

Quantitative analysis of uterine peristalsis in adenomyosis using optical flow for motion quantification

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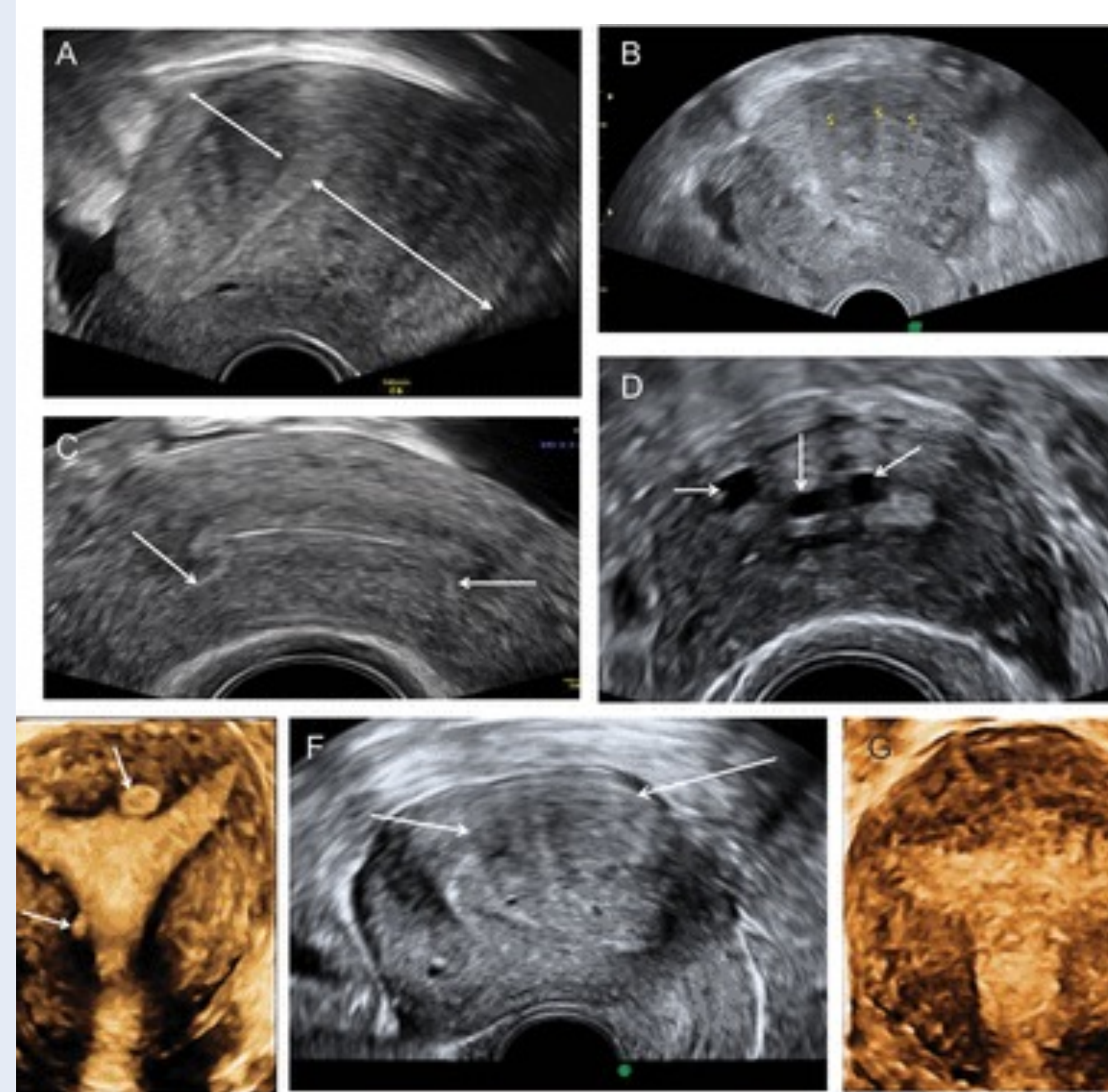
Study question: Do women with adenomyosis have altered uterine peristalsis?

Summary answer: Women with adenomyosis have altered uterine peristalsis on transvaginal sonography (TVS), as measured using optical flow for motion quantification.

Background: Adenomyosis reduces clinical pregnancy rates in women undergoing assisted conception, with altered uterine peristalsis proposed as a mechanism.

Objective: We aimed to develop an objective tool to quantify uterine peristalsis on TVS using an algorithm based on optical flow for wave motion quantification.

