changes	Indentation only= 7 Pigmentation only =3 Both = 30

A total of 40 patients underwent 44 constriction ring releases, each patient had a two-staged release with a gap of average 7.5 months (6 months – 9 months) The operative approach was individualized according to the anatomical extent and depth of the constriction.

Following surgical procedures were performed:

1. For deep constriction rings and gross limb oedema distally: Excision of constriction ring followed by fascial release and Z-plasty.
2. For superficial constriction rings with mild/none oedema: excision of constriction ring followed by Z-plasty.

Table 2: Distribution of surgical procedures

Operations	Numbers
Z-plasties performed	44 (100%)
Excision of constriction ring	44 (100%)
Fascial release performed	28 (63.6%)
Combination of procedures	28 (63.6%)

Table 3: Postoperative anatomical outcomes at final follow up after second stage surgery

Outcome	After final follow-up
Visible constriction ring	3 (6.8%)
Residual indentation	2 (4.5%)
Distal oedema	2(4.5%)
Contour irregularity	2 (4.5%)
Recurrent constriction	0 (%)
Need for revision surgery	0 (%)

Among post operative complications, wound infection and dehiscence was observed in only 5 patients out of 40. Skin necrosis was seen in 2 patients. Persistent oedema was seen in 2 patients. No patient had hypertrophic scar or any scar contracture. There was no recurrence

Table 4: Aesthetic outcomes at final follow-up after second stage surgery

Outcome	Suggested assessment
Residual groove	Absent- 40, mild- 2, moderate- 2 severe-0
Scar appearance	Flat- 42, raised/widened – 2
Contour symmetry	Improved- 43 unchanged/worsened- 1

Joseph Upton and Cissy Tan criteria for evaluation of results: Excellent: Normal contour, inconspicuous scars, no depression and no distal swellings

Satisfactory: Improved contour, noticeable scars with slight depression over site of original constriction and no distal swelling-

Poor: No contour improvement, conspicuous incision with depressions or recurrence of original deformity

According to the above criteria it was found that 35 releases yielded excellent results, 7 releases had satisfactory result and only 2 releases had poor results.

Discussion

Amniotic band syndrome occurs when fibrous bands entrap different parts of the developing fetus during intrauterine life. The limbs and digits are most commonly affected, although other body regions may also be involved [1]. Involvement of the lower limbs is reported more frequently than that of the upper limbs, consistent with the findings in our patient population [10]. Conservative management is generally appropriate for mild cases of amniotic band syndrome in the absence of neurovascular compromise [11]. Elective surgical release is usually delayed until after six months of age to minimize anesthesia-related complications, except in cases associated with severe lymphedema, impaired perfusion, or functional restriction. Constriction rings are often released in two or three stages to reduce the risk of compromising blood supply to the distal parts of the affected limb. This technique was first proposed by Stevenson [15] and is currently supported by several surgeons [9,16]. In our study, all the patients underwent constriction ring release surgery in two stages. Surgical decompression of lymphedematous tissues is generally easier during infancy, as these tissues have not yet developed significant fibrosis or scarring [13]. In our study also most of the patients were infants and majority of cases developed resolution of distal lymphedema, improvement in distal neurovascular status. Complex procedures requiring multiple stages may need to be postponed until the affected structures can be assessed more accurately in terms of their size and function. According to Upton, major reconstructive surgery should be completed before school age, and simultaneous correction of hand and foot deformities is preferably performed before the child starts walking [14].

Conclusion

Apart from causing visible deformities, congenital constriction rings may impair blood circulation and result in lymphedema or even amputation in severe cases. Correction is therefore important to restore function and improve the appearance of the affected limb. Our study once found that a two staged release of the constriction ring few months apart yielded satisfactory results where in each stage, one half of the constriction ring was released with excision, fascial release and wound closure via multiple Z plasty in series along the ring.

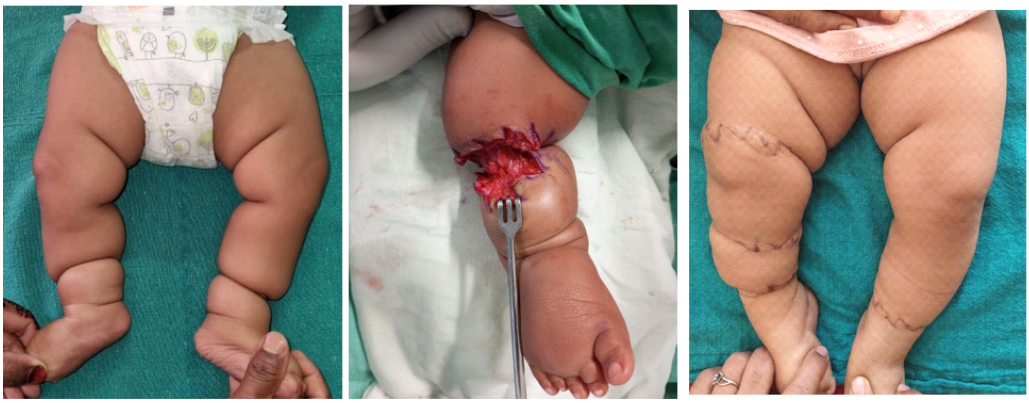


Figure 1: multiple constriction rings in bilateral lower limbs, excision over anterior half of ring with z plasty in series, post operative follow up after 3 weeks.



Figure 2: single constriction ring release over anterior half

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