Quantitative approach in vessel morphology analyses in corneal eye diseases

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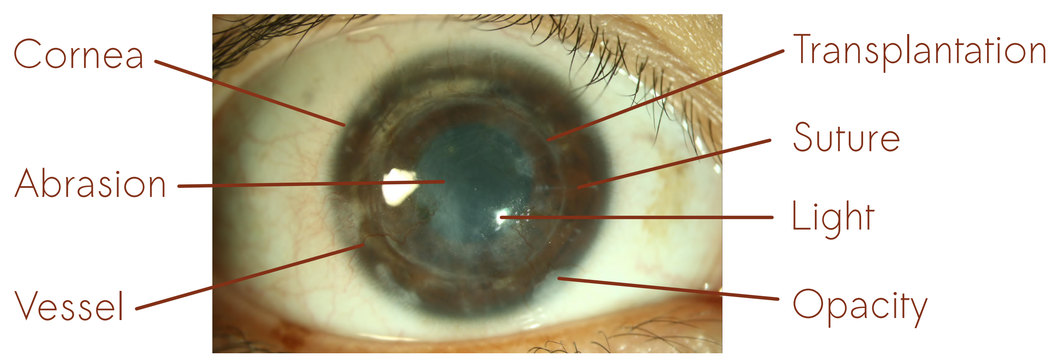
Context

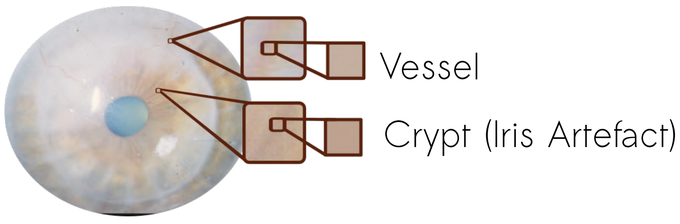
- Cornea neovascularisation : **Vessel in the cornea**
  Loss of the vision acuity, pair with opacity and loss of the immune privilege of the eyes, increase risk of greff rejection

- **Slit-lamp microscope** : cheapest, easiest and none invasive method

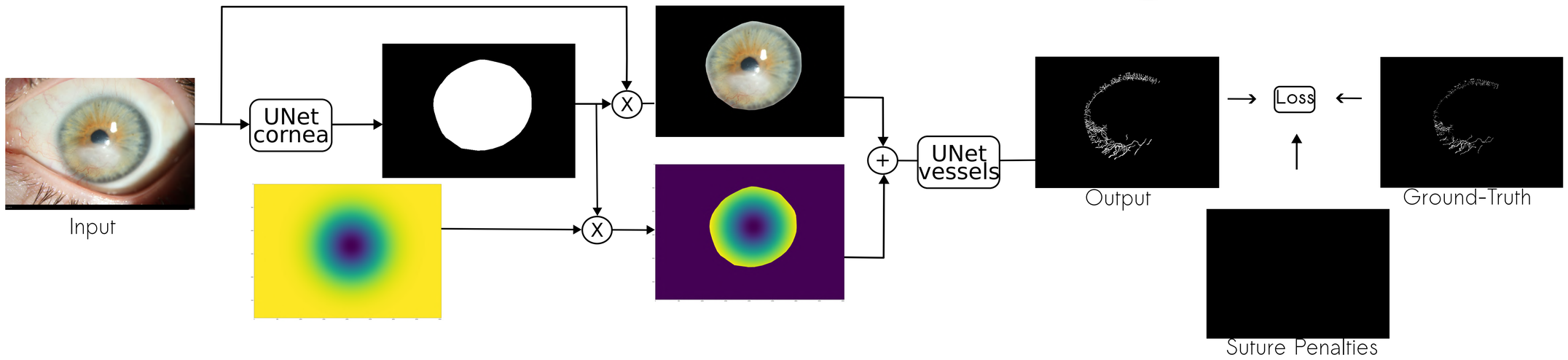
- **Only criterion** to evaluate vessels progressions :
  % vessels / cornea

Problematic : Describe vessels morphology
Vessels, suture points and crypts (Iris artefact) have similar appearances
Important : to keep the vessels **topology** and **vascular network**

