Comparative Study of Stromal Bed of LASIK Flaps Created With Femtosecond Lasers and Mechanical Microkeratome

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- Non of the authors has a financial interest in the subject matter of this poster.

Introduction-Background

- Femtosecond (FS) laser technology has been introduced in corneal and refractive surgery, and commercially available platforms are commonly used in LASIK surgery for flap creation. FS laser technology is capable of offering patients results comparable or even superior to mechanical microkeratome.
- Flap and stromal bed surface quality is considered to play a significant part in refractive results and optical quality after LASIK. A newer FS laser platform is the WaveLight FS200 femtosecond laser (Alcon Laboratories, Inc. Fort Worth, TX) which presents new features and has not yet been studied in terms of bed surface quality.

Purpose:

The purpose of our study is to compare in vitro the LASIK flap quality between two different femtosecond laser platforms (IntraLase FS150 [Abbott Medical Optics, Santa Ana, CA] and WaveLight FS200) and a mechanical microkeratome (Carriazzo-Pendular, SCHWIND eye-tech-solutions GmbH & Co.KG, Kleinostheim, Germany).

Study

Methods:

60 porcine eyes used for flap creation at two depths: 110 µm and 130µm

- 20 eyes with Intralase (10@110µm & 10@130µm)
- 20 Eyes with Wavelight (10@110µm & 10@130µm)
- 20 Eyes with SWIND Carriazzo-Pendular (10@110µm & 10@130µm)
- Images were assessed with light microscopy and scanning electron microscopy.
- Images were graded by 5 masked observers:
  - Two images from each subgroup were presented to each observer (12 images per observer) in a random order. Observers were asked to grade the images as follows: 1 = smoothest samples among all; 2 = next smoothest; 3 = median group; 4 = rough, but not worst; 5 = roughest samples among all.
- Scores of corresponding subgroups were compared with the Mann-Whitney U test.

