

# Left Underlapping Third Toe in a Patient who Underwent Ventricular Assist Device Implantation: A Case Report and Literature Review

by Massimiliano Polastri, MSc, PT<sup>1</sup>✉, Walter Trani, PT<sup>1</sup>, Mariano Cefarelli, MD<sup>2</sup>  
Sofia Martín-Suàrez, MD<sup>2</sup>

The Foot and Ankle Online Journal 5 (12): 2

*This case report describes a rare abnormality of the forefoot in an adult who underwent implantation of a ventricular assist device. Toe deformities are not necessarily related to pain and/or functional foot limitations. An underlapping toe is a rarely-described disorder. Ventricular assist devices (VAD) are comprised of a set of tools that allows the system to substitute for the pump function of the heart in eligible patients. A 60-year-old Caucasian man affected by ischemic dilated cardiomyopathy underwent ventricular assist device implantation as a bridge to transplantation. The third toe abnormality reported here did not influence the ventricular assist device implantation or postoperative recovery in terms of exercising. An underlapping third toe can coexist in the presence of debilitating illness without causing particular physical difficulties.*

**Key words:** Blood circulation, Forefoot, Gait, Heart transplantation, Quality of life, Rehabilitation, Toe abnormalities.

**Accepted:** November, 2012

**Published:** December, 2012

This is an Open Access article distributed under the terms of the Creative Commons Attribution License. It permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. ©The Foot and Ankle Online Journal ([www.faoj.org](http://www.faoj.org)), 2011 All rights reserved.

**T**oe deformities are not necessarily related to pain and/or functional foot limitations.<sup>1</sup> Rare abnormalities such as overlapping toes are a condition for which there is no possibility for spontaneous improvement.<sup>2</sup>

In contrast, an underlapping toe is a rare and little-described disorder. Friend found that the fourth and fifth toes are the most involved in an underlapping toe abnormality even if the second or third toes are also affected. The combination of congenitally elongated toes and an acquired adductovarus is the major mechanism that produces this deformity.<sup>3</sup> Ventricular assist devices (VAD) are comprised of a set of tools that allows the system to substitute for the pump function of the heart in eligible patients.

**Address correspondence to:** Massimiliano Polastri, Physical Medicine and Rehabilitation, Bologna, University Hospital Authority, Sant'Orsola-Malpighi Polyclinic, Via G. Massarenti, 9. 40138 –Bologna, Italy.

<sup>1</sup> Physical Medicine and Rehabilitation, Bologna University Hospital Authority, Sant' Orsola-Malpighi Polyclinic, Bologna, Italy.

<sup>2</sup> Cardiac Surgery Department, Sant' Orsola-Malpighi Polyclinic, Bologna University, Bologna, Italy.



**Figure 1** Standing position. Right side: hallux valgus, hammertoes second to fifth. Left side: hammertoes first to fifth, hallux valgus, underlapping third toe.



**Figure 2** Dorsal view of the left side: underlapping third toe.

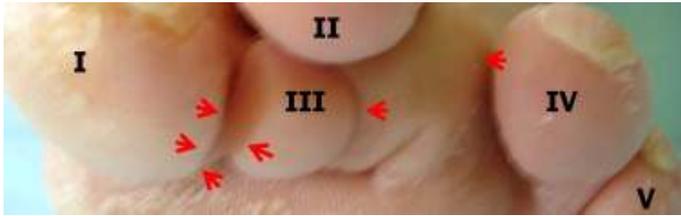
The main body of the device includes a miniaturized titanium pump. The power cord of the device used in the case described here was connected to a titanium base fixed to the skull (parietotemporal).<sup>4</sup>

The system is powered by lithium and lead batteries—which have different durations—and is transported in a bag in a horizontal position so as not to cover the microphone alarm. Left ventricular assist devices (LVAD) are an effective strategy to prolong survival and improve quality of life.<sup>5</sup> The Interagency Registry for Mechanically Assisted Circulatory Support has been created to collect information about patients, devices, and outcomes, including adverse events.<sup>6</sup> The main purpose of this report is to describe a rare abnormality of the forefoot in an adult who underwent implantation of a VAD.

