

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

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INTEGRATING
Delivery Science
ACROSS DISCIPLINES



UNIVERSITY of
GREENWICH

Our Three Campuses



Famous Filming Site



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**



Conclusions

Acknowledgments

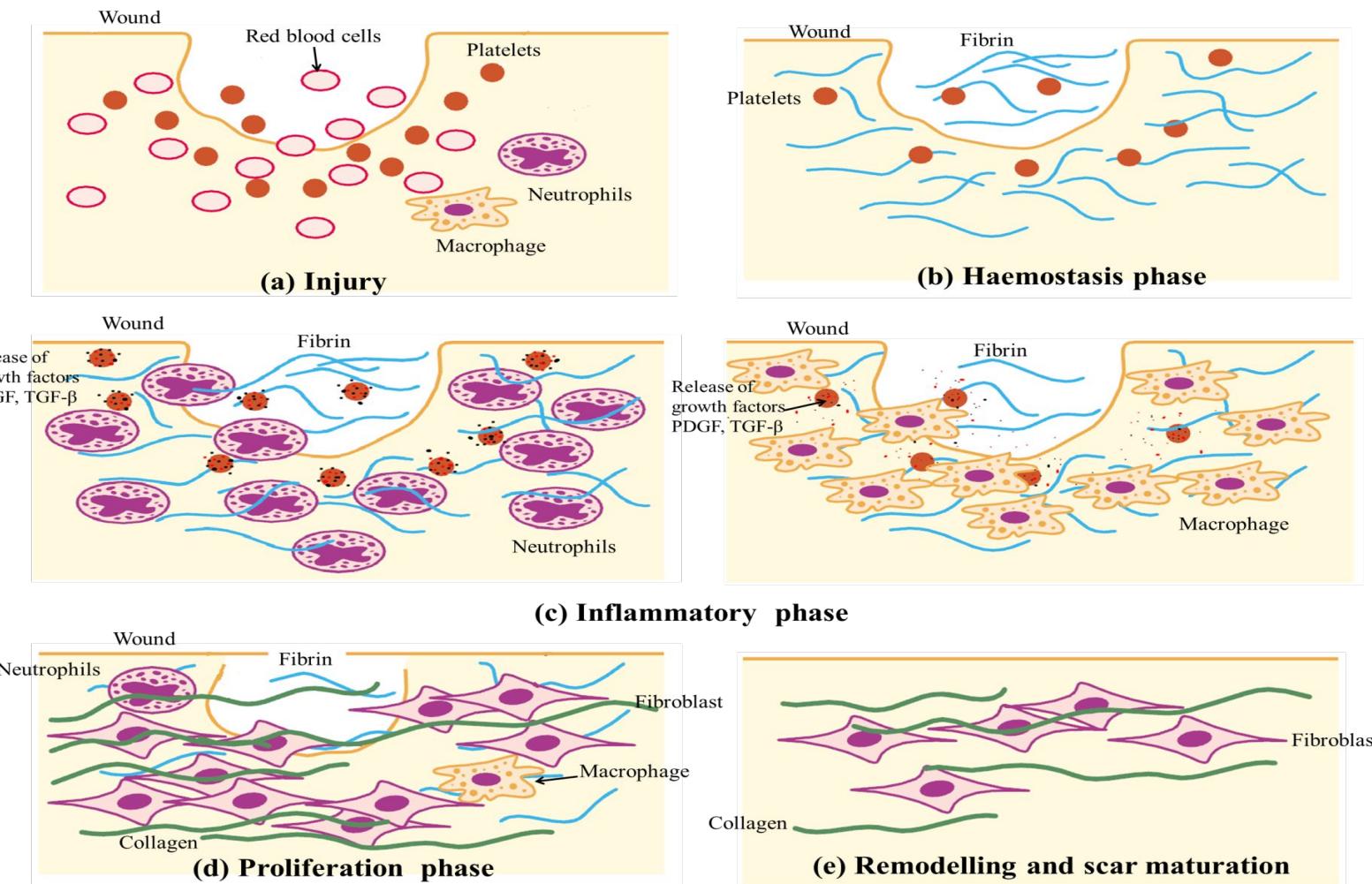
Potentially
Distressing
Images



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

The screenshot shows a web browser with multiple tabs open, including Home - gre.ac.uk, Email - Joshua Boateng, Polymers | Free Full-Text, Nature Awards Subm..., My files - OneDrive, (2054) KISS MY WIFE, and Email - Joshua Boateng. The main content is a page from MDPI's Polymers journal. The URL in the address bar is mdpi.com/2073-4360/14/8/1550. The page title is "Composite Fish Collagen-Hyaluronate Based Lyophilized Scaffolds Modified with Sodium Alginate