Continuously Adjustable Eyewear
A powerful tool to address fluctuating vision in the management of diabetes

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Summary
• Fluctuating vision is particularly common amongst people who are developing diabetes or who are trying new medications to bring their diabetes under control.
• Fluctuating vision poses a unique problem to the eyecare professional seeking to offer viable solutions to his/her patient during this difficult time.
• Prescription eyeglasses prepared during this period are unlikely to work once vision has stabilized. Recommending patients spend money on lenses that will only work for a limited period is likely to create distrust of medical care.
• Adjustable eyeglasses can be used as a temporary, non-prescription pair of eyeglasses to offer symptomatic relief for diabetics suffering from fluctuating vision.
• Adjustable eyeglasses are able to correct for a large range of spherical powers (-6.0D to +3.0D) and as each lens can be adjusted individually it is possible for patients to easily manage differences in power between eyes.

Glucose
Glucose is a fuel used by the body’s cells as a source of energy to work, play and live. It is essential for life. Glucose comes from the food we eat and, once ingested, enters the blood stream to circulate throughout the body. Despite its obvious benefits, the concentration of glucose in the blood must be carefully regulated. If its concentration rises too high the red blood cells that transport it quite literally become sticky, affecting circulation and causing damage to the fragile blood vessels in the eyes, kidneys and feet.

Diabetes
The body uses insulin, a hormone produced by the pancreas (Figure 1), to carefully regulate the concentration of glucose in the blood stream. Insulin can be thought of as a key that unlocks the door to the body’s cells: once the door is unlocked, glucose is free to enter the cells to supply energy. Diabetes develops when the body cannot effectively transport glucose into cells. This happens when either:

• there is no insulin to unlock the cells (Type 1 Diabetes)
• there is not enough insulin (or the insulin isn’t working properly), so the cells are only partially unlocked (or not at all) (Type 2 Diabetes)

<table>
<thead>
<tr>
<th>Type 1 diabetes</th>
<th>Prevalence: 10% of all diabetics</th>
<th>Treatment: Insulin injections, diet, exercise</th>
<th>Onset: Usually before the age of 40 years</th>
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<tbody>
<tr>
<td>Type 2 diabetes</td>
<td>Prevalence: 90% of all diabetics</td>
<td>Treatment: medication, diet, exercise</td>
<td>Onset: usually after the age of 40 years</td>
</tr>
</tbody>
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Figure 1. Insulin, the hormone that regulates blood-glucose concentration, is produced in the pancreas (highlighted).
Prevalence of diabetes

According to the Centers for Disease Control and Prevention\(^1\), in the U.S. alone almost 26 million people (8.3% of the population) have diabetes (Figure 2). The problem, however, is global. The World Health Organization estimates that 347 million people are affected worldwide and that figure is growing rapidly.

The eye and diabetes

Long term effects of diabetes on vision

People who suffer from diabetes are prone to developing a variety of ocular complications including cataract, eye infections and even sight threatening conditions like retinopathy. Between 2005 and 2008 over 4 million people in the U.S. (28.5% of those with diabetes) developed diabetic retinopathy, and of these, 650,000 (4.4% of those with diabetes) developed advanced diabetic retinopathy that could lead to severe vision loss\(^1\). Much of this vision loss is preventable. The CDC claims that treating diabetic eye disease with laser therapy can reduce the development of severe vision loss by an estimated 50% to 60\(^1\). As such, the need for regular eye examinations by a trained professional cannot be overstated.

Short term effects of diabetes on vision

It is now widely accepted that the refractive power of the eye is linked to glucose metabolism. As blood glucose concentrations fluctuate, so too does the power of the eye. As diabetes is characterised by poor glucose metabolism it should come as no surprise to hear diabetics often complain about fluctuations in the quality of their vision. Fluctuating vision has a marked impact on the sufferer’s quality of life and affects everything from reading through to safety on the road while driving.

Fluctuating vision is particularly common amongst people who are just developing diabetes or who are trying new medications to bring their diabetes under control. Learning to control the concentration of glucose in the blood through changes to lifestyle, diet and medication is not something that happens overnight and it may take several months before glucose levels (and vision) stabilize. Eyecare professionals frequently observe that glasses prepared during this time usually do not ‘work’ after a few months\(^2,3\) and it is for this reason that optometrists, opticians and ophthalmologists tend to avoid prescribing glasses over this period\(^3,4\).
Diabetes and its effect on the optical elements of the eye

While all studies agree that the refractive power of the eye changes in diabetic patients on account of changes in blood-glucose concentration, there is very little agreement on what change is likely to occur: some studies suggest that a rise in blood-glucose concentration leads to an increase in far-sightedness5,7,8,9,10, whereas others suggest that near-sightedness is the norm10,11,12,13,14,15,16,17,18, and others found mixed results18.

Needless to say, the biological mechanisms for refractive changes in the eyes of diabetics are poorly understood. Many studies point to changes in the eye’s crystalline lens (Figure 3). Some scientists report that the central thickness of the crystalline lens increases8,18,22,23, whereas others claim that fluctuations in the refractive power of the eye are linked to changes in the refractive index of the crystalline lens4,24. A number of studies indicate that the thickness of the cornea changes quite early on in the disease and tends to remain unchanged thereafter irrespective of fluctuations in blood glucose levels23,25,26.

Changes in the power of the eye

During treatment

Okamoto et al.5 reported how the power of the eye changed over the course of intensive treatment for diabetes. Power shifts of between 0.50 D and 3.75 D were observed in all eyes (n = 28) over the treatment period. While these refractive shifts varied considerably over the course of treatment the refractive power of the eye appeared to stabilize between 14 and 84 days after treatment began. Figure 4 shows the change in the power of the eye in one of the diabetic patients enrolled in the study over a period of 16 weeks of intensive treatment for diabetes.

Before and after treatment

Giusti et al.27 compared the refractive power of the eye before and after intensive treatment for diabetes in 20 hyperopic adolescents. The subjects were examined every two weeks for a four month period. There was a statistically significant difference in the power of both right and left eyes before and after treatment (Figure 5). On average, the power for right eyes prior to treatment was +3.51 ± 0.46 D. Following treatment the average power of for right
eyes had changed to $+1.75 \pm 0.39D$ (p < 0.001). Similarly, the pre- and post-treatment average power for left eyes was $+3.56 \pm 0.51$ and $+1.86 \pm 0.48 D$ respectively.

**What can adjustable eyewear offer you and your patients?**

Fluctuating vision is one of the first signs of uncontrolled diabetes. It is particularly common amongst people who are just developing diabetes or who are trying new medications to bring their diabetes under control. Fluctuating vision poses a unique problem to the eyecare professional seeking to offer viable solutions to his/her patient during this difficult time. Prescription eyeglasses prepared during this period are unlikely to work once vision has stabilized. Recommending patients spend money on lenses that will only work for a limited period is likely to create distrust of medical care.

Adjustable eyeglasses can be used as a temporary, non-prescription pair of eyeglasses to offer symptomatic relief to diabetics suffering from fluctuating vision. Adjustable eyeglasses are able to correct for a large range of spherical powers (-6.0D to +3.0D) and as each lens can be adjusted individually it is possible for patients to easily manage differences in power between eyes. Adjustable glasses are best used during the period in which diabetics are trying to establish control of their glucose levels under the supervision of a medical advisor. It is important to emphasis to patients that adjustable eyeglasses are a temporary device to enhance their quality of life and that fluctuating vision and the underlying metabolic causes thereof should always be managed in the context of a wider medical supervision.

**Bibliography**