Title of the dataset

Figures and videos supporting the paper: 1D sensitivity and feasibility

Files and descriptions

The files in this online resource correspond to the published paper *"Sensitivity and feasibility of a one-dimensional morphoelastic model for post-burn contraction".* Within this paper, we consider a one-dimensional morphoelastic model that predicts contraction in scars. This paper is our first sensitivity analysis in 1D. We study the model's sensitivity and feasibility to predict contraction for patients of different ages.

The following videos show an example the evolution of the model's variables in a single simulation.

Evolution_chemicals.avi: In this video, we show how the densities of the four chemicals evolve in a simulation of one year. The blue lines represent healthy tissue, and the red lines represent damaged tissue.

On the upper left, we see the fibroblast density. We see that in the first 65 days, the cell density in the wound decreases as cells differentiate to myofibroblasts. After 65 days, the density increases in the wound as the wound contracts further. The wound retracts after 100 days and the density increases further. After one year, the cell density is not yet in equilibrium.

On the upper right, we see the myofibroblast density. We see that, shortly after the simulation starts, the cell density increases inside the wound. There is a high peak of myofibroblasts near the wound boundary, inside the wound, and further, inside the wound, the cell density increases. The peak on the boundary of the wound reaches maximum on day 80, after which the peaks decrease. It seems that more cells are present outside the wound than inside the wound. After one year, there are no cells present anymore.

On the lower left, we see the signaling molecule density. Some molecules are (initially) present. We see the density increasing in the center of the wound rapidly, peaking on day 62. Then, the molecules gradually disappear. The molecules vanished on day 124.

On the lower right, we see the collagen density. We see that there is collagen present in the wound, representing a skin graft. We see the density increasing gradually during wound healing with a high peak of collagen around the wound's boundary inside the wound. The density evolves like the myofibroblast cell density. Here, the peaks decrease from day 98 on, and the density decreases. The collagen density is not yet in equilibrium after one year, but almost.

Evolution_mechanics.avi: In this video, we show how the densities of the mechanics evolve in a simulation of one year. The blue lines represent healthy tissue, and the red lines represent damaged tissue.

On the upper right, we see the displacement velocity. Soon after the wound healing starts, the velocity on the left side of the wound increases, and it decreases on the right side of the wound, peaking on the left and right of the wound boundary. We see the density moving slightly toward equilibrium after 21 days and changing sign on day 91. Now, the density moves slightly away from equilibrium, as the wound retracts. The density peaks again on day 120, after it moves to equilibrium, relaxing the scar. The scar relaxes within one year.

On the upper right, we see the evolution of the effective strain. Soon after wound healing starts, the density decreases in the wound, and increases in the healthy tissue. There is a peak inside the wound, nearby its boundary. This phenomenon is clearly visible in the remainder of the contraction until day 73. The peaks do not increase in intensity anymore, and the density moves toward equilibrium. After one year simulation time, the density is not yet fully in equilibrium, which is not zero, but between zero and one.

On the lower left, we see the evolution of the displacement density. Soon after the wound healing starts, the displacement on the left side of the wound increases, and it decreases on the right side of the wound, peaking on the left and right outside the wound. We see the density peaking around day 100, after which is changes gradually to equilibrium as the wound retracts. The resulting scar shows remaining displacement after one year.

The following figures are shown in the paper.

Fig2a.fig – Fig2e.fig: These Matlab figures correspond to Figure 2 in the paper. The figures present the effect of the variations on the parameters on both the post-burn contraction and the discomfort that a patient might experience. For a written description, we refer to our paper, as the figures seem self-explaining.

Fig3.fig: This Matlab figure corresponds to Figure 3 in the paper. It shows the confidence intervals for the contraction of burns in different age groups. The intervals show the mean values and the 95% confidence values of the mean. There is no legend in this Matlab figure. The colors represent: blue for group 1, orange for group 2, green for group 3, red for group 4.

Fig4a.fig & Fig4b.fig: These Matlab figures correspond to Figure 4 in the paper. The figures represent the estimated probability density function and the cumulative distribution function of the minimum relative surface area. For a written description, we refer to our paper, as the figures seem self-explaining.

Fig5a.fig & Fig5b.fig: These Matlab figures correspond to Figure 5 in the paper. The figures represent the estimated probability density function and the cumulative distribution function of the relative surface area on day 365. For a written description, we refer to our paper, as the figures seem self-explaining.

Fig6.fig: This Matlab figure corresponds to Figure 6 in the paper. It shows the confidence intervals for the strain energy in the healing of burns in different age groups. The intervals show the mean values and the 95% confidence values of the mean. There is no legend in this Matlab figure. The colors represent: blue for group 1, orange for group 2, green for group 3, red for group 4.

Fig7a.fig & Fig7b.fig: These Matlab figures correspond to Figure 7 in the paper. The figures represent the estimated probability density function and the cumulative distribution function of the maximum total strain energy. For a written description, we refer to our paper, as the figures seem self-explaining.

The following datasets are generated in the studies.

Data_Feasibility.xlsx: In this dataset, we see 8 tabs: for each group of patients (4 groups), the data of the relative surface area and the total strain energy (2 types of data). For example, the first tab shows the relative surface areas of 1950 simulations for group 1. The second tab shows the total strain energy of these 1950 simulations for group 1.

Data_Sensitivity.xlsx: This dataset shows the results of the sensitivity analysis. There were 341 simulations because of variations in the parameters (hence, 341 rows). The data represents the minimum of the relative surface area, the day when the minimum is reached, the relative surface area on day 365, the maximum of the total strain energy, and the day the maximum total strain energy is reached (hence, 5 columns).

Methodology

We used the finite element method and implemented the equations in Matlab. This way, we were able to produce the data, the figures and the videos.

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