



CHANGES IN ANKLE MUSCULAR STRENGTH AFTER ANTERIOR TIBIALIS TENDON TRANSFER IN CHILDREN WITH CLUBFEET DEFORMITIES:

A PROSPECTIVE STUDY

Aaron Lyles, MD^c, Hank White, PT, PhD^a, J.J. Wallace, MS^a, Sam Augsburger, MS^a,
Erika Erländson, MD^c, Janet Walker, MD^{a, b}, Henry Iwinski, MD^{a, b}

^a Shriners Hospitals for Children, Lexington, KY

^b University of Kentucky Department of Orthopaedic Surgery, Lexington, KY

^c University of Kentucky Department of Physical Medicine and Rehabilitation, Lexington, KY

CONGENITAL
TALIPES
EQUINOVARUS
(CLUBFOOT
DEFORMITY)



Graham, John M., MD, ScD - Smith's Recognizable Patterns
of Human Deformation, 40-47
© 2007 Copyright © 2007, Elsevier Inc. All rights reserved.

DEMOGRAPHICS

- The incidence as high as 1-2 cases per1000 live births.
- The incidence is higher in the Polynesian population and lower in the Chinese population.
- Congenital club-foot is also twice as common in male patients.



PONSETI METHOD

Serial long leg casting in the following order (CAVE):

Pes **C**avus

Metatarsus **A**dductus

Hindfoot **V**arus

Hindfoot **E**quinus

Followed by use of a foot abduction brace

PONSETI METHOD



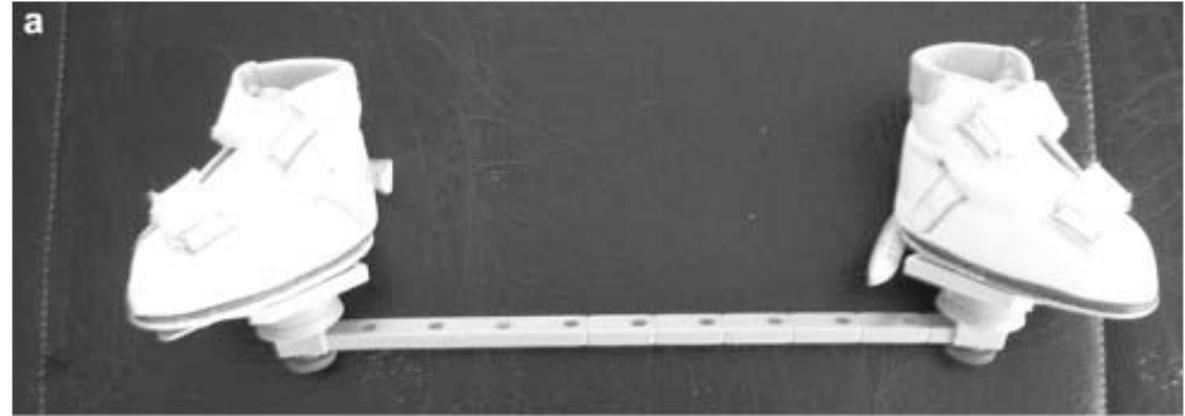
Ricco, Anthony I. - Tachdjian's Pediatric Orthopaedics, 761-883
© 2014 Copyright © 2014, 2008, 2002, 1990, 1972 by Saunders, an imprint of Elsevier Inc.

DEROTATION SPLINTS

“Denis Browne bar” and
boots.

a: Unibar®

b: Ponseti Mitchell.



