

Putting ChromaGen to the test

I am fortunate to have been one of the few contact lens practitioners to stumble across the ChromaGen man at Optrafair in 1997. He was tucked away on the Cantor & Silver stand and was selling licences to fit special coloured contact lenses. At nearly £2,000 for the licence (and lenses 10 times more expensive than standard lenses), there were not many takers. Yet those who now fit ChromaGen are enthusiastic about the merits of the system and they are not out of pocket. Whilst there are a lot of sceptics, there is an enormous group of patients whose lives have been changed by the system.

Types of defect

As there are three colour pigments in the retinal cones, there are three basic categories of colour defect. The rods control the amount of light and dark and they, too, can be deficient, causing night blindness. Essentially, the cones are concentrated in the macula and foveal area of the retina and become more and more sparse and absent the further away they are from the macula. Optometrists know, from visual field screening, that the limits of the colour vision fields are quite narrow. The cones can be severely damaged by macula disease, which can sometimes cause total loss of colour vision. Such patients are unlikely to be helped by ChromaGen therapy. Colour defectiveness is caused by a reduction or

abnormality in one of the three retinal pigments (red, green and blue) or by the total absence of one of them. Loss of the blue pigment is very rare; less rare is the loss of the red and most common is a defect in the green. Fortunately, the green is in the centre of the spectrum and so the patient is not such a liability as the loss of the red end of the spectrum causes to the protanope (failure to see red traffic lights on foggy nights).

Table 1 shows figures on colour vision defects released by City University's colour vision clinic.

Colour vision testing

Although colour vision assessment is a very complex task using many different tests, for colour vision assessment with ChromaGen, all you need is the Ishihara test for adults and the junior Matsubara version for children. The patients not only recognise the tests, but family and friends watching can appreciate the defects from their funny answers. This is the most important part of the therapy and it usually takes 15 minutes to discuss with the patient all the problems that they have had with colour during their lives, particularly at school and in their occupations. Whilst you should not use the Ishihara test to suggest that you have cured their colour vision, it can be quite exhilarating for them and their audience to actually read the plates correctly with the ChromaGen lens in. (One of my patients was able to pass the Ishihara and thereby not lose his job as a printer when they went over to computer technology. Another was able to enter the US Air Force

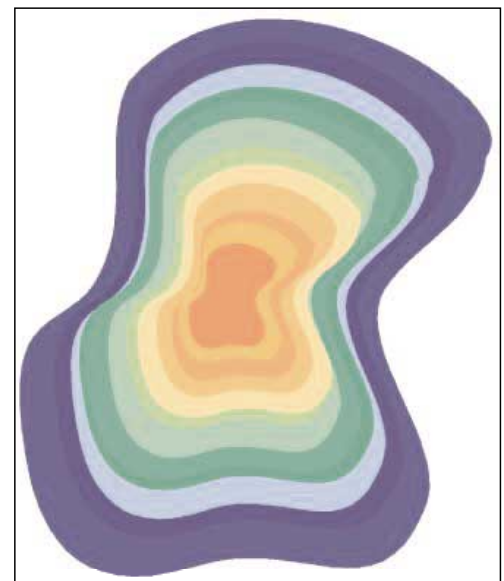


Figure 1a
ChromaGen screen

Table 1
Colour vision defects - type and frequency

Type of defect	Number of photopigments	Frequency	
		Men	Women
Protanopia	2 - no long-wave (red) pigment	1%	0.01%
Protanomalous trichromatism	3 - long-wave (red) pigment is abnormal	1%	0.03%
Deuteranopia	2 - no middle-wave (green) pigment	1%	0.01%
Deuteranomalous trichromatism	3 - middle-wave (green) pigment is abnormal	5%	0.35%
Tritanopia	2 - no short wave (blue) pigment	0.005%	0.005%
Tritanomalous trichromatism	3 - short wave (blue) pigment is abnormal	0.005%	0.005%

