

## Original article

# Basic Study and Clinical Implications of Left Ventricular False Tendon. Is it Associated With Innocent Murmur in Children or Heart Disease?



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## ABSTRACT

**Introduction and objectives:** Left ventricular false tendon is a structure of unknown function in cardiac physiology that was first described anatomically by Turner. This condition may be related to various electrical or functional abnormalities, but no consensus has ever been reached. The purpose of this study was to determine the time of appearance, prevalence and histologic composition of false tendon, as well as its association with innocent murmur in children and with heart disease.

**Methods:** The basic research was performed by anatomic dissection of hearts from adult human cadavers to describe false tendon and its histology. The clinical research consisted of echocardiographic study in a pediatric population to identify any relationship with heart disease, innocent murmur in children, or other abnormalities. Fetal echocardiography was performed prenatally at different gestational ages.

**Results:** False tendon was a normal finding in cardiac dissection and was composed of muscle and connective tissue fibers. In the pediatric population, false tendon was present in 83% on echocardiography and showed a statistically significant association only with innocent murmur in children and slower aortic acceleration. The presence of false tendon was first observed on fetal echocardiography from week 20 of pregnancy.

**Conclusions:** Left ventricular false tendon is a normal finding visualized by fetal echocardiography from week 20 and is present until adulthood with no pathologic effects except for innocent murmur during childhood. It remains to be determined if false tendon is the cause of the murmurs or if its absence or structural anomalies are related to disease.

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## Estudio básico e implicaciones clínicas del falso tendón del ventrículo izquierdo. ¿Está asociado al soplo inocente infantil o a enfermedad cardiaca?

## RESUMEN

**Introducción y objetivos:** El falso tendón del ventrículo izquierdo es una estructura descrita anatómicamente por Turner. Se desconoce su función dentro de la fisiología cardiaca. Se ha postulado, sin alcanzar consenso, su relación con diversas alteraciones eléctricas o funcionales. El objetivo es conocer cuándo aparece, su prevalencia, su composición histológica y su asociación con el soplo inocente infantil o con enfermedad cardiaca.

**Métodos:** La investigación básica se realizó por la disección anatómica en cadáveres de corazones humanos adultos para describir el falso tendón y su histología. La investigación clínica se realizó en población pediátrica mediante ecocardiografía y se analizó su relación con cardiopatía, el soplo inocente infantil u otras alteraciones. Prenatalmente se realizaron ecocardiografías fetales a diferentes edades gestacionales.

**Resultados:** La presencia del falso tendón es la norma en la disección cardiaca, y está constituido por fibras de tejido muscular y conectivo. En la población pediátrica, la presencia ecocardiográfica del falso tendón fue del 83%, y solo mostró relación estadísticamente significativa con el soplo inocente infantil y una menor aceleración de la aorta. Por ecocardiografía fetal, se objetivó su presencia desde al menos la semana 20 de gestación.

## Palabras clave:

Falso tendón del ventrículo izquierdo

Investigación básica

Soplo inocente

Pediatría

Ecocardiografía

Anatomía humana

Histología

Periodo fetal

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**Conclusiones:** El falso tendón del ventrículo izquierdo es una normalidad clínica visible por ecocardiografía fetal ya desde la semana 20, con presencia hasta la edad adulta sin relación con enfermedad, únicamente con la presencia de soplo inocente en edad pediátrica; queda por determinar si es la causa del soplo y si es su ausencia o anomalías estructurales lo que se relaciona con enfermedad.

