# Computer Simulation of Post-Burn Skin

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## SCOPE OF THE METHOD

| | |
|---|---|
| **The Method relates to** | Human health |
| **The Method is situated in** | Translational - Applied Research |
| **Type of method** | In silico |
| **Specify the type of cells/tissues/organs** | human skin |

## DESCRIPTION

### Method keywords

mathematical modelling

finite element methods

uncertainty quantification

skin contraction

hypertrophic scar

## Scientific area keywords

dermal contraction

fibroblasts

cellular traction forces

momentum balance

morphoelasticity

statistical sampling

uncertainty assessment

stochastic models

partial differential equations

## Method description

Severely burned skin can exhibit serious contractions that may negatively impact the mobility of joints of patients. The method deals with post-burn evolution of skin, in which one considers the balance of momentum, cells, collagen and chemokines. The balances are represented in terms of partial differential equations, of which the solution is approximated by the use of numerical techniques. These techniques combine finite element discretization, time integration and root finding problem to solve the resulting nonlinear algebraic equations. Since many of the input parameters are unknown, uncertainty assessment is done in order to obtain output results in terms of estimations of probability distributions. The main output variables are the wound area and total dermal stress energy as a function of time after injury, since these parameters quantify the extent of dermal contraction.

## Lab equipment

For this method one only needs a computer with software.

### Method status

Still in development

Internally validated

Published in peer reviewed journal

## PROS, CONS & FUTURE POTENTIAL

### Advantages

- The method is useful for the prediction of skin behavior over time;
- The method is allows results to be interpreted in a probabilistic sense ;
- The method does not need additional animal experiments.

### Challenges

- Incorporation of treatments;
- Using machine learning to decrease simulation times.

### Modifications

- Implementation of therapies;
- Machine learning to decrease simulation times;
- Improvements in describing the underlying physics.

### Future & Other applications

The mathematical method is generic in nature, we expect many principles to be applicable to cancer, diabetic wounds and organ development.

## REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION

### References

G Egberts, FJ Vermolen, PPM van Zuijlen (2023). Stability of a two-dimensional biomorphoelastic model for post-burn contraction. Journal of Mathematical Biology 86 (4): 59

G Egberts, A Desmoulière, FJ Vermolen, PPM van Zuijlen (2023). Sensitivity of a two-dimensional biomorphoelastic model for post-burn contraction. Biomechanics and Modeling in Mechanobiology 22 (1): 105-121

G Egberts, FJ Vermolen, PPM van Zuijlen (2023). High-speed predictions of post-burn contraction using a neural network trained on 2D-finite element simulations. FRONTIERS MEDIA Statistics and Applied Mathematics

**Associated documents**

Sensitivity of a two-dimensional biomorphoelastic model for post-burn contraction.pdf
s00285-023-01893-w.pdf
High-speed predictions of post-burn contraction using a neural network trained on 2D-finite element simulations.pdf

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