# ein Loaded aterial-Based posite Scaffolds otential Healing of nic Wounds

Prof Joshua Boateng, Dr Meena Afzali

UNIVERSITY of GREENWICH

CONTROLLED RELEASE SOCIETY
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INTEGRATING
Delivery Science
ACROSS DISCIPLINES

# Our Three Campuses

UNIVERSITY of GREENWICH


## Greenwich

The university's largest campus, Greenwich has three 17th century buildings designed by Sir Christopher Wren.

## Medway

A recently modernised Edwardian redbrick and ivy-clad campus at Chatham maritime, Kent.

## Avery Hill

This campus in Eltham combines the grace of a Victorian mansion with modern living and teaching facilities.

# Outline

Background

Case Study

Composite Alginate-Collagen-Hyaluronate Scaffolds

Potentially Distressing Images

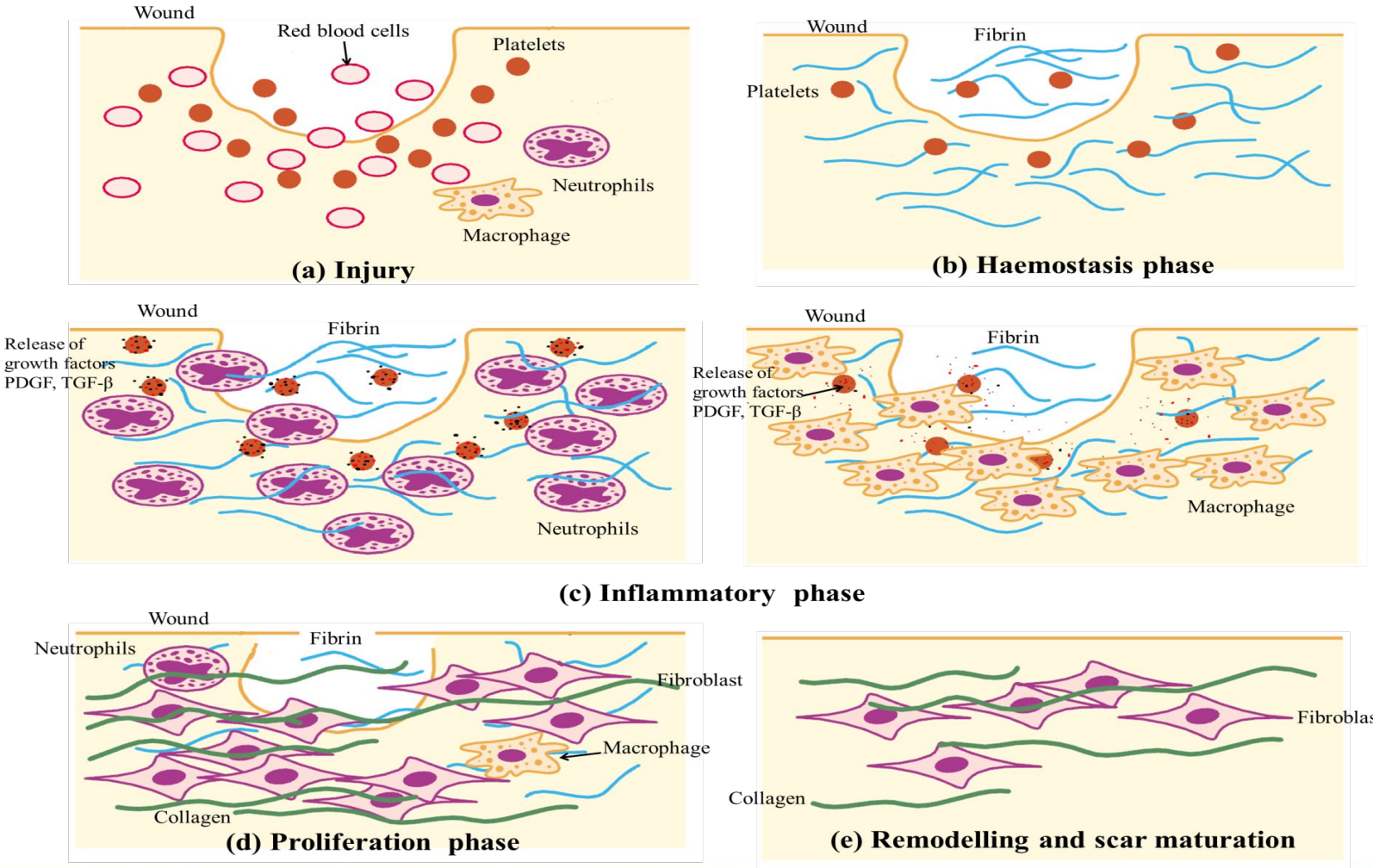
Conclusions

Acknowledgments

# Background

## Wound Healing is a ***Complex Process***

- Several biochemical and physiological activities
- Different stages of wound healing
- Alterations in any phase can cause impaired healing



# Challenges & Needs

**Most dressings target only one healing phase**

**Biologically inactive (passive healing)**

**Depend on normal body function to heal**

**No single dressing meets all ‘Ideal’ characteristics**

# Advanced Solutions

## Tissue Engineered Skin Substitutes

- ❖ Significant tissue loss
- ❖ Effective / **Expensive**


## Skin Grafts

- ❖ Significant tissue loss
- ❖ Creation of another wound (**painful**)
- ❖ Effective / **Expert Personnel** / **Expensive**

