

# Selective botulinum toxin injection in the treatment of recurrent deformity following surgical correction of club foot

## A preliminary report of 3 children

Piers D Mitchell, Martin Tisdall and Hamid G Zadeh

West Middlesex University Hospital, Twickenham Road, Isleworth, Middlesex TW7 6AF, UK  
Correspondence HZ: zadeh@zadeh.co.uk  
Submitted 03-06-25. Accepted 04-02-28

**ABSTRACT** Management of a child with club foot deformity that recurs after an apparently successful posteromedial soft tissue release remains a challenge. Revision surgery is often attempted, but this carries a high risk of significant scarring or neurovascular complications. We have treated 3 children (3 feet) with relapsed club foot and fixed deformities, using Botulinum toxin A (BTX-A) injection into muscle groups clinically thought to be responsible for recurrent deformity, followed by moulded plaster casts. Two cases have maintained a good foot position with an minimum follow-up of 18 months, and one other is also doing well having had a tibialis anterior tendon transfer as well as the BTX-A therapy. In our limited experience, targeted BTX-A injection with plaster casting has been safe, and may obviate the need for major revision surgery in a proportion of cases with recurrent club foot deformity following previous posteromedial soft tissue release.

Approximately 25% of patients undergoing open surgery for club foot later develop a recurrence of some aspect of their deformity (Cummings et al. 2002). Reasons proposed for this include an underlying neuropathy, muscle imbalance, inadequate initial correction, loss of reduction, persistent primary deformity of the talar neck, and bad scarring (Crawford and Gupta 1996).

A child whose deformity recurs after undergoing extensive posteromedial soft tissue release remains

a difficult clinical problem. Early revision surgery will not only worsen the scarring around the foot, but also carries a significant risk of complications such as damage to neurovascular structures. We have employed targeted botulinum toxin (BTX-A) injections into muscle groups clinically thought to be responsible for the recurrent deformity in conjunction with a short period of casting to maintain the correction, and we report our preliminary experience in 3 feet.

### Patients and methods

This report concerns 3 children (3 feet) treated at our unit between 1999 and 2002 (Table). In all, 10 children (12 club feet) underwent such surgery at our institution during this period, giving a recurrence rate similar to that published previously (Cummings et al. 2002). We have included those children who underwent apparently successful correction of congenital talipes equinovarus deformity, but had recurrent deformity within 3–6 months of the index procedure. None of these children had any evidence of underlying neuromuscular disorders. The severity of the deformity was graded according to the Harrold classification (Harrold and Walker 1983). This was chosen for its simplicity compared to other classifications. All three cases had severe fixed deformities at presentation (Harrold C). They were initially referred to the pediatric physiothera-



Method of targeting BTX-A injections using a cannulated nerve stimulator in a child with clubfoot.

pist for a 6-week trial of supervised stretching and strapping. As this failed to correct the deformity, a posteromedial soft tissue release was made between 11 and 13 months of age. This timing was chosen as the children would be walking at that age, which should help to maintain the corrected foot position. The average age at the time of soft tissue release was 12 months, at the time of BTX-A injection 19 months and at the latest follow-up 40 months. The minimum follow-up period following BTX-A injection was 18 months.

#### *Posteromedial soft tissue release*

In each case, surgery employed the extended posteromedial incision (Turko 1971) and was performed by the senior author (HGZ). Postoperatively, the foot was kept in a cast for 2–3 months. After removal of the cast, the immediate correction of deformities was judged to be excellent in all 3 cases. The parents were advised to continue with regular stretching and to apply a night splint. The recurrent deformity was noted in these cases within 6 months of removal of the cast.

#### *Treatment of recurrent deformity (targeted BTX-A injection)*

The muscles thought to be responsible for the recurrence were determined clinically. The foot was stressed towards the neutral position and tight structures beneath the skin identified by palpation. If progression of the deformity continued despite intensive physiotherapy, then targeted BTX-A injections were performed with the informed consent of the parents.

This procedure was undertaken under general anesthesia, with electromyography to ensure the accuracy of each injection (O'Brien 1997). We used a cannulated nerve stimulator (Stimuplex, B Braun, Sheffield, UK) to identify the individual muscles, by observing the movement resulting from their stimulated contraction (Figure, Table). Generally, 10 i.u. of BOTOX (Allergan Ltd., High Wycombe, Bucks, UK) was injected into each injection site. For tendo-Achilles contractures, 2–4 injection sites were used in the calf, but for other muscles only 1 was used. A below-knee weight-bearing cast was applied following the injection and this was changed under general anaesthesia, within 2–3 weeks. This change of cast was to optimize the foot position once the muscles had come under the full effect of the BTX-A. The cast was removed after 6 weeks and regular exercises were continued under the supervision of the physiotherapist. The children were then reviewed regularly in the outpatient clinic with assessment of their feet using the Harrold classification, as had been done preoperatively.