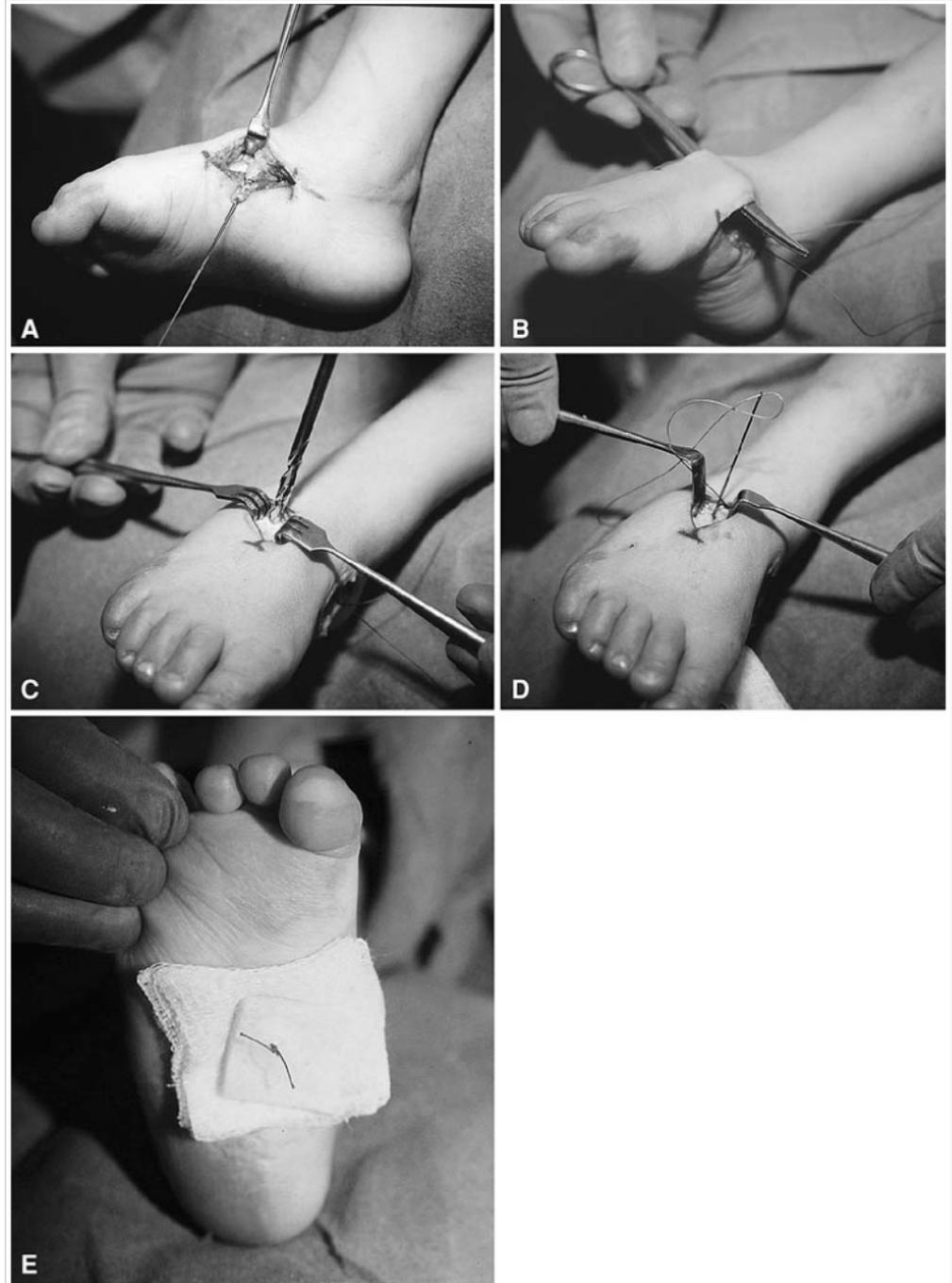
Bergerault, F., Fournier, J., Bonnard, C. - Orthopaedics & Traumatology:
Surgery & Research - Volume 99, Issue 1, Supplement, S150-S159 © 2012
Elsevier Masson SAS



RECURRENCE

- Initial correction is achieved in almost 95% of clubfeet after treatment with Ponseti casting.
- Recurrence rates of almost 50% have been reported.
- Compliance with the use of orthoses after the initial correction can decrease the recurrence rate.
- Recurrence of clubfoot deformity usually happens before the age of four years.
- Tibialis anterior tendon transfer to the third cuneiform has been shown to prevent recurrence in patients with dynamic supination.

ANTERIOR TIBIALIS TENDON TRANSFER SURGERY



(Thompson, Hoyen et al. 2009)

- ATTx is done to improve the imbalance between foot inverters (including the tibialis anterior) and weak foot everters, but tendon transfer surgery may weaken the transferred muscle, which may affect its primary function of dorsiflexion.
- Hand held dynamometers are a standard, unbiased way of measuring muscle strength and have been validated for use in young children.

