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## ***Vascular Considerations in Clubfoot Treatment***

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In this article, Zionts et al. have expertly detailed the contemporary intermediate outcomes of the treatment of the congenital clubfoot condition (talipes equinovarus, TEV) by the Ponseti technique (1). Earlier, more extensive surgical approaches to treatment by the past century's old masters of clubfoot treatment—Hiram Kite (2), Vincent Turco (3) and George Simons(4)—have been forsaken in favor of the “less invasive” methodology.

Yet a need for prolonged care (5 years), frequent relapses (68%), and the frequent necessity of tendon transfer (38%) suggest that the biology of TEV remains perplexing. Kite (2) cited an editorial by Barr in his text (5): “It is well known that a tendon transplant will not correct a fixed deformity. Anterior tibial tendon transfers have a very limited place.”

Turco (3) acknowledged that “all agree that non-operative treatment is best and should be attempted before considering surgery.” He also added, “Notably absent in the literature are the reasons why certain methods of treatment have been discharged. In reviewing the history of clubfoot, one is impressed by the fact that succeeding generations rediscover the forgotten contributions of our predecessors and time again present them as something new.”

Both the more and less extensive surgical approaches to treatment of TEV rely on a mechanistic realignment of the peritalar structures with almost no regard for the biology of TEV. Congenital deficiency of the anterior tibial artery (ATA) (6) and its derivatives, the dorsalis pedis artery (DPA) including the medial angiosome of the foot (7), necessarily results in a relative deficiency of blood supply to the medial column of the foot (8) compared to the lateral column, which is supplied by the lateral plantar artery via the posterior tibial artery. Lateral column overgrowth becomes unavoidable (9). We have suggested that the relative lateral column overgrowth may reasonably be postulated to lead to recurrence of the TEV deformity (9).

In this and another study, Zionts et al. noted that more severely deformed feet were more likely to relapse (10); the more severely deformed feet also exhibit a higher percentage of ATA/DPA/medial arterial deficiencies (11). Despite the fact that embryonic arterial dysgenesis has not been demonstrated to be the

proximate cause of TEV (12), ongoing arterial imbalances between the medial and lateral columns of the affected feet demand consideration (13). An appreciation of the underlying biology of TEV will result in its treatment becoming less of a craft and more of a science.

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Conflict of Interest: None Declared

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## Article Author Response

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### *Article Author(s) to Letter Writer(s)*

We read with interest the letter from Dr. Hootnick about our article. Dr. Hootnick states that “both the more and less extensive approaches to treatment of TEV rely on a mechanistic realignment of the peritalar structures with almost no regard for the biology of TEV.” He further states that “an appreciation of the underlying biology of TEV will result in its treatment becoming less of a craft and more of a science.”

For a number of idiopathic orthopaedic conditions, including clubfoot and scoliosis, surgeons rely on a

mechanistic approach to realign osseous structures to provide the best clinical outcome for their patients. This is not due to a lack of appreciation for the biology. Unfortunately, the understanding of the biology of these deformities has not progressed to the point where it can offer a better clinical solution to deformity correction. Until such time as a biologic solution is defined, we must continue to provide the best alignment of the clubfoot, while minimizing stiffness and residual deformity. Despite its somewhat labor-intensive nature, the Ponseti method achieves these goals.

Dr. Hootnick notes that more extensive surgical approaches to the management of clubfoot deformity described “by the past century’s old masters” have been forsaken in favor of less invasive options. We suggest that these surgical methods were generally abandoned due to dissatisfaction with the intermediate and long-term results (1-3). These surgical approaches were also accompanied by difficult-to-manage complications, including overcorrection, undercorrection, navicular subluxation, talar deformity (including avascular necrosis), and gastrocnemius weakness. Recent studies of long-term outcome of release surgery have also found disappointing results compared to those achieved by Ponseti (4, 5).

We certainly agree with Kite’s observation – as quoted by Dr. Hootnick – that a tendon transplant will not correct a fixed deformity. This is why Ponseti recommended that the relapsed clubfoot must be well-corrected with 2 or 3 manipulations and cast applications before transfer of the tendon (6). It is quite possible that with any mode of clubfoot treatment, some imbalance of the foot will remain. Whether this is due to slight, persistent undercorrection of the foot (such as a partially medially displaced navicular) (6, 7) or hypoplasia of the peroneal musculature (8, 9), a tendon transfer will be needed to provide balance and prevent further relapses. As noted in our article, an anterior tibial tendon transfer is likely to remain a part of the Ponseti method. Compared to the extensive release surgeries done in the past, a tendon transfer is a minimally invasive procedure.

It has long been recognized that not all clubfeet are alike. In some, there may be substantial alterations in the vascular anatomy as suggested by Dr. Hootnick. In addition, recent studies have demonstrated other anatomic alterations such as hypoplasia/aplasia of muscle groups, and increased fibrosis of ligaments, joint capsules, and tendons in some feet (9).

Today, as in the past, the goal in treatment of clubfoot is to obtain a functional, pain-free, plantigrade foot, with good mobility and without calluses, that does not require special shoes (10). Both craftsmanship and scientific knowledge are necessary to improve and advance our field, but, in the words of Goethe, “Not art and science only, but patience will be required for the work.”

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