

VAGINA, ABDOMINAL SKIN, AND APONEUROSIS: DO THEY HAVE SIMILAR BIOMECHANICAL PROPERTIES?

Hypothesis / aims of study

Despite minimal fundamental works, there is increasing use of meshes in urogynecology. However, the mechanical characteristics of these materials have not yet been compared with those of the vagina. Moreover, to date, the majority of observations on synthetic prostheses have come from the field of abdominal wall surgery and the repair of groin hernias, and prostheses currently used in vaginal prolapse surgery do not mirror the biomechanics of "normal vaginal tissue". In this study, we aimed to characterize and compare the biomechanical properties of tissues derived from the vagina, the abdominal aponeurosis, and skin of 11 fresh women cadavers without POP. Our goal was to test if the aponeurosis or the skin could serve as suitable tissues to be studied in order to extrapolate the biomechanical properties of vaginal tissue.

Study design, materials and methods

Tissues were obtained from 11 fresh women cadavers without POP. The mean age was 78.5 (range, 61 to 87) years. The cadavers were not formalized but frozen for conservation and unfrozen just before the dissection. In accordance with the previously established protocol [1], all samples were orientated and marked before being frozen in 0.9% salt solution at -18°C. The excised tissues were used to carry out uniaxial tension tests to the point of rupture as previously described [1]. Subsequently, the stress-strain curves were obtained and analyzed to characterize the biomechanical behaviour of the considered tissues. The mechanical response of the specimens before rupture was then studied. The fact of studying non-linear elasticity required at least the application of two parameters: C0 and C1 (Mooney-Rivlin model) [2]. The stress-strain curves allowed calculation of these values; C0 characterizes the stress-strain curve at its beginning phase (i.e. low strains), whereas C1 characterizes the form of the asymptote towards the end of the stress-strain curve (i.e. large strains)

Results

We were able to demonstrate a non-linear relationship between stress and strain and a hyperelastic behaviour (i.e. with large deformation) of the tissues examined [Figure 1].

Biomechanical properties of the vagina, aponeurosis, and skin differed significantly. The aponeurosis was much more rigid and less extendible than the vagina and skin. Vaginal tissue was less rigid but more extendible than skin. There was no difference between the vagina and skin at low strains ($p=0.341$), but a highly significant difference at large strains ($p=0.005$).

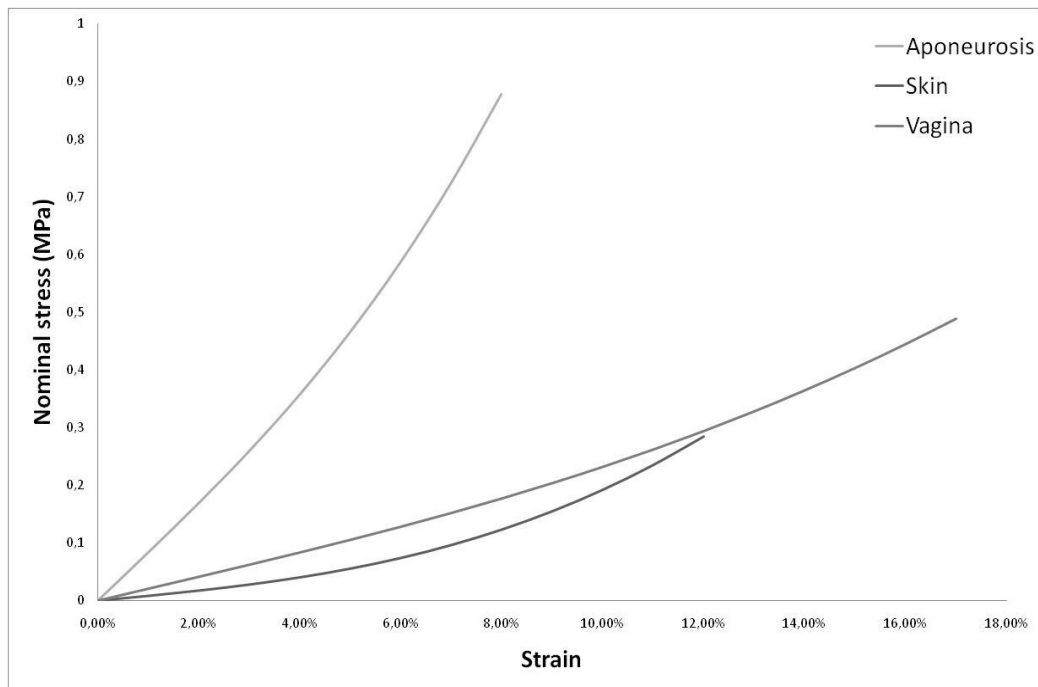
Interpretation of results

We were able to demonstrate that the biomechanical properties of the abdominal aponeurosis, skin, and vagina differed significantly. Abdominal skin and aponeurosis, cannot be used to extrapolate biomechanical properties of vaginal tissue. Therefore, we have to study the biomechanical properties of the vagina. If a non-invasive test is considered in the future, it would be reasonable to develop it for the use in the vaginal cavity, rather than on skin. Moreover, it becomes clear that a simple transfer of knowledge from the abdominal wall to vaginal reconstructive surgery seems to be inappropriate.

Concluding message

Skin and aponeurosis are not suited to predict vaginal tissue biomechanics. We should be cautious when transferring experiences from abdominal wall surgery to vaginal reconstructive surgery. Further studies are warranted to elucidate the biomechanics of the normal human vagina, which may lead to more functional meshes.

Figure 1



References

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2. Rubod C, Boukerrou M, Brieu M, Clay J-C, Dubois P, Cosson M (2008) Biomechanical properties of vaginal tissue: preliminary results. Int Urogynecol J 19:811-16

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Is this a clinical trial?

No

What were the subjects in the study?

HUMAN

Was this study approved by an ethics committee?

Yes

Specify Name of Ethics Committee

Institutional Review Board CHRU Lille

Was the Declaration of Helsinki followed?

Yes

Was informed consent obtained from the patients?

Yes