VGENOMICS™

Decode. Diagnose. Discover.

CASE STUDY

Discovery and Validation of a Novel Biomarker VSP-2224 in Keratoconus

www.vgenomics.in

The Clinical Challenge

Keratoconus (KC) is a progressive corneal disorder characterized by **thinning, protrusion, and biomechanical instability.** It can cause severe visual impairment and is a leading cause of corneal transplantation worldwide.

Most patients are young adults, and delayed diagnosis disrupts education and productivity.
Current tools like corneal topography and tomography detect the disease only after structural changes are visible, leaving a very narrow therapeutic window for interventions such as corneal collagen cross-linking (CXL).

The Clinical Gap

A diagnostic approach capable of detecting the disease before irreversible structural change occurs to improve risk stratification, monitoring and treatment outcomes.

Discovery through Genomic Intelligence

Using **RgenX**'s advanced analytical workflows, which combine high-throughput RNA sequencing **(RNA-seq)** with powerful meta-analysis, Vgenomics uncovered **VSP-2224**, a novel and consistently dysregulated biomarker in keratoconus. VSP-2224 maps directly to the biological networks of extracellular matrix remodeling, epithelial integrity, oxidative balance, and inflammatory signaling, core mechanisms that drive corneal degeneration. Remarkably, it is detectable in tear fluid, offering a non-invasive window into early disease detection and a promising therapeutic target.