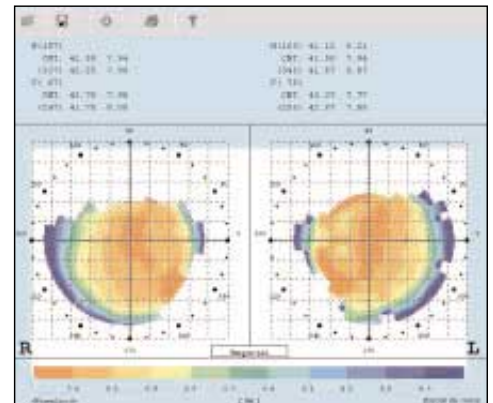


Figure 1b
Author's version

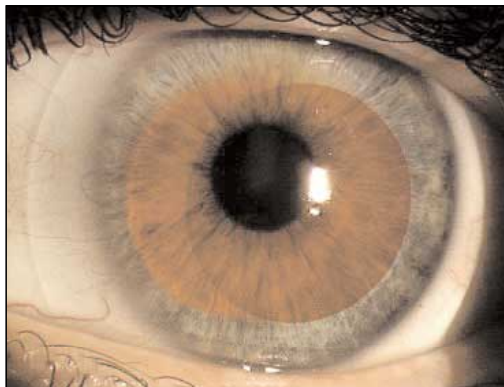


Figure 2
ChromaGen lens on the eye

after having been unsuccessful in the past, and a third was able to see the differences in colour of the paints he had been mixing for years and telling his customers not be so fussy.)

Fitting

The ChromaGen therapy was first devised by David Harris, who carried out his research and development at the Corneal Laser Centre in Clatterbridge. All patients attending for the therapy must have two eyes, because a colour filter is placed over the non-dominant eye whilst the patient observes a colour screen, such as shown in **Figures 1a and b**.

The dominant eye sees the colours as always seen and the non-dominant has its colour perception changed dramatically. It does not matter if the eye is amblyopic or even divergent. The filters are coloured

violet, purple, orange, yellow, green, amber and magenta. The filter which brings out the colours on the screen the most is determined by trial and error. There may be two or three colours which enlarge the colour range and make certain colours fluoresce.

Once the optimum filter is found, an appropriate soft contact lens of the same colour is inserted in the eye (**Figure 2**). There are three intensities to choose from and the tint diameter can be varied (5, 6 or 7mm). (Naturally, no contact lens should be fitted without a full eye examination and contact lens work up.)

The patient is then sent off on a tolerance trial for several hours to see how the lens helps their general colour perception and how the eye reacts to the contact lens. Usually, about one in three patients notice an improvement.

A final contact lens is then offered or the patient can have tinted spectacles. To hide the spectacle tint, the lenses are usually mirrored or semi-mirrored and look like sunglasses. These are better for outdoor use, whereas the contact lens can be worn all the time. In most cases, a plano contact lens is used and the patient wears his regular spectacles over the top.

Normal contact lens aftercare procedures apply, and the lens needs replacing on a six-monthly basis. Some patients, who are spectacle wearers, may seize the opportunity to switch to contact lenses for both eyes. Often they have avoided them before, but the use of the ChromaGen lens shows them how easy and comfortable contact lenses can be.

Mechanism

No two colour defectives are exactly the same; everybody has a different perception of colour. However, broadly speaking, the majority of patients are red/green deficient or red deficient in a ratio of three to one. Some patients are almost totally monochromatic; they usually have a macula problem. Few women are colour defective (0.4%), though when they are, their defects are usually more intense and complicated than the men's (8%).

I usually explain to the patient as follows: "Everybody has three colour pigments in their retinas in an equal ratio of red, green and blue. Colour defective people have a deficiency in either red or green or perhaps both. Also, like dyslexia, there may be a chance of misinterpretation of the red versus green signals in the brain.

"ChromaGen works by changing the level of each colour going to the non-dominant eye. For example, there might be 20% red, 30% green, 50% blue in the leading eye, but 50% red, 40% green and only 10% blue in the non dominant-eye, with the ChromaGen filter over it. The brain is being sent two completely different sets of signals and the confusion caused allows the brain to differentiate between colours which had previously looked the same. The result is that the colour range perceived by the colour defective is increased two or three-fold.

"Before therapy, the 'normal' person might see 10,000 colours and the colour defective only 2,000, but after therapy, the colour defective may have 6,000 colours. The therapy does not give the colour defective perfect colour perception, but it does give them more colours, plus an ability to see colour differences which they could not see before and more accurate colour naming. They feel more 'normal' and hugely excited by their new colour perception ability".

