



Modified Grice-Green subtalar arthrodesis performed using a partial fibular graft yields satisfactory results in patients with cerebral palsy

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Introduction

- Grice–Green extraarticular subtalar arthrodesis
 - valid surgical method
 - improves foot alignment in pediatric population with pes planovalgus deformity
- Originally described to treat children with poliomyelitis
 - Grice DS. JBJS (Am) - 1952*
- Satisfactory long-term results in children with cerebral palsy (CP)
 - Mazis GA, et al. Foot Ankle Int – 2012*
 - Bourelle S, et al. JBJS (Br) – 2004*
 - Jeray KJ, et al. J Pediatr Orthop – 1998*
 - Alman BA, et al. J Pediatr Orthop – 1993*



Introduction

- Different bone graft sources
 - Fibula, tibia, or iliac crest
- Graft-related problems (**15-33%**)
 - delayed union or complete dissolution of the graft
 - fractures of the graft or donor site
 - technical problems with contouring of the graft to achieve adequate correction
 - loss of correction because of slippage of the graft
 - valgus deformity of the ankle

Scott SM, et al. J Pediatr Orthop – 1988

Ross PM, et al. CORR – 1980

McCall RE, et al. J Pediatr Orthop – 1985

Jeray KJ, et al. J Pediatr Orthop – 1998

Moreland JR, et al. CORR – 1986



Introduction

- Several modifications of the type of bone graft and graft harvesting techniques
 - A double layer of a corticocancellous tibial graft
(Chigot PL, et al. *Rev Chir Orthop Reparatrice Appar Mot* – 1965)
 - a strip of corticocancellous bone from the lateral wall of the calcaneus
(Alban SL, et al. *JBJS (Am)* – 1975, Romanini L, et al. *J Orthop Traumatol* – 1983)
 - an osteoperiosteal based flap from the surface of the talus and calcaneus
(Howie CR, et al. *JBJS (Br)* – 1989)
 - local bone graft with percutaneous fixation
(Jeray KJ, et al. *J Pediatr Orthop* – 1998)
- Partial subperiosteal fibular graft technique
 - Faraj AA. *J Foot Ankle Surg* - 1999
 - patients with poliomyelitis to decrease graft site morbidity
 - using of two partial fibular bone blocks placed across the subtalar joint



Purpose

- This is the first report of using the same technique (partial subperiosteal fibular graft), which was performed by obtaining only one partial subperiosteal fibular bone graft in patients with CP
- Our aim was to evaluate the radiological and clinical results of this modified technique in patients with CP



Materials & Methods

- Between the time period May 2011 and May 2014
- 15 feet of 11 patients (6 girls, 5 boys) with CP
 - 4 right feet, 3 left feet, 4 bilateral
 - 3 patients (5 feet) - spastic quadriplegics
 - 6 patients (8 feet) - spastic diplegics
 - 2 patients (2 feet) - spastic hemiplegics
- Mean age at the time of surgery - **10.7 (range 6–15) years**



Materials & Methods

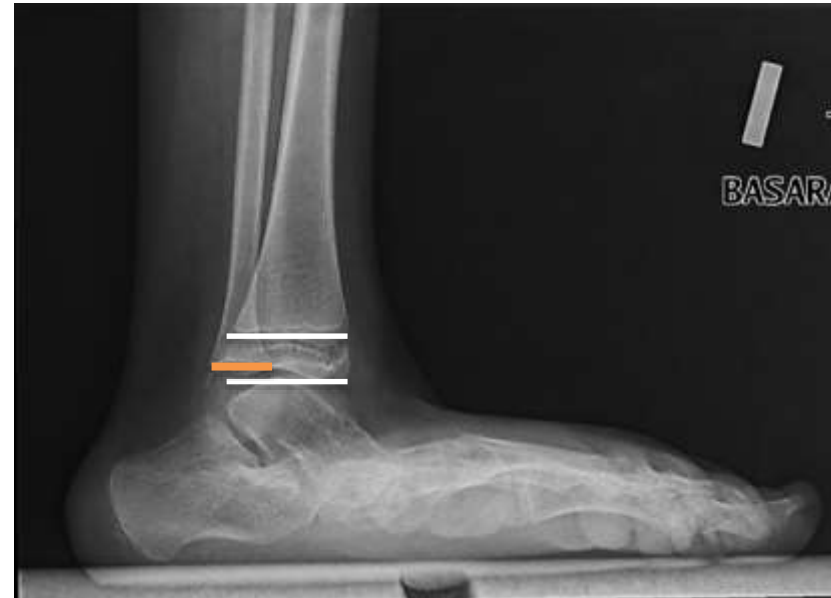
- Gross Motor Function Classification Scale (GMFCS)
 - GMFCS level I – 2 hemiplegics
 - GMFCS level II – 1 diplegic
 - GMFCS level III – 5 diplegics, 1 quadriplegic
 - GMFCS level IV – 2 quadriplegics
- Before the subtalar arthrodesis procedure
 - multiple tendon release for 5 patients (3 quadriplegics, 2 diplegics)
 - multiple botulinum toxin injections for 6 patients (3 quadriplegics, 3 diplegics)
- All patients received the physiotherapy rehabilitation protocol during their operative period



