MECHANICAL CHARACTERISATION OF FAT SUBSTITUTES FOR SUBCUTANEOUS DRUG DELIVERY EXPERIMENTAL MODEL

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Introduction

Subcutaneous tissue (also known as hypodermis or fat tissue) is a typical route for drug delivery. The primary advantage of subcutaneous drug delivery is it enables self-administration, which shifts the focus of patient care from hospital to the patient's home. Despite the major benefits, it is difficult to accurately predict the dispersion and absorption of drug inside the subcutaneous tissue due to the complex interaction between not only the vasculature and lymphatics, but also with tissue deformation during injection. Hence, there is a need to develop an experimental model that can not only predict the mechanical behaviour of tissue, but also the drug delivery mechanics inside the tissue. With that as the ultimate goal, the present study has mechanically characterised commercial fat substitutes to provide a good understanding on the mechanical behaviour of potential materials in the market that can be used for developing the experimental model.

Methods

Commercial fat substitutes, namely Simulab, LifeLike and SynDaver were chosen for this study. Tests performed on the aforementioned fat substitutes include hardness, needle insertion, tension and compression. Hardness was measured using the durometer type OOO, while the remaining tests were performed with a universal mechanical testing machine (Lloyd LS1, AMETEK, Inc., USA). For the needle insertion test, a minimally (Ø20 mm) and highly (Ø1 mm) constrained boundary constraint condition was also investigated.

Results

Figure 1 shows the results obtained for the hardness, needle insertion, tensile and compression tests. Human data from literature was added into Figure 1c and d for comparison purposes [1-2].

Discussion

Results of the present study will serve as the baseline in developing an experimental model that can capture both tissue deformation and drug delivery mechanics for subcutaneous drug delivery. In addition, results of the present study will prove to be useful for any researcher considering the use of these commercial fat substitutes for their research.

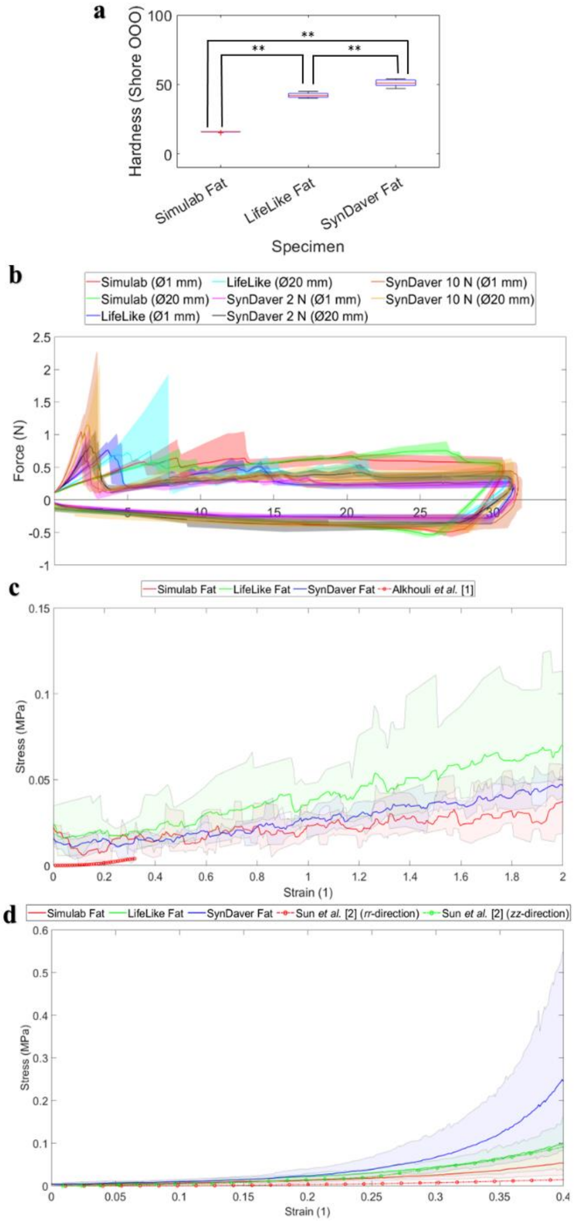

Figure 1: a) Box plot of hardness test, b) force-displacement curve of needle insertion test, c) stress-strain curve of tensile test and d) stress-strain curve of compression test.

References

1. Alkhouli et al, Am J Physiol Endocrinol, 305(12): E1427-E1435, 2013.
2. Sun et al, Acta Biomater, 129:188-198, 2021.