12 months Post-Doctoral Fellow CNRS & Univ. Grenoble Alpes

Modelling the mechanical interaction between dressings and pressure ulcers.

TIMC-IMAG Laboratory (Grenoble)
& URGO R.I.D. Company (Dijon)

Planned starting date: December 1st 2020

Application Form: https://bit.ly/2Zxfv89

Context:

Generally speaking, pressure ulcers and pressure sores were defined in 1989 by the National Pressure Ulcer Advisory Panel as skin lesions of ischemic origin linked to a compression of the soft tissues between a hard surface and a bony prominence. While the formation of such wounds is multifactorial, a distinction is made between (i) extrinsic or mechanical risk factors such as immobility, hyper-pressure, friction, shear or maceration and (ii) intrinsic or clinical risk factors such as age, nutritional status, skin condition, sensory or motor, vascular, metabolic neurological pathologies. However, the interface pressure between the skin and the support represents the most important factor in the formation of bedsores and ulcers. This is why they are called "pressure ulcers".

In recent years, many efforts have been made to improve the quality of interface supports with the main objective of better pressure distribution on the soft tissue surface. This has resulted in a number of advances and in particular the flourishing of cushion and/or mattress manufacturers. With the same objective of distributing pressure over anatomical areas that are often prone to wounds such as the sacrum or heel, the dressing industry has proposed a "prophylactic" use of these dressings, i.e. their application to healthy skin, in order to act as a "protective cushion" that aims to mechanically absorb surface pressure.

This research project takes a new step in the treatment of pressure ulcers by attempting to quantify the "protective cushion" effect a dressing may have on an already formed wound.

Description of the research project:

While the ischemic origin of the onset of pressure ulcers has been known for a long time, with the instruction given to careers to provide postural changes to patients every 2 to 4 hours (thus avoiding any cellular necrosis due to the absence of oxygen), it is only very recently that a purely mechanical origin to the onset of pressure ulcers has been discovered. Any soft tissue placed under normal pressure and/or shear can indeed become necrotic as a result of the mechanical deformation caused. Moreover, such necrosis can occur within minutes if the deformation is significant. In the case of pressure ulcers already formed in anatomical regions such as the heel or the sacrum, the application of dressings is recommended to promote healing and protect the wound from external aggression. To our knowledge, little work has been done to study the protective role that these dressings could have from a mechanical point of view. It seems appropriate to reduce as much as possible the pressure exerted on the wound and on the soft tissues surrounding the wound. Of course, these pressures cannot be completely relieved when the skin and the dressing are in contact with a mattress-like support. However, it is to be hoped that the dressing will (1) absorb some of the mechanical energy from the contact and (2) distribute this pressure more evenly around the wound in areas less susceptible to the risk of cell necrosis.

The aim of this research project is to simulate, with the help of a computer tool, the way in which the dressing will distribute the mechanical stresses of surface contact towards the wound and the surrounding soft tissues. For this purpose, biomechanical soft tissue modelling methods and numerical simulation tools will be used.

URGO Dressings :

The URGO dressings recently launched on the market are adhesive dressings composed of a micro-adherent LCT matrix (lipido-colloid technology), an absorbent compress and a waterproof and adhesive outer support.

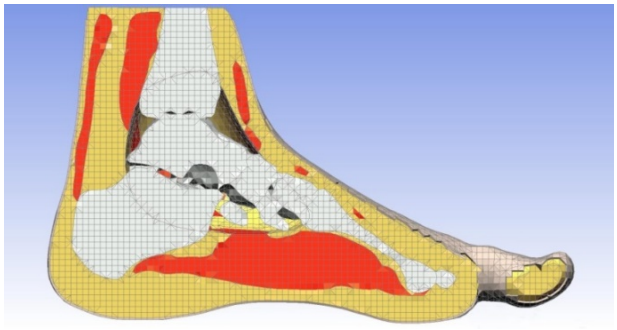
The properties of these URGO dressings are as follows:

- Absorption of exudates.
- Waterproof adhesive silicone edges.
- Very conformable and easily repositionable.
- Painless and atraumatic removal for patients.
- Maintenance of a moist environment favorable to healing.

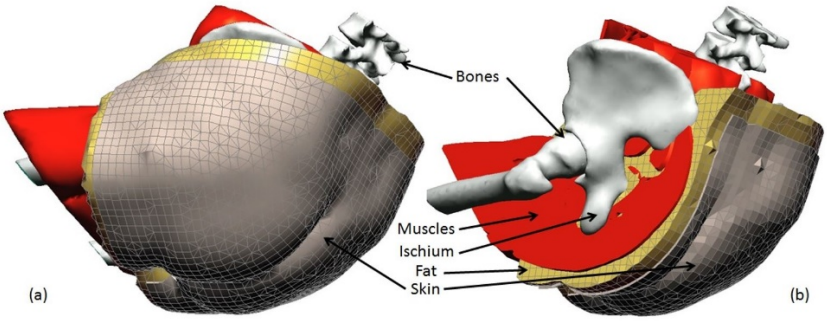
These dressings are indicated for the treatment of acute and chronic exuding wounds. The Sacrum format is recommended for wounds located in the sacral region (sacral bedsores...).

Soft tissue biomechanical modelling:

The most widely used mathematical method for modelling soft bodies and for simulating their deformation is the "Finite Element Method" which consists of discretising the partial differential equations of the mechanics of continuous media. The TIMC-IMAG laboratory has thus developed numerous biomechanical models of the organs and soft tissues of the human body, including a model of the foot and a model of the gluteal region (figure below).



Finite Element foot model (sagittal cut)



Finite Element model of the buttocks

During this research project, pressure ulcer geometries will have to be collected in order to modify these two models and simulate wounds in the heel and sacrum regions. A finite element model of the dressing will then be developed for application to the simulated wounds. This model should represent the different components of the dressing and the interactions between these components. The constitutive laws of these constituents will be estimated from uniaxial and bi-axial traction experiments carried out within URGO R.I.D. They will then be entered as parameters of the finite element model of the dressing, in interaction with the wound models included in the biomechanical models of the foot and gluteal soft tissues. Boundary conditions of pressure loading will then be simulated to quantify the protective effect of the dressing.

The ANSYS software platform will be used to model the coupling between dressing and pressure wound.

Work plan :

The post-doctoral work will be carried out over 12 months with the following stages:

Month 2: Proposal of a constitutive law for the materials making up URGO dressings.

Month 5: Modelling of all the constituents of URGO dressings.

Month 8: Modelling the coupling between the dressing and a generic wound.

Month 11: Modeling on two test tubes (heel and sacrum)

Month 12: Submission of a scientific journal article

CONTRACT AND TIME LINE :

- A 12 months contract, planned between December 1st 2020 and November 30th 2021.

SALARY:

- Brut salary between 2648 et 3054 € per month according to experience

EXPECTED SKILLS:

The desired candidate will have a PhD background in tissue biomechanics with knowledge of the finite element software ANSYS. He/she should be interested in the theoretical and experimental aspects related to the targeted application, with an interest in medical applications.

APPLICATION FORM:

- Your application should be submitted here: https://bit.ly/2Zxfv89

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