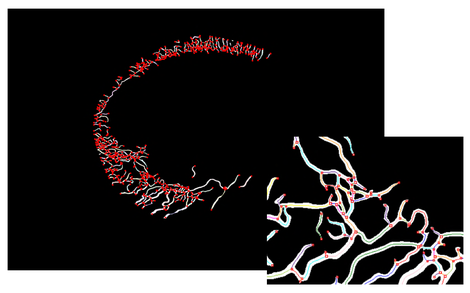




Segmentation of cornea and vessels

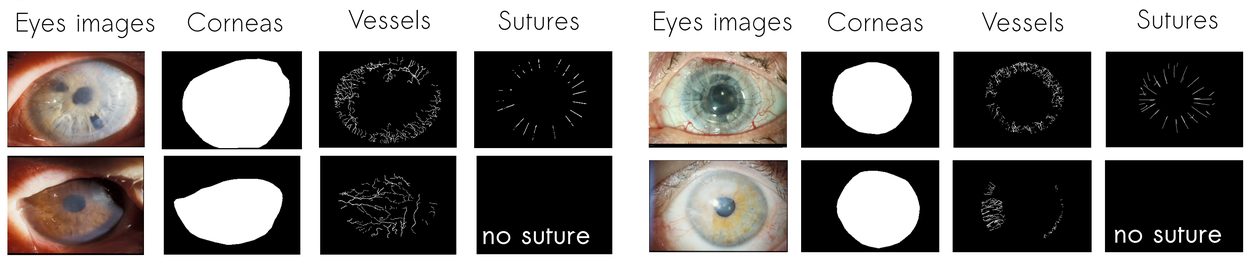


Morphological parameters

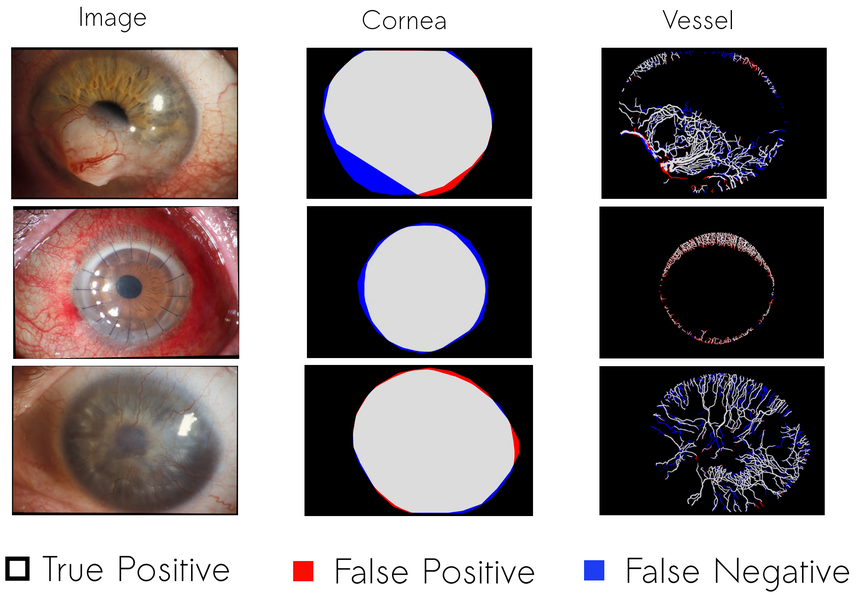


- % Vessels / Cornea
- Number of junctions
- Vessels Thickness
- Lenghts
- Position
- Tortuosity
- Color
- Lacunarity