## Biological Dressings

- E.g. **Collagen*, Hyaluronic acid***
- Natural skin matrix

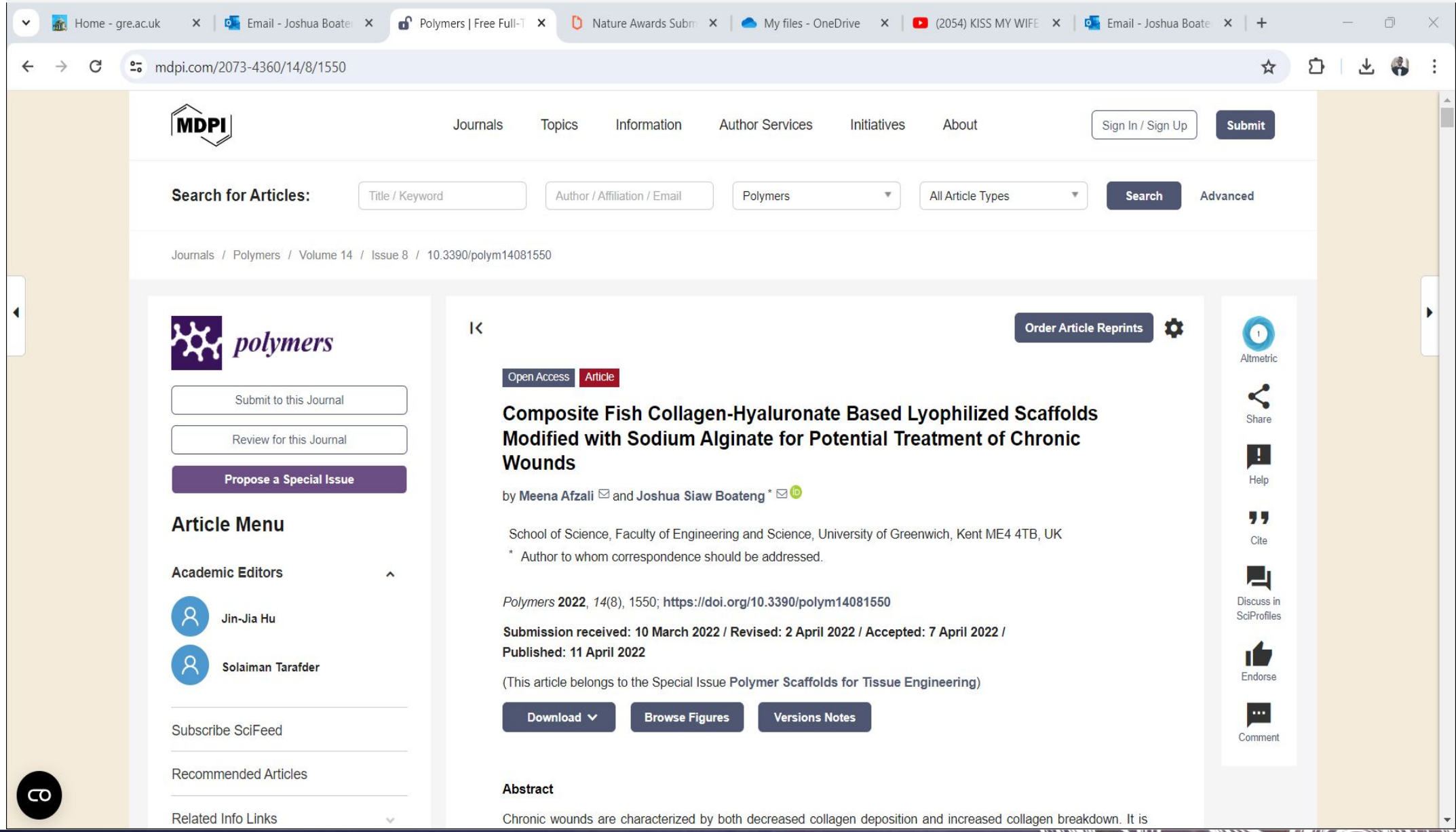
## Medicated Dressings

- Analgesic / anti-inflammatory - pain
- Antimicrobial - infection
- **Growth factors to actively aid tissue regeneration***

## Natural Products

- Honey, Plant Extracts

# Previous Results



# Objectives

**Crosslink HA within composite SA-FCOL-HA scaffolds to enhance functional performance for chronic wound healing**

**Use as platforms for delivering GFs directly to take active part in the wound healing process**

# Scaffold Design & Development

- Sodium alginate (SA), fish collagen (FCOL) and hyaluronic acid (HA)-based gels prepared
- HA crosslinked by PEGDE in the presence of IT and freeze-dried to obtain porous scaffolds

| Formulations | Polymer weight ratio | Constituent amount (mg) | | | | |
|---|---|---|---|---|---|---|
| | | SA | FCOL | HA | IT | PEGDE |
| 2.0% SA: FCOL: HA | 3:4:1 | 750 | 1000 | 250 | 250 | 500 |
| 2.0% SA: FCOL: HA | 1:2:1 | 500 | 1000 | 500 | 500 | 1000 |
| 2.0% SA: FCOL: HA | 1:1:2 | 500 | 500 | 1000 | 1000 | 2000 |
| 2.0% SA: FCOL: HA | 2:3:3 | 500 | 750 | 750 | 750 | 1500 |
| 2.0% SA: FCOL: HA | 1:2:5 | 250 | 500 | 1250 | 1250 | 2500 |
| 2.0% SA: FCOL: HA | 0:3:5 | 0 | 750 | 1250 | 1250 | 2500 |

# Characterization

NMR and GPC confirmed crosslinking

Texture analysis (hardness and adhesion)

