Refinement of Pre-Set Corneal Epithelial Thickness and Stromal Ablation Rate in One-Step Trans-Epithelial Ablations

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No financial interests.
C-TEN: trans-epithelial PRK
iVis excimer laser suite (iVis Technologies)

• Pre-refinement ablation calculation values

  – Preset epithelial thickness
    • 65 μ over whole ablation zone
  – Assumed ablation rate (average stroma and epithelium)
    • 1.48 μ per “layer”

  – Epithelial ablation rate slightly higher than stromal ablation rate.
C-TEN: trans-epithelial PRK
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- Consequences of error in assumed values
  
  - If the assumed epithelial depth is incorrect
    
    • If 65\(\mu\) is an overestimate
      
      - excess stromal ablation will take place
    
    • If 65\(\mu\) is an underestimate
      
      - insufficient stromal ablation
      - Reduction of the optical zone
      - Reduction of aspheric corrections
  
    - These effects will be
      
      - exaggerated with lower attempted stromal ablations
      - minimised in higher attempted stromal ablations
  
  - If the assumed stromal ablation rate is incorrect
    
    • Over-ablation:
      
      - Refractive correction not affected since uniform over whole treated area
    
    • Under-ablation
      
      - Refractive under-correction
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• Purpose of the study:
  – Establish true epithelial thickness
  – Establish a true stromal ablation rate
  – Derive a radial adjustment to allow for the thicker epithelium in the periphery of the ablation zone
Method

- 88 eyes in 64 patients
- 2 centres in Australia
- C-TEN trans-epithelial PRK for any refractive error
- 3 month follow-up
- Comparison of achieved versus attempted ablation depth
  - Precisio tomography pre-op and at 3 months ("surgical")
  - 3μ tolerance at each measured point
to 6 mm zone with test-to-test mapping
Method

• \( R_i = xE_{si} + yE_p \)
  – \( i = 1 \ldots n \), \( n \) = treated eye number
  – \( R_i \) = the real value of ablation depth including the epithelium for each treated eye;
  – \( E_{si} \) = the expected value of the ablation depth of the stroma for each treated eye (1.48 \( \mu \) per layer);
  – \( E_p \) = the constant default value used to ablate the epithelium (65\( \mu \));
  – \( x \) = the correction constant to be defined for the stromal ablation;
  – \( y \) = the correction constant to be defined for the epithelial ablation;
  – \( yE_p \) = the corrected constant of the total epithelial ablation depth.

• The Least Squares method used to define \( x \) and \( y \):
• Repeated for each radial zone from
  – 1mm to 10mm diameter
  – 1mm diameter steps
Results

Corrected epithelial thickness function
Results

• $x = 0.96$
  – correction constant for pure stromal ablation vs. average epithelium and stroma ablation rate
  – 4% over-ablation

• $y_{Epj}$
  – range of variability in radial distance of the corrected function vs. the default value to ablate the epithelium from the center of the ablation up to 10 mm zone.
  – -15.9% centrally
  – +15.9% peripherally,
  – unadjusted at 5mm zone
Results

• $x = 0.96$
  − Pre-adjusment assumed average ablation rate 1.48 $\mu$ per layer
  − Adjusted stromal ablation rate 1.42 $\mu$ per layer

• $y_{Epj} = +/- 15.9\%$
  − radial function in the range of $+/- 15.9\%$ of the default value of 65 $\mu$. 
Conclusion

• Pre-adjustment estimate of epithelial thickness
  – Oversesimate out to 10mm zone
  – Minimal effect on refractive outcome
  – Small stromal wastage

• Update has adjusted epithelial depth to established values

• Update has adjusted stromal ablation rate to established values