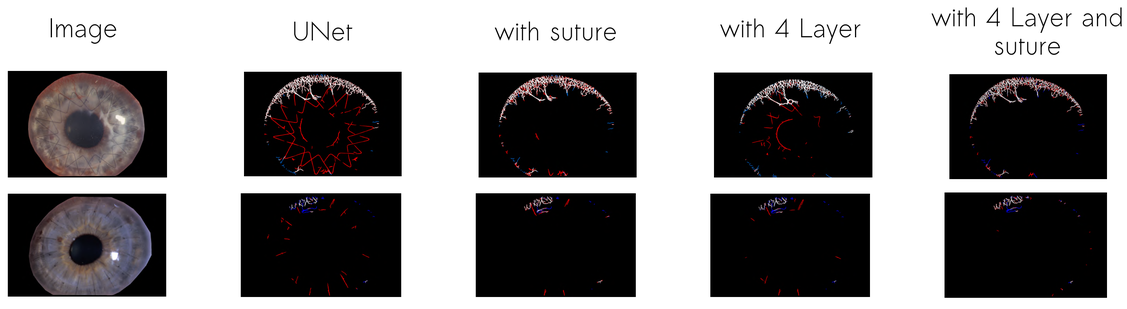
Dataset



Results



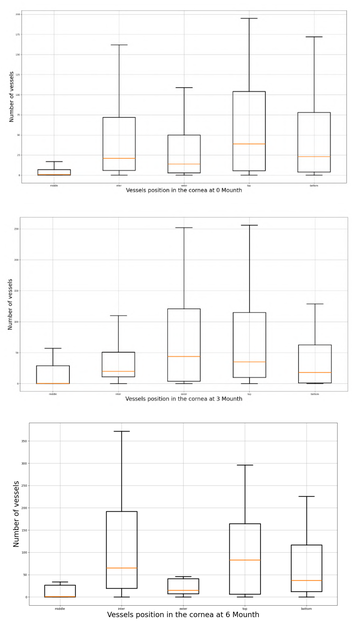
Ablation study



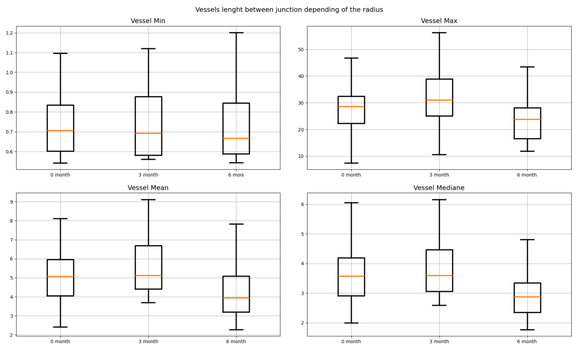
Model	Only Vessel	Area under Precision recall-curve	Global Accuracy	Sensitivity	Specificity	Precision	Jacquard Score	F1 Score	clDice Score
UNet	False	0.7087	0.9421	0.7147	0.9668	0.6746	0.5049	0.6586	0.7030
UNet with suture	False	**0.8610**	0.9564	0.7572	0.9752	0.7402	0.6062	0.7469	0.7872
UNet with 4 layer	False	0.7502	0.9547	0.7476	0.9771	0.7281	0.5780	0.7220	0.7620
Unet with 4 layer + suture	False	0.7799	**0.9599**	**0.7760**	**0.9808**	**0.7610**	**0.6174**	**0.7552**	**0.7979**

Exemple application study

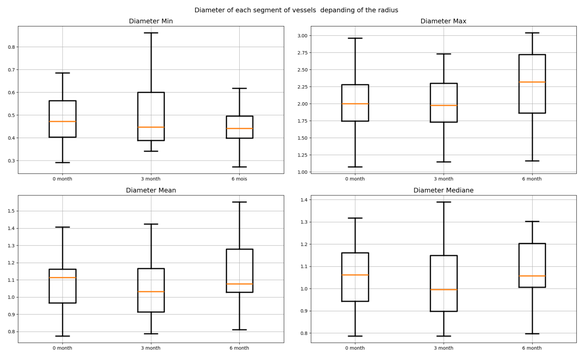
Number of vessel depening of their position



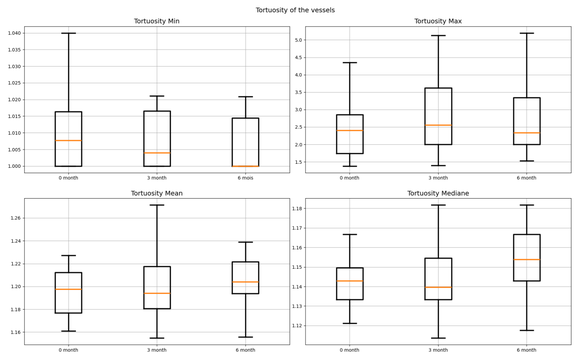
Vessel lenght between junctions or endpoint



Vessel diameter



Tortuosity



Cuersifen et al, GS101 - Antisense Oligonucleotide EyeDrops Inhibit Corneal Neovascularization Interim Results of a Randomized Phase II Trial – Cc et al (2015)