A strategy to save vision using Decellularized Cornea Matrix (DCM) Hydrogel by IITHyderabad Researchers

This technology offers a minimally invasive procedure to prevent scarring following corneal injury and also a new treatment strategy to cure the existing blinding scar for which the currently available option is corneal transplantation. Also, a human-sized cornea has been fabricated by Bioprinting technology towards the development of artificial cornea for transplantation.

Highlights:

- *The study offers a less invasive technique in the field of ophthalmology*
- *Can replace some of the complex surgical procedures in ophthalmology*
- *This technology was developed using discarded cornea from slaughterhouses and disqualified cornea for transplantation from Eye banks*
- *The processing method is simple and using only eco-friendly and harmless chemicals*
- *Preclinical studies indicate that the corneal scar for which cadaveric corneal grafting is the only available option currently, can be cured using this hydrogel*
- *Introduced, for the first time, a preventive measure using this hydrogel for corneal scarring following traumatic corneal injuries*
- *Its potential to treat thinning corneal disorders was also explored with successful outcomes.*

Hyderabad, Sep 20, 2021: IIT Hyderabad's Researcher Dr Faliguni Pati, Associate Professsor, Department of Bio-medical Engineering along with his team has developed a hydrogel from discarded corneas from human and bovine sources using a novel and simple method. Serendipitously, they discovered the most striking feature of this tissue-specific hydrogel to prevent the cells from scar tissue formation, which is attributed to the microenvironment that cannot be offered by any synthetic or other natural material. Capable of being injected owing to its two phases (liquid and gel) based on the incubation temperature, we explored its potential to serve as a material for minimally invasive treatment to replace complicated surgeries. Until now, no strategy is available to prevent corneal scarring following an injury. They demonstrated, for the first time, that this hydrogel can be applied immediately after injury which helps to regenerate the cornea without scarring. Furthermore, no treatment is available other than partial donor corneal graft or corneal transplantation for scarring, which is already present in the visual acuity.

Congratulating the team on this novel innovation, Prof B Murty, Director IIT Hyderabad, added, *"Vision, being one of the most important organs of any living being, this innovation by Dr Falguni and team will indeed bring light to many lives. This innovation has once again demonstrated IITH's zeal to collaborate for synergistic outcomes to serve the society at large."*

Dr Sayan Basu, Prof. D Balasubramanian Chair of Eye Research & Virender Sangwan Chair of Regenerative Ophthalmology, and Director, Centre for Ocular Regeneration (CORE), Prof Brien Holden Eye Research Centre (BHERC), LVPEI, and one of the Principal Investigators of this project says *"Corneal disease is a leading cause of blindness and visual impairment in India, and in the rest of the developing world where there is also a huge shortage of donor corneal tissue. Our collaboration with Dr Pati and his group at IITH on innovative approaches like the DCM is very promising and could restore vision to millions with corneal blindness, who are awaiting or unlikely to receive a corneal transplant."*

Dr Vivek Singh, Senior Scientist at LVPEI and one of the Principal Investigators of this project believes that *"this technology will have a big impact in countries where there is a scarcity of Eye bank and donor tissue. Dr Singh being from Varanasi, the constituency of PM Modi has experienced that the southern part*

of India is much more developed than the northern part for Eyecare. Still, states like UP and Bihar have the least accessibility to Donor cornea and they have to travel to South India for any corneal perforation, scars, or related disease. This Technology will even be used to prevent blindness in northern rural India where there is limited availability of donor cadaveric transplantation grade cornea as well as eye hospitals like LV Prasad and Sankara Nethralaya."

Dr B Kiran Kumar, Senior Scientist, CCMB, and one of the Principal Investigator of the study "*Conducted in vivo studies using the biomaterial as prophylactic to prevent scar tissue following an injury on Rabbits and also evaluated its potential to thicken and strengthen thinned Ectatic cornea by introducing this injectable hydrogel. The CCMB team is also conducting experiments to understand the process of corneal healing using proteomic approaches, added Dr Kumar*."

Relishing this innovation, Dr Falguni Pati, Associate Professor, Department of Biomedical Engineering, said, *"The department has taken many ingenious initiatives from offering BTech in Bio-medical Engineering to MTech in Medical Device Innovation. Medical science backed by the expertise of engineering will bring many such life-changing research and make it a reality."*

Proudly presented his innovation at IIT Hyderabad, Shibu Chameettachal, PhD Scholar, Department of Biomedical Engineering, said, *"Many works are in the pipeline. Already we completed multiple sets of pre-clinical studies, which provided us with promising results. We are planning for human pilot studies for some of its applications soon".*

Furthermore, they have explored and initiated a new strategy of excising only the scar tissue and filling the wound bed with DCM hydrogel that can regenerate the corneal tissue to a normal level with fair transparency. They also checked its potential to be a treatment strategy for Ectasia for which only complicated therapeutic strategies and troublesome surgeries including donor cornea transplantation are available. For the first time, they demonstrated that the DCM hydrogel has the potential to thicken the Ectatic cornea to normal thickness. Finally, their aim is to develop a complete human cornea to replace the human cadaveric donor cornea with 3D bioprinting technology. Shibu Chameettachal, PhD Scholar with his supervisor Dr Falguni Pati at the Department of Biomedical Engineering along with a collaboration with Dr. Vivek Singh and Dr. Sayan Basu from LV Prasad Eye Institute, and Dr. Kiran Kumar Bokara from CCMB, Hyderabad has published two research papers in international journals on these studies. The study also received the Cutting Edge Innovation BIRAC-GYTI Award (Biotechnology Industry Research Assistance Council-Gandhian Young Technological Innovation) 2018. They have filed both Indian and US patent for the preparation of this tissue-derived hydrogel.

Refer to the latest publication on the subject for more details: https://pubs.acs.org/doi/10.1021/acsabm.0c01112

The Electronic Press can be accessed at: https://youtu.be/SrK6UvSpfyk.

About IIT Hyderabad

Indian Institute of Technology Hyderabad (IITH) is one of the eight new IITs established by the Government of India in 2008. In a short span of **12** years, the institute has become a top ranker and currently has **242** full-time faculty, **3,491** students (**20**% women), and nearly **200** state-of-the-art laboratories, and five research and entrepreneurship centers. The institute has a strong research focus with approx Rs **575** crore of sanctioned research funding with PhD scholars accounting for about **30**% of total student strength. IITH has to its credit more than ~**6000** research publications, **195** patent disclosures, **1440** sponsored/consultancy projects, and about **50** startups.

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