Treatment of Constriction Bands of Limbs by Fat Injection: An Additional Modality

Le traitement des brides amniotiques des membres par injection de graisse : une modalité supplémentaire

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Abstract

Background: Constriction bands in the majority of cases presents as a contour deformity. The gold standard of treatment is a single-stage constriction ring excision and serial Z-plasty. The expense is unsightly scarring. We present case reports of deformity correction by serial fat injections. **Methods and Participants:** Three case studies of children in whom this modality was used in limbs to correct the deformity are presented. **Results:** Two participants showed a good correction of the deformity and in a single-case treatment failed requiring excision and serial Z-plasty for correction. **Conclusion:** Fat injection in combination with Khouri's technique of aponeurotomies is an attractive modality of managing superficial constriction bands of limbs.

Résumé

Historique : La majorité des brides amniotiques sont responsables d'une malformation des contours. Le traitement de référence est une intervention unique pour exciser les brides amniotiques, suivie de plasties en Z sérielles, au prix de cicatrices disgracieuses. Les auteurs présentent un rapport de cas de malformations corrigées par l'injection sérielle de graisse. **Méthodologie et sujets :** Les auteurs présentent l'étude du cas de trois enfants chez qui ils ont utilisé cette modalité pour corriger la malformation. **Résultats :** Chez deux sujets, la malformation a bien été corrigée, mais dans un seul cas, le traitement a échoué et il a fallu procéder à une excision et à des plasties en Z sérielles. **Conclusion :** L'injection de graisse alliée à la technique d'aponévrotomie de Khouri est une modalité intéressante pour traiter des brides amniotiques superficielles des membres.

Keywords

amniotic bands of the limbs, constriction rings of the limbs, contour deformities, fat injection or infiltration, lipofilling, aponeurotomies, Rigottomies

Introduction

Amniotic band syndrome affecting the limbs have a variable presentation from a superficial constriction band to complete amputation. The band can be associated with vascular,¹ lymphatic, musculoskeletal, and neurological compromise. Amniotic band is a rare congenital abnormality that is not clearly understood. Both intrinsic² and extrinsic³ theories have been suggested with latter enjoying greater popularity. The mainstay of treatment is excision of the ring and circumferential serial Z-plasty of the adjacent tissue to correct the deformity. The major shortcoming of this technique is unsightly scarring. In the last decade, fat grafting has convincingly demonstrated its power as a minimally invasive reconstructive

tool for various types of contour deformities. This retrospective clinical observational case study aims to demonstrate the role of fat injection in the correction of amniotic constriction bands of the limb.

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Figure 1. A, Both legs show constriction rings of both legs and larger dorsum of the foot on the left at the age of 4 months. B, Distal forearm shows a constriction ring at the age of 4 months.

Participants and Methods

A retrospective chart review for the period 2006 to 2014 was performed to identify patients who were treated for the constriction band or bands by fat injection.

Technique of Fat Transfer

The Coleman technique was used in all cases.⁴ The fat was harvested from various donor sources including lipodystrophic sections of the limb, outer thighs, and abdomen. Two to 3 puncture incisions were made in the band for access and with a type 3 Coleman cannula the fibrotic tissue below the dermis of the band was pre-tunnelled. Fat was injected in small fractions with each pass. The compliance of the overlying skin determined the volume of injection, being careful not to allow for the extravasation of the injected fat into the fatty rolls on either side of the band. Post-operatively, a soft bulky dressing of dry gauze was used and the limb was observed for any evidence of vascular compromise. The procedure was repeated if required at later stage.

Results

Three patients presenting with this rare deformity were treated with fat injections. A clinical account of these cases is summarized below.

Case 1

The first child's initial presentation was at the age of 4 months. Constriction bands were present in both lower legs and 1 distal forearm (Figure 1A and B). Although the bands were deep, there was no distal limb vascular, neurological, or lymphatic compromise. The surgery was deferred until the age of 1 (Figure 2A and B). At that operation, a single band on 1 leg only was treated by band excision and a serial Z-plasty. At a year's follow-up, the Z-plasty scarring was displeasing (Figure 3A). However, the remaining constriction bands on all limbs seemed

Figure 2. A, Both legs show constriction rings at the age of 1 year. B, Distal forearm shows constriction ring at the age of 1 year.

Figure 3. A, The left leg shown at the age of 2 one-year post Z-plasty surgery. Photo was taken prior to contour correction by liposuction of the foot and leg and lipofilling of the band. B, The right leg shown at the age of 2 before surgery. Note the spontaneous partial improvement in the contour of the leg. C, The left forearm shown at the age of 2 before surgery. Note the spontaneous partial improvement in the contour of the forearm.

shallower (Figure 3B and C). In the operated limb, lipodystrophic fat deposits were more obvious on the dorsum of the foot and portions of the leg adjacent to the semicircular bands (Figure 3A). This observation prompted the use of fat injection to treat the deformity. Dysmorphic areas were liposuctioned

Figure 4. A, Long-term follow-up result of the right leg at the age of 4 following 2 sessions of fat injection 1 year apart at the age of 2 and 3 years. B, Long-term follow-up result of the left leg at the age of 4 following 2 sessions of fat injection 1 year apart at the age of 2 and 3 years. C, Long-term follow-up result of the left forearm at the age of 4 following 2 sessions of fat injection 1 year apart at the age of 2 and 3 years.

with a syringe. Six mL of fat was injected into the bands of each leg and 2 mL into the forearm. Two years later, the procedure of fat injection was repeated to fill in remaining residual deformity. At 6-month follow-up, the contour of the legs and forearm was acceptable and scarring was absent (Figure 4A-C).

