Wavefront-guided PRK produces better optical results than wavefront-guided or optimised LASIK

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in Lisbon

Wavefront-guided photorefractive keratectomy (PRK) induces fewer higher-order aberrations than wavefront-guided LASIK, while the latter induces fewer higher order aberrations than conventional or optimised LASIK, suggest the preliminary results of two new studies presented at the XXIII Congress of the ESCRS.

“In my practice, I employ wavefront guided technology in every patient that is eligible,” said Steve Schallhorn, MD, director of the Refractive Surgery Center at the Naval Medical Center in San Diego, California.

In the first study, 58 patients received wavefront-guided PRK or wavefront-guided LASIK. The surgeons used the Amoils brush for the PRK treatments, and the Hansatome microkeratome or the IntraLase femtosecond laser for the LASIK procedures. They used the Fourier VISX Star 5/ WaveScan 3.62 system for both types of procedures, using an identical ablation profile with no nomogram adjustment.

After three months, 91% in the PRK group and 88% in the LASIK group were within 0.50 dioptre of the intended treatment target. Moreover, 75% of the PRK treated eyes and 63% of the LASIK treated eyes were within 0.25 dioptre of the treatment goal.

Three months after the procedure, 97% of the LASIK group and 89% of the PRK group achieved an uncorrected visual acuity of 20/20, and 95% of the LASIK, eyes and 79% of the PRK eyes achieved an uncorrected visual acuity of 20/16. Half of the PRK eyes achieved 20/12.5 uncorrected visual acuity as did 35% of the LASIK-treated eyes.

The average post-operative uncorrected acuity was better than the average best spectacle corrected acuity before surgery.

This was true for both the PRK treated and the LASIK treated eyes. Both methods lead to a slight improvement in best-corrected visual acuity and photopic low contrast acuity and no average loss of scotopic contrast acuity.

While PRK and LASIK performed comparably in all of the above-mentioned areas, there was a significant difference between the two wavefront-guided treatments when it came to higher order aberrations. Wavefront-guided PRK induced significantly fewer higher order aberrations than LASIK. The difference was particularly noted when it came to coma aberrations. However, the difference in higher order aberrations could be due to the type of keratome the surgeons used, according to Dr Schallhorn.

Dr Schallhorn considers his results preliminary, and he is planning on enrolling a larger number of subjects. In addition, the patients will be followed for twelve months after surgery to see if some continue to improve.

“We're anxious to see how the two treatments will compare in a larger sample size. This will also allow us to break out the two microkeratomes to evaluate differences in their outcome,”

“Wavefront maps was performed using the higher order aberration distribution. Next, the investigators determined the induction of the Zernike terms after both wavefront-guided and conventional treatment by randomly assigning the post-operation higher order of 10,000 random pre-operation wavefront maps was performed using the higher order aberration distribution. Next, the investigators determined the induction of the Zernike terms after both wavefront-guided and conventional treatment by randomly assigning the post-operation higher order aberration within one standard deviation of the induced aberration depending on the surgery and pre-operative higher order aberration level. The team assumed that all the procedures had perfect corrections in sphere and cylinder and that optimised treatment induced no change in spherical aberrations.

The patients were assigned to groups based on their aberations. The first group included eyes with a normal amount of pre-operative higher order aberrations (defined as aberrations within one standard deviation of the mean pre-operative level). The second group included all eyes with negative spherical aberrations, and a third group consisted of highly aberrated eyes (defined as aberrations greater than two standard deviations above the mean of the group).

The simulations demonstrated that conventional LASIK induced significantly more higher-order aberrations than wavefront-guided and optimised LASIK in all three groups. Wavefront-guided treatment induced the least higher-order aberrations. While optimised LASIK induced fewer aberrations than conventional LASIK, the two treatments performed similarly in patients with negative spherical aberrations. This is because conventional procedures induce positive spherical aberrations, which counters the patients' negative spherical aberrations, explained Dr Schallhorn.

Conventional LASIK five times more likely to induce higher order aberrations

To get a better idea of how these results would affect the patients, Dr Schallhorn looked at the odds of inducing significant higher order aberrations, defined as RMS greater than 0.1 microns. This analysis showed that conventional LASIK is five times as likely to induce higher order aberrations as wavefront-guided LASIK and twice as likely as optimised LASIK. In addition, optimised LASIK is twice as likely to induce significant higher-order aberrations compared to wavefront-guided LASIK.

“My conclusion looking at this model is that the visual quality of wavefront-guided is better than either conventional or optimised because optimised is designed to minimise induction of spherical aberrations, but there are other higher order terms that are induced by conventional LASIK,” said Dr Schallhorn.

And, while optimised LASIK is an improvement over conventional LASIK, it performs similarly to conventional LASIK on eyes with pre-op negative spherical aberration, he added.

Eye surgeons have known for some time that conventional LASIK induces higher-order aberrations, particularly spherical aberration. On the other hand, wavefront-guided procedures result in less induction of higher aberrations. In some cases, wavefront-guided treatment reduces the higher order aberrations, especially in highly aberrated eyes.

The fact that spherical aberration is the most prominent aberration induced by conventional LASIK beggled the question whether the visual performance of optimised LASIK is equivalent to wavefront-guided treatment. Dr Schallhorn's simulation demonstrates that optimised LASIK is indeed an improvement over conventional LASIK, but it still induces more higher-order aberrations than wavefront-guided procedures.

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