Study design: Prospective observational cohort study, July - December 2021, of women with moderate/severe adenomyosis (n=16) and a normal pelvis (n=24), having TVS during assisted conception.



Moderate/severe adenomyosis ≥4 features:

A - Asymmetrical myometrial thickening

B - Parallel shadowing

C - Linear striations

D - Myometrial cysts

E - Hyperechoic islands

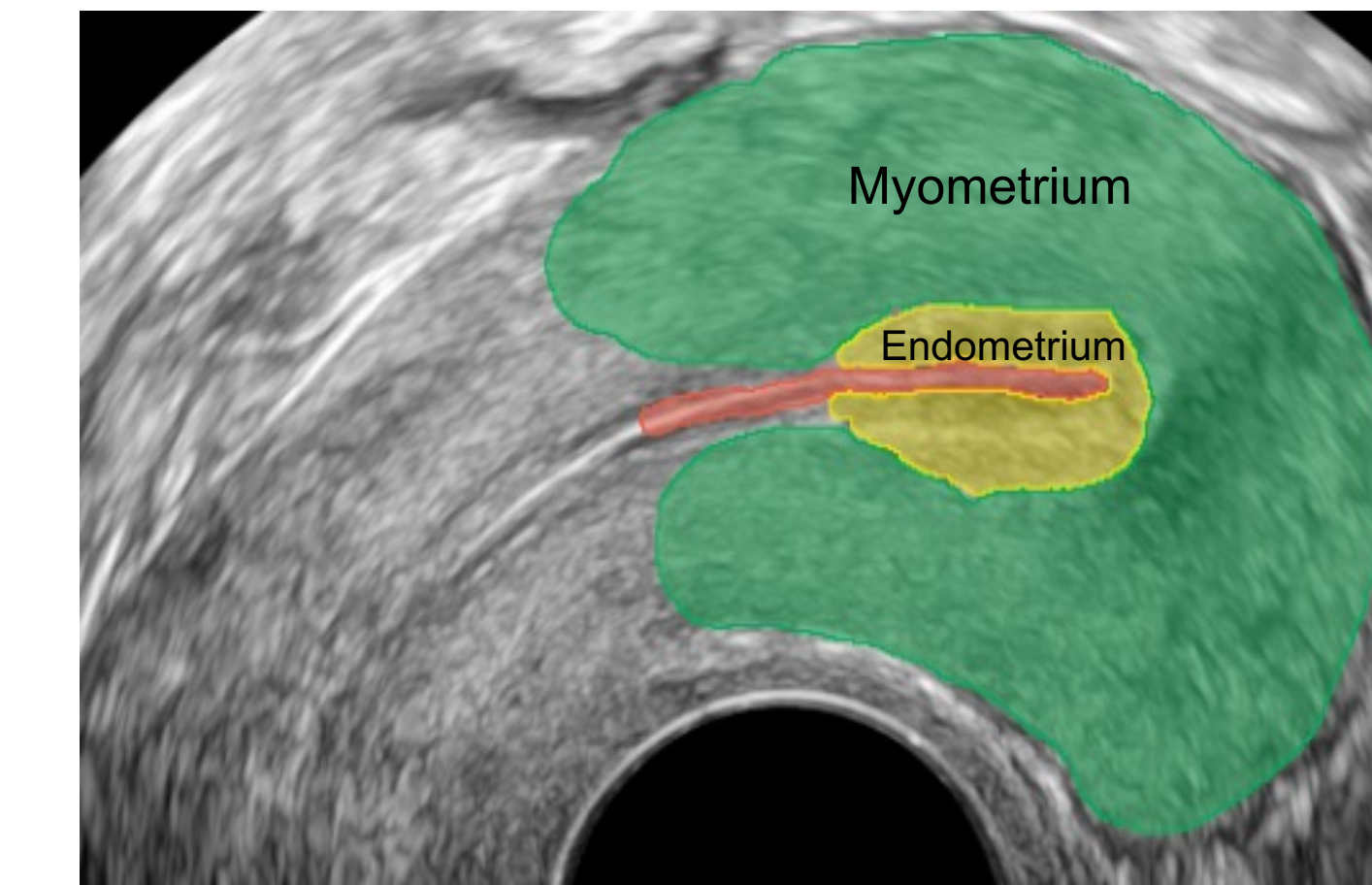
F - Adenomyoma

G - Irregular endometrial-myometrial junction

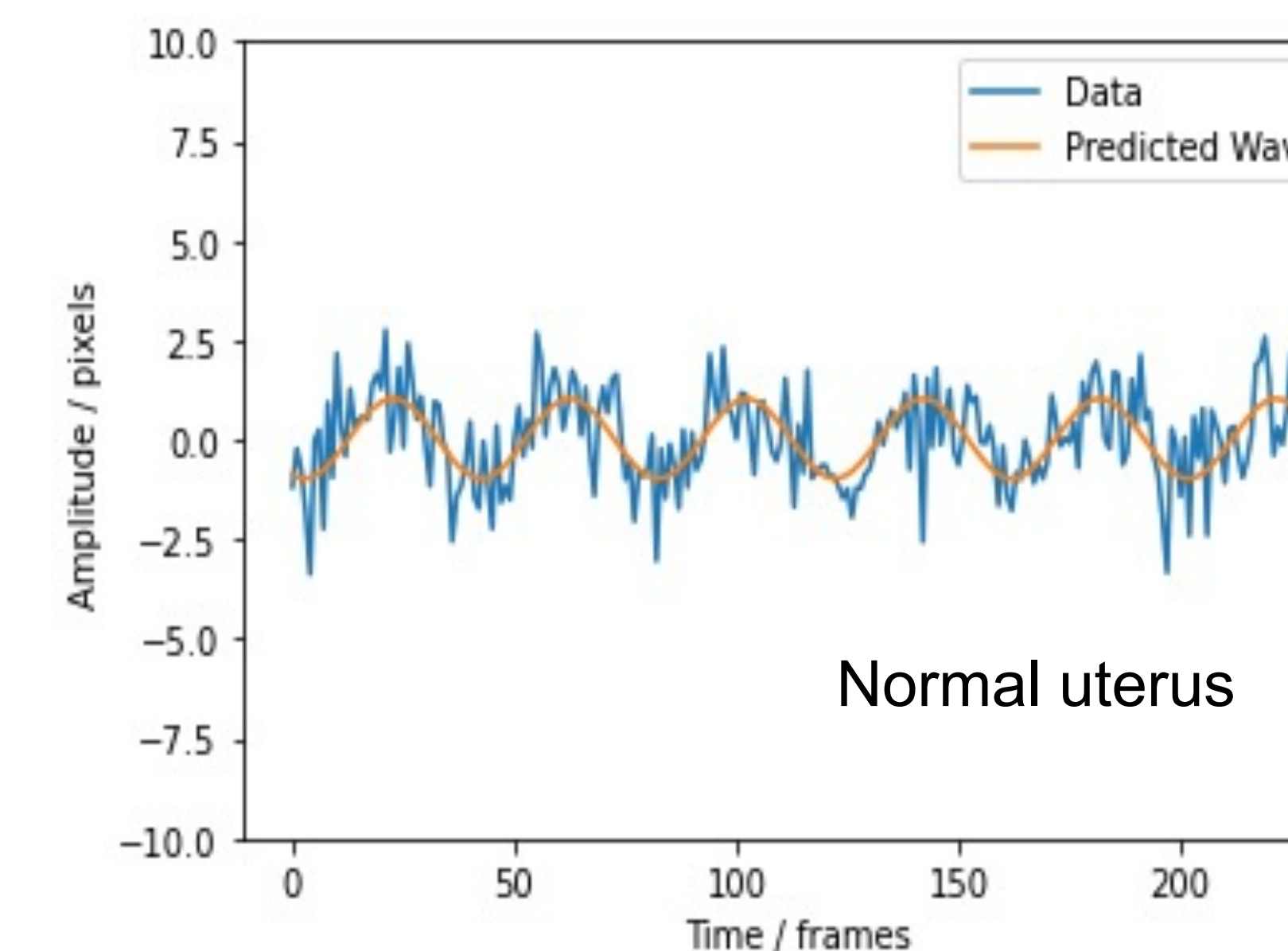
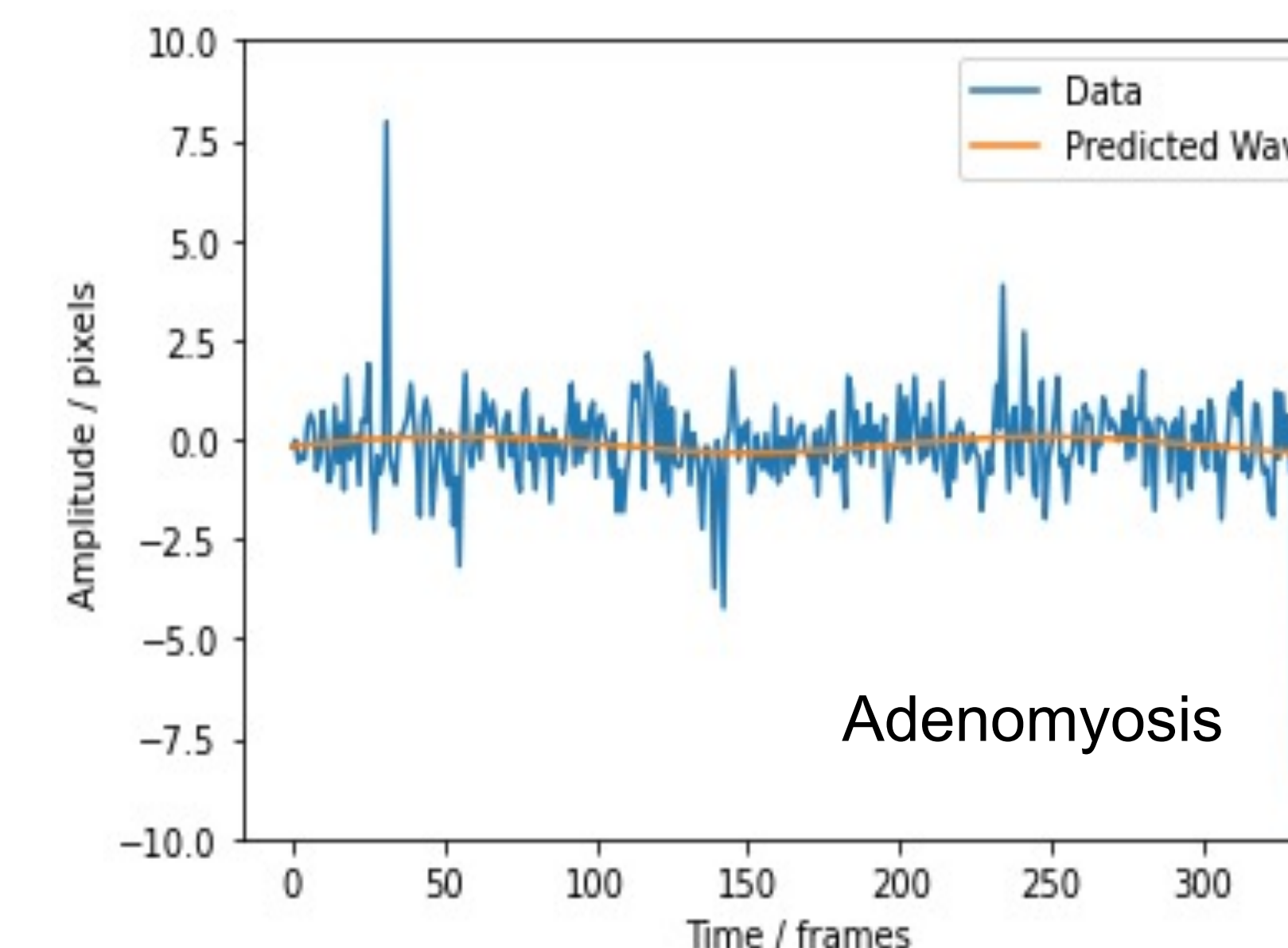
Naftalin et al., 2012

Optical flow algorithm:

$$\{(dx_{R_{avg},t+1}, dy_{R_{avg},t+1})\}_{t=0}^{T-1} = \left\{ \left(\frac{\sum_{n=1}^N dx_{R_n,t+1}}{N}, \frac{\sum_{n=1}^N dy_{R_n,t+1}}{N} \right) \right\}_{t=0}^{T-1}$$



Segmentation of the uterus



Methods: TVS was performed in the mid-sagittal plane at baseline (BL), day 6-12 of ovarian stimulation (OS) and day of embryo transfer (ET). Recordings were sampled at constant intervals using 3D slicer to achieve a set of frames for segmentation and optical flow analysis.

Results:

The observed wave of uterine peristalsis at the endometrial-myometrial junction in women with adenomyosis showed a significantly poorer fit with the ideal wave equation compared to women with a normal uterus at all time points (BL (+ 0.725), OS (+ 0.612) and ET (+ 0.627) (n = 37, p < 0.001)).

Conclusions: Women with adenomyosis have altered uterine peristalsis and myometrial contractility, which may account for their reduction in chances of conception. The proposed approach for wave motion quantification is an objective tool to quantify uterine peristalsis, with potential for wide clinical application in the gynaecology and assisted conception setting.