for Potential Treatment of Chronic Wounds" by Meena Afzali and Joshua Siaw Boateng. The article is marked as Open Access and is in Article format. The journal logo "polymers" is visible. The article menu on the left lists Academic Editors (Jin-Jia Hu, Solaiman Tarafder), and links for Subscribe SciFeed, Recommended Articles, and Related Info Links. The right side of the page includes a sidebar with icons for Altmetric, Share, Help, Cite, Discuss in SciProfiles, Endorse, and Comment. The abstract section notes that chronic wounds are characterized by decreased collagen deposition and increased collagen breakdown. It is part of the Special Issue Polymer Scaffolds for Tissue Engineering.

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

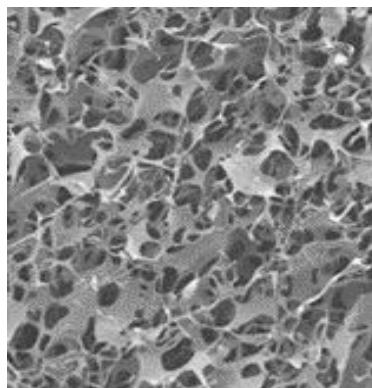
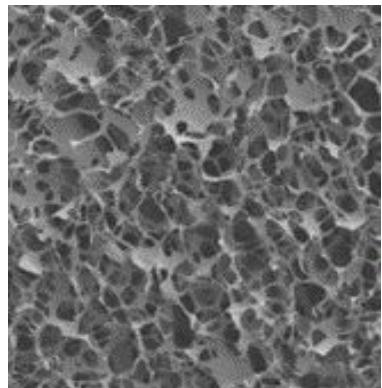
NMR and GPC confirmed crosslinking

Texture analysis (hardness and adhesion)