Study

I carried out a brief analysis of the first 33 patients who came to my practice for colour vision therapy. They were attracted by the national press coverage generated by the press releases issued by the Corneal Laser Centre.

Table 2 shows the defects divided into four types and gives their success with a ChromaGen lens. There were only two females and only one protanope. Neither female was straightforward. One had severe macular degeneration and VAs of 6/60 - she was totally monochromatic and, therefore, failed to benefit from the therapy. The other was a 15-year old with almost total loss of colour perception and VAs of R&L 6/18. She

Table 2
Analysis of 33 patients attending the practice in six months for ChromaGen therapy

Type of defect	Total	Success		Failure	
		No.	%	No.	%
Trichromatic deutanopes	15	15	100	0	0
Deutanopes	14	5	36	9	64
Trichromatic protanopes	0	0	0	0	0
Protanopes	1	0	0	1	100
Monochromatic	2	1	50	1	50
Extremely anomalous trichromatic	1	1	100	0	0
Tritanopes	0	0	0	0	0
Total	33	22	67	11	33

Overall success rate 67%

benefited greatly with the use of a P3 tint.

Success was defined as a patient who now wears a ChromaGen contact lens or spectacles on a regular basis and finds that their colour vision is helped by its use. The overall success rate was 67%.

Discussion

It would seem from the data that the results are severely skewed as a result of the majority of patients being deuteranomalous. However, the statistics for colour defects suggest that I should have seen a few more protanomalous patients. However, two thirds of the colour defectives randomly attending the practice have been helped by ChromaGen lenses. You cannot tell what you are going to get - patients usually just say: "I'm colour blind". However, colleagues considering referral should note that 100% of deuteranomalous trichromats (the largest group) were thrilled with the treatment. As soon as the defect gets more severe, then the success rate plummets to 36%. I have not seen enough protanopes to make any conclusions, but I suspect trichromatic protanopes will get greater than 50% success and be far safer at traffic lights. My patient who failed was able to see reds far more brightly, but he found it very disconcerting and, after three weeks, stopped using the lens preferring not to see red standing out so bright.

Every patient needs to be screened and given a trial and even the most unlikely colour defects might be helped. However, you can confidently recommend deuteranomalous trichromats, the most common defect, for ChromaGen therapy.

Patient feedback

There follows reports from two patients, both trichromatic deutanopes. The first is amblyopic in the non-dominant eye - it made no difference to his success. These are reported descriptions and we have tried to reproduce the illustrations provided by the first.

Patient I.S. fitted with ChromaGen contact lens

"I had seen the article in the Daily Telegraph last March explaining the use of coloured contact lenses in the weaker eye to correct colour blindness. I was, therefore, very interested when asked by my nephew if I would like to try one.

The first part of the examination was to find the best lens to work with. This was carried out by viewing a colour VDU with a pattern (Figure 3).

The effect of changing the lens caused some changes in the colours, but also produced a shimmering sensation. A soft lens was chosen and inserted in my left eye. I then went for a walk in Regents Park.

I first gained an idea of the changes when I closed my compensated eye. When I looked at some traffic lights, the green light was now coloured rather than whiteish, but for car driving, distinguishable from red and amber. My walk to Regents Park was interesting in that there was a sort of three-dimensional, slightly scary effect - but I was told that it would probably be like that to start with. In the park, I drew two sketches of the flowers. Although the pansy beds came alive, the first real difference was with the lupins.

The reds of the lupins and the beds of greenery just jumped out at me (Figures 4 and 5). There were no flowers with my lens covered; opened, and it was a new world - not only 3D but fluorescent. I kept opening and shutting my eye - it was very enjoyable.

I next looked at the sky and saw depth in the clouds, the flatness had gone, I could imagine the puffiness. Then a helicopter flew over and I caught the shimmering rotors, another first. It disappeared when I closed the eye with the lens in.

My return to 7 Devonshire Street, to have the lens removed, was full of 3D and fluorescence.

June 5, 1997

I had the lens fitted on June 5 and after the full eye examination and training on how to put the lens in and out, I set off with five hours of wear, to be increased by one hour a day.