Materials & Methods

Radiological assessment

- Anteroposterior (AP) and lateral weight-bearing radiographs of the feet
 - AP and lateral talocalcaneal angles
 - AP and lateral talus-first metatarsal angles
 - Calcaneal pitch angle
 - Ankle valgus according to Malhotra et al. (*Malhotra D, et al. JBJS (Br) – 1984*)
 - Distal fibular epiphyseal line located between the talar plateau and the distal tibial epiphysis (grade 1) in all feet





Materials & Methods

Surgical technique

- A 5cm oblique skin incision centered over the sinus tarsi
- Visualization of sinus tarsi and cleaning from the soft tissues
- Applying plantar flexion and inversion to the foot
- Calcaneus inverted out of its valgus position under the talus
- Then, attempting dorsiflexion of the foot
 - In 3 patients (4 feet; 26.6%), lengthening of the aponeurosis of the gastrocnemius (Vulpinus) procedure
- Preparing of the graft bed by using a thin osteotome

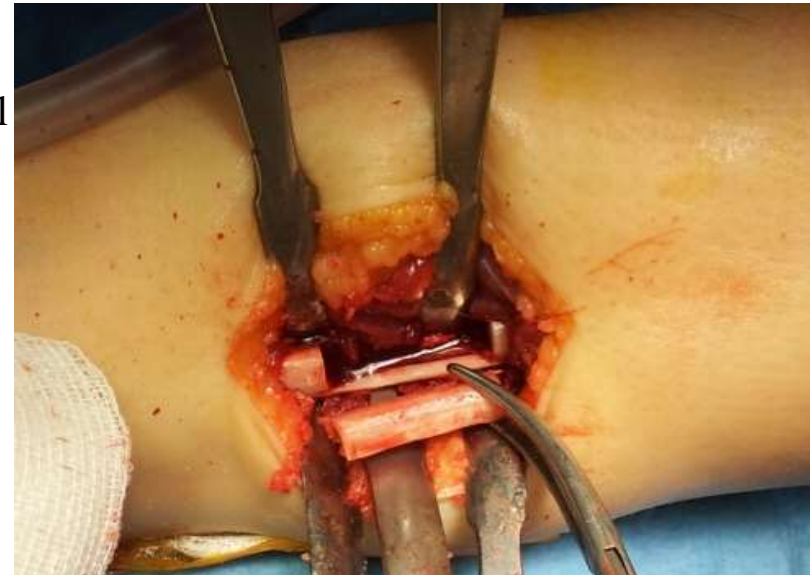




Materials & Methods

Surgical technique

- The ipsilateral fibula – graft donor
 - A 5–6 cm lateral longitudinal incision over the distal third of the fibula
 - A subperiosteal strut graft obtained from the junction of the middle and distal third of the fibula above the syndesmosis
- Fibular osteotomy carried out using an oscillating saw by respecting the periosteum in each case



Care was taken to obtain a 2/3 semicircular partial fibular graft with an intact posterior cortex of the fibula



Materials & Methods

Surgical technique

- Fibular graft placed into its bed in the sinus tarsi extraarticularly while forcing the subtalar joint into the varus position
- **Attention was paid to ensure that the long axis of the graft was parallel to the long axis of the tibia while the ankle was held in a neutral position**
- Varus–valgus position of the heel was assessed on clinical examination intraoperatively
- No internal fixation was needed in any of the cases after locking the graft at its slots





Materials & Methods

Postoperative period and follow-up

- Immobilization in circular short leg cast for 4 weeks
- Partial weight-bearing at 4th week
- Short leg cast continued until early incorporation of the bone graft visible on the lateral weight-bearing radiographs of the foot
- After removal of the casts, patients were advised to use orthoses according to the individual patient's needs and comfort, but no general recommendations were provided



Materials & Methods

Postoperative period and follow-up

- Follow-up at monthly intervals up to 3 months, every 3 months up to 12 months, and every 6 months up to the last visit
- Same radiographic angles measured on the immediate postoperative and final follow-up radiographs
- Graft position against the weight-bearing axis of the tibiotalar joint
- Functional parameters
 - walking ability, pain and skin problems
 - need for orthoses and special orthopedic shoes
- A questionnaire to assess the subjective outcome of the procedure
(*Jeray KJ, et al. J Pediatr Orthop – 1998*)



Results

- Average follow-up period - **24 (range 9–39) months**
- Average age of the patients on the final follow-up – **12.4 (range 8–17) years**
- Postoperative recovery was uneventful without infection in any of the cases
 - One superficial skin necrosis under a cast was the only immediate postoperative complication
- Cast removal at the 7th week (range 6–9) on average

- All grafts were stable and solid fusion with sustained correction occurred in all feet
- The gap at the donor site showed complete fibular regeneration in all procedures



Results

Radiological outcomes

- Improvement for all radiographic parameters
- **Preoperative ankle valgus remained unchanged for all applications**