Case 2

The second child's initial presentation was at the age of 2 months. Both hands had deformities synonymous of amniotic band syndrome. One lower limb had a circumferential superficial band of the leg (Figure 5A). At the age of 3, 6 mL of fat was injected into the band followed a year later by another further 12 mL of fat. One-year follow-up at the age of 5 showed a very minor residual deformity and no surgery-related scarring (Figure 5B).

Case 3

The third child's initial presentation was at the age of 10 months. The child had a deep band on one of the legs and foot deformities synonymous with amniotic band syndrome.

Figure 5. A, Right leg shows a superficial constriction band at the age of 3 months. B, Long-term follow-up result of the right leg shows correction of the contour deformity at the age of 5 following 2 sessions of fat injection 1 year apart at the age of 3 and 4 years.

Figure 6. The right leg shows a deep adherent constriction band which failed to be corrected by 3 sessions of fat injections eventually corrected by a single-stage Z-plasty.

Surgery was deferred until the age of 3 years (Figure 6). Sixteen mL of fat was injected under the band and the acrosyndactyly of the toes was also treated. Of note, during the injection process, the band progressively tightened and extravasation of the fat to either side of the band was difficult to control. The surgeon (author) specifically noted in the operative records that any further fat injection was to be deferred until the so-called baby fat is lost which could take a few years. An error of omission by other members of the team resulted in a further 2 sessions of fat injection of 16 mL within the next 12 months. At 2-year follow-up, the residual deformity was still significant and the mother was unhappy with the result. An excision of the constriction band and serial Z-plasty was performed.

Discussion

The treatment of choice in the management of constriction ring of the limb is a single-stage excision of the ring and related

fibrotic tissue and circumferential serial Z-plasty repair.⁵ The contour is easily corrected but the scarring can be unsightly. A reasonable explanation for poor scarring is Z-plasty scars are not in relaxed skin tension lines (RSTL). Ironically, the constriction rings are more or less in RSTL.

Our primary aim was to avoid scarring and fill in the soft tissue defect. In the majority of the cases of amniotic band syndrome, the underlying deficiency at the band is subcutaneous tissue only. It was our hypothesis that replacing this will improve or correct the deformity.

Surgeons who manage this condition would have observed that the constriction ring grows with the limb as opposed to causing progressive constriction with growth of the limb. Vascular, lymphatic, musculoskeletal, or neurological compromise when present at birth is developed in utero. It is my thinking that the birth process or an adverse event may be responsible for a threatened limb necessitating early neonatal intervention to assist the limb in recovering from the underlying vascular insufficiencies. Neurological, musculoskeletal, and lymphatic problems may also require early intervention. Conceptually then in the absence of these problems, to replace the deficiency with fat by injection is a sensible approach.

Khouri et al introduced the concept of percutaneous aponeurotomy and lipofilling.⁶ They managed many different reconstructive conditions in their series with this technique, hence avoiding flap surgery. They however did not elaborate on the 3 congenital constriction band group treated in this way.

The first 2 cases clearly demonstrated the value of the fat injection. The third case did not. In the latter's case, failure could potentially have been avoided if treatment was deferred to a later stage and allowing for compliance of the band to improve and the adjacent subcutaneous fat compartment to deflate before further fat injection is performed. Conversely, the band was intrinsically too deep and tight for treatment by fat injection. Khouri's technique by performing Rigottomies transforms the underlying tissue into a matrix that expands and renders it more compliant to the lipofilling and improves fat survival.⁶ When dealing with a deep tight band, this technique maybe a solution.

A crucial observation of the constriction ring bands in the fat limbs by the author is the apparent depth due to the relative underlying fat deficiency under the band. As the baby grows and the "baby fat" adjacent to the ring is lost, the deformity significantly improves. Therefore, it will make sense to defer the corrective fat injection until the age of 2 years or more.

There is probably no limit to the number of fat injection sessions that can be performed. The only limitation is the volume that can be injected at any given session without increasing tension in the compartment under the ring. The tension created will be detrimental in 2 respects. One is the impact on fat survival and the other is extravasation of the fat to the normal adjacent subcutaneous compartment. Graft loss and inappropriate fat augmentation will not correct the deformity. Therefore, in managing amniotic constriction bands by fat

injection timing, volume and interval between sessions may be important factors.

In the recent past, several authors have published their series in treating constriction rings by excision and direct straight-line closure in an attempt to avoid the unsightly scars.^{7,8} Importantly, the deformed section of the skin and band is excised and released, and the sleeve of the adjacent skin and subcutaneous tissue is advanced to get full-thickness closure. The scar quality was also very good, and no constriction was seen with growth in the limb.

Conclusion

In constriction band deformities of the limbs without functional compromise, surgery only serves an aesthetic purpose. A serial Z-plasty correction of the constriction ring is aesthetically a poor solution. Our small series supports the use of fat grafting. Kouri's technique of aponeurotomies is a very useful adjunct. Deeper and tighter bands are probably best treated by excision and a straight-line closure.

Author's Note

The ethical approval number BCA 083/12 was obtained from university's Biomedical Research Ethics committee.

Declaration of Conflicting Interests

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