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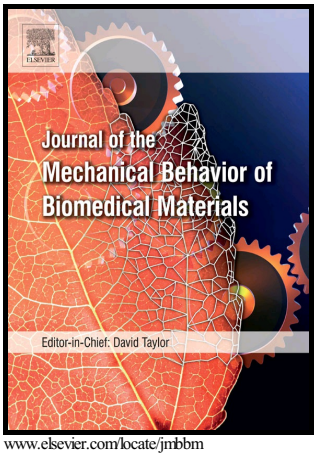

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Experimental characterization of the biaxial mechanical properties of porcine gastric tissue

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Abstract

Health problems related to the stomach are among the most important sources of morbidity in industrialized countries. There is evidence that mechanics may play an important role in various such pathologies. However, so far experimental data characterizing the mechanical properties of gastric tissue remain scarce, which significantly limits our understanding of the mechanics of the stomach. To help close this gap, we performed biaxial mechanical tests of porcine gastric tissues patches. Our experiments reveal a considerable anisotropy and different mechanical properties in the three major regions of the stomach (fundus, corpus, antrum). Moreover, they demonstrate that the mechanical properties of the gastric wall and the physiological function of the different regions of the stomach are closely related. This finding suggests that further examination of the mechanics of the gastric wall may indeed be a promising avenue of research towards a better understanding of the organic causes of frequent health problems related to the stomach.

Keywords

gastric tissue, stomach, biaxial testing, constitutive model, inverse analysis

1 Introduction

Health problems related to the mechanics of the stomach (gastric mechanics) are among the most important causes of morbidity in industrialized countries. For example, intraluminal pressure in the stomach exceeding the closing pressure of the esophagus frequently results in gastro-esophageal reflux disease (GERD). The economic costs associated with GERD are an estimated US$ 20 billion/year in the US alone [1]. Another common pathology closely related to the stomach is dyspepsia (difficult digestion) with a prevalence estimated between 10% and 45% [2]. Dyspepsia significantly affects the personal well-being and thereby also economic productivity. In many cases, the exact organic cause of dyspepsia cannot be identified (so-called functional dyspepsia), which naturally limits therapeutic options. Nevertheless, there is considerable evidence that dyspepsia is linked in some way to dysfunctional gastric mechanics such as problems with distension or emptying of the stomach after ingestion of food. Unraveling the biomechanics of the stomach may be an important step to better understand the organic origin of highly prevalent pathologies such as GERD and dyspepsia and towards the development of new therapies. However, compared to areas such as cardiovascular mechanics, our understanding of gastric mechanics remains limited so far. There is only a handful of papers reporting mechanical tests of the