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## Abbreviations

FT: left ventricular false tendon

## INTRODUCTION

Left ventricular false tendon (FT) was first described in 1893 by Dr Turner, who observed it on dissection of the human heart.<sup>1</sup> This fibromuscular structure originates in the interventricular septum and crosses the left ventricle to the papillary muscles, lateral wall, or cardiac apex. Since that time, the structure has been studied by human<sup>2–4</sup> and animal<sup>5,6</sup> cadaver dissection. Technological breakthroughs have also led to other techniques, such as echocardiography<sup>7–11</sup> (including 3-dimensional)<sup>12</sup> and magnetic resonance imaging,<sup>13,14</sup> that permit visualization of live human hearts. The percentage of FT visualization in humans has been rising with technical improvements: the earliest studies report rates of 0.5% whereas current investigations have achieved up to 78%.<sup>7–12,15–17</sup> False tendon has been related to clinical signs, such as innocent murmur,<sup>16–18</sup> conduction and heart rate abnormalities,<sup>19,20</sup> cavitory thrombi,<sup>21</sup> and even infections,<sup>22</sup> although there is no consensus on the implication of FT in human physiology or disease. Its morphogenesis and embryonic origin are not well known, and prenatal imaging has been rare, with only a few reports of the condition observed during the fetal period.<sup>23,24</sup> Our study sought further information on the gestational age at which FT can first be seen, the implications of its presence during childhood, the actual prevalence in adults by postmortem studies, and the histologic characteristics of the structure.

## METHODS

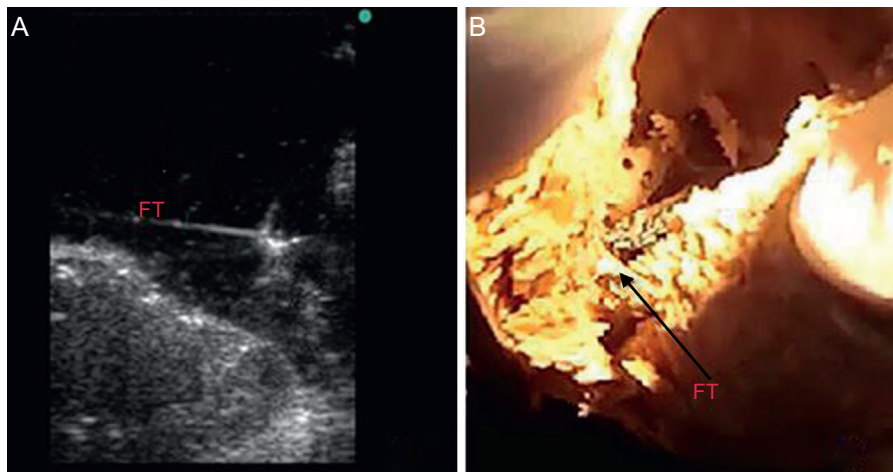
### Basic Research

#### Anatomic Study

The basic anatomic study was designed to determine the actual prevalence of FT in human hearts by anatomic dissection. We selected 41 human cadavers (age range, 65–88 years; 18 women/23 men) from voluntary donors between January and November 2012. The bodies were previously fixed by perfusion through a cannula implanted in the common carotid artery and then preserved in ponds of 5% formaldehyde solution. The hearts were extracted by thoracotomy, labeled from #1 to #41, weighed on a precision scale, and measured (length and width) with a caliper. The interventricular septal and lateral wall thicknesses were also measured. A scalpel was used to make incisions on the lateral wall of the left ventricle to visualize the interior of the left ventricle and FTs, with FT anatomically defined as fibromuscular structures originating at the interventricular septum that cross the left ventricle to the papillary muscles, lateral wall, or cardiac apex. The number, location, and thickness of the FTs were studied; 10 of the dissected hearts with a visible FT were submerged in a basin with water for direct ultrasound of the structure (Figure 1).

#### Histology

False tendon specimens were obtained for histological examination from 5 of the 41 hearts studied. In this case, the specimens were preserved in formaldehyde, then sliced and stained with hematoxylin-eosin and Masson trichrome. We obtained microphotographs at  $\times 10$ ,  $\times 20$ , and  $\times 40$  (Figure 2).



**Figure 1.** A: Direct ultrasound of a heart showing left ventricular false tendon as echo-refringent image. B: The same heart by direct visualization. FT, left ventricular false tendon.

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