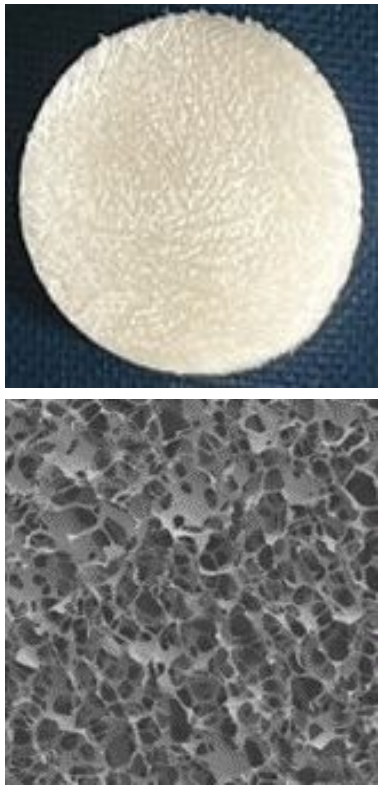
Scanning electron microscopy

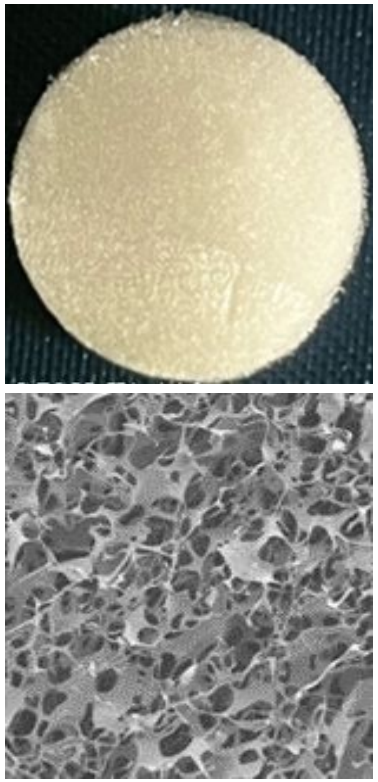
Porosity, swelling capacity, gel strength

- Exudate handling

❖ Water vapor transmission rate
❖ Equilibrium water content
❖ Water absorption
❖ Evaporative water loss
❖ Drug release

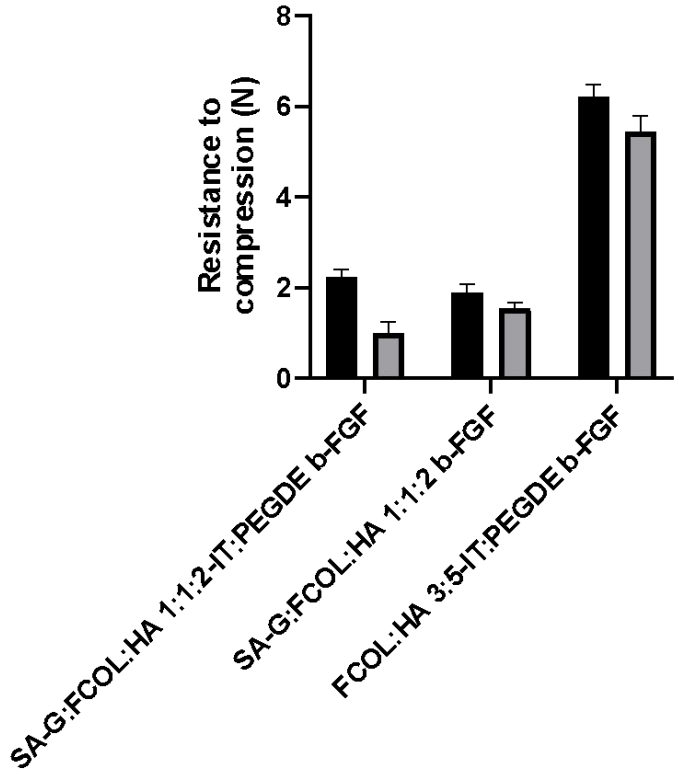
- MTT assay (cell viability)
- Coagulation effect
- Scratch assay

