LASIK at the North Pole - taking refractive surgery to extremes

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Refractive surgeons whose patients are inclined to adventure travel to extreme locations may want to prepare those patients for potential eye problems, suggests a case report from the North Pole.

Surgeons at the Eye Institute, Tan Tock Send Hospital in Singapore report the unusual case of 39 year old male who trekked to the geographic North Pole following the Arctic Circle.

The patient had undergone standard LASIK with the Technolas 217z excimer laser (Bausch & Lomb) and the Hansatome microkeratome. His pre-operative refraction was –11 D in the right eye and –12.75 D, –1.00 Dx145 degrees in left eye. Preoperative pachymetry was 559 microns in the right and 562 microns in the left eye. Corneal topography showed regular with the rule astigmatism.

Eight weeks after LASIK surgery the patients’ vision was stable in both eyes with uncorrected visual acuity of 20/20. Manifest refraction was 0.0 D sphere and –0.5 D of cylinder in the right eye and plano in the left eye.

The patient travelled to the geographic North Pole shortly after his eight week follow-up examination. Once there, he experienced temperatures of –30°C and 0% humidity. He developed symptoms of myopia, with a sphere of –2.5 D and a cylinder of –0.5 D in the right eye and a sphere of –1.5 D and cylinder of –0.75 D in the left eye.

His surgeon was able to examine him one week after his return from the North Pole.

An evaluation of manifest refraction confirmed the myopic shift. He was able to exclude ciliary spasm as a cause of the problem with cycloplegic refraction. The ophthalmic examination was otherwise normal.

The surgeon obtained corneal topography measurements using the Orbscan II (Bausch & Lomb) and was able to compare the results with serial measurements he had obtained before the surgery and at subsequent follow-up visits. The measurements obtained following the patient’s Arctic ordeal revealed peripheral flattening and central steepening.

Myopia resolved after three months

Fortunately, the patient had a complete resolution of symptoms within 12 weeks of his return. His refraction returned to the initial post-operative level and has remained stable.

Additional follow-up corneal topographic studies showed central corneal flattening and peripheral steepening. These contour changes paralleled the resolution of the patient’s symptoms.

The researchers believe that the temporary myopic shift could be attributed to corneal deisecation in a context of changes in corneal tissues associated with LASIK surgery. They note that the central and peripheral cornea do not behave the same, as the peripheral corneal lamellae are severed during LASIK flap creation and laser ablation and are therefore not tension bearing. They suggest that the peripheral lamellae relax after LASIK, causing an increase in the peripheral corneal curvature because of an increased distance between the layers of severed lamellae.

They hypothesise that these swollen peripheral lamellae dehydrate when desiccated, leading to a reversal of the biomechanical steepening. They theorise that as each layer of lamellae is connected to another by a network of cross-linking, the central lamellae respond by steepening, causing the observed myopic shift.

LASIK may present hazards to thrill seekers

The fact that the post-surgical cornea reacts differently to hypoxia than unoperated corneas raises potential issues for those patients who may be inclined to pursue adventure sports including mountaineering, trekking, and diving. The visual impairment experienced by our patient was unexpected and represents a potential hazard to individuals involved in outdoor activity requiring exposure to extremes of environmental conditions, in the immediate post-LASIK period. Such patients should be warned to prepare for visual acuity fluctuations and reduced vision in extreme environmental conditions, including cold, aridity and hypoxia, “the researchers caution.

The current case joins a short list of interesting reports about refractive surgery patients who have experienced visual problems under extreme conditions. Visual problems have been reported by patients at high altitude who have undergone LASIK, PRK, RK, and corneal grafts. The current consensus is that these refractive changes are caused by hypoxia producing endothelial dysfunction, resulting in corneal oedema and alterations in central corneal keratometry.

Refractive surgery implicated in Everest tragedy

Perhaps the most notorious case involved an ill-fated expedition to Mt. Everest in 1976 during which several climbers died. One member of that trip, Beck Weathers MD, who had previously undergone radial keratotomy, reported significant visual difficulties, which he felt caused him to eventually lose both hands and nose to frostbite.

The mountaineering ophthalmologist Geoff Tabin MD believes the effects of the RK may have been exaggerated by Dr Weathers. He notes that blurred vision can result when the hypoxia of altitude produces swelling along the RK scars resulting in a flattening of the central cornea and a hyperopic refractive shift.

This can lead to a blurring of vision, but not the incapacitating blindness reported by Dr Weathers. Moreover, Dr Weathers was on relatively gentle ground which would have been easy to negotiate back down to camp by an experienced climber, even with loss of vision.

“Dr Weather’s tragic injury was much more the result of an inexperienced climber going on a guided trip to a serious mountain rather than being caused by refractive surgery,” Dr Tabin said.

Dr Tabin concluded that LASIK might be a good choice as a refractive procedure for patients involved with high altitude activities. He cautioned that patients achieving extreme altitudes (above 26,000 feet) should be warned of possible visual fluctuation. He notes that any climber who has undergone LASIK needs to be evaluated for dry eye and to be maximally treated prior to going. LASIK patients should also be advised to bring appropriate drops on the expedition.

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Going to extremes

In the Arctic region the annual mean temperature is between –30°C and –60°C with winds up to 55 km per hour and annual precipitation of less than 25.0 mm per year. The frozen sea extends south from the North Pole for at least 800 km. A new study of nine million temperature readings taken between 1965 and 1995 shows that 4,800 cubic miles of fresh water have melted from the Arctic region and poured into the normally salty northern Atlantic, raising concerns about accelerating climate change.