HYPOTHESIS

- No significant weakening of the tibialis anterior will be detected with hand held dynamometers measurements at the ankle.

METHODS

- Part of the prospective arm of a larger study looking at objective outcomes following ATTx surgery using a convenience sample of patients. Uninvolved limbs were used as a control.
- Patient selection:
 - Inclusion criteria:
 - Diagnosis of idiopathic clubfoot deformity previously treated by Ponseti casting with or without Achilles tenotomy
 - Scheduled to undergo anterior tibialis tendon transfer
 - Exclusion criteria:
 - Treatment of clubfoot deformity by any other treatment than Ponseti casting with or without Achilles tenotomy
 - Associated neuromuscular disease
 - Unable to walk and cooperate with foot contact pressure assessment or strength measurement

MEASUREMENTS

- Isometric muscle strength at the ankle was measured by a single experienced physical therapist using a hand-held dynamometer (PowerTrack II Commander from JTech Medical, Salt Lake City, UT) prior to surgery and around 6 months following surgery. The reliable method for quantifying foot and ankle strength in young children described by Rose et al. was followed except that the patient's knees were allowed into 30-45 degrees of flexion. The method includes a "make" tests whereby the examiner holds the dynamometer stable and the child is subsequently prompted to exert maximal force against the meter.
- Strength data were converted to kilograms and normalized to body weight (%BW) at each visit

SURGERY

- Performed by one of 4 experienced surgeons
- In all procedures, the tibialis anterior tendon was wholly transferred to the lateral cuneiform
- 2 incisions under retinaculum, tendon secured as tightly as possible.
- Placed in cast for 6 weeks in dorsiflexion and valgus and allowed to walk in cast. Following removal of cast, patient placed in AFO.

STATISTICS

Mean of 3 trials used for all statistics.

Repeated measures ANOVA with between-subjects factors was performed using SPSS 21 (Chicago, IL) software. Measured strength was evaluated as a within-subjects factor and surgical intervention was evaluated as a between-subjects factor. Differences between groups also evaluated, equal variance was not assumed.

RESULTS: PATIENT CHARACTERISTICS

- 16 Patients
 - Age at initial evaluation: 49 +/- 14 months
 - 10 male, 6 female
 - 23 involved limbs
 - 2 Left
 - 7 Right
 - 7 Bilateral
 - 16 patients had undergone transcutaneous Achilles tendon lengthening

RESULTS: STRENGTH BETWEEN GROUPS

	Baseline			6 months post-op		
	Uninvolved (n = 9)	Surgery (n = 23)	p value*	Uninvolved (n = 9)	Surgery (n = 23)	p-value*
Strength (% BW):						
Plantar flexion	57 (27)	54 (30)	0.753	69 (27)	68 (30)	0.953
Dorsiflexion	29 (10)	23 (9)	0.160	32 (12)	29 (10)	0.406
Eversion	25 (8)	18 (10)	0.053	33 (14)	23 (11)	0.080
Inversion	22 (9)	20 (9)	0.633	31 (7)	22 (9)	0.009[†]
Eversion/ Inversion ratio	1.193 (0.400)	0.983 (0.620)	0.272	1.097 (0.498)	1.130 (0.596)	0.874

Values expressed as percent body weight with SD in parentheses; *p values obtained from T-test using SPSS 21 software, equal variance not assumed.
[†]Considered significant if p < 0.05.

RESULTS: REPEATED MEASURES ANOVA ANALYSIS

	Test for difference in strength between baseline and 6 month follow-up		Test for difference in strength between intervention and control groups	
	F (1,30)	p value	F (1,30)	p value
Plantar flexion	6.36	0.017[†]	0.76	0.785
Dorsiflexion	6.59	0.015[†]	0.38	0.541
Eversion	6.9	0.013[†]	0.38	0.545
Inversion	12.89	0.001[†]	5.19	0.030[†]

[†]Considered significant if $p < 0.05$.

DISCUSSION

- Data supports hypothesis as no significant difference seen between surgical and uninvolved limbs with the exception of decreased ankle inversion strength in the surgical group. ANOVA analysis suggests that increase in strength seen in all groups following surgery was not attributable to the surgery except for a relative weakness again in the angle inverters of the surgical group.
- Study weaknesses:
 - Small sample size
 - Short follow up (in cast for 6 weeks)