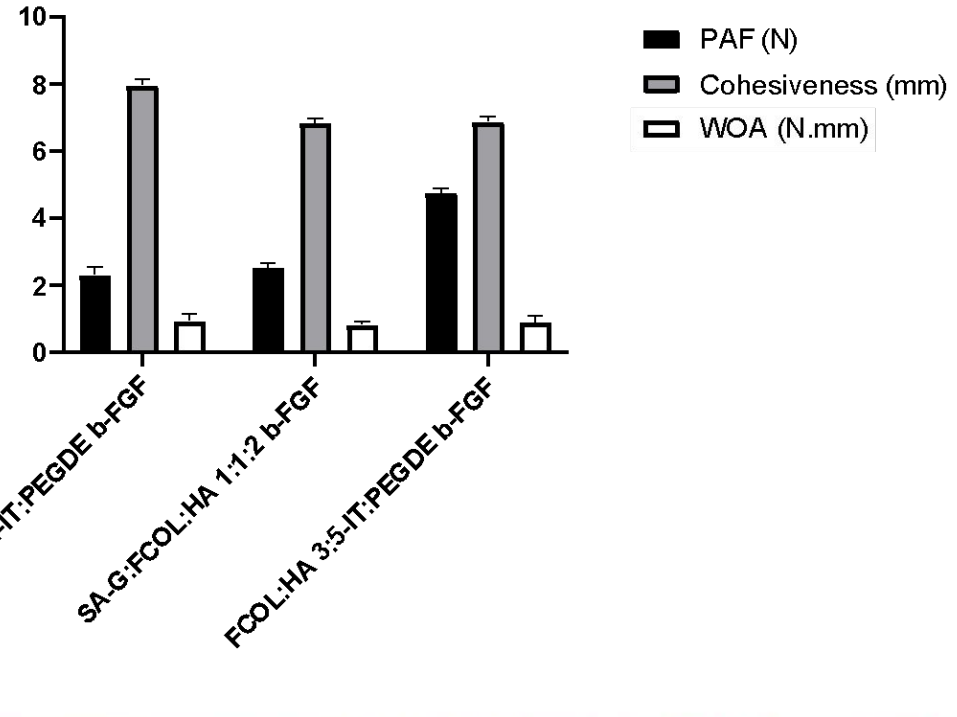




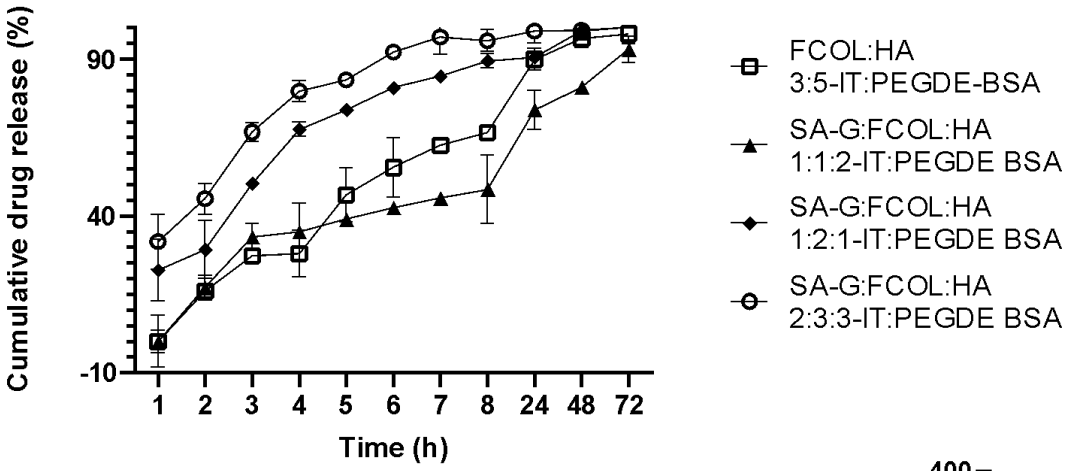
**SA:FCOL:HA 1:1:2**

**SA:FCOL:HA 1:1:2 FGF**



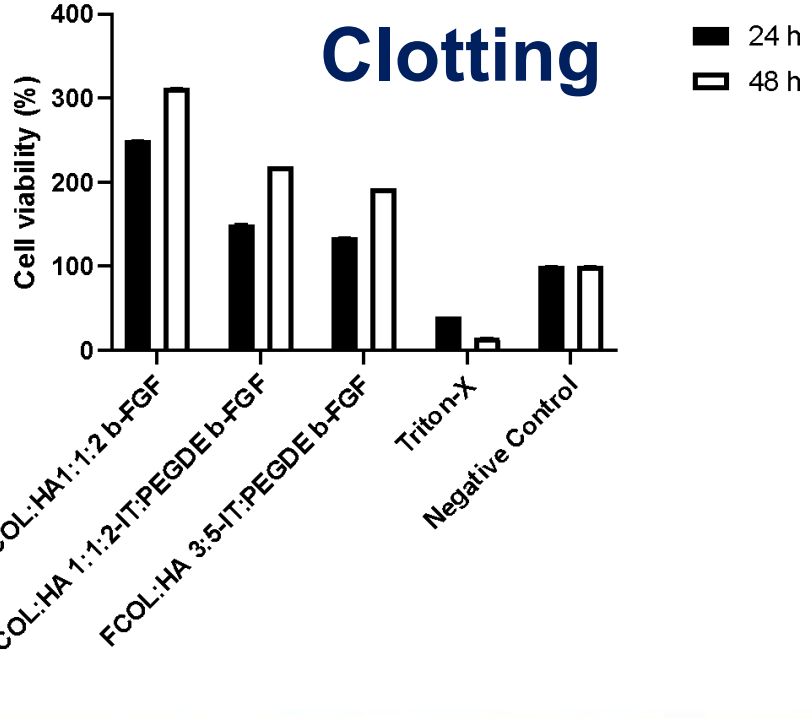



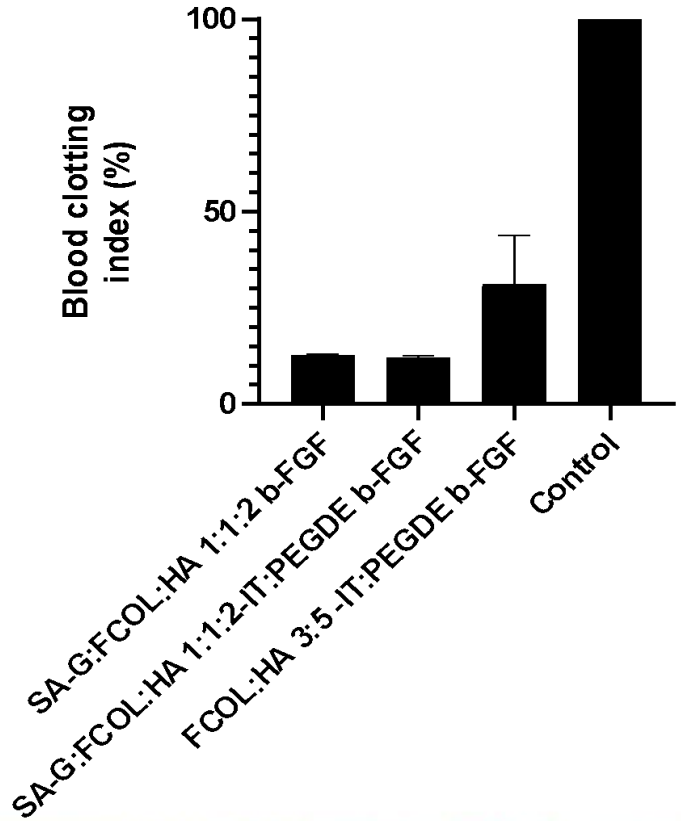
| Sample name | Porosity (%) ± SD | WVTR ($g/m^2day^{-1}$) ± SD | AW (%) ± SD | EWC (%) ± SD |
|---|---|---|---|---|
| SA-G:FCOL:HA 1:1:2 75ng b-FGF | 70 ± 10 | 4254 ± 50 | 921 ± 44 | 92 ± 2 |
| SA-G:FCOL:HA 1:1:2-IT:PEDGE 75 ng b-FGF | 82 ± 3 | 4181 ± 206 | 1190 ± 16 | 95 ± 1 |
| FCOL:HA 3:5-IT:PEDGE 75 ng b-FGF | 87 ± 1 | 1685 ± 26 | 1378 ± 99 | 93 ± 0 |