Scanning electron microscopy

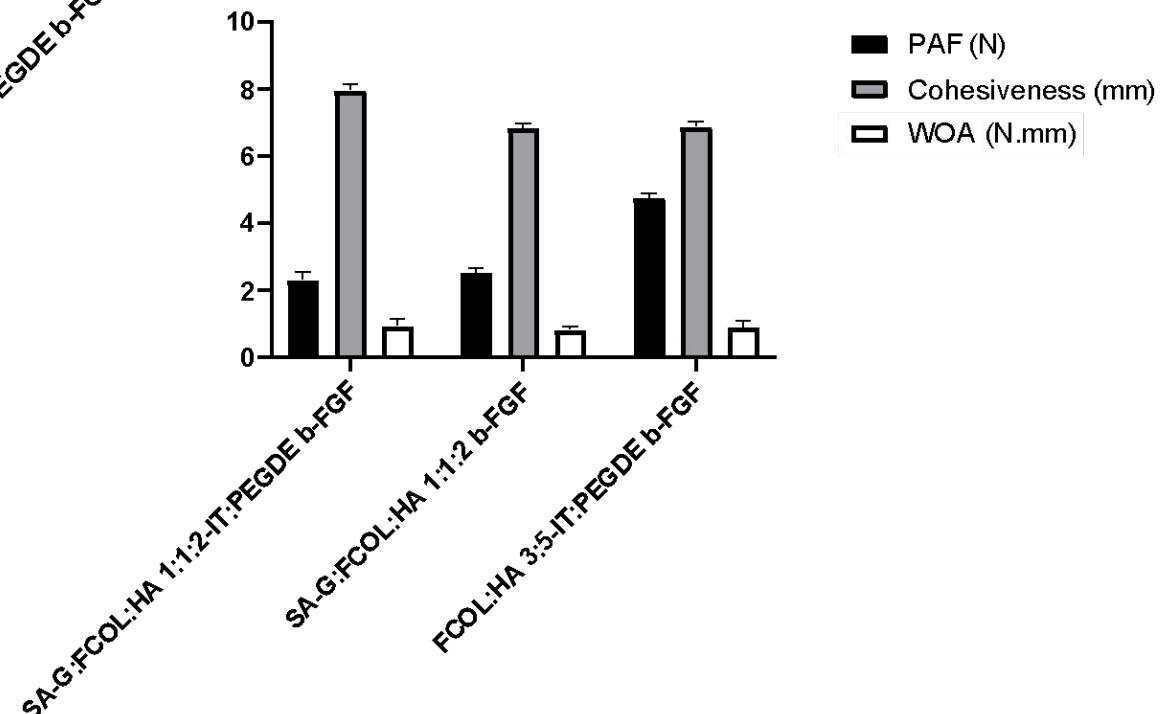
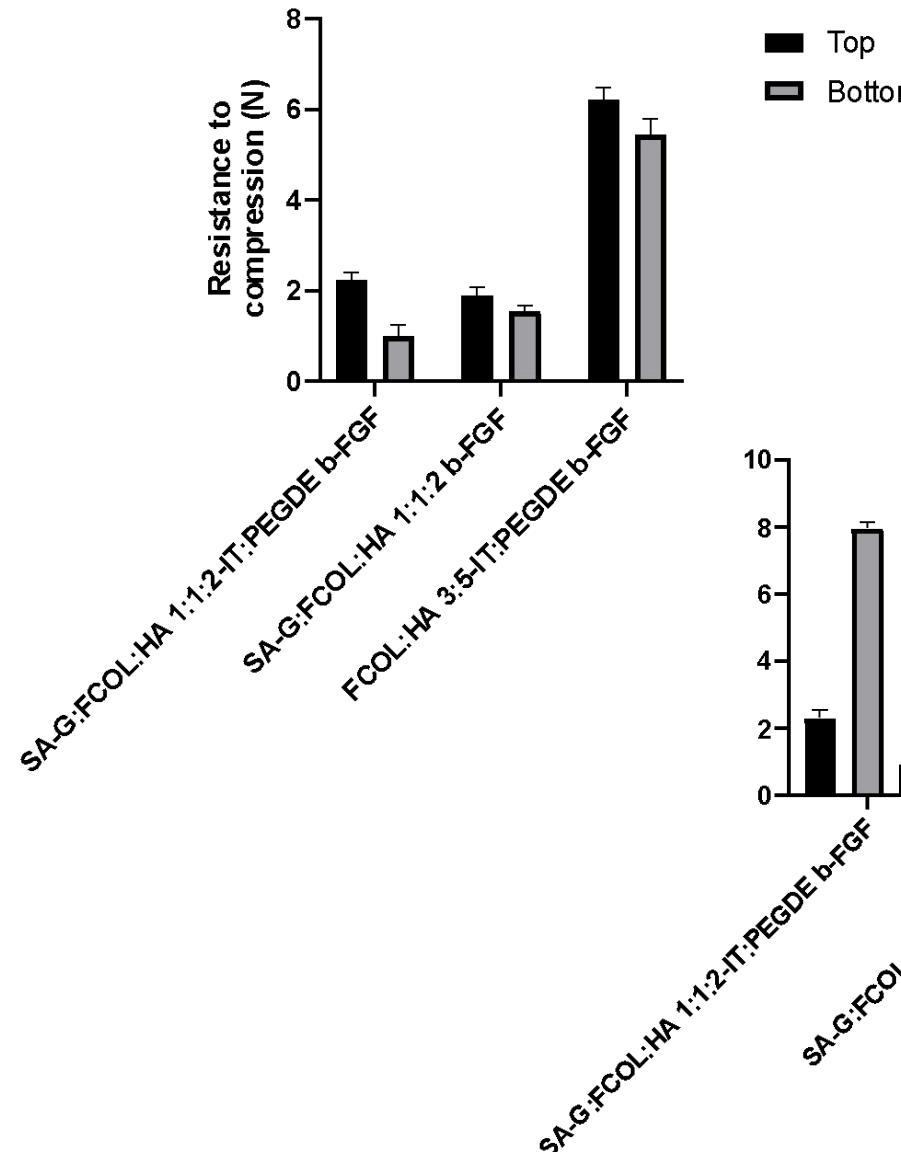
Porosity, swelling capacity, gel strength