### Case Report

A 60 year-old Caucasian man affected by ischemic dilated cardiomyopathy underwent LVAD implantation (Jarvik Heart<sup>®</sup>, New York, NY, USA) as a bridge to transplantation. He had diabetes, dyslipidemia and was an ex-smoker.

He did not undergo myocardial revascularization after two episodes of acute myocardial infarction, and 8 years ago he was implanted with a single-chamber implantable cardioverter. The patient underwent pre-transplant screening for nearly 2 years. It was decided to apply a temporary LVAD due to his low cardiac ventricular function (ejection fraction, 22%) and significant pulmonary hypertension. This device has a compact axial flow impeller pump with an outflow Dacron graft for anastomosis to the descending thoracic aorta. The pump was inserted through a sewing cuff into the apex of the left ventricle. The adult model measured 2.5 cm in diameter by 5.5 cm in length. Its weight was 85 g with a displacement volume of 25 mL. The postoperative course was free of complications. Bilateral hallux valgus and an underlapping third toe on the left side were noted by observation of the patient in a standing position. (Fig.1) Deviation in the valgus of the right big toe was more evident, as was pronation of the first metatarsophalangeal joint (this condition probably avoided the hammer toe on the same side). The left foot was characterized by hammer toes (Fig. 2), and the congenital underlapping third toe was attached to the first toe through the distal portion of both toes. (Fig. 3)



**Figure 3** Plantar view of the left side: the third toe is medially deviated (two red arrows) and attached to the first (four red arrows).

The patient had no difficulties ambulating and was free from pain. Thus, postoperative rehabilitation was centered on recovery of motor activity and reconditioning after the VAD implantation. The first line of the rehabilitative treatment in the sub-intensive setting was focused on encouraging the patient to perform exercises (even in a group) such as cycling, climbing stairs, and walking (even outside the pavilion); the patient's performance of exercises was monitored. Furthermore, all motor activities were performed in association with respiratory exercises, such as deep breathing and incentive spirometry. The patient provided written informed consent for this study.

## Discussion

The absence of both foot pain and functional limitations at the initial examination was unexpected, but allowed the patient to adhere to the postoperative rehabilitation program, with excellent results. Augustine and Jacobs described hammertoes as the most common deformities of the foot.<sup>7</sup> Abnormalities of the forefoot, particularly in children are described in the literature. Smith, et al., found that an underlapping toe was common in a pediatric population of 44 newborns and proposed a simple algorithm for treatment.<sup>8</sup> In the mid-1960s, Greenberg discussed the possibility of resolving underlapping and contracted toes by plantar digital tenotomy, in the absence of shortening of the dorsal tissue and subluxation of the metatarsophalangeal.<sup>9</sup>

Similarly, Korn proposed a surgical approach for correction of a painful underlapping fifth toe and reported excellent outcomes of surgery.<sup>10</sup> Fattiroli, et al., discussed the importance of a customized rehabilitation program in patients undergoing VAD to enhance function and the quality of life.<sup>4</sup> A multidisciplinary approach is the ideal solution for long-term care during postoperative recovery.<sup>11</sup> Furthermore, the benefits of exercise training were reported by Bellotto, et al., who discussed the postoperative course of a patient with an implanted artificial heart.<sup>12</sup> Polastri investigated the role of postoperative rehabilitation after hallux valgus surgery, and surmised that a rehabilitative intervention is required to encourage both plantar pressure on the first ray and joint mobility.<sup>13</sup> If these are the objectives of hallux valgus surgery, what is advisable in terms of exercise in a case such as that we report here in which the deformities were not corrected? The answer to this question must consider the rationale of the treatment according to both the condition of the patients and their quality-of-life expectations. In fact, the patient described here was admitted so that his cardiac function issues could be addressed; the feet abnormalities (hallux valgus, hammer toes, and underlapping third toe) were an occasional finding of secondary importance considering his overall condition. The postoperative rehabilitation pathway, particularly in specialized settings, must be appropriate and centered on the patient's needs with due consideration of their priorities. In this regard, the third toe abnormality reported here did not influence the VAD implantation or postoperative recovery in terms of exercising. The main limitation of this case report is the lack of quantification of the foot-joint deformities by means of range-of-motion measurements. However, the aim of this case study was to describe an unusual abnormality that does not require deep investigation. Furthermore, our findings should not be extended to a larger population. Nevertheless, this is to our knowledge the first report of feet deformities in a patient implanted with a VAD. In summary, an underlapping third toe can coexist in the presence of debilitating illness without causing particular physical difficulties.