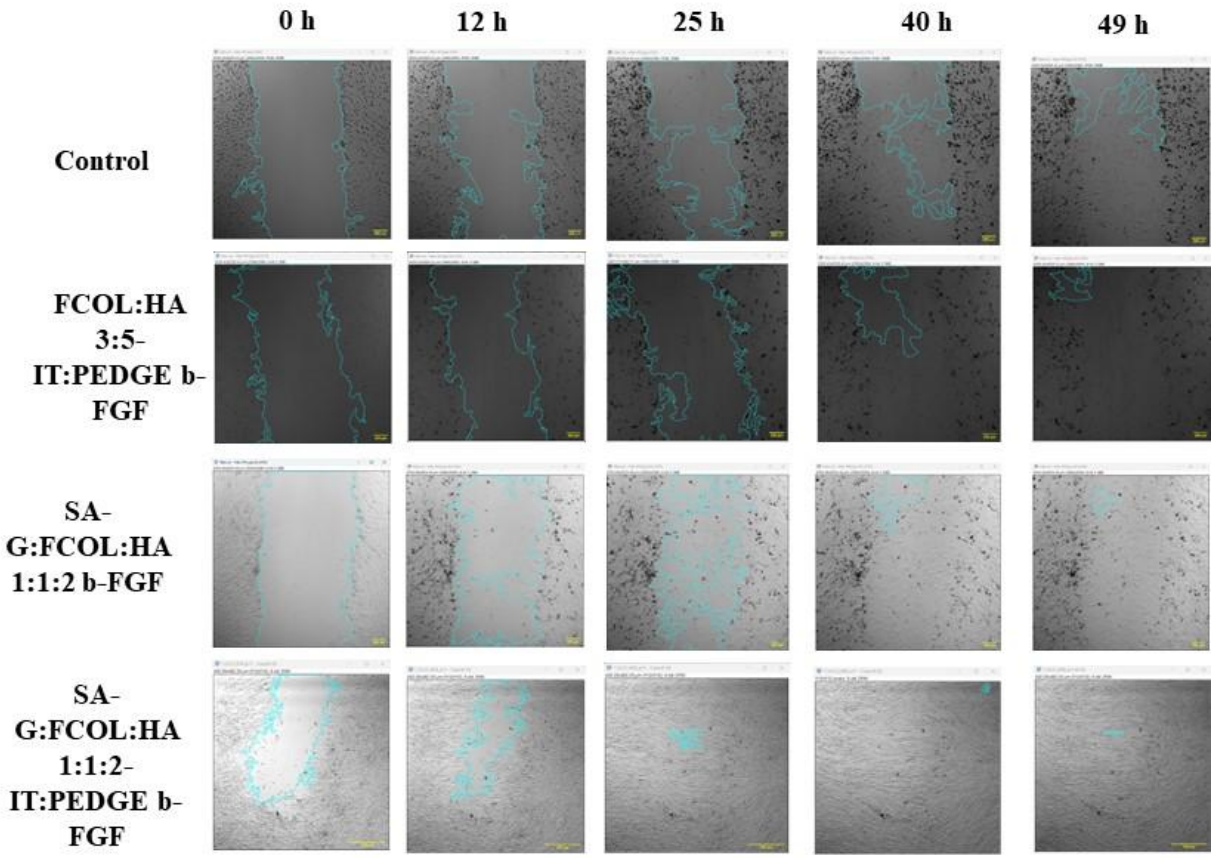

# Protein Release

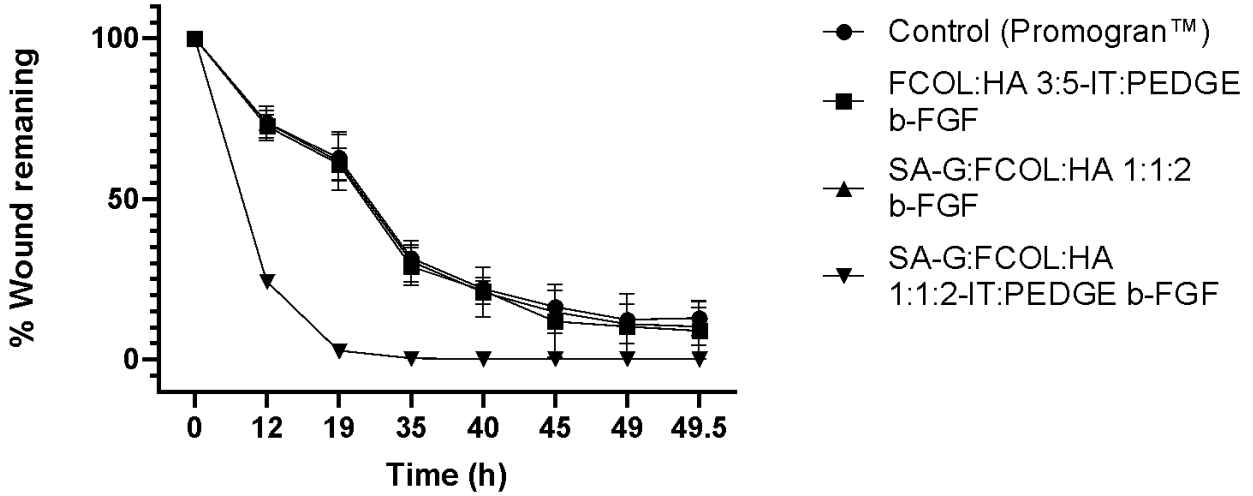
# MTT & Blood Clotting

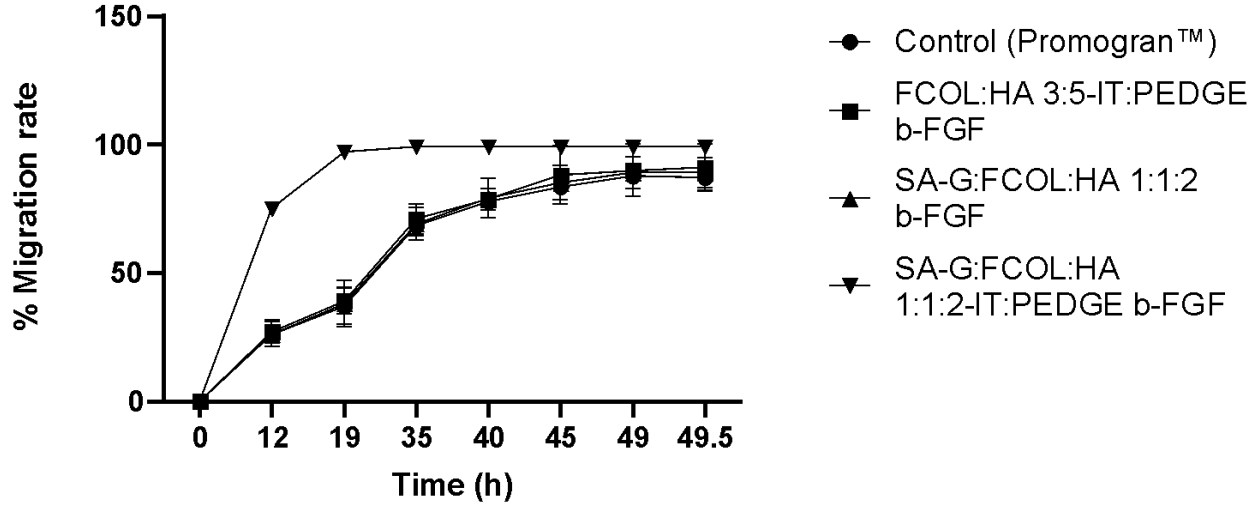



# Scratch Assay



# CONCLUSIONS

PEGDE was able to successfully crosslink HA present in composite SA:FCOL:HA based scaffolds

Superabsorbent, biocompatible and hemostatic properties. Comparable/better than (Promogran™)

Growth factor successfully loaded into the scaffolds

Potential as medicated dressings for delivering proteins to chronic wound sites to take active part in wound healing

# Acknowledgements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