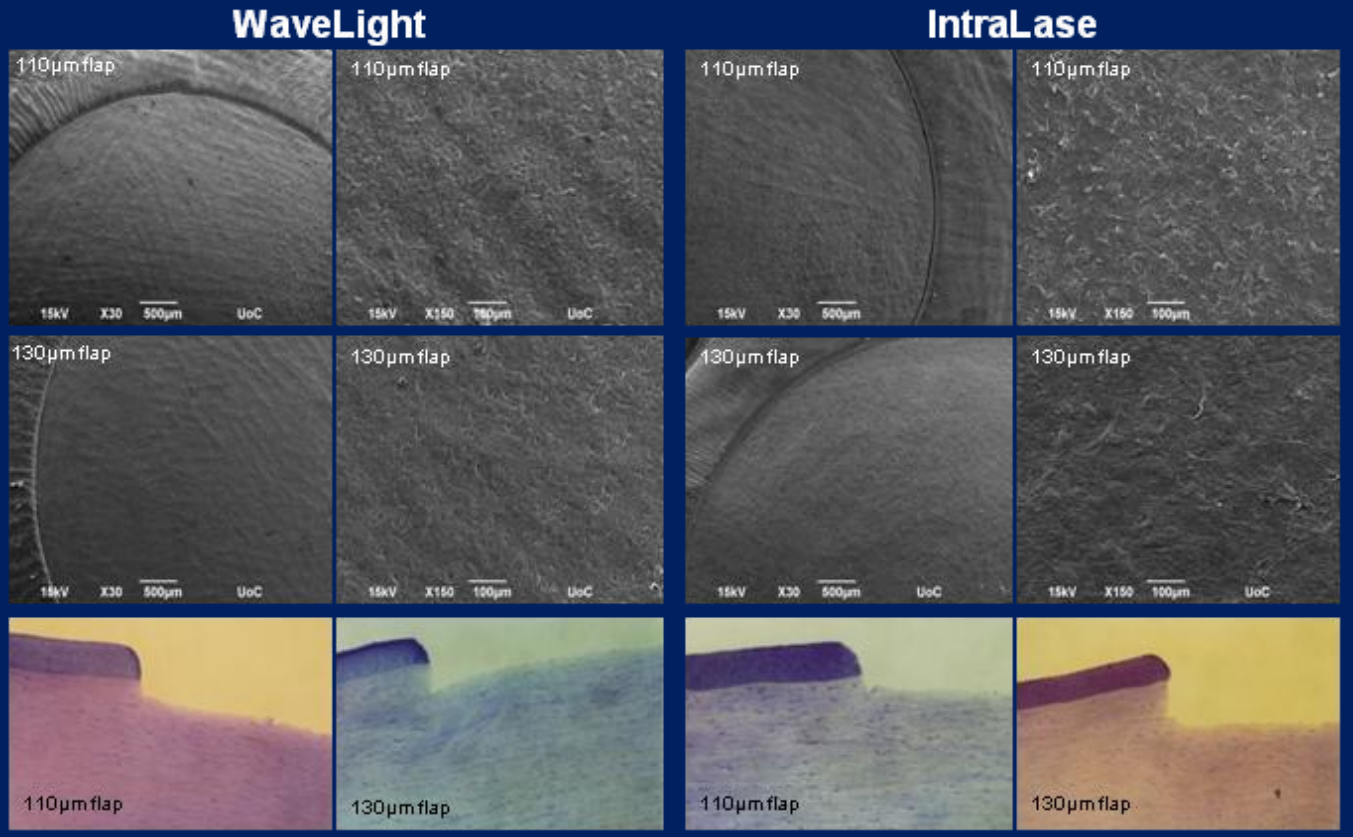
Methods:
Laser settings

- Diameter of the flap was 8.5mm, and the bed laser pulse energy was 0.9μj for both lasers.
- For Intralase bed separation, both spot and line separations were 6μm
- For Wavelight both were 8 μm.
- For the side cut ,in Wavelight system the spot separation was 5μm and the line separation was 3μm with the same energy as for the bed(0.9μj), while for the Intralase the spot and line separation was 3 and 3 μm but with the energy slightly higher at 1μJ .
- At both systems, for the prevention of opaque bubble layer, a small resection was active, centered at the hinge position but outside the perimeter of the side cut, named “pocket” and “canal” for the Intralase and WaveLight system respectively.

Results

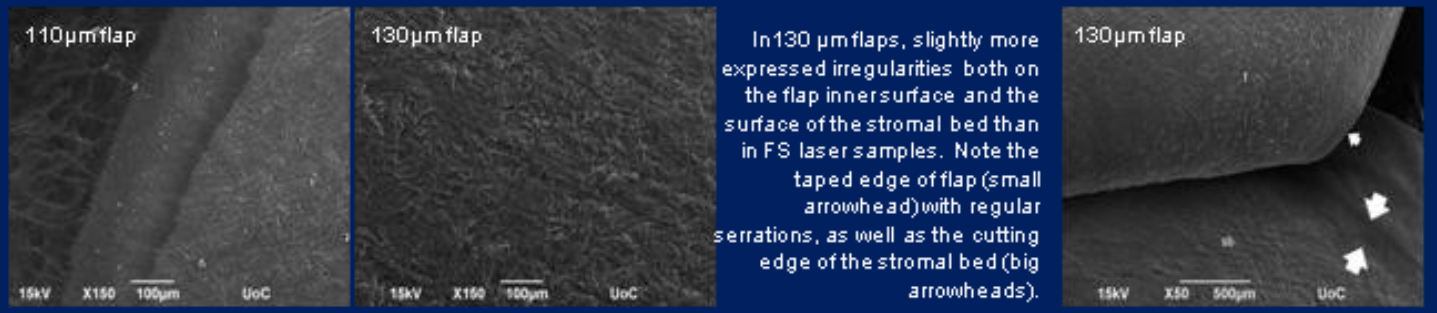
In SEM, at low energy levels the microphotographs reveal well-defined flap edge and relatively smooth stromal bed surface. At higher energy levels the central zone of the stromal bed demonstrates regular roughness due to stromal bridges that have similar appearance in all samples.

In LM, the bed surface is smooth, and there is no significant difference between the corresponding specimens.



Mechanical microkeratome

With the help of bigger magnifications reveals more prominent surface irregularities in 130 µm flaps.



In 130 µm flaps, slightly more expressed irregularities both on the flap inner surface and the surface of the stromal bed than in FS laser samples. Note the taped edge of flap (small arrowhead) with regular serrations, as well as the cutting edge of the stromal bed (big arrowheads).

Qualitative surface roughness grading comparisons

Flap group	Score (mean±SD)	p value*	p value†	p value‡
WaveLight flap thickness 110 µm	2.00 ± 1.05			**0.001**
WaveLight flap thickness 130 µm	2.40 ± 0.84	0.270		**<0.001**
IntraLase flap thickness 110 µm	2.20 ± 0.98		0.750	**0.002**
IntraLase flap thickness 130 µm	2.60 ± 0.52	0.340	0.728	**<0.001**
Mechanical microkeratome flap thickness 110 µm	4.20 ± 0.79			
Mechanical icrokeratome flap thickness 130 µm	4.40 ± 0.52	0.615		

SD: standard deviation
*†‡ p-values derived from Mann-Whitney U test comparisons
*comparison between flap thickness settings in each flap maker group
†comparison between different FS laser flap makers with corresponding flap thickness settings
‡comparison of each FS laser flap group with corresponding thickness mechanical microkeratome group

- No significant difference between the two FS lasers when comparing the subgroups with same flap thickness.
- No statistically significant difference ($p>0.05$) in each flap maker group between different thickness subgroups.
- The scores of the fs laser subgroups were significantly better than the scores of the mechanical microkeratome subgroups with corresponding flap thicknesses

Conclusion

In the current study, the IntraLase FS150 and the WaveLight FS200 had a similar performance and provided flaps with smooth surfaces. In comparison to the mechanical microkeratome, the studied femtosecond laser systems had a superior performance in terms of smoothness.