The day was overcast, but I noticed the depth of colour in the clouds and sky was not there without the lens. It had almost a plain backdrop without the lens, but with the lens a whole new world appeared. I then travelled back home, noticing mainly the higher resolution of most coloured hoardings, papers etc, resulting from the lens. The reds were still fluorescent.

That evening I enjoyed some strawberries which came alive in their punnet. I then saw a TV programme on tree blossom and the television picture was in three dimensions; the blossom was jumping out of the screen and the colours were alive. I accept that the 3D effect will go as I get used to the lens. The other area of interest was that I was able to distinguish much more clearly the background pictures. Watching cricket was much more interesting - the ball was very visible.

I removed the lens on the second attempt.

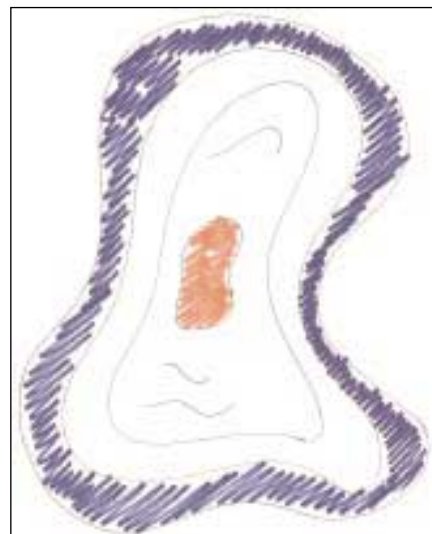


Figure 3
How patient I.S. saw the screen shown in Figure 1a

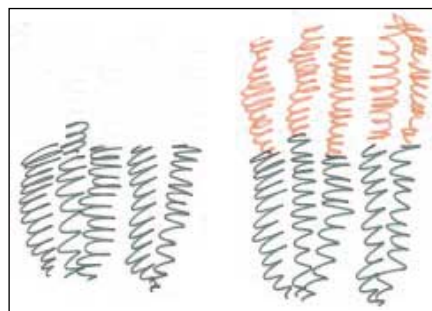


Figure 4
How patient I.S. saw the lupins with (right) and without the lens

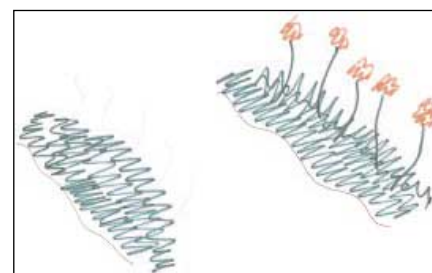
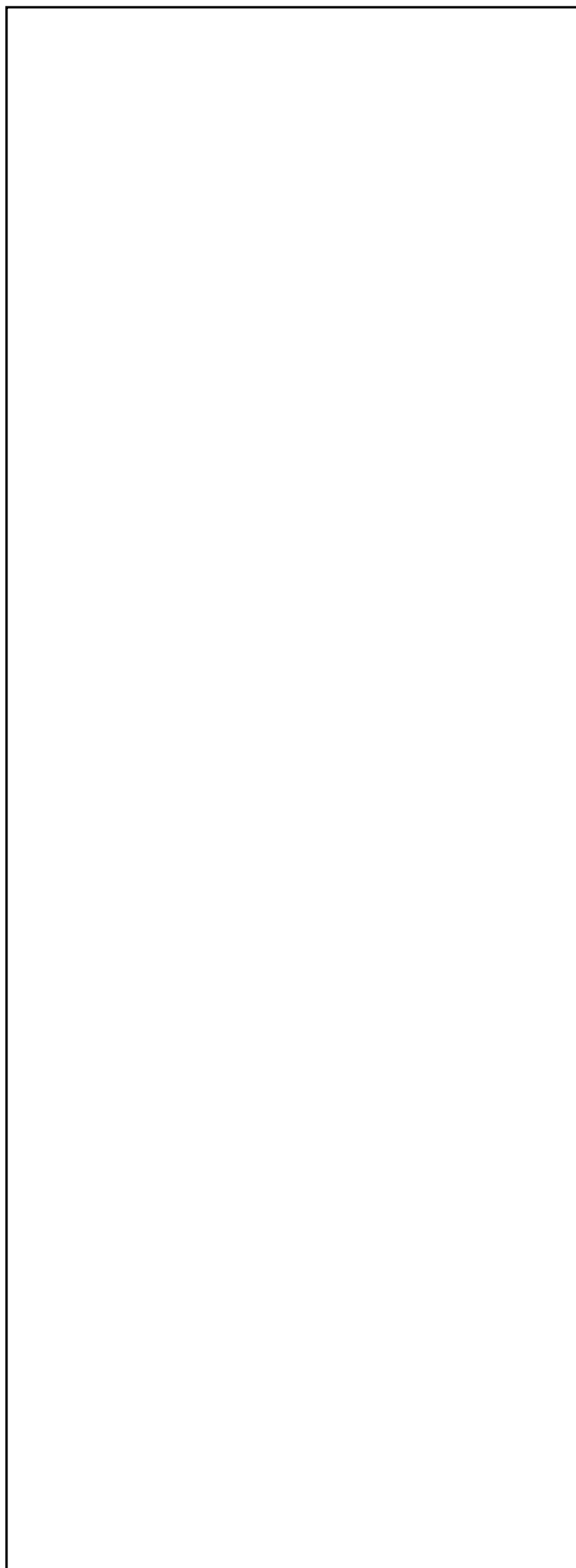