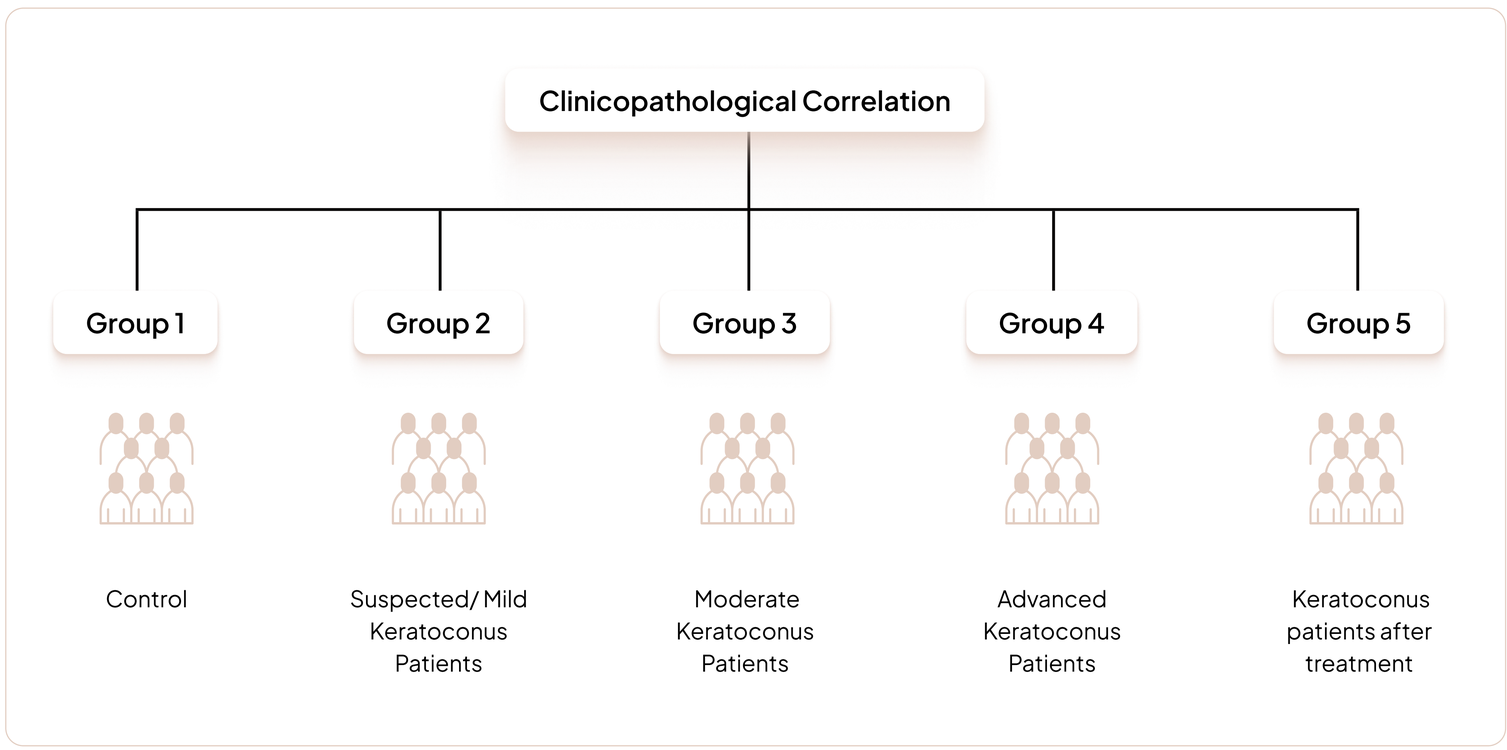

Fig 1 : Clinicopathological Correlation Across Study Groups

In Vitro Validation

We carried out extensive validation to ensure reproducibility and translational robustness of VSP 2224:

- On more than **150 patient samples**, including tear fluids, corneal epithelial cells, and KC patients derived cell lines
- Observed **significant** elevation compared with healthy controls.

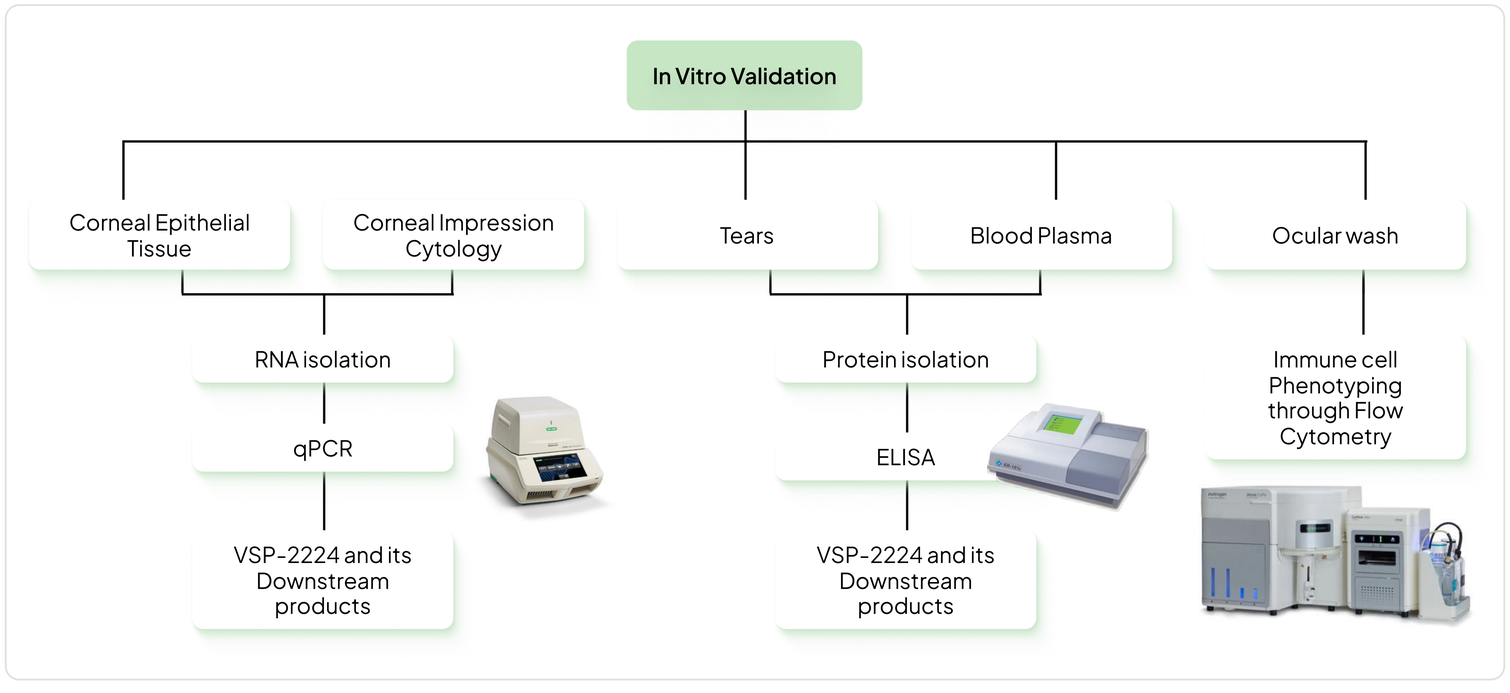

Fig 2 : In Vitro Experimental Workflow for Biomarker Validation

Functional Evidence in Preclinical Models

The pathogenic relevance of this biomarker was also demonstrated in a rabbit model, wherein intrastromal injection as well as topical application of the biomarker elicited early keratoconus-like alterations, as evidenced by Pentacam-based corneal imaging. This initial experimental work provided proof-of-concept for its role extending beyond correlative association, implicating a potential functional involvement in disease initiation. Building on these findings, the work has now progressed into the preclinical validation phase, where ongoing studies continue to demonstrate reproducible upregulation of the biomarker during disease progression.