## Results

All 3 children had marked correction of their deformities following the injections and casting (Table). In both patients with hind foot equinus, the deformity resolved and did not recur. In the patient with hind foot varus, the deformity resolved and did not recur. In both patients with forefoot adductus, the deformity was substantially improved and converted from fixed adductus into dynamic adductus, which was passively correctable to the neutral position. In one of these cases, a tibialis anterior tendon transfer (Kuo et al. 2001) was performed at a later date, and the adductus resolved. No side effects from the BTX-A were reported by the parents.

## Discussion

Recurrent deformity following surgical release of CTEV is a major problem (Crawford and Gupta 1996). However, early revision surgical release is associated with significant risks. In many cases,

## Patient details

Patients	1	2	3
Age at surgery	13 months	12 months	12 months
Recurrent deformity before BTX-A injection	Fixed equinus and forefoot adductus	Fixed hind foot varus, forefoot adductus and supination	Fixed equinus
Age at BTX-A injection	17 months	17 months	21 months
Muscles injected	Gastrocnemius, tibialis posterior and abductor hallucis muscles	Abductor hallucis and flexor digitorum brevis	Gastrocnemius and soleus
Recurrent deformity after BTX-A injection	Dynamic forefoot adductus	Dynamic forefoot adductus	nil
Revision surgery	Tibialis anterior tendon transfer	nil	nil
Age at final follow-up	42 months	46 months	34 months
Deformity at final follow-up	nil	Dynamic forefoot adductus	nil

the underlying cause of recurrent deformity is residual muscle imbalance. This has led some authors to advocate muscle transfer as well as soft tissue release at the time of surgical correction for club foot deformity (Huang et al. 1999). Others favor muscle transfers and plantar fascia release if recurrent deformity persists despite serial casting (Ponseti 1996). BTX-A injections have given us the opportunity to correct muscle imbalance in a selective and reversible manner, to correct recurrent deformity. The use of plaster casting is presumed to complement the effects of the BTX-A by maintaining the optimal foot position, thus lessening the chances of the deformity recurring in the early postinjection period. The minimal side effects associated with BTX-A therapy (Gormley et al. 1997) make it an attractive alternative to more radical approaches such as revision surgery or Ilizarov frame correction (Bradish and Noor 2000, Simons 1985). In any case, these techniques remain an option for the clinician at a later date should BTX-A therapy be unsuccessful.

Delgado et al. (2000) have described targeted injections with BTX-A for the treatment of unoperated club foot, in the hope of avoiding surgery in those who had failed to improve sufficiently with physiotherapy. In consequence, they have treated a different group to the children we describe. The deformity recurred in 2 of their 4 cases, however, and they believe that this was due to an underlying neurological disorder. It seems likely that BTX-A treatment will only have a role in a proportion of patients. As there is a tendency for muscle imbalance to improve with increas-

ing age, we believe that by treating the recurrent deformity with BTX-A therapy, we might avoid the need for revision surgery in some patients in the long term.

No competing interests declared.

- Bradish C F, Noor S. The Ilizarov method in the management of relapsed club feet. *J Bone Joint Surg (Br)* 2000; 82: 387-91.
- Crawford A H, Gupta A K. Club foot controversies: complications and causes for failure. In: *Instructional Course Lectures. Series no. 45* (ed. D J Pritchard). Rosemont, Illinois: American Academy of Orthopaedic Surgeons 1996: 339-46.
- Cummings R J, Davidson R S, Armstrong P F, Lehman W B. Congenital club foot. *J Bone Joint Surg (Am)* 2002; 84: 290-308.
- Delgado M R, Wolson H, Johnston C, Richards S, Karol L. A preliminary report of the use of botulinum toxin type A in infants with club foot: four case studies. *J Pediatr Orthop* 2000; 20: 533-8.
- Gormley M E, Herring G M, Gaebler-Spira D J. The use of botulinum toxin in children: a retrospective study of adverse reactions and treatment of idiopathic toe-walking. *Eur J Neurol (Suppl 2)* 1997; 4: S27-30.
- Harrold A J, Walker C J. Treatment and prognosis in congenital club foot. *J Bone Joint Surg (Br)* 1983; 65: 8-11.
- Huang Y T, Lei W, Wang J. The treatment of congenital club foot by operation to correct deformity and achieve dynamic muscle balance. *J Bone Joint Surg (Br)* 1999; 81: 858-62.
- Kuo K N, Hennigan S P, Hastings M E. Anterior tibial tendon transfer in residual dynamic club foot deformity. *J Pediatr Orthop* 2001; 21: 35-41.
- O'Brien C F. Injection techniques for botulinum toxin using electromyography and electrical stimulation. *European J Neurol (Suppl 2)* 1997; 4: S47-51.

Ponseti I V. Congenital club foot. Fundamentals of treatment. Oxford: Oxford University Press, 1996.

Simons G W. Complete subtalar release in club feet. *J Bone Joint Surg (Am)* 1985; 67: 1044-55.

Turco V J. Surgical correction of the resistant club foot. *J Bone Joint Surg (Am)* 1971; 53: 477-97.