

Forgues F<sup>1,2</sup>, Schlaen A<sup>3,4</sup>, Bellotti MI<sup>5</sup>, Torres RM<sup>6,7</sup>, Rudzinski I<sup>1</sup>, Chegade Villalba P<sup>5</sup>, Chau M<sup>2</sup>, Bonetto F<sup>5,7</sup>, Saravia MJ<sup>1,7</sup>.

1. Buenos Aires Macula - Buenos Aires, Argentina. 2. Fundación Retina - Buenos Aires, Argentina. 3. Hospital Universitario Austral - Pilar, Buenos Aires, Argentina.

4. Hospital de Clinicas Jose de San Martin, Buenos Aires, Argentina. 5. Instituto Balseiro - San Carlos de Bariloche, Río Negro, Argentina. 6. ROMAT Creator Center - Colonia Avellaneda, Entre Ríos, Argentina. 7. 2. BAMTech Devices - Buenos Aires, Argentina.

## INTRODUCTION

Ocular pemphigoid is a progressive autoimmune disease that can lead to severe ocular surface damage if not detected early. Early-stage disease often presents with subtle changes that are difficult to quantify using conventional diagnostic methods. There is a need for objective tools capable of detecting early physiological alterations of the ocular surface.

Noninvasive impedance sensing detects early ocular pemphigoid

## PURPOSE

To evaluate whether a second-generation corneal impedance device can discriminate between eyes with early ocular pemphigoid and healthy controls.

## METHODS

A second-generation impedance prototype (IMPEL) was used to obtain multifrequency corneal measurements.

A total of 44 eyes were evaluated: 28 healthy controls and 16 patients with biopsy-confirmed early ocular pemphigoid.

Resistance (R) and capacitance (C) were recorded across the full frequency range.

Data were normalized and analyzed using supervised machine-learning models, with separate training and testing datasets.

A discriminant component was derived to evaluate classification performance.

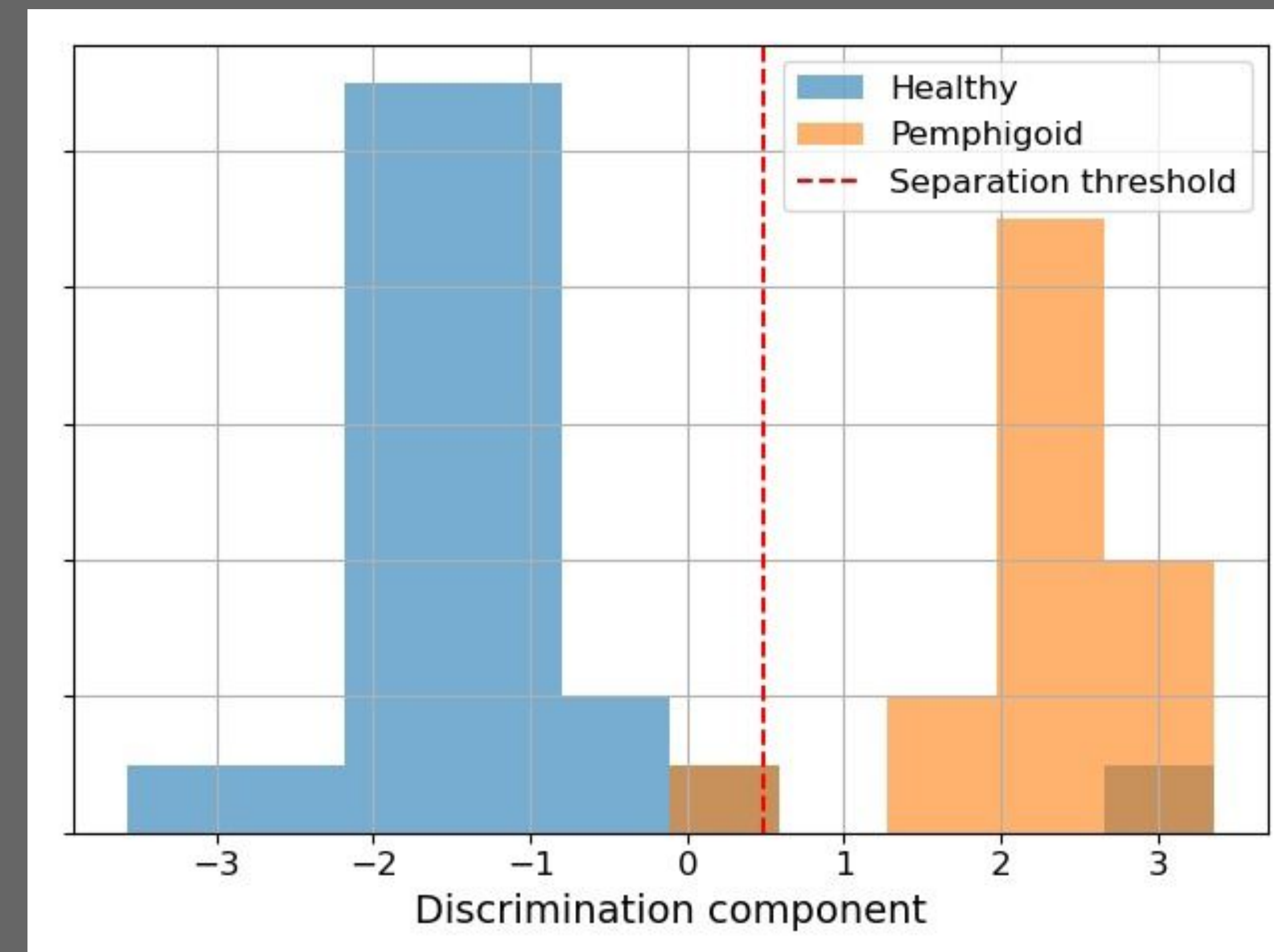


Figure 1. Histogram of classification output

Distribution of the main discriminant component derived from the machine-learning model. Healthy eyes cluster on one side of the threshold, while ocular pemphigoid eyes cluster on the opposite side.