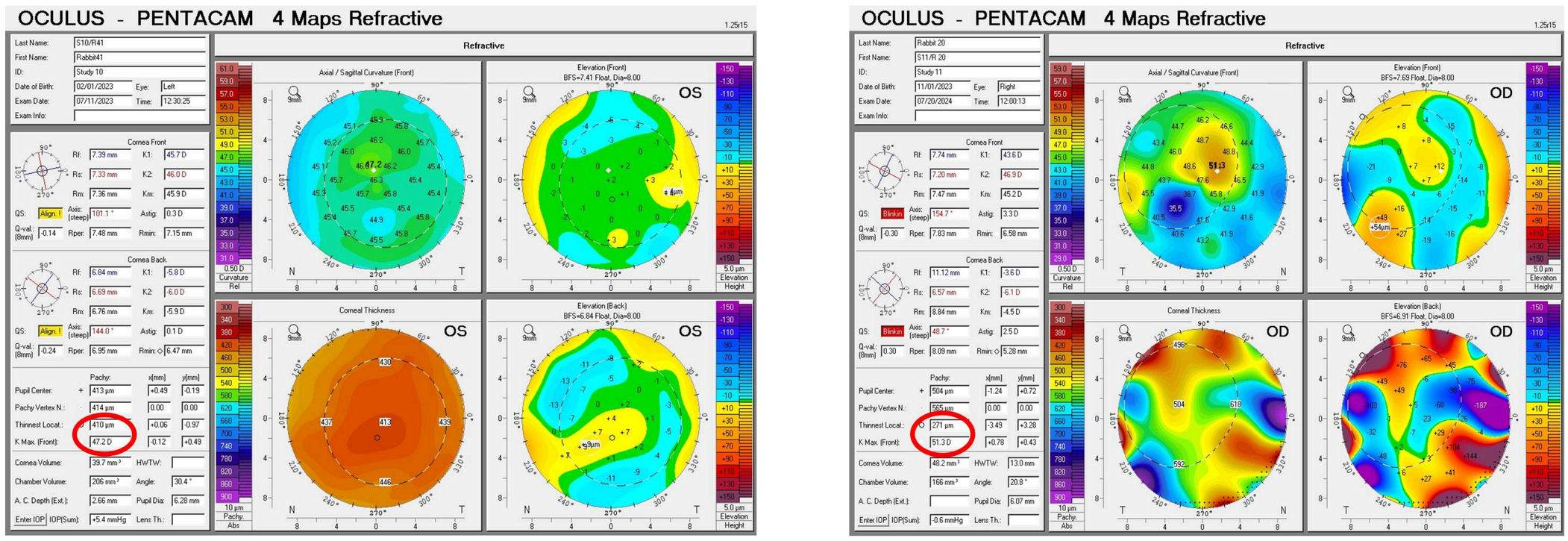

Fig 3 : Pentacam image of rabbit cornea after VSP-2224 injection

Translational Potential (Investigational)

Unlike many markers that act only as correlates of disease state, this biomarker appears to play an active role in keratoconus pathophysiology.

Diagnostic: Non-invasive early detection and biomarker expression profiles could be used to stratify patients, ensuring personalized therapy tailored to molecular risk levels.

Monitoring: Enables real-time tracking of disease progression and treatment response.

Therapeutic: An active role in extracellular matrix turnover, inflammation and epithelial signaling makes it a viable target for small molecule inhibitors, monoclonal antibodies, or RNA-based therapies to stabilize corneal biomechanics, slow or halt progression, and reduce the reliance on corneal transplantation.

Intellectual Property & Future Applications

Developed in collaboration with **Dr. Shroff's Charity Eye Hospital**, a patent and PCT application has been filed for this discovery to enable:

- Diagnostic kit development for point-of-care screening.
- Therapeutic innovations targeting VSP-2224 activity.

Summary

With ongoing preclinical validation and robust translational pathways, this work represents a paradigm shift toward molecularly guided management of keratoconus empowering earlier intervention, personalized treatment, and improved patient outcomes.