## References

1. Badlissi F, Dunn JE, Link CL, Keysor JJ, McKinlay JB, Felson DT. Foot musculoskeletal disorders, pain and foot-related functional limitation in older person. *J Am Geriatr Soc* 2005 53: 1029-1033. [[PubMed](#)]
2. Hulman S. Simple operation for the overlapping fifth toe. *Br Med J* 1954 2: 1506-1507. [[PubMed](#)]
3. Friend G. Correction of elongated underlapping lesser toes by middle phalangectomy and skin plasty. *J Foot Surg* 1984 23: 470-476. [[PubMed](#)]
4. Fattirolli F, Bonacchi M, Burgisser C, Cellai T, Francini S, Valente S, Sani G, F. Cardiac rehabilitation of patients with left ventricular assist device as “destination therapy”. *Monaldi Arch Chest Dis* 2009 72: 190-199. [[PubMed](#)]
5. Maciver J, Ross HJ. Quality of life and left ventricular assist device support. *Circulation* 2012 126: 866-874. [[PubMed](#)]
6. Rector TS, Taylor BC, Greer N, Rutks I, Wilt TJ. Use of left ventricular assist device as destination therapy in end-stage congestive heart failure: a systematic review. 2012, Washington (DC), Department of Veterans Affairs. URL: <http://www.ncbi.nlm.nih.gov/books/NBK99059/pdf/TOC.pdf>. [[PDF](#)](accessed 18 August 2012). [[Website](#)]
7. Augustine DF, Jacobs JF.V Restoration of toe function with minimal traumatic procedures including advanced diaphysectomy. *Clin Podiatry* 1985 2: 457-470. [[PubMed](#)]
8. Smith WG, Seki J, Smith RW. Prospective study of a noninvasive treatment for two common congenital toe abnormalities (curly/varus/underlapping toes and overlapping toes). *Pediatr Child Health* 2007 12: 755-759. [[PubMed](#)]
9. Greenberg HH. Plantar digital tenotomy for underlapping and contracted toes. *J Am Podiatry Assoc* 1966 56: 65-66. [[PubMed](#)]
10. Korn SH. The lazy S approach for correction of painful underlapping fifth digit. *J Am Podiatry Assoc* 1980 70: 30-33. [[PubMed](#)]
11. Pistono M, Corrà U, Gnemmi M, Imparato A, Caruso R, Balestroni G, Tarro Genta F, Angelino E, Giannuzzi P. Cardiovascular prevention and rehabilitation for patients with ventricular assist device from exercise therapy to long-term therapy. Part II: long-term therapy. *Monaldi Arch Chest Dis* 2011 76: 136-145. [[PubMed](#)]
12. Bellotto F, Compostella L, Agostoni P, Torregrossa G, Setzu T, Gambino A, Russo N, Feltrin G, Tarzia V, Gerosa G. Peripheral adaptation mechanisms in physical training and cardiac rehabilitation: the case of a patient supported by a CardioWest total artificial heart. *J Card Fall* 2011 17(8): 670-675. [[PubMed](#)]
13. Polastri M. Postoperative rehabilitation after hallux valgus surgery: a literature review. *FAOJ* 2011 4(6): 4. [[Website](#)]