- Exudate handling
 - ◆ Water vapor transmission rate
 - ◆ Equilibrium water content
 - ◆ Water absorption
 - ◆ Evaporative water loss
 - ◆ Drug release
- MTT assay (cell viability)
- Coagulation effect
- Scratch assay



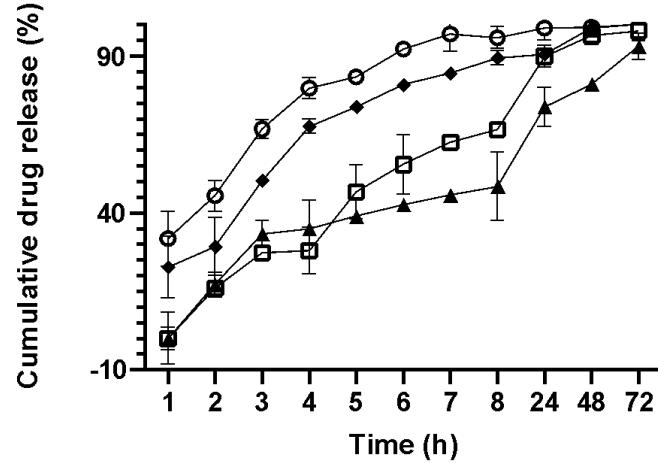
SA:FCOL:HA
1:1:2

SA:FCOL:HA
1:1:2 FGF

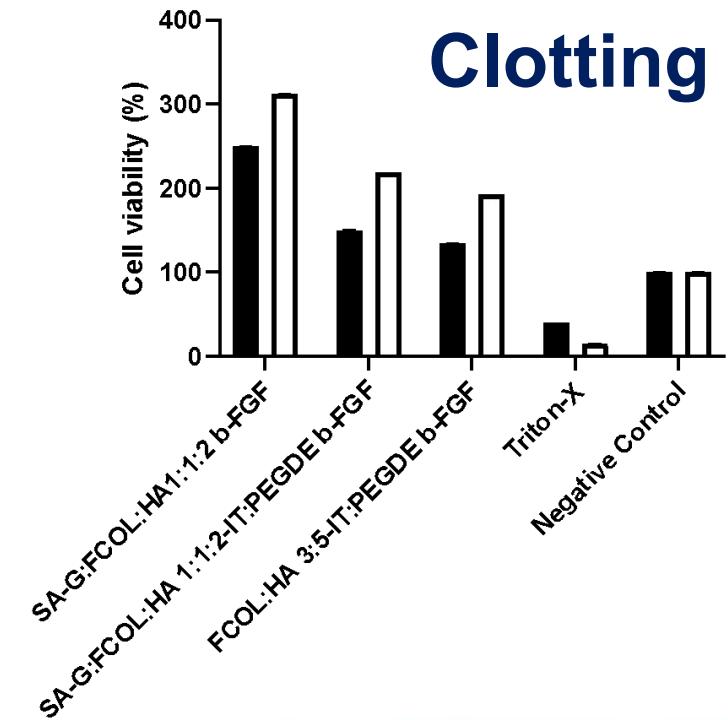


Sample name	Porosity (%) \pm SD	WVTR (g/m ² day ⁻¹) \pm SD	AW (%) \pm SD	EWC (%) \pm SD
SA-G:FCOL:HA 1:1:2 75ng b-FGF	70 \pm 10	4254 \pm 50	921 \pm 44	92 \pm 2
SA-G:FCOL:HA 1:1:2-IT:PEDGE 75 ng b-FGF	82 \pm 3	4181 \pm 206	1190 \pm 16	95 \pm 1
FCOL:HA 3:5-IT:PEDGE 75 ng b-FGF	87 \pm 1	1685 \pm 26	1378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