Figure 5
How patient I.S. saw a bed of shrubs (greenery) with (right) and without the lens

June 6, 1997

I inserted the lens at 6am and later drove from Orpington to Farnborough on the M25. Again, the morning sky was very different - much, much more definition. I was beginning to ignore the lens or was it beginning to settle in the eye? The reds were still alive, but colours now appeared where a bland background existed. I was able to read and see at distances with the lens and glasses off and on.



I removed the lens on the second try after six hours.

June 13, 1997

I am now wearing the lenses for 10 to 12 hours a day. My morning drive along M25 is beginning to stabilise in that I am enjoying and accepting changes. My main enjoyment is looking at the clouds.

An immense amount of detail now visible in the clouds. The fluorescence is beginning to reduce, as is the 3D effect. I had a long day on the June 11 and couldn't remove the lens and so it was in for 13 hours, but I had no major problems, or even minor for that matter. The lens is now part of my way of life and I have no problems inserting or removing it.

I am beginning to see 'new' colours and associate names with colours; previously these were just names.

My most enjoyable change is the early morning drive around the M25 with the cloud formations. The various, numerous colours really make the journey so different and much more enjoyable - therefore, I should keep my eyes on the road.

August 21, 1997

When I take the lens out, there appears to be a residual effect. I believe that I see more colours than I did previously.

The fluorescence and 3D effect have almost gone."

Letter from patient J.W. fitted with ChromaGen mirrored spectacles

Dear Mr Burnett Hodd

I am pleased to report back that my ChromaGen lenses have been a big success and I will try to put into words the direct and indirect effects they have made to my sight.

When I first put the spectacles on, the changes were not instantaneous but after 10 to 15 minutes, they started to appear. This process of change

reduces each time I wear them and is now probably down to not more than a couple of seconds each time I put them on. I can only assume that this is because the process is a form of re-education which takes time for the brain to recognise.

The spectacles are amazing as they change the way I see everything. Most colours, particularly reds and blues, are much brighter and stronger and, surprisingly, seem to have a greater 3D effect. I have especially noticed this when looking at traffic and warning signs, which now seem to jump out at me and attract my attention a lot more effectively.

Other colours, such as greens and browns, now have a wider range of shades and tones which enables me to differentiate between them a lot more easily. When I have been out walking through country or wooded areas, colours in the scenery are a lot more varied and the overall view is not as bland as before.

My brother, who is also red green colour blind, has borrowed the spectacles and his thoughts on their effects mirror my own, with the emphasis on the increased brightness and variation of colours. Whereas before everything seemed to contain a lot more shades of grey, the greens and browns now figure where they didn't before and the other colours are more prominent.

I would like to thank you for asking me to test your new lenses as they have made a great improvement in the way I see things and my appreciation of them.

These two patient reports show why it is wrong to doubt this therapy - we can at last treat colour deficiency in the majority of sufferers.