Radiological outcomes of patients

	Preoperative	Postoperative	At the latest follow-up
AP TCA	41.3°±8.5° (31°–63°)	26.4°±4.3° (20°–35°)	25.7°±2.6° (21°–32°)
Lateral TCA	44°±7.3° (35°–58°)	28.4°±4.7° (20°–35°)	28.6°±3° (23°–33°)
AP TFM	22.1°±9.4° (10°–44°)	6.2°±2.2° (3°–11°)	6.5°±2° (4°–11°)
Lateral TFM	18.2°±11.6° (8°–40°)	6.9°±4.2° (4°–18°)	6.4°±3.5° (3°–15°)
CPA	10.4°±3.9° (3°–17°)	17.4°±3.7° (12°–23°)	16.9°±2.7° (12°–21°)
Ankle valgus according to Malhotra <i>et al.</i>	<u>All in grade 1</u>	<u>All in grade 1</u>	<u>All in grade 1</u>

Values are given as the mean and SD, with the range in parentheses.

AP, anteroposterior; CPA, calcaneal pitch angle; TCA, talocalcaneal angle; TFM, talus-first metatarsal angle.

Results

Radiological outcomes

- Graft alignment
 - 13 (86.6%) feet - neutral
 - 2 (13.4%) feet - posterior
- In two feet (13.4%) - 5° valgus angulation of the distal fibula on the coronal plane **without any upward migration of the lateral malleolus**
- No angulations on the sagittal plane in any of the patients





Results

Functional outcomes

- Cosmetic foot appearance and walking ability - markedly improved
 - preoperative complaints were reduced in all patients
- **Nine (81.8%) patients were still able to walk, seven (64%) of whom required no support**
 - GMFCS levels of four diplegic patients, who were able to walk with support (GMFCS level III) preoperatively, upgraded to level II
 - GMFCS levels of the remaining patients were unchanged
 - of those unable to walk, two patients were still able to stand with orthoses and support
 - six patients required orthopedic shoes



Results

Satisfaction questionnaire

- **Ten (91%)** of the 11 patients (13 feet) were **satisfied** with the surgical procedure and one (9%) patient (two feet) was dissatisfied

Clinical results obtained from the questionnaire on patients'/parents' satisfaction

Questions	Response (n)		Patients (%)	Feet (%)
	No	Yes		
Does your child's foot/feet look better now than it did before surgery?	1	10	91	86.6
Was the surgery worth it?	1	10	91	86.6
Would you have this surgery again for the same condition?	1	10	91	86.6
If your child had pain before surgery, has this been improved since surgery?	–	11	100	100
Are you pleased with the outcome of your child's foot/feet?	1	10	91	86.6

n, number of patients.



Discussion

- Technique described in the present study is a modification of the original Grice– Green procedure
- In addition, **a more distal site for harvesting of the bone graft** and use of **only one partial fibular graft** for a **different clinical patient group** are main differences from the study of Faraj AA
- On the basis of the radiological results and patients’ /parents’ satisfaction, the patients participating in the present study benefited from modified Grice– Green arthrodeses performed on their flexible planovalgus foot deformity
 - The **number of patients** who were **able to walk independently increased from three (27.3%) to seven (64%)** during the postoperative period
 - The **overall satisfaction rate** of the patients/parents was **91%**



Discussion

- All patients in the present study had a valgus hindfoot deformity secondary to spasticity that was correctable passively
- In other words, all feet were flexible. Therefore, we conclude that the **results were related only with flexible planovalgus feet**
- Although conclusive statistical analysis of the results could not be carried out because of the small number of feet in the present study, we are convinced that this modified technique can be performed easily and gives a greater assurance of solid fusion and adequate correction of the planovalgus feet in cerebral palsy



Conclusion

- This modification of the Grice– Green subtalar extraarticular arthrodesis can eliminate graft-site morbidity and related complications caused by bone taken from the fibula completely and can be used easily and effectively in the correction of flexible planovalgus foot deformity in patients with cerebral palsy



Thank You ...



Modified Grice–Green subtalar arthrodesis performed using a partial fibular graft yields satisfactory results in patients with cerebral palsy

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The aim of this study was to report the experience with the use of a modified Grice–Green technique, which was performed using a partial subperiosteal fibular bone graft because of valgus unstable foot in children with cerebral palsy. Fifteen feet of 11 patients were evaluated on the basis of the appearance of the feet, clinical symptoms, and radiographic measurements. After an average follow-up duration of 24 (9–39) months, all feet showed satisfactory clinical and radiological results. Solid fusion and sustained correction took place in all feet. The gap at the donor site was bridged with new bone in all cases. No donor-site morbidity was detected. This modification of the Grice–Green technique can be used effectively in the

correction of planovalgus foot in cerebral palsy. *J Pediatr Orthop B* 25:119–125 Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.

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Keywords: ankle valgus, cerebral palsy, extra-articular subtalar arthrodesis, Grice–Green, modification, partial fibular graft, planovalgus foot

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