## RESULTS

Healthy and pemphigoid eyes exhibited distinct impedance behaviors across frequencies.

Pemphigoid eyes showed broader and elevated resistance and capacitance trajectories compared to controls.

Machine-learning analysis identified a discriminant component that effectively separated the two groups. Histogram visualization demonstrated clear clustering, with healthy eyes and pemphigoid eyes distributed on opposite sides of the classification threshold.

Cross-validated classification confirmed consistent discrimination between groups.

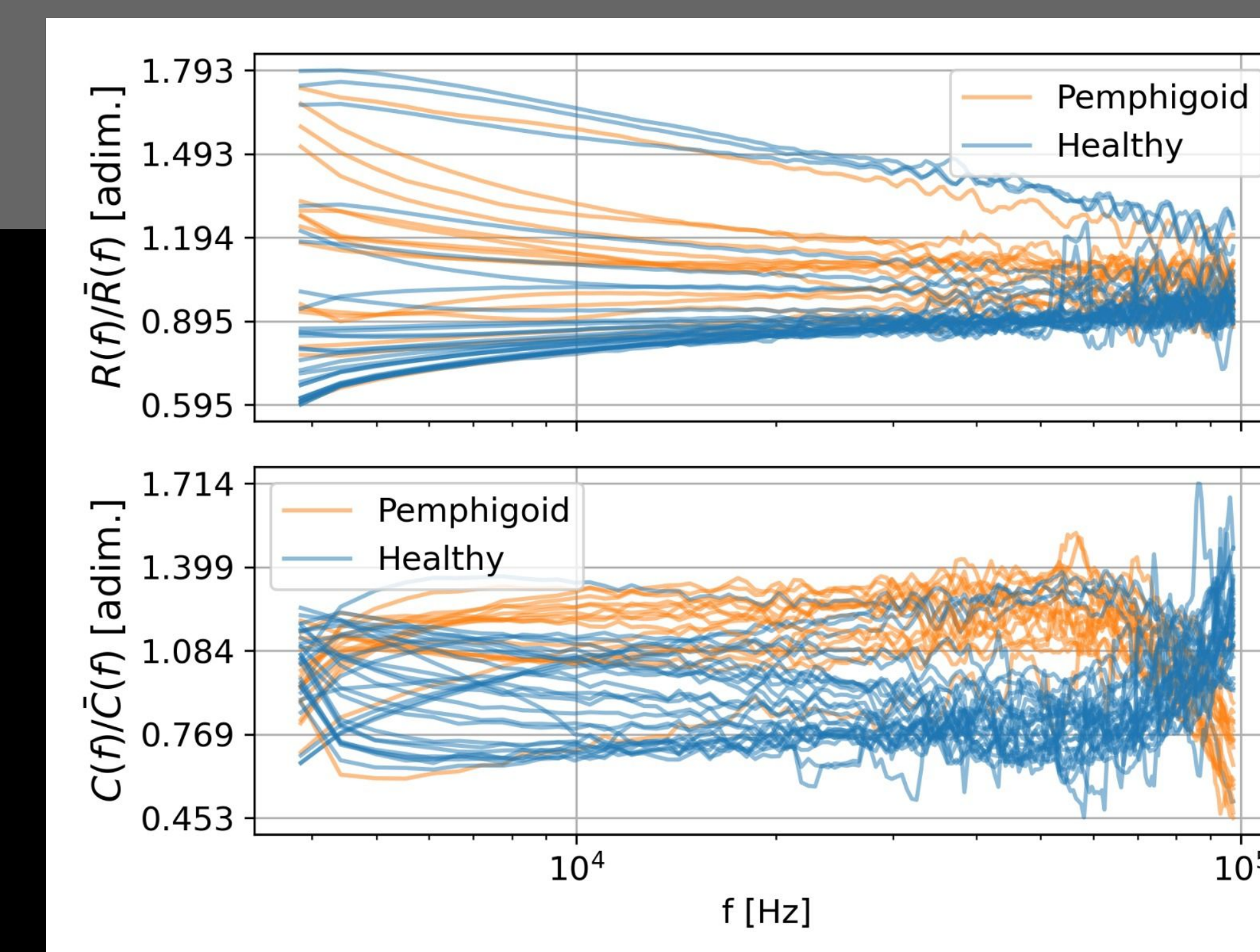


Figure 2. Impedance behavior across frequencies

Normalized resistance and capacitance curves showing broader and elevated patterns in pemphigoid compared to healthy controls.

*Electrical impedance reveals early physiological changes not visible clinically*

## CONCLUSIONS

The IMPEL second-generation device successfully captured corneal impedance signatures capable of distinguishing early ocular pemphigoid from healthy eyes.

These findings support the potential of impedance-based sensing as a noninvasive tool for early detection of ocular surface disease.

Further studies are required to validate these results across larger populations and disease stages.