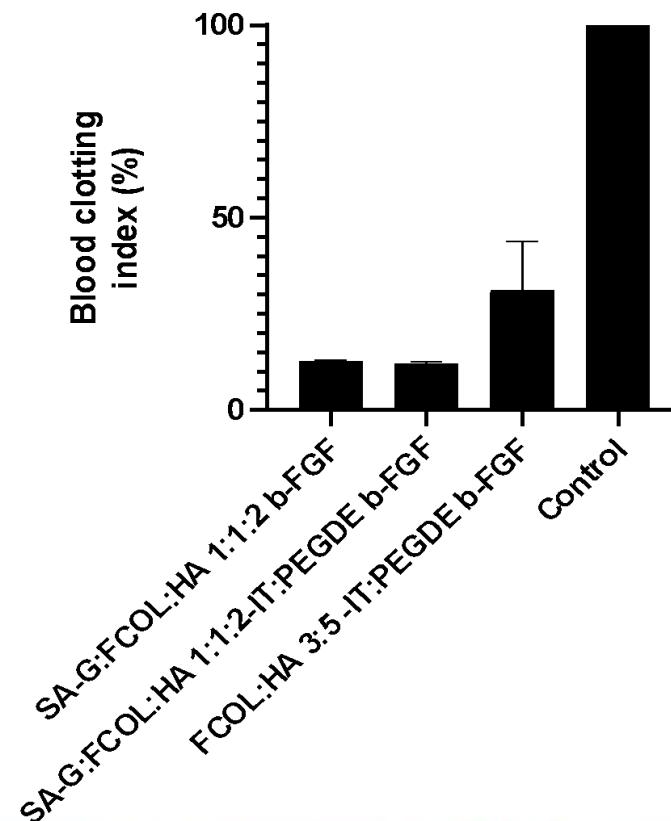
Protein Release



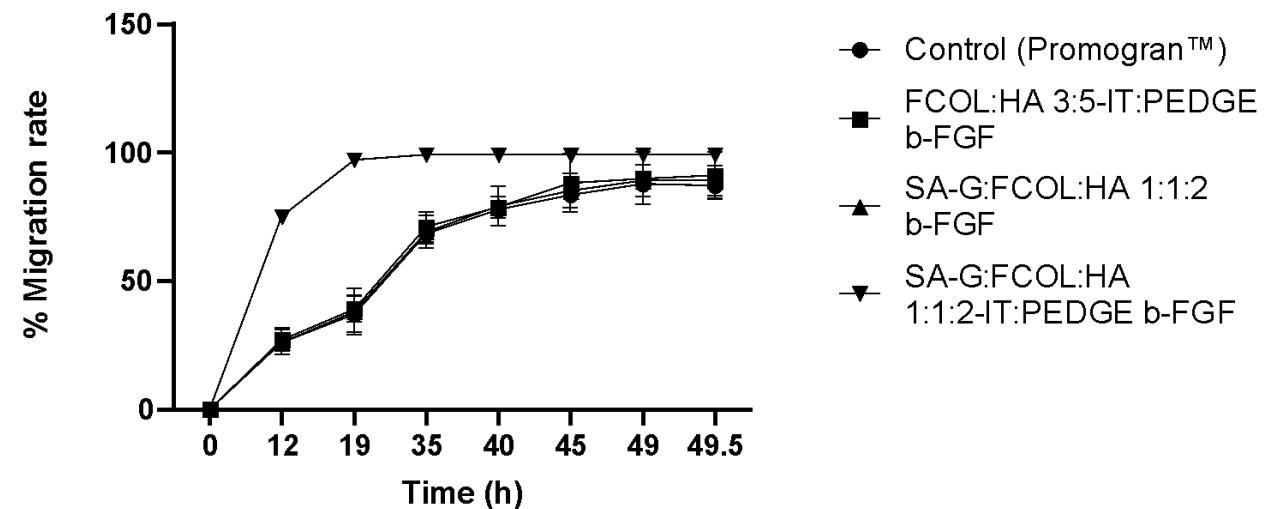
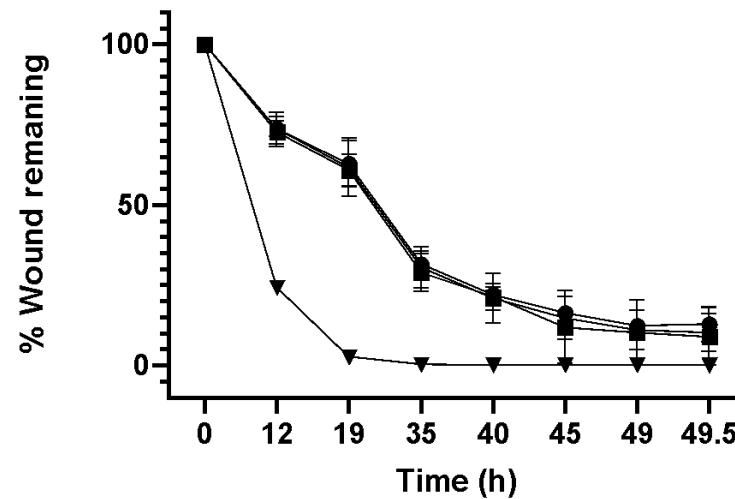
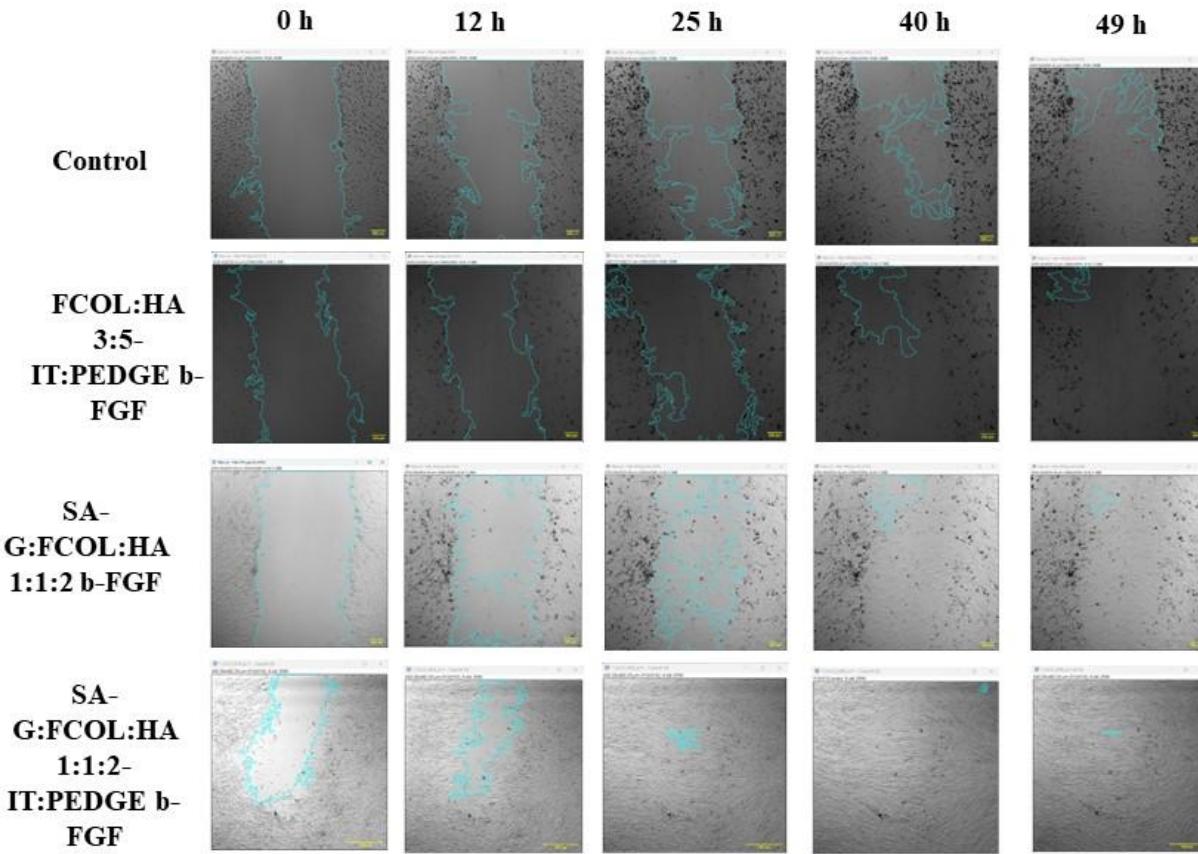
MTT & Blood Clotting



SA-G:FCOL:HA 1:1:2 b-FGF SA-G:FCOL:HA 1:1:2 IT:PEGDE b-FGF FCOL:HA 3:5 IT:PEGDE b-